FAO
COMMODITIES
AND TRADE
PROCEEDINGS

ISSN 1816-5303

2

Governance, coordination and distribution along commodity value chains

Rome, 4–5 April 2006

FAO
COMMODITIES
AND TRADE
PROCEEDINGS

2

Governance, coordination and distribution along commodity value chains

Rome, 4–5 April 2006

Trade and Markets Division

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2007

ISBN 978-92-5-105748-3

Table of contents

Preface

The Commodities and Trade Division[1] of FAO organized a two day workshop on 4 and 5 April 2006 in Rome, immediately after the meeting of the Common Fund for Commodities (CFC) with the various Intergovernmental Commodity Bodies (ICBs), thus benefiting from the presence in Rome of experts on various commodities from around the world. Additional analysts presented their work to the workshop.

The workshop was held in the light of significant changes which are continuing to take place in the value chains for many agricultural commodities, particularly those fresh products destined for supermarket shelves. The changing pattern of these value chains has important, but not well understood, implications both for domestic policy in producing countries and for international trade.

The objective of the workshop was to explore the issues arising from the changing structure of the various commodity chains, and to guide the future work of the Division in this area, in order to produce information and analysis of use to the FAO members. The workshop brought together the latest thinking on these issues to provide a stock-taking of the various problems, and more importantly, to identify the policy and technical issues on which there is consensus, and those where further analytical and empirical work is needed.

Alexander Sarris

Director

Trade and Markets Division

[1] Now the Trade and Markets Division

Introductory Note

Brian Moir[2]

A two-day workshop was held by the Commodities and Trade Division[3] at FAO in Rome, 4-5 April 2006. The objective was to explore the issues arising from the changing structure of the various commodity chains, and to guide the future work of the Division in this area.

This set of proceedings of the workshop is published to assist in understanding the implications of the developments in agricultural value chains and in the analysis of value chains by economists, from a competitive market structure to one where market players are characterised by varying degrees of market power. This changing pattern and the development of market power affect resource allocation in agriculture and equity between producers, and have implications for domestic as well as international policies.

THE CHANGING PATTERN OF AGRICULTURAL MARKETS

The traditional pattern of agricultural production and markets as described by economists was (and to a large extent, still is) one of more-or-less perfect competition, typified by, *inter alia*, product homogeneity, a large number of buyers and sellers, and freedom of entry to the market. Under this model, each small farmer determines the volume and type of output to be produced and placed on the market. The relationships between seller and buyer (producer:wholesaler; wholesaler:retailer) are generally limited to simple spot transactions.

The widely noted exception to the free market was the operation of various state trading enterprises. In countries such as the communist states of Eastern Europe, as well as China and Viet Nam, the supply chain was integrated and controlled by the state. Production, processing, marketing, and the provision of inputs and credit were all centrally planned. But in other countries also the state played a significant role in vertical coordination in food supply chains. In many African countries, parastatal organizations provided inputs and extension services to farmers and purchased their output and, despite the liberalization that has occurred in the past 20 years, this state controlled vertical coordination is still common in some African countries. Elsewhere, the state controlled the export of commodities from Canada and Australia, and controlled imports into Japan, Korea and India, among others.

In recent decades, this perception of commodity markets has been changing. Some analysts believe that market power has not been adequately recognised in the literature. Raw commodities are typically inputs into a vertical commodity chain, such that the raw commodity is only a small proportion of the value of the final product, the downstream stages of which may, in both developed and developing countries, be less than perfectly competitive. Coffee producers, for example, account for 10 percent of total value added while processors, roasters and retailers receive between 20-30 percent respectively. The data are similar for cocoa, with farmers receiving around 15 percent of the total value of the finished product. Even where the commodity involved requires little processing, the shares received by commodity producers can be rather small. Banana plantations typically receive only 10 percent of the total value, while the share of retailers may be as much as 40 percent.

Market power can be exerted by participating firms in these chains. If the retail or processing sector is highly concentrated, then there is the possibility of oligopoly power being exerted by these firms in selling their produce. At the same time, the downstream firms can act as oligopsonists in purchasing produce from farmers, middlemen and processors. Where the retail and processing sectors are imperfectly competitive, successive market power may be exercised at each stage of the food chain. In the coffee sector, for example, McCorriston in his paper notes that only three roasters (Philip Morris, Nestlé and Sara Lee) account for just less than 50 percent of the total market, while in the cocoa

---

2 Senior Economist (Trade), Trade Policy Service, Trade and Markets Division, FAO Rome

3 Now the Trade and Markets Division

market, six chocolate manufacturers account for around 50 percent of total sales. Three global companies account for 80 percent of the total soybean crushing industry in the European Union and 70 percent of that market in the United States.

The exercise of market power in the supply chain is particularly evident where successive stages are closely coordinated by contractual arrangements. Arrangements of this type, which have become much more developed in recent decades, are particularly evident in the supply of fresh food to supermarkets, where there are close vertical relationships in the chain, controlled by private companies. The development of supermarkets, initially in the developed countries and more recently, but at a rapid rate, in developing countries, has been one of the drivers behind these developments. Small numbers of buyers are prevalent in these markets, and product differentiation (the provision of particular product qualities for a particular outlet) is evident. Farmers in this system produce under contract to agents acting on behalf of supermarkets, with product quantities, qualities, timeliness and prices specified in advance. However, many farmers are unable to enter this system. Small, less capitalized, less technically advanced ones are unable to reach the required standards. Often a two or three-tier system develops in agricultural production, with some farmers producing on contract to supply to tightly controlled standards for export; other, typically smaller farmers, producing independently for the traditional local market; with perhaps an intermediate group supplying local supermarkets.

The level of competitiveness in the supply chain of agricultural commodities has important implications for productivity in the sector, for growth of production and incomes, for equity and farmer welfare, and on the impact which trade liberalization can have on the sector. A non-competitive market structure does not, however, necessarily imply a lack of competitive practices, as firms do not necessarily exercise their market power.

IMPACT OF MARKET POWER ON THE BENEFITS FROM TRADE LIBERALIZATION

Hallam and Rapsomanikis note that there is broad agreement in the economics profession that trade liberalization and the subsequent integration of developing and least developed countries into the world trading system are potentially important drivers of economic growth. However, the magnitude of the impact of trade reform on economic agents in these countries, as well as the distribution of benefits to population groups will be determined by the structure and characteristics of commodity supply chains. The presence of market power exerted by successive oligopsonies or oligopolies will result in the impact of trade reform being different from what would be realised under competitive conditions for both exporting and importing developing countries. More importantly, market power affects the distribution of benefits and costs across economic agents, such as producers, processors and consumers. In this context, analysis of the structure of commodity supply chains and the vertical linkages that characterise them is necessary in order to assess the welfare changes which arise from trade reform. In particular, for developing and least developed countries, it is important to examine marketing systems that are characterised by high concentration and market power, especially in cash crops, where volatile prices in conjunction with the need for liquidity favour large trading enterprises.

Market structure and the nature and intensity of competition are intrinsically related to the marketing margin. The marketing margin consists of the costs of services such as processing, distribution, marketing and retailing, as well as valuations of risk and expectations of how markets will evolve. In general, marketing margins will tend to vary due to factors such as the changing costs of providing services, the introduction of new technologies and changes in the quantity of the product marketed. In the event that the structure of the supply chain beyond the farm-gate is not perfectly competitive, marketing margins will also reflect market power over the consumer (producer) level with oligopoly (oligopsony) price distortions that widen the margin by increasing the consumer (producer) price.

Typically, as McCorriston points out, the potential impact of trade liberalization is modelled on the assumption of perfect competition. However, this has been shown to understate the benefits which can be realised if, in fact, the supply chain is characterised by oligopolistic and oligopsonistic relationships. In the presence of imperfect competition, the welfare gains from trade are higher than under perfect competition, the demand for labour increases more, and the productivity increases are

higher. The consensus from most studies is that analyses which assume the existence of perfect competition are likely to under-estimate the welfare effects from trade reform. Trade liberalization will have a pro-competitive effect leading to lower prices, the mechanism being via changes to the price-cost margin.

EMPIRICAL STUDIES OF MARKET POWER IN VALUE CHAINS

The New Empirical Industrial Organisation (NEIO) conduct parameter model was used to analyse the jute market in Bangladesh by Hallam and Rapsomanikis.

The characteristics of the supply chain for jute suggest *a priori* that buyer power may exist. Jute fibre is bulky and subject to high transport costs, restricting the mobility of traders and limiting producers' access to local traders. Processors' needs are specific, as the possibility of substitution with other inputs is limited. Also, raw fibre supply is relatively inelastic, as jute is cultivated in some form of crop rotation with rice. Articles in the national press in Bangladesh frequently suggest that price increases are not passed through to producers. Jute producers receive only some 54 percent of the consumer price, as compared to 71 and 66 percent for rice and wheat respectively.

The study estimated the conduct parameter at 0.006, suggesting that the wedge between price and marginal cost, in proportional terms, is very small. This provides evidence against the presence of oligopsony power in the jute supply chain. It appears that in spite of the structural characteristics of the jute market and the relatively high marketing margins, conduct in the jute supply chain is close to perfect competition.

In the cocoa and coffee markets also, the exercise of market power has been shown to be low, despite popular perceptions to the contrary. Gilbert notes the "cake division" fallacy, in which value at one stage is seen as being at the expense of value at another. The majority of smallholder coffee farmers have not obtained satisfactory returns over much of the past fifteen years, but it is not the case that the prosperity of the processors is a cause of the difficulties experienced by the farmer. Gilbert used a global value-chain (GVC) analysis to examine the coffee and cocoa markets. In both coffee and cocoa industries, it has been suggested that market concentration has allowed value to be appropriated by multinational processing companies at the expense of developing country farmers and that this was one of the factors underlying the Coffee Crisis. Gilbert shows that there is no evidence that the margins in either cocoa or coffee processing have risen over time. This is not to imply an absence of monopoly or monopsony power, but only that a loss of producer share cannot be explained through an increase in market power. Instead, the decline in the producer share of the retail coffee price is due to the fact that only around one half of the costs underlying retail coffee prices are attributable to the fob price of coffee. The proportion of chocolate production costs attributable to raw cocoa is even lower. The remaining costs are incurred in consuming countries. Productivity gains have reduced coffee production costs but coffee processing and distribution costs have risen, at least until the start of this decade. The result is that retail coffee and chocolate prices have fallen only modestly implying a decline in the producer shares of the retail price.

Swinnen and Vanderplas studied a number of markets, and concluded that the competitive structure of firms in the supply chain has an important bearing on farmers. Competition in the chain results in better returns to producers who are able to capture a larger percentage of the export price. Where firms compete with one another, farmers are offered higher prices, and are typically also offered inputs and credit as firms attempt to secure their supplies. Conversely, under monopolised systems, where a state-owned enterprise is the only trader, such as in some east European countries, rent is extracted from farmers, who fare more poorly than under a competitive system. Competition among buyers, however, undermines enforcement, and side-selling can become a problem. Although contracted to sell to one firm, farmers may be tempted to dishonour contracts and sell to another who offers higher prices. Firms can guard against default by means such as incorporating appropriate incentives and penalties into contracts, informal personal relationships, coordination among buyers, publicising defaulters thus attacking their reputations, and setting up a system of group responsibility among farmers.

VERTICALLY-COORDINATED SUPPLY CHAINS

Much of the discussion on value chains in agriculture focuses on the development of vertically coordinated supply chains, which typically have farmers under contract to provide fresh food to supermarkets.

These contractual arrangements with firms can provide farmers with a number of advantages. Firms may provide farmers with inputs, training, technical assistance and other services, and credit, as well as having a guaranteed market for their produce. These farms are larger, and more highly capitalized, and have more access to credit, and they use more fertilizers and chemicals than those in the traditional sector. At the same time, however, farmers give up their independence to varying degrees. In some cases firms employ extension agents to supervise farmers to ensure that they adhere to the company's production requirements. Farmers are locked in to producing a specific product, possibly following practices prescribed by the firm, and may have limited capacity to negotiate advantageously with the firm. Despite their limited bargaining power, however, it is typically found that farmers in this sector have higher levels of income and wealth than those in the traditional sector.

Centralized procurement offers a number of cost-savings, from reduced coordination costs, less inventory management, reduced supervision, savings in transport and other transaction costs for suppliers and buying in one place in bulk. Farmers under contract generally supply produce of a higher quality, and often add value by sorting, cleaning, processing and packaging.

Traditional wholesalers who do not get involved in production support programs and usually do not enter into long term commercial relationships with producers generally buy and sell on a day-to-day basis. They typically lack the capacity to define, monitor, or enforce a quality or safety standard beyond basic requirements such as refusing decayed produce.

The paper by van der Meer and Ignacio discusses major changes in global food markets that have taken place in recent times. Food safety scares such as those associated with BSE, salmonella, Avian Flu and pesticide and antibiotic residues have increased the pressure from public authorities for tighter control on the food chain, and the imposition of higher standards by private companies, requiring increased certification and verification. The paper discusses factors which affect safety and quality requirements, including the diverse preferences of countries and buyers; the nature of the market outlet, where fast food chains in particular are very sensitive to product quality and safety; and the nature of the product, where markets for perishable fresh produce are more sensitive that those for frozen and processed produce.

Van der Meer and Ignacio describe the three-tiered nature of a typical market, and apply this concept to discussions of the Chinese market for fruits and vegetables, and to the Chinese market for food staples and tropical products. Traditional local markets, which take the bulk of the production, are the least demanding of quality and safety; a more elite, but much smaller, urban retail segment is more demanding; while the export market is more demanding again.

Coordinated supply chains are most likely to be feasible where market requirements on product quality, consistency, safety and delivery schedules are more demanding. Van de Meer and Ignacio discuss the potential for small-scale producers to participate in these different market segments, and for private investment in these segments. The authors consider that small producers might successfully participate in coordinated supply chains when they have a cost advantage over large producers, and this would be most likely to occur with labour-intensive production.

In the light of the rapid rise of supermarkets in Central America in the past decade, and the accompanying changes in the procurement system, Reardon *et al* surveyed some 600 farmers and made comparisons between those growing produce for supermarkets and those in the traditional channel. Farms in the supermarket channel were generally, though not always, larger and in all cases more specialised than those in the traditional channel. Supermarket suppliers are more capitalized and receive more credit, and generally receive more technical assistance. They use more chemicals and more fertiliser, and less labour. They received higher prices, achieved higher yields and, despite their higher costs, they made larger profits. Four key "pillars" of the new kind of procurement system were

identified, involving specialised procurement agents, centralised procurement through distribution centres, consistent supply through preferred suppliers, and quality and safety standards imposed on suppliers. Buying companies prefer to purchase larger volumes from producers, and hence prefer farmers dedicated to producing a single product.

The study of value chains in horticultural production in Central America by Lundy et al examines the participation of vegetable farmers in value chains in Honduras and El Salvador. Vegetable farming has expanded rapidly in these countries since the 1970s. Direct participants in the supply chain include producers, traders and retailers, while indirect participants include providers of technical and business services, researchers, banks, etc. Three groups of producers can be identified: unorganized small producers, small producers in formal organizations, and independent producers with secure markets. The study found that only a small number (5 percent) of producers are encompassed by producer organizations in the countries. A skewed governance structure was identified, in which the rules of the game are developed and imposed by the stronger members of the supply chain (e.g. the retailers) while other members have little or no choice but to accept. A third problem is that public-sector policies in Honduras and El Salvador are not adapting to the rapidly changing market conditions. Public decision-makers have little or no access to consistent and up-to-date information regarding the economic, social and environmental effects that these changes are having on rural development. As a result, policies change slowly, and have not provided food safety standards to protect consumers or fair marketing practice standards to protect weaker members of an increasingly concentrated supply-chain. The authors advocate the development of more effective organizational models, the development of improved governance structures, and the development of public policies as appropriate strategies to upgrade the supply chain.

Minten's study in Madagascar used primary data gathered from a domestic agricultural trader survey and from interviews of representatives of global retail chains and the farmers they work with, to contrast the functioning of traditional with the global retail supply chains. Traditional marketing is done by a myriad of small traders who offer little trade credit, use no forward ordering and enact on the spot transactions with poor market institutions, high search costs and imperfect and asymmetric information. Larger traders rely more on relationships and social capital to partly overcome these problems. However, global retail chains put different systems in place. They procure their goods through micro-contracts, fixing the price in advance and supplying seeds, fertilizers and chemicals on credit. The one major firm which exports vegetable to Europe imposes rigid control and monitoring of production. It provides training to farmers, and the study found that farmers under contract achieved considerably higher productivity than those without contracts. Contracts are honoured as a result of social pressure rather than legal processes. These contracts are further characterized by extensive farm assistance and supervision programs. In the case study and the business model presented, there is no evidence that this is a bad development for poor farmers.

CONCLUDING COMMENTS

The emergence of market power in agricultural supply chains, and the increasing recognition of market power in these chains by economic analysts, has given rise to some changes in the way agricultural markets are analysed. The assumptions of perfect competition are inapplicable in many situations. Equity among farmers, equity between farmers and downstream elements of the chain, and the need for and impact of domestic and international policies demand re-assessment. The rapid development of vertically-coordinated supply chains have important, but not necessarily negative, implications for the farmers who participate in them.

PART 1

CONCEPTUAL ISSUES OF MARKET STRUCTURE IN AGRICULTURAL COMMODITY VALUE CHAINS

Market Control and Competition Issues along the Commodity Value Chain

Nikolaos Vettas[4]

ABSTRACT

This paper examines from the viewpoint of microeconomic theory and, in particular, from that of the modern theory of industrial organization, issues that arise when agricultural and food markets deviate substantially from the perfectly competitive model. We review some important ways in which terms of trade, profits, and the allocation of resources are affected when markets are monopolistic or oligopolistic at various stages of the vertically related commodity value chain. We also discuss the role of contracts between upstream and downstream producers and how contracts affect the firms' incentives for investment, innovation, and pricing decisions. Finally, we refer to possible issues raised for vertical markets in the context of competition policy.

Keywords: Vertical markets, contracts, value chains, market concentration, oligopoly markets, competition policy.

INTRODUCTION

The importance of agricultural and food markets for consumers, producers, national economies and international trade has always been and is expected to be extremely high. Taking a historic perspective, such markets have been generally viewed as working in a way that can be approximated by the textbook "perfectly competitive" model, or simply by "demand and supply". Among the more pronounced related features are product homogeneity, small scale, relatively low entry barriers and (most importantly) a large number of buyers and sellers. While there may be market uncertainty (manifested either through demand or supply shocks), this doesn't generally upset the validity of the general model adapted: the appropriate general theoretical vehicle for analyzing such markets and for discussing policy issues has been traditionally the perfectly competitive economic model. In such a setting, one looks first for an equilibrium in the market and the associated prices and quantities. Even in such a (perfectly) competitive framework, of course, important policy issues may arise.[5] From these, I would like to single out two that are the most important, in my opinion: (a) the insurance policies against aggregate or local market fluctuations that may adversely affect the prices, volumes and producers' incomes and (b) the incentives for innovation (or the lack of such sufficient incentives), in particular for the adoption of new technologies under uncertainty and/or with network effects. Both of these issues are particularly important in agricultural and food markets and also quite interesting in theory, independently of whether the market structure is nearly perfectly competitive or not.

While the competitive framework has to be taken as a starting point, gradually over the last decades (and more recently at an accelerating rate) the structure of agricultural and food markets appears to be changing in fundamental ways. The main way in which such markets are changing is by the emergence of significantly increased concentration at one or more stages of the value chain: where we may have used to have a very large number of buyers and/or sellers that each operated as small price takers, we now may have large buyers and sellers, each with significant market power. We are also

[4] Professor, Department of Economics, Athens University of Economics and Business, 76 Patission Str. Athens 10434, Greece, nvettas@aueb.gr, Tel: (+30) 210 8203344. I would like to thank Gustavo Anriquez , the discussant, and the other workshop participants for their helpful comments and suggestions and Frago Kourandi for research assistance.

[5] See e.g. Johnson, ed. (1981) for articles on the important policy issues for food and agricultural markets in the 1980s.

starting to see product differentiation emerging as an important strategy and, for some products, even a significant number of "brand" names that become strong in the market.[6]

In particular, there is evidence of significantly increased concentration at the distribution and retail stage (see e.g. Clarke *et al.,* 2002, for an analysis and further references), increased concentration in the production stage, as well as also in the middle stage (transportation). Once it is recognized that it may be now "large" players that compete in the market, the issue of strategic behavior and, in particular, the emergence of product differentiation and of the formation of vertically linked chains comes to the centre of the discussion.

It is crucial to start our analysis of at hand by the observing that in markets organized as oligopolies, above normal profits can be sustained on average, while there is also a possibility of some insurance against low prices. But "moving out of commodity markets" raises a number of additional issues. If such a transition takes place, is it driven by demand (consumers are willing to pay enough for different varieties or higher qualities) or supply (the need of sellers to strategically position/differentiate themselves) or both? How should production and trade be vertically organized? At which stage of the vertical chain high rents tend to be realized? Do such strategies offer some insurance against risks or these risks become more threatening? What are the implications for policy design?

More specifically, changes like the ones mentioned above, in my view, imply (at least) four sets of issues that become important both for policy makers and also for the firms' strategies:

- How does the treatment of important more "traditional" themes (like the ones mentioned above: insurance from fluctuations and innovation incentives) get modified when there is a concentrated market structure?
- How do the market conduct and performance get modified when certain stages of the market (production, retail, transportation or intermediation) are oligopolistic, especially taking into account the vertical structure of the value chain? Does increased concentration upstream (large producers) or in the middle stage (large intermediaries) have different implications from increased concentration downstream (large retailing sellers)? Can the final consumer benefit from such developments?
- What is the role of product differentiation, and how the goal of moving away from undifferentiated "commodity" markets towards differentiated products of higher value is related to increased concentration and oligopoly pricing?
- To what extent the presence of market power raises issues of competition (antitrust) policy and in particular such issues related to merger control (horizontal or vertical), cartel-like behavior and "collusive practices", and "abuse of dominance" by dominant firms.

This paper focuses on the basic theory for the issues mentioned above, and on some of the main implications related to the introduction of market power in value chains in agricultural and food markets. The important issue of general interest here for agricultural products can, more broadly, be described as the (partial) transition from "demand and supply" commodities markets to markets where products are differentiated and supplied through distinct vertical chains. Research in this area is gradually attracting significant and increasingly strong interest. This paper will hopefully provide a useful link with some of the important ideas developed in the context of the industrial organization literature and can be useful when applied appropriately in agricultural and food markets. Since the number of the various issues involved is quite large, this presentation here will be necessarily brief and selective.

The structure of the remainder of the paper is as follows. Section 2 reviews some of the important recent trends from the viewpoint of the implied changes in the (vertical) structure and concentration of the market chain. Section 3 presents the basic externality (double marginalization) in vertically related chains when linear contracts are used and discusses possible solutions. Section 4 is an introduction to

[6] See Sarris and Hallam (2006) for a recent overview of the important issues and trends in agricultural markets and trade. Also McCorriston *et al.* (2004) and Reardon & Timmer (2005) for related discussions.

strategic pricing issues when there are multiple oligopolistic competitors at the upstream or downstream stage of a chain. The issue of quality provision is also discussed. Section 5 considers the important issue of investments that are specific to a particular value chain and the implied incentives for contracting and exclusive versus multiple sourcing. Section 6 turns to dynamics and in particular examines the role of learning effects. Section 7 reviews the main competition (antitrust) issues that may emerge as important in the near future in these markets. Section 8 discusses that, given various forms of policy interventions is the norm rather than the exception in agricultural and food markets, increased concentration at some stage of the vertical chain may affect policies and the economic results for buyers and sellers via its direct or indirect influence on policy. Section 9 concludes.

REVIEW OF SOME MARKET TRENDS AND SOME OF THE IMPLIED ISSUES

In the agricultural and food economics literature it is important to understand the vertical structure of the supplier-retailer relation. We need to distinguish between upstream firms, i.e. the producers or suppliers and the downstream firms, i.e. the processors or manufacturers or retailers. The market structure organized along these two main stages is very important for the analysis of the food chain. Each stage may be characterized by imperfect competition (low number of firms upstream and downstream). For example, in many developing countries the decrease observed for the purchasing prices that receive the upstream suppliers is often not proportional to the reduction of the final prices set by the supermarkets. This phenomenon can be contributed to the oligopolistic nature of the downstream level of the market, the profits at which generally tend to increase. It should also be noticed here that many upstream suppliers of raw materials or unprocessed food commodities are exporters that reside in developing countries, while the downstream firms are importers in developed countries. Hence, the tariff system (tariff escalation) and other international trade barriers are really important for the formation and development of the food chains.

The main market trends downstream

Market structure in the agricultural and food sectors has changed fundamentally and rapidly since the 1950s both in the developed and developing countries (in the latter countries usually with a delay of three decades or more). Before this transformation period, the norm in most cases tended to be the existence of informal and traditional domestic food markets with many small producers in the production segment and direct sale or local brokers for the rural market or traditional wholesale to the urban market in the wholesale segment. Also, at the retail stage the main form of market organization were small shops or central markets. After this traditional phase, a new phase emerged with "modernized" domestic food markets with significant concentration in the wholesale sector. This phase has been characterized by some researchers and policy makers as the "supermarket revolution". Initially, this change referred mainly to the processed food sector, due to the non-perishable character of these products, but gradually it has become relevant also to the fresh fruit and vegetables sectors of the market. [7]

This transformation occurred in three main waves at different times and places, with the first wave in much of South America, East Asia besides China and Northern-Central Europe. The second wave occurred in much of Central America and Mexico, Southeast Asia, Southern-Central Europe and South Africa, and the third wave in South Asia, China, Eastern Europe and parts of Africa. This transformation was, of course, not always with uniform characteristics, but dependent on the specific socioeconomic and structural characteristics of each region. [8]

Today, taking an average concentration in the areas mentioned above, the three or four top supermarkets in each country tend to possess a share of 50 percent in many national food retail systems. This share differs, of course, across countries. The main reason for this supermarket revolution is the increased demand for supermarket services. The demand-side incentives were primarily related to the urbanization and the consequent entry of women in the workforce outside the

[7] See e.g. McCorriston (2006) for an analysis.

[8] For evidence and analysis from different regions see e.g. Balsevich *et al.* (2003), Berdegue *et al.* (2005), Boselie *et al.* (2003), Hu *et al.* (2004), Neven & Reardon (2004), Reardon *et al.* (2003).

home. This has increased the opportunity cost of women's time (and more generally the household's time) and their incentive to seek shopping convenience and processed food to save cooking time at home. Second, the operation of large supermarkets, often in combination with large-scale food manufacturers, reduced the prices of processed products and offered greater variety than traditional retailers could offer, due to economies of scale in procurement and improved inventory management. Recent improvements in marketing research, on the one hand, and in information technology, on the other hand, have also improved the efficiency of large retail units.

On the demand capacity-side, several reinforcing factors in play were the real per capita income growth in many countries of most of the above mentioned regions since the 1990s, as well as the rapid growth in the 1980s in ownership of refrigerators that meant an increased ability to shift from daily to weekly or even less frequently shopping. Increased access to cars and public transportation reinforced this trend.

The growing supply of supermarket services was driven by several factors. One important factor was the increased level of Foreign Direct Investment (FDI) mainly by chains from developed countries that were seeking new markets to supply their products due to saturation and intense competition in their home markets. A second crucial supply-side factor was the revolution in retail procurement logistics technology and inventory management. The use of the Internet and computers for inventory control improved the supplier-retailer coordination and minimized the inventories on-hand. Finally, the gradual liberalization of the tariff system in many countries and generally the significant reduction of trade barriers helped to the creation of a better supplier-retail system.

All the above factors in combination led to an increased concentration at the downstream level of the food supply chain with main features the centralized procurement system, the consolidation of distribution, the increase, in general, in food quality and safety due to implementation of private and public standards, the "most preferred" supplier, economies of scale in transportation, storage and finance, the increase of barriers to entry for the competitors and the ability to demand lower merchandise prices or greater provision of services from their suppliers. These and other improvements in organization and institutions "drove costs out of the system".[9]

Implications for market competition upstream

The need to supply large volumes according to strict delivery schedules and to consistently meet high enough quality standards means that the preferred suppliers of supermarkets will naturally tend to be primarily large growers. Small producers will be at a disadvantage because of small financial base, lower expertise and relatively weaker abilities and incentives to maintain consistent and high enough quality. Hence, the consequences of the above described concentration trends in the retail stage developments for the smallholders are not always positive. The inability to exploit positive economies of scale and the need for certification that face the smallholders do not help them remain as significant players in the vertical supply food chain. On the other hand, the ability to provide the care required for high quality and possibly even production at a lower cost (sometimes due to the "family" labor supply) can be the comparative advantages of the small growers. As a result, if smallholders are to continue playing collectively an important role in the market should meet the new challenges via appropriate coordinated actions and, when needed, the support of the governments or local agencies (for reasons of technological and institutional innovations). [10]

---

[9] In a study of the European food retailing sector, Clarke *et al.* (2002) examine the welfare effects of the observed significantly increased buyer power. They explain that the final evaluation depends on a number of trade-offs including one between increased buyer power and increased retailing power (large supermarkets obtain better terms of trade from their suppliers but may not have an incentive to pass these savings to the final consumers) and one between the short-term benefits of lower prices and the long-term effect on increased concentration. They also discuss important similarities as well as differences among the countries studied. Dobson and Waterson (1997), also, analyze the issue of the increased (countervailing) buyer power.

[10] For analysis of the implications for producers see e.g. Cacho (2003), Crespi & Gao (2005), Dries *et al.* (2004), Key & Warning (2002), and Reardon *et al.* (2003).

Contracts

Economists generally distinguish three broad methods for organizing the transfer of commodities from farms (upstream stage) to the next stages of food production: a) spot markets where the price of the commodities is set at the time of sale based on the current market demand and supply, b) vertical integration which combines the farm and downstream users of a commodity under some single ownership, and c) contracts i.e. formal agreements between the suppliers and the retailers.

Spot markets represent the dominant traditional method for organizing the transfer of agricultural and food commodities for a long time. Economic theory and business practice alike indicate that when markets have perfectly competitive features, the "free market" price (generated by the demand and supply mechanism) has strong and desirable efficiency properties, at least when the market is viewed from a static perspective. In particular, the market price tends to reflect the true economic cost and value of each commodity and its relative scarcity. Still, when the market is viewed dynamically, competitive spot prices may have problematic properties and adverse implications – this issue is particularly relevant for the allocation of risks and the investment incentives in new technology. At the same time, as already discussed above, the observed increased concentration downstream has had as a direct implication a fundamental change in the way that producers and retailers transact and determine the terms of trade; in particular, more and more transactions from the farm to the retail level are organized through agricultural specific contracts. The gradual liberalization of agricultural markets and the removal of trade barriers worldwide have accelerated the formation of such "vertical" agricultural contracts. These contracts usually specify the quantity to be delivered, the time of delivery, the buying price (before harvest begins), the quality of the product and/or the type of variety or seed to be used. Depending on the type of the contract (for example, if it is production or marketing contract) the contractor can provide the grower inputs, labor for harvesting or technical advice and support. Moreover the duration of such contracts often tends not to be too long, a few months or near to one year, while the suppliers that agree to formal contracts are large growers. While in some cases the length of the contracts is increased, this has not been the norm.

The advantages of the farming contracts are that the farmers know that they have an assured buyer for their production, the provision of inputs, "security" about the prices, the quality control and the cash in advance. All these factors lead to the reduction of the risk for the farmers. On the other hand, the farmers often get a lower price due to the high bargaining power of the downstream firms than what they may obtain in a free (spot) market. Thus, producers may face a trade-off between risk and return. Another disadvantage is that farmers lose their autonomy and having full control of their operation – as a result, in some cases they may find it more profitable to work for themselves and arrange their business dealings independently. Moreover, contracts serve as incentives to the suppliers to stay in a transaction relationship with the same buyer and over time make investments in assets (such as equipment and learning) that are specific to the particular retailer. Such specific investments can lower significantly the cost of production and increase the attractiveness of the farmer's product to the buyer, but they also reduce the flexibility of the growers.[11]

An alternative to shorter or longer term contracting is for the firms to follow vertical integration strategies, though mergers, acquisitions or simply by expanding their business along the value chain. By following such strategies, a firm can integrate backwards, typically with a large retailer moving back towards the distribution, transportation and even the production stage. Or producers (once they each reach a critical size or in some collaboration among them) can integrate forward by moving into the distribution stage and even all the way to the stage of sales to the final consumers. Vertical integration can be full (in the sense that it covers all the stages along the value chain) or partial. Compared to contracting, integration may allow firms to solve problems due to high transaction costs, by internalizing risk-related and other incentives. However, vertical integration is associated with a loss of flexibility and also – if it proceeds beyond a certain level – with high internal transaction and administrative costs as a result of a larger combined size of the firms and of operating in multiple markets.

[11] See Eaton and Shepherd (2001) for details on contract farming with emphasis on the institutional environment and the responses of the farmers to changes in this environment. See also MacDonald and Korb (2006).

It is obvious that due to the growing use of vertical contracts in the concentrated food chain, it is necessary to analyze the role that they play for the level and division of the profits in the vertical chain and the formation of the final price that pay the consumers. It is important to also identify the policy implications for the government and, in particular, for competition policy.

THE BASIC VERTICAL EXTERNALITY AND SOLUTIONS

It is sometimes informally suggested that a larger number of stages in the vertical chain, essentially a larger number of intermediaries leads to higher final product prices. To understand this argument, which is indeed correct but only under certain conditions, let us consider a simple vertical market structure or value chain with one upstream firm (U) and one downstream firm (D), like that shown in Figure 1. Note that here we assume, for simplicity, that there are one only two stages. Firm U's product is sold to firm D, which in turn sells to the final consumers (possibly after some packaging or other processing). Thus, in this simple example, with only two stages, the upstream firm may be a producer and the downstream a retailer.

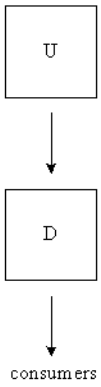


Figure 1: Value chain with one upstream and one downstream firm

The main *double marginalization* argument can be understood as follows. Demand in the final market is taken as given (and can be formally represented by any strictly decreasing function of the final price). Suppose that pricing can be only "linear", that is, we have a constant per unit pricing. The U firm sets a price P_w (the wholesale linear price) and then the D firm makes its purchasing decisions from the U firm and decides the price that it sets for the final consumers, P_R (retail price). Each firm is independent from the other, in the sense that it seeks to maximize its own profit. The fundamental result that one obtains in the equilibrium of this model, a relatively well-known result since Spengler (1950), is that this process of double marginalization leads to prices for the final consumers that *exceed* the prices they would face under a vertically integrated (VI) monopoly. Since the monopoly profit is by definition the maximum possible in a market, we also find that, under vertical separation, the aggregate profits (for D and for U) will be *below* the profits for the VI case. So, vertical separation with linear pricing tends to hurt both the consumers and each of the two firms, while integration seems to benefit them. The underlying reasoning is that the firms fail to internalize the vertical externality that exists in their pricing (in particular that the U firm ignores part of the effect that an increase in its own price will have on the final price).

The following remarks are important in order to understand how this fundamental vertical externality works in value chains:

- From the above discussion, it follows that one "solution" to the double marginalization problem is vertical integration. This would take the market structure to a simple monopoly that covers both stages of the market.

- However, this problem can also be solved if different pricing schemes can be used (instead of linear pricing), like two-part tariff arrangements. Under such an arrangement, if the marginal price is set at the competitive level (cost) and the fixed fee is set to be equal to the total monopoly profit (or just below that, so that it is not rejected) then we can recover exactly the monopoly solution (without having formally a vertical integration arrangement).
- If there are additional stages in the vertical market (that is, not only two stages as assumed above, but more), the problem under linear pricing becomes even worse. In fact, the more stages there are, the more severe the "multiple marginalization" problem becomes and the higher the final prices for the consumers will be. One interpretation of this result is that a larger number of "intermediaries" would imply a higher final price.
- The picture changes if we allow the D firm to have the price setting (or bargaining) power against both the final consumers and also the U firm. In such a setting, only one profit margin can be applied and there is no additional distortion.

EQUILIBRIUM PRICING INCENTIVES WITH STRATEGIC PRICING

Based on the insights from the above discussion about double marginalization, one can proceed to an analysis of pricing in more complicated vertical structures. One of the important cases in practice is when, in addition to the basic vertical externality discussed above, we also have a horizontal externality that takes the form of "interbrand" oligopolistic competition. This may correspond to the case of one producer that deals with two (or more) retailers. In such cases, there is market power not only in the vertical sense but also in the horizontal: not only strategic interaction between producers and retailers matters, but also among retailers. Let us discuss a case like that of Figure 2 with one firm upstream and two downstream. The U firm should then understand that given the oligopolistic competition downstream (more precisely, here, duopolistic), prices in the final market tend to be too low relative to what the U firm would like to have seen (that is, the monopoly price). A two part tariff instrument would be sufficient so that the U firm can make competition in the D market soften and prices to rise to the monopoly level, and then capture the total monopoly profit via a fixed fee. The reason that two instruments would be required here is because one instrument is needed to control the horizontal externality (competition between the D firms) and the second instrument could then transfer the profit (or part of it) upstream. In this case, the U wholesale price (as part of the two part tariff) has to be higher than cost, exactly to make the two D firms behave more passively against each other.

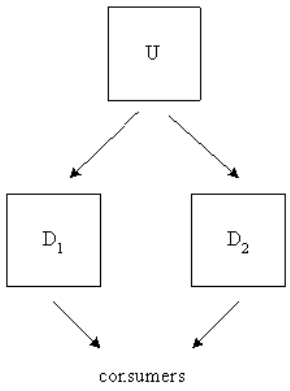


Figure 2: One upstrean firm and downstream duopoly

The situation described just above would not be very different if, instead of having only two D firms, we had several firms (see Figure 3). Again, the marginal price charged downstream (for buying one additional unit) can make them passive enough against each other and then the fee can transfer the profit upstream. This is the case in reality when we have one large producer (or one large wholesaler) and many small retailers.

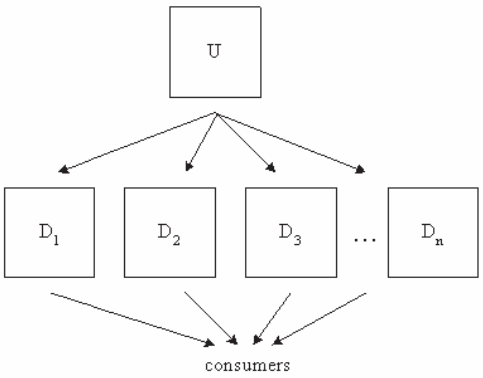


Figure 3: One upstream firm and downstream oligopoly

Of course, the picture will be very different when there is both interbrand and intrabrand competition at the same time. Suppose, for example, that there are two upstream firms, one trading exclusively with *n* downstream firms and the other with *m* downstream firms (the assumption of exclusive dealing for each upstream-downstream pair is maintained here to keep the analysis simple but is not without restriction). In this case, the dominant effect may be that each vertical chain may like its own retailers to have more aggressive marginal incentives in the market *vis-à-vis* rival retailers (see e.g. Vickers, 1985, Fershtman and Judd, 1987). Then the equilibrium wholesale prices will tend to depend on the number of retailers that each upstream firm is associated with (see Saggi and Vettas, 2002). Of course, what is also important for the exact results is the form of downstream competition, e.g. whether that is in quantities or in prices. With quantity competition (Cournot) assumed downstream, each chain would like to assist its own downstream firms to commit to more aggressive behavior and to seek a larger market share. With price competition (Bertrand) assumed downstream, if each chain encourages its own downstream firms to have more passive behavior the outcome may be higher profits and desirable for all parties.

Also important is the strategic case when there are two upstream firms (say two producers) that may have to go through a single downstream firm (say a retailer or a wholesale firm). In such a case, the D firm is a "bottleneck" and typically can use its bargaining power to obtain high profits (each of the U firms has no outside option in the bargaining, while the D firm can play one D firm's incentives against the other). The exact details depend on how bargaining takes place – in general such situations are mentioned in the literature as "common agency" (see Figure 4).[12]

[12] See Rey and Tirole (2004) and Rey and Verge (2005).

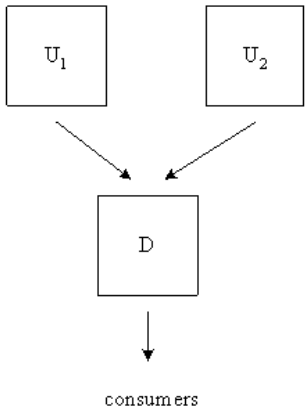


Figure 4: Upstream duopoly and downstream monopoly

Of course, cases of vertically related markets can be quite complex even with only a small number of firms. See e.g. Figure 5, where there are two large upstream and two large downstream firms. How is trade going to take place? What are the prices for the final consumers? The answers will depend on a number of factors including: is the product a homogeneous commodity or is it differentiated – and what are the bargaining powers of each party and the outside options? As can be seen in Figure 5, one of the chains can be exclusive and the other may allow trade of both products.[13]

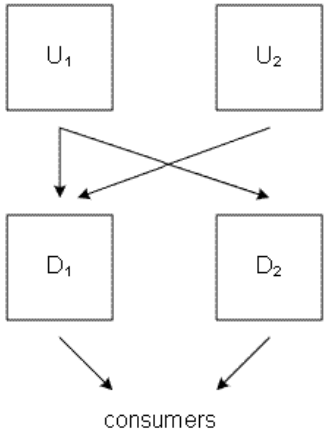


Figure 5: Upstream and downstream duopoly

In addition to prices, the horizontal and vertical features of the market structure also affect another important dimension, this of quality provision. This dimension of the product may be viewed by the final consumers as equally important or even (especially for certain food products) more important than the prices. It is therefore important to examine what are the incentives that the market structure and the associated contracts give to the various parties for providing the appropriate product quality. Quality for the final consumer typically depends on actions taken by all involved parties along the value chain.[14] For example, for most food products, the quality of the product when it leaves the farm is often not less important than the way it is treated during the transportation and distribution stages. In that sense, decisions by the various parties that may affect the product quality should be viewed as complementary. Assuring a particular quality typically requires the collaboration of these various

[13] On the incentives for forming excusive relationships with large buyers, see e.g. Innes and Sexton (1994). Another interesting issue here is the endogenous formation of *stable* trading structures in bilateral oligopoly markets; see e.g. Bloch and Ghosal (1997).

[14] See Fafchamps *et al.* (2006) for a study of quality control in India.

parties. If this collaboration cannot be assured, then product quality will be below the optimal one not only from the view point of the final consumers but also of the entire supply chain. For instance, suppose that there is one upstream producer that attempts to establish a reputation for his product (possibly using a specific brand name) as having high and/or consistent quality. Suppose that to reach the final consumer, the producer supplies various retailers (who in turn sell to the final consumers, possibly in markets that communicate only through information exchange and reputation building). If assuring a specific product quality is costly but also important, and if quality depends on actions by all parties (from the producer until the final buyer), the incentives for the final retailers to provide high quality may be weaker than optimal. The reason is because of "spillovers" or informational externalities: a retailer that does not assure high enough quality standards (e.g. in how a particular food product is stored or presented to the buyers) hurts not only his own sales but also the reputation of the product and, thus, the profitability of the other retailers as well. As this cost is not fully internalized by each independent retailer the market will tend to provide sub-optimal quality.[15] It follows that appropriate measures will have to be taken to solve the problem, like specifying particular details in contracts when this is possible, profit sharing schemes along the chain so that the relevant incentives are aligned, exclusive dealing, or vertical integration solutions.[16]

INVESTMENT INCENTIVES AND SPECIFIC ASSETS, EXCLUSIVE CONTRACTING AND DUAL SOURCING.

When analyzing vertically linked markets (or "value chains") the exact form that vertical organization takes is critical, as one moves from the producers-farmers to the distributors and retailers. As discussed in previous Sections, such vertical structures may vary greatly between the two extreme structures, that of full vertical integration (the formation of a single firm that covers all vertically linked stages and internalizes the corresponding vertical transactions) and that where all trade takes place through the markets. Many intermediate forms exist involving longer or shorter contracts and exclusive or not exclusive dealing. To understand the market forces that may push the organization towards one or the other extreme, the fundamental guiding conditions have to be traced back to the celebrated work of Coase (1937): the boundaries of the firm, he explained, depend mainly on the nature of transaction costs. To the extent that markets exist and operate efficiently, internalizing the corresponding transactions only increases the overall cost for the parties involved. So if there are competitive markets that one can rely upon either upstream or downstream there are little or no benefits from a vertical integration decision. This tends to be the case when the products are homogenous and there are a large number of (potential) buyers and sellers. If, for instance, there are many possible producers able to provide the desired quality and quantity at the desired time, then a retailer would not wish to integrate backwards – supply is assured and competition would drive the supply price close to cost. Similarly, if there are many possible retailers able to absorb the desired quality and quantity at the desired time and offer access to the final consumers, then a producer would not need to integrate forward: demand is assured and competition between retailers would drive the purchasing price close to what final demand would dictate. Uncertainty in the market would be representing only aggregate (demand or supply) shocks, not firm specific or idiosyncratic shocks. There is no efficiency or risk-reduction rationale for an integration strategy, while there is also no incentive for incorporating profits, as these are kept roughly at the normal level. Contrary to such cases, if there are products that are differentiated and specialized and / or the number of buyers and sellers is small, there may be both a transaction cost rationale and a profit rationale for a vertical integration decision.

Of particular importance when evaluating the relevant transaction costs is the issue of specific assets and investments (see e.g. Grossman and Hart, 1983). To the extent that the supply of products or their retail processing requires investments that are specific to the particular pair of transacting buyer and

[15] See e.g. Blair and Kaserman (1994) for a related simple model of quality incentives and Blair and Lafontaine (2005) for a general analysis and possible solutions to the problem.

[16] Vertical integration typically will not be a feasible solution in the case the downstream stage firms are multi-product, like in the case of food retailers (supermarkets) that carry different categories and varieties of products.

seller, there may be a dynamic rationale for vertical integration as market forces and contracts may not be sufficient for the investments needed. This is of course a more general issue that emerges in many markets, but also one that is also particularly relevant for food and agricultural markets. Supermarkets and other large retailers would tend to prefer having quality and quantity assurance and/or to achieve product homogeneity within each type and variety of product (because consumers dislike quality variance, prefer returning to the same retailer for their purchases once they have been satisfied, and certainly dislike not finding an item when they are looking for it, due to a possible shortage). As a result, they would need to give incentives to the producers that they transact with (directly or through intermediaries). The reason is that assuring a quality and quantity level for the product would typically require significant investments that become sunk once undertaken and, in particular, because they can involve specific assets (that is they do not have value, or only have a small value for other buyers). That is, the particular quality or characteristics of the product that one retailer may require may not be similar to the one that another may require. If this is so, and as a result the markets become very "thin", the farmers may require assurances that the strong buyers will not behave opportunistically and would not "hold them up" after they have first committed themselves by making specific choices and/or investments. In other words, given that a specific investment is required to take place before supply is provided and given that exactly by its specific nature this investment would be losing much of its value outside the particular transaction, the party that has invested may find itself in a weak bargaining position (since there is no significant outside option available) and as a result the other party may extract a large part of the trade surplus. Anticipating in a rational manner this behavior, parties that consider undertaking such specific investments may simply not invest at all or invest at an inefficient level.

As a solution to the problem associated to specific investments, it appears that agreeing on contracts that are long and broad enough to cover for the risks involved may be needed for the transaction and for the market to operate effectively. The design of such contracts, however, presents two difficult and crucial choices. If these contracts tend to be short-term, they may not protect the parties from opportunistic behavior and may be too weak for giving incentives to make initial specific investments (there may be the fear that after the contract expires one of the parties will hold up the other). On the other hand, long-term contacts may open up the possibility that after the contract has been signed, one of the parties may not have enough incentives to spend enough effort for producing a good enough product or timely delivery, especially if it is costly or impossible to write complete enough contacts and these have to be incomplete. This is an important "moral hazard" problem associated with longer contracts. It follows that, as a result of the above-described problems, the appropriate contracts and organizational form would have to balance the incentives for specific investments and the incentives for effort for quality assurance during the entire contract horizon for all the parties involved.

The picture in agricultural markets in practice currently appears to be pointing in the direction of vertical chains that allow intermediate degrees of flexibility, through medium-run contractual arrangements. What is the key issue here? If retailers wish to provide to their customers products that meet certain quality standards or are differentiated in certain dimensions, then they need to form links with producers that will produce such products in a consistent and reliable manner. The more formal these links and the longer their horizon are, the lower the chance that appropriate products will not be available, but the higher the management cost, as well as the risk in case of a negative shock. At the same time, it is also observed quite often that it is the buyers that typically undertake to finance, at least at a significant part, the specific investments required by the producers. This is primarily for two reasons. First, buyers tend to be larger firms and financially stronger than producers and more able to absorb risks. Second, being in closer contact with the final consumers, they have a clearer idea about the qualities, features and quantities of the product that the market requires than the producers have.

The other side of the same coin is how many producers a distributor/retailer should be linked to (see the related literature on split awards and dual sourcing, e.g. Anton and Yao, 1987, Demski *et al.*, 1987, and Riordan and Sappington, 1987). Given that enough assurances and incentives have to be given for a producer to make the necessary investments to supply products that meet the predetermined criteria (otherwise, a "hold-up" risk exists), reliance on a small number of producers (only one producer in the

limit) minimizes the cost of these incentives. On the other hand, reliance on a single or a small number of producers would tend to reverse the hold-up risk (so that now it is the retailers that become exposed to that) and only provide low marginal incentives to the producers. The arrangements that currently seem to be more frequent in practice are ones of intermediate levels of dependence, with each retailer being linked to a small but not too small number of producers. It would be interesting to study the details of these relations and to explore how they are expected to evolve in the future.

DYNAMIC EFFECTS AND LEARNING

Much of the literature on vertical contracts has focused on static models that do not take dynamic interactions into account. One important way to introduce dynamic interactions in the vertical environment is to examine vertical contracting with learning-by-doing technologies at the production stage (see Kourandi and Vettas, 2006). The basic idea is that over time the (generalized) unit cost of production may decrease as the producer gains more experience, that is, may be a decreasing function of past accumulated production. An interesting question is set forth is how vertical relations affect the dynamics of cost and learning-by-doing. One can consider a formal model where upstream producers supply the downstream firms with inputs and gain proficiency through the repetition of their production. Production costs then decline with accumulated output and this process affects the market outcomes in all periods. The notion of "learning-by-doing" technologies is not new. Previous theoretical studies have examined the "learning curve hypothesis" (e.g. Spence 1981, Cabral and Riordan, 1994, Lewis and Yildirim, 2002) and the implications of this hypothesis for market conduct and performance. However, these studies do not examine how the vertical structure of an industry may affect the dynamics. Within such a framework, important questions arise: How do final market outcomes depend on the "learning curve hypothesis"? Will the market competition favour an outcome with lower prices or more varieties in the market? Under what conditions can exclusive dealing emerge and be beneficial for consumers and firms? What is the strategic role of the intermediaries? In the absence of the downstream firms, do the producers take advantage of the learning-by-doing technologies in the most efficient way or is the presence of a large downstream firm necessary in order for coordination to be achieved? This set of questions is not only of theoretical interest but also of practical importance, as vertical contracting with learning-by-doing technologies is commonly observed in many industries. Kourandi and Vettas (2006) offers a theoretical treatment of how markets may work when there is both vertical contacting and learning-by-doing. The exact results depend on the assumptions one has to make about the mode of competition (i.e. whether firms compete in quantities or in prices) and the allocation of bargaining power among firms. Still, a key implication is that concentration (exclusive dealing as an extreme case) in the downstream stage may benefit final consumers when compared to a more competitive market at that stage. The reason is that with one or few buyers at the downstream (or at an intermediate) stage purchases can be concentrated, at the equilibrium of the model, to a smaller number of producers. As a result, this concentration implies (through learning-by-doing) a lower unit production cost and prices for the buyers. This welfare benefit may have to be compared with a corresponding welfare loss due to a decrease in the available product varieties in the final market.17 Thus, a trade-off emerges between lower prices and increased variety that large retailers as well as policy makers should be taking into account.[18]

COMPETITION POLICY ISSUES

Competition (or antitrust) policy has become increasingly important the last 15 years or so in almost all developed countries and, gradually, also in many developing ones. National authorities (like the Federal Trade Commission and the Department of Justice Antitrust Division in the U.S., having the

[17] Variety in the production of a particular agricultural product, in addition to satisfying different consumer tastes, may also be desirable for reasons related to the protection of the production process itself. In particular, it may be desirable for experimentation purposes as well as for reasons related to the protection of genetic diversity.

[18] While related, learning-by-doing is a distinct technological and organizational feature from economies of scale, as what matters is the accumulated production, not the current scale. Economies of scale or increasing returns may also lead to exclusive contracting. See also Fafchamps (2003) for the related implications in agricultural markets.

longer histories of important activity, as well as in other countries) and also the EU Competition Commission have become increasingly active. Competition policy has been receiving significant attention, with firms in many markets becoming very much affected in several aspects of their operation. The coordination of Competition policy at an international level has also become the subject of important studies and debates in the context of the WTO or the OECD. Agricultural and food markets have not been as affected as some other industries, perhaps due to the fact that in many countries these tend to operate in a less concentrated manner. Not surprisingly, most of the cases when competition authorities have looked into possible violations of the competition laws involve "horizontal" merger cases at the retail level, that is, increased concentration among supermarkets. I expect that, as agricultural and food markets become increasingly oligopolistic, competition cases about them will become more often and receive more attention.

The application of competition policy falls under three broad categories. These are, in general:

- *merger control* – in cases of proposed mergers or acquisitions among two or more companies (the market share or the size of which exceeds a predetermined threshold) approval will have to be given once the Competition Authority in charge finds that this increased concentration will not lead to "substantial lessening of competition" or will be compatible to some other similar criterion,
- actions against organized (hard core) *cartels*, as well as against occasional *collusive behaviour* among companies – where it may be found that companies collectively behave in a way that decreases competition in a market (through price fixing, market sharing, decreasing innovation incentives or other dimensions), whether following an explicit agreement or not, and
- actions against *abuse of dominance*, where firms found to have a dominant position in a given market have to be checked to assure that their behavior does not hurt consumers or competition – examples include predatory behavior, possibly cases of tying and forced bundling, some discriminatory practices and other.

In the EU, important is also a fourth category, that of

- "State aid" cases, where the general idea is to prevent an even competitive playing field among Member States and to protect companies from unfair national subsidies that their rivals may be receiving.

Regarding the application of competition policy in agricultural and food markets and the expected directions this will take in the future, the following observations are in order:

- Regarding merger control, I expect two issues will become increasingly important in the next decade or so. One issue concerns increased vertical integration through mergers or acquisitions. In general, vertical integration is viewed by competition policy much more favorably than horizontal concentration. This is both because the implied adverse effect on competition is lower or not existent, and because of expected technological and distributional efficiencies, more significant than under horizontal concentration. The other issue is about increased horizontal concentration either at the downstream level (large supermarkets) or at the upstream level (large producers). Regarding horizontal mergers and acquisitions, what is important to note is that both the theoretical results and the empirical evidence is mixed in vertically related markets (see e.g. Motta, 2004): increased concentration at one stage of the market, will tend to alter the relative upstream-downstream *bargaining* power and, thus, the implied terms of trade in ways that could either benefit or affect adversely the final consumers and/or the producers/farmers (for some work on bargaining in oligopolistic vertical chains, see Horn and Wolinsky, 1988, Hendricks and McAfee, 2000 and more recently Inderst and Wey, 2003 and Milliou *et al*. 2004).
- Regarding now abuse of dominance, I expect this may be, for the moment, an area of some less immediate action than merger control in agricultural and food markets. However, important cases may emerge especially regarding the behaviour of large intermediary firms (wholesalers)

when the latter face smaller and weaker farmers. Also, such policy issues may be important in segments of the market with increased product differentiation and brand-name properties.

- Regarding cartels and collusive behavior, this may also be an important area in the next few years. Again, I expect that most of the action in this category will be concerning the behavior of intermediary wholesale firms. The cases that will emerge are expected to be weaker and fewer when one looks at the behavior of large retail supermarkets, where in most countries competition appears to be working (at least for the moment!) reasonably well in the horizontal dimension (among supermarkets that fight for market share).
- Finally, in the EU there is the issue of State aid. While subsidies have been the norm in most agricultural markets in the last decades, in the EU these practices have not raised issues of state and legislation violation (other than in marginal cases). This happens for at least two reasons: one is that most producing companies in the EU are small companies, each without significant market share. The second reason is that subsidies in EU Member States generally fall under common and agreed at a central level agricultural policies, with each Member State giving priority only, at this central stage, to matters of its own national interest. Insofar as these factors may change in the future and we observe larger producing agricultural and food companies possibly with ownership that cuts across state lines, we may see an interest towards national subsidies also in the context of state aid control.

POLITICAL ECONOMY

Competition policy is, of course, only one way in which policy may affect the way agricultural and food markets may work. In fact, for the reasons discussed in the previous Section, it is one of the *less* important ways that policy intervenes in these particular sectors. The reason it has received attention in this article is simply because Competition policy becomes more important as certain stages of the value stage gradually become oligopolistic. Still, other, more traditional, ways in which policy affects these markets are very important. These have included in the recent past, various types of price support programs, direct subsidies, export subsidies, import tariffs and quotas, subsidies for new products and so on. Many of these policies have welfare effects that are ambiguous and/or transfer rents among various groups of buyers and producers. The establishment of a particular policy and the exact terms it specifies may be extremely important. For example, opening up or closing the market via the control of trade barriers is crucial for the profitability of a category of producers as well as for the implied market structure. It follows that producers and other firms along the agricultural or food chain may have strong incentives to try to influence the policies that will be put in place, if they can do that.

Given the important role that policies play for the division of profits, increased concentration at some stage may affect policy because large players are usually able to shift their weight more capably and effectively, pushing for the adoption of policies that are favorable to them. The sugar industry in the U.S. with very large producers concentrated in certain southern States (e.g, Florida) and benefiting enormously from imposed quotas on sugar imports, immediately comes to mind. Policy negotiations at the international level concerning the EU position and more general rules for the banana market is another example. In these cases, profits may depend as much on policy decisions as to other production decisions of the firm. How changing concentration at certain stages of the value chain may affect the division of profit along the chain, not directly but indirectly through its influence on policy, seems a question that is both empirically important and theoretically challenging. For instance, when production is more concentrated in larger firms, does this affect the type of protection they may receive and in which way? Or, how does increased concentration downstream affect the policy protection that upstream suppliers (farmers) may receive? An important insight is that, depending on the exact form that vertical trading takes, policies that benefit firms at a certain stage of the vertical chain may either operate at the expense of firms at another (linked) stage of the same chain or benefit the entire chain. However, despite its importance, this general topic - which is clearly one of political economy - has not received much attention in the literature yet and remains open for future research.

CONCLUSION

In this article we briefly reviewed aspects of control and competition that tend to be important along a commodity value chain. Such matters have been the subject of industrial organization theory for a long time and now become important in the area of food and agricultural economics, as parts of these markets become oligopolistic and increasingly concentrated. In analyzing oligopolistic, vertically related markets, both from the business strategy and the policy viewpoint, the focus of the analysis shifts in an important way towards issues like contracting, double marginalization, buyer power and bargaining, strategic behavior, product differentiation, specific investments, exclusivity of contracts, concentration and competition policy, and other issues. To the extent that food and agricultural markets gradually move away from the standard commodities model, a new set of possible policy interventions emerges, whereas policies designed for undifferentiated commodities may be no longer advisable. Our tools for analysis should, therefore, be accordingly modified.

In the present paper, an attempt has been made for a critical presentation of the issues that emerge as more important. The task of market analysis and identifying appropriate policy measures becomes much more dependent on the exact assumptions and details of the model than in competitive markets. Since the issues raised are abound “rich” and the spectrum of possible different structures is wide, a challenging aspect of looking into such matters is that no single model exists that can be used as a basis for the analysis in all cases. Instead, features from different models may have to be combined for each particular application. The associated lack of robustness would have to be seriously taken into account by researchers and policy advice should always be given with caution. Thus, I expect and hope that more research, theoretical and empirical, will emerge in the near future, with specific applications in the important food and agricultural sectors.

REFERENCES

Anton, J. & Yao, D. 1987. Second sourcing and the experience curve: price competition in defense procurement. *Rand Journal of Economics,* 18: 57–76.

Balsevich, F., Brdegue, J., Flores, L., Mainville, D. & Reardon, T. 2003. Supermarkets and produce quality and safety standards in Latin America. *American Journal of Agricultural Economics*, 85(5): 1147–1154.

Berdegue, J., Balsevich, F. & Reardon, T. 2005. Central American supermarkets' private standards of quality and safety in procurement of fresh fruits and vegetables. *Food Policy*, forthcoming.

Blair, R. D. & Kaserman, D. L. 1994. A note on incentive incompatibility under franchising. *Review of Ind. Organization*, 9: 323-330.

Blair, R. D. & Lafontaine, F. 2005. *The Economics of Franchising,* Cambridge University Press.

Bloch, F. & Ghosal, S. 1997. Stable trading structures in bilateral oligopoly. *Journal of Economic Theory*, 74: 368–384.

Boselie, D., Henson, S. & Weatherspoon, D. 2003. Supermarket procurement practices in developing countries: Redefining the roles of the public and private sectors. *American Journal of Agricultural Economics*, 85(5): 1155–1161.

Cabral, L. M. B. & Riordan, M. H. 1994. The learning curve, market dominance and predatory pricing. *Econometrica*, 62: 57–76.

Cacho, J. 2003. The supermarket 'Market' phenomenon in developing countries: Implications for smallholder farmers and investment. *American Journal of Agricultural Economics*, 85(5): 1162–1163.

Clarke, R., Davies, S., Dobson, P. & Waterson, M. 2002. *Buyer Power and Competition in European Food Retailing,* Edward Elgar.

Coase, R. 1937. The theory of the firm. *Economica,* 4: 386–405.

Crespi, J. & Gao, Z. 2005. A simple test of oligopsony behaviour with an application to rice milling. *Journal of Agricultural &Food Industrial Organization*, 3(6): 1–17.

Demski, J. S., Sappington, D. E. M. & Spiller, P. T. 1987. Managing suppplier switching. *Rand Journal of Economics*, 18(1): 77–97.

Dobson, P. & Waterson, M. 1997. Countervailing power and consumer prices. *Economic Journal*, 107: 1461–1477.

Dries, L., Reardon, T. & Swinnen, J. 2004. The rapid rise of supermarkets in Central and Eastern Europe: Implications for the agrifood sector and rural development. *Development Policy Review*, forthcoming.

Eaton, Ch. & Shepherd A. W. 2001. Contract farming: Partnerships for growth. FAO Agricultural Services Bulletin, no. 145, Rome.

Fafchamps, M., Gabre-Madhin, E. & Minten, B. 2003. Increasing returns and market efficiency in agricultural trade. *International Food Policy Research Institute*, MTID Discussion Paper No. 6.

Fafchamps, M., Hill, R. & Minten, B. 2006. Quality control in non-staple food markets: Evidence from India.

Fershtman, C. & Judd, K. 1987. Equilibrium incentives in oligopoly. *American Economic Review*, 77: 927–940.

Grossman & Hart, O. 1986. The cost and benefits of ownership: a theory of lateral and vertical integration. *Journal of Political Economy,* 94: 691–791.

Hendricks, K. & McAfee, R. P. 2000. A theory of bilateral oligopoly, with applications to vertical mergers. University of Texas, Austin (manuscript).

Horn, H. & Wolinsky, A. 1988. Bilateral monopolies and incentives for merger. *Rand Journal of Economics*, 19(3): 408–419.

Hu, D., Reardon, T., Rozelle, S., Timmer, P. & Wang, H. 2004. The emergence of supermarkets with Chinese characteristics: Challenges and opportunities for China's agricultural development. *Development Policy Review*, forthcoming.

Inderst, R. & Wey, C. 2003. Bargaining, mergers, and technology choice in bilaterally oligopolistic industries. *Rand Journal of Econ*, 34(1): 1–19.

Innes, R. & Sexton, R. J. 1994. Strategic buyers and exclusionary contracts. *American Economic Review*, 84: 566–584.

Johnson Dale, D. 1981. *Food and Agricultural Policy for the 1980s*. American Enterprise Institute for Public Policy Research, Washington and London.

Key, N. & Warning, M. 2002. The social performance and distributional consequences of contract farming: An equilibrium analysis of the Arachide de Bouche Program in Senegal. *World Development*, 30(2): 255–263.

Kourandi, F. & Vettas, N. 2006. Dynamic contracting with learning by doing. Working paper, Athens University of Economics and Business.

Lewis, T. R. & Yildirim, H. 2002. Managing dynamic competition. *American Economic Review*, 92: 779–797.

Ma, A. Ch.-to. 1997. Option contracts and vertical foreclosure. *Journal of Economics and Management Science*, 6(4): 725–753.

MacDonald, J. & Korb, P. 2006. Agricultural contracting update: Contracts in 2003. United States Department of Agriculture, *Economic Information Bulletin* No. 9.

McCorriston, S. 2006. Imperfect competition and international agricultural commodity markets. Chapter 6 *In* Sarris, A. & Hallam, D. (eds) *Agricultural commodity markets and trade: New Approaches to analyzing market structure and instability.* FAO and Edward Elgar.

McCorriston, S., Sexton, R. & Sheldon, I. 2004. *Vertical market structure, commodity exports and trade reform*. 7th Annual Conference on Global Economic Analysis, World Bank, Washington.

Milliou, C., Petrakis, E. & Vettas, N. 2004. Endogenous contracts under bargaining in competing vertical chains. Working paper, Universitat Carlos III de Madrid.

Motta, M. 2005. Vertical restraints and vertical mergers. ch.6 *In Competition Policy*, pp. 302–410, Cambridge Univ. Press.

Neven, D. & Reardon, T. 2004. The rise of Kenyan supermarkets and the evolution of their horticulture product procurement systems. *Development Policy Review*, 22(6): 669–699.

Reardon, T., Timmer, P. & Berdegue, J. 2003. The rise of supermarkets in Latin America and Asia: Implications for international markets for fruits and vegetables. *In* Regmi, A. & Gehlhar, M. *Global Markets for High Value Food Products*, *Agriculture Information Bulletin*, USDA-ERS.

Reardon, T., Vrabec, G., Karakas, D. & Fritsch, C. 2003. The rapid rise of supermarkets in Croatia: Implications for farm sector development and agribusiness competitiveness programs. Report under the DAI/MSU collaborative project for RAISE.

Reardon, T. & Timmer, P. 2005. Transformation of markets for agricultural output in developing countries since 1950: How has thinking changed? ch. 13 *In* R.E Evenson, P. Pingali & Schultz, T. P. *Handbook of Agricultural Economics: Agricultural Development: Farmers, Farm Production and Farm Markets*, Vol. 3.

Rey, P. & Tirole, J. 2004. A primer on foreclosure. University of Toulouse, manuscript, forthcoming *In* the *Handbook of Industrial Organization*, vol. III, North Holland, Elsevier.

Rey, P. & Verge, T. 2005. *The economics of vertical contracts*. University of Toulouse and University of Southampton.

Riordan, M. H. & Sappington, D.E.M. 1987. Awarding monopoly franchises. *American Economic Review*, 77: 375–387.

Saggi, K. & Vettas, N. 2002. On intrabrand and interbrand competition: The strategic role of fees and royalties. *European Economic Review*, 46(1): 189–200.

Sarris, A. & Hallam, D. (eds) 2006. *Agricultural commodity markets and trade: New Approaches to analyzing market structure and instability.* FAO and Edward Elgar.

Spence, M. 1981. The learning curve and competition. *Bell Journal of Economics, 12*: 49-70.

Spengler, J. 1950. Vertical integration and anti-trust policy. *Journal of Political Economy*, 58: 347-352.

Vickers, J. 1985. Delegation and the theory of the firm. *Economic Journal*, 95: 138–147.

Trade Liberalisation under Imperfect Competition in Commodity Markets

Steve McCorriston[19]

ABSTRACT

This paper focuses on the potential impact of imperfect competition in determining the outcome of trade liberalisation in commodity markets where the commodity sector forms only a part of the vertical chain. Specifically, we consider the role of imperfect competition in the vertical chain where one or more downstream markets may be imperfectly competitive and where both selling and buying power may exist. In the first part of the paper, the main lessons that arise from the general trade literature are reviewed. In the second part, we outline the issues relating to market power that may arise in commodity markets with special emphasis on *successively* imperfectly competitive markets. A simple model of a vertical chain with successive market power is outlined. We then show that the welfare effects of trade liberalisation are largely determined by market power throughout the vertical chain. We conclude by highlighting issues that need to be addressed in future research.

INTRODUCTION

The 1980s witnessed a considerable sea-change in the analysis of international trade. Previously tied to the neoclassical model of trade, most analysis of trade flows between countries relied upon the stringent assumptions of perfect competition, constant returns to scale and product homogeneity. This was also true of the analysis of trade policy with the impact of trade instruments being restricted to deadweight loss triangles and, where relevant, terms of trade effects though alternative trade policy instruments could give rise to issues concerning the allocation of quota rents. As such, the study of trade liberalisation was relatively straightforward, the increase in welfare being associated with the trade-off between efficiency gains and potential terms of trade effects. However, it became increasingly clear that the standard trade models were ill-equipped to explain a significant proportion of trade flows: rather than trade being explained by differences in relative factor endowments (i.e. inter-industry trade), the data showed the majority of trade being between countries where relative factor endowments were similar and with two-way trade in differentiated goods (i.e. intra-industry trade). This gave rise to theoretical developments broadly referred to as "new" trade theory, the key features of which were imperfect competition, product differentiation and non-constant returns to scale[20]. In general, the gains from trade reflected these features with increasing market size giving rise to pro-competitive effects, increasing variety of goods available to domestic producers and (depending on the assumptions made) greater efficiency through scale effects. In many ways, the key feature of these developments being to move away from the country as the agent of trade to increasing focus on the firm, with the main methodological developments in trade being to have a closer marriage between trade theory and developments in industrial organisation.

Subsequent developments moved on to considering the role of imperfect competition on trade policy issues. At the risk of over-simplifying, there are two broad themes that have been the focus of this literature. First, if imperfect competition matters for understanding trade flows, does it change the way we would think about the normative role for governments in using trade policy instruments? This is commonly associated with the pioneering work of Brander and Spencer (1984, 1985) who showed that there may be a first-best case to use trade policy when markets are oligopolistic since policy may induce "rent-shifting" between countries such that protectionism may increase national welfare[21]. Second, if trade flows between countries can be, in large part, better explained by models of imperfect

[19] Department of Economics, University of Exeter, England, UK. E-mail: s.mccorriston@ex.ac.uk

[20] The major developments in this area are summarised in Helpman and Krugman (1985).

[21] See Brander (1995) for an overview.

competition and if market structure influences how we think about the use of government instruments, the follow up question to ask is how the effects of trade liberalisation may be influenced by these concerns? Trade liberalisation, therefore, has the potential to affect not only the standard mechanisms associated with deadweight losses and terms of trade effects but also efficiency via economies of scale and by affecting the profits of (the limited number of) firms competing in the market (or, depending on the model used, through changes in the number of varieties of the goods available in the market). In sum, not only does market power change the mechanisms via which trade liberalisation may affect national welfare but also may lead to the quantitatively impact from trade liberalisation being more significant.

The aim of this paper is not to provide a detailed overview of these issues but rather to consider the role of imperfect competition in understanding trade liberalisation in commodity markets. As such, we will draw upon the key lessons that have arisen from this research area as our starting point though, in the process, highlight the differences that will likely arise with respect to imperfectly competitive vertical chains. However, at the outset it should be noted that, by and large, these developments in the mainstream economics literature have, with some exceptions, more or less by-passed agricultural economics. Specifically, if we take the recent *Handbooks of Agricultural Economics* to be representative of the "state of the art" in this sub-discipline, the links between trade policy and imperfect competition are hardly ever-addressed. For example, surveying research on the industrial organisation of agricultural and food markets (see Sexton and Lavoie, 2001), the reported research is mainly done in a closed economy context, the main focus of food industry research being to characterise the nature and extent of competition on these markets with little attention given to the "so-what?" question of how the resulting market structure may influence the understanding of policy issues including trade policy. Similarly, the research of agricultural trade issues reviewed by Karp and Perloff (2002) also pays little attention to market structure issues and when it does, the research mainly addresses whether commodity markets are imperfectly competitive or not, with little or no attention on the implications for trade policy. As such, there is a significant gap in the understanding of how imperfect competition affects the outcome of trade liberalisation in commodity markets, not because of a widespread belief that commodity and related markets are necessarily competitive (though this view is still common among some researchers) but because the links between market structure and trade policy have typically been ignored.

This paper addresses these issues. A number of topics are covered including a justification as to why imperfect competition should be a serious consideration when characterising commodity markets, the mechanisms via which imperfect competition may affect the outcome of trade liberalisation and the overall implications of getting the story wrong when imperfect competition is inadequately accounted for. Particular attention is given to issues that arise in dealing with imperfectly competitive vertical markets; this is an area that has not received much attention in the mainstream literature so there are likely new challenges in addressing this issue. The paper is organised as follows. In Section 1, I summarise briefly the main issues addressed in the international economics literature with respect to trade liberalisation and market structure and the overall lessons that arise from this including reference to selected empirical studies and the methods and data that are employed. In Section 2, I turn to the issue of market structure in commodity markets. Reflecting the role of primary commodities as inputs into a vertical chain, the downstream sectors of which are imperfectly competitive, attention will be paid to the issues involved in characterising imperfect competition in vertically-related markets. This is arguably one key issue that does not arise in the standard trade literature which is largely concerned with horizontal issues, though there are important exceptions[22]. In large part, the mechanisms via which imperfect competition affects trade reform will remain intact but, where additional issues arise, these will be highlighted. In Section 3, a simplified model of a vertical chain is presented which highlights the role of imperfect competition in determining the margins at each vertical stage, the effect of trade reform on the change in this vertical margin and the distribution of welfare between consumers, producers and downstream firms. The implications of omitting imperfect competition

[22] In large part, research that has identified the importance of vertically-related imperfectly competitive markets has focussed on optimal policy issues. See, for example, Ishikawa and Spencer (1999).

when evaluating the outcome of trade liberalisation are addressed in Section 4 and, in Section 5 we summarise and conclude by highlighting potential avenues for future research in this area.

Trade Liberalisation and Market Structure: Some General Lessons

As noted above, the impact of imperfect competition on trade liberalisation is now firmly grounded in the international economics literature not only from a theoretical perspective but it has also featured in empirical work. In this section, I provide a cursory overview of the main mechanisms via which market structure can influence the outcome of trade reform and the results from selected empirical studies. These issues are informative in highlighting the methodological tools employed but also serve to form the basis how the issues reflecting aspects of market structure in commodity markets may differ from the competitive benchmark.

Theoretical Considerations

As a starting point, consider the effects on national welfare following trade reform. Omitting the technical details which can be found elsewhere (see, for example, Feenstra, 1995), the effect of a change in a tariff can be divided into four effects:

$$\Delta Welfare = \Delta DWL + \Delta ToT + \Delta SCALE + \Delta PROFITS \qquad (1)$$

Assuming perfect competition, the change in national welfare depends only on the first two effects. ΔDWL represents the gains associated with the deadweight losses associated with the distortion to production and consumption decision caused by the tariff. With trade liberalisation, this effect will be positive. The second effect represents the terms of trade effect associated with trade policy which exists if the country is sufficiently "large". With trade liberalisation, this effect is negative such that the net welfare effect for a large country depends on which effect dominates. In the small country case, only the former effect exists and the effects of trade reform are therefore unambiguously positive.

With imperfect competition, the latter two effects ($\Delta SCALE$ and $\Delta PROFITS$) become potentially important though the existence of these effects will depend directly on the specifics of the model employed. Scale effects relate to the size of the market so, with the possibility of an exporter given increased market access through trade liberalisation, there is also the potential to benefit from cost reductions due to unutilised economies of scale. With imperfect competition, there are generally speaking two alternatives. First, with monopolistic competition with free entry and exit, each firm produces individual varieties guaranteeing that super-normal profits do not exist. If profits do appear (say through the opening of markets), the assumption of free entry assumes that they rapidly disappear. In this case, the benefits from trade reform will depend on lower prices, product variety and scale effects. To the extent that imperfect competition gives rise to super-normal profits, for example, in the context of game-theoretic models, the effect of trade liberalisation is then to affect the level of profits attained by the domestic firm. Specifically, trade liberalisation will have a pro-competitive effect leading to lower prices, the mechanism being via changes to the price-cost margin.

Since this will be the focus of our discussion later, I provide a bit more detail on this. Consider the following example where the importing firm is subject to a specific tariff. Profits for a representative firm are given by:

$$\pi_i = (p - c_i - t)q_i \qquad (2)$$

Assuming quantity setting strategies, the first order condition for profit maximisation is given by:

$$\frac{\partial \pi}{\partial q_i} = p - p' \frac{\partial Q}{\partial q_i} q_i - c'(q_i) - t = 0 \quad (3)$$

which, assuming constant marginal costs and aggregating over *n* firms, gives:

$$p(1 - \frac{\theta}{n\eta}) = c + t \quad (4)$$

where the parameter θ represents an index of market power: explicitly, if $\theta = 0$, the market is competitive; if $n = 1$, then $\theta = 1$, this is the monopoly outcome and if $\theta = 1/n$, we have the Cournot outcome[23]. (4) can be re-written as:

$$p = (\frac{n\eta}{n\eta - \theta})(c + t) = \lambda(c + t) \quad (5)$$

The effect of trade reform on the price cost margin is via the change in the elasticity of demand. Then the change in the mark-up will be given by:

$$\frac{d\lambda}{dt} = \left(\frac{\theta}{n\eta - \theta} \right) \frac{d\eta}{dt} \quad (6)$$

Intuitively, trade reform lowers costs which increases the quantity of the good available. This will increase the demand elasticity as firms will price in a more elastic region of the demand function thus representing a pro-competitive effect from trade reform. Note, at this point, that the general trade literature has generally dealt with "horizontal" issues i.e. the pro-competitive effects arise from increasing competition among firms competing in a specific market. In the analysis of vertical chains, ideally we would wish to consider "horizontal" issues combined with "vertical" issues where the presence of imperfect competition throughout the chain can influence the magnitude of the pro-competitive effects.

In general, when evaluating the effect of trade liberalisation when markets are imperfectly competitive, we need to account for effects that are additional to those that arise from the assumption of perfectly competitive markets. The next question that arises relates to whether these additional effects are quantitatively significant?

Empirical Evidence

Accounting for the potential role of imperfect competition in influencing trade liberalisation outcomes has featured in empirical work. There are essentially two approaches taken: the first is to use calibration models in which a theoretical model is specified and calibrated with often limited (and selective) data; the second approach is based on econometric models largely focusing on whether trade reform affects price-cost margins. The data for these studies are country and/or industry specific with the data relating to plant level observations. With reference first of all to calibration methods, these can be either general or partial equilibrium. The advantage of these models is that since they have explicit micro-foundations that are used as the basis of the calibration, they have the advantage of being theoretically consistent and generally can rely on limited data (though this does not appeal to all observers). Aside from the data issues, the drawback of these methods is that you get back what you put in. So, for example, if one specifies a model where product varieties do (or do not) matter, the effects of trade reform will reflect an outcome where product varieties do or do not matter! On the other hand, econometric studies focusing on changes on price-cost margins are data intensive; not only to they have to focus on country-specific cases where trade reform has been undertaken but rely on plant or firm-level data on price cost margins which potentially limits the number of cases where this

[23] Although the use of conjectural variations faces criticism from game theorists, it is a convenient way of benchmarking an index of market power.

methodology can be applied. Moreover, these econometric studies rely on case studies where the reform programme is specific and observable[24]. Both approaches have their potential uses in giving a clear picture of trade reform. The interesting issue is whether the effects of trade reform with imperfect competition are potentially more significant than those arising from perfectly competitive models.

Early work by Richard Harris on computable general equilibrium models allowing for scale and imperfect competition showed that these characteristics of market structure could have a significant impact on the outcome of trade reform. Focusing on Canada as a small open economy, when engaged in reciprocal trade liberalisation, the presence of imperfect competition and scale was to increase more than three-fold the net welfare increases one would have expected from confining the analysis to a perfectly competitive environment (Harris, 1984). Since then, imperfect competition and scale have become commonplace in computable general equilibrium models. For example, Francois *et al.* (1994) allowed for these influences in their analysis of the possible Uruguay Round outcomes. More recently, Francois *et al.* (2005) have allowed for scale and imperfect competition in the analysis of the Doha Round. They also provide a decomposition of the net welfare changes due to allocative effects (i.e. associated with the deadweight loss triangles), the terms of trade effects and effects due to variety (since their theoretical underpinnings relate to a model of monopolistic competition) and scale. There are two interesting observations to be made from their results. First, the effect of scale and variety is potentially significant. For example, from global trade liberalisation, the sources of the gains from trade reform are split 50:50 between the standard allocative effects and the changes due to variety and scale. In other words, not accounting for imperfect competition can lead to a serious mis-measurement of the welfare effects of trade reform. The second observation to be made is that, from an individual country's perspective, the role of imperfect competition may reduce rather than increase the benefits from trade liberalisation, a result consistent with earlier general equilibrium studies. For example, if protection provides a larger market for the domestic (and potentially relatively less efficient) firms to serve, increased competition may lead to a potential welfare loss at the national level, even though global welfare may increase.

With reference to computable partial equilibrium models, perhaps the most notable is by Venables and Smith (1988). Focussing on the potential changes brought around by the Single European market, they showed that the effects on net welfare due to imperfect competition were potentially large. Moreover, the effects of trade reform were larger when free entry and exit was assumed leading to further efficiency effects. By contrast, calibrating a game theoretic model with a fixed number of firms, the analysis of Dixit (1988) suggested lower net gains though the distributional effects were potentially significant particularly in shifting rent between domestic and foreign firms. More recently, in his comprehensive analysis of EU trade policy, Messerlin (2001) showed that significant pro-competitive gains could arise following EU trade reform if trade liberalisation resulted in a more competitive market structure. It should be pointed out though that the incorporation of the pro-competitive effects were rather *ad hoc* and arose from arbitrarily imposing the pro-competitive effect. Nevertheless, taken with the results from other studies, the main lessons we can draw from these studies is that allowing for imperfect competition has the potential to give a significant kick to the welfare impact arising from trade liberalisation. The consensus from most studies is that assuming perfect competition will likely under-estimate the welfare effects from trade reform. If imperfect competition matters in terms of characterising industries, it also matters for considering when these industries face larger markets and more competition.

In terms of econometric studies of the impact of trade reform on price-cost margins, they have progressed from the earlier inter-industry studies of the impact of import penetration (see Schmalenesee, 1988, for a review). Recent best practice is to use the methodology developed by Hall (1988) which provides a growth decomposition that links output growth to inputs, productivity and mark-ups. With trade reforms, the mark-up should vary by influencing the elasticity of demand (see

[24] For example, if the government introduces a definitive reform package where the before and after effects are potentially identifiable, then the impact of trade reform can be measured. For a recent example of this applied to economic reform in Colombia, see Eslava *et al.* (2004).

the discussion above). Using plant level data for Turkey, Levinsohn (1993) confirms the pro-competitive effects from trade reform while Harrison (1994) shows declines in price-cost margins following trade reform in the Ivory Coast. In a recent study using data for Turkey, Kambhapati *et al*. (1997) also show that price-cost margins fell with trade reform.

Further Considerations

The above theme is fairly straightforward: if imperfect competition is seen to be an important characteristic of industries, we should incorporate this in trade models. When focussing on trade liberalisation, imperfect competition may determine the welfare outcome via either scale, variety and/or pro-competitive effects. Recent efforts to incorporate these mechanisms in empirical models confirm the presence of these effects and suggest that their role may be potentially significant. In other words, limiting ourselves to perfect competition, while relatively easy, carries the risk we under-sell the effects of trade reform. But the story does not end there. First, trade reform may also lead to productivity improvements but where economies of scale and mark-ups exist, there may be a tendency to under-estimate the extent of the productivity boost that may arise. This is confirmed in Harrison's study of the Ivory Coast who estimated that productivity growth was around four times higher in the less protected sectors (Harrison, op. cit.). Second, recent studies have highlighted a vertical link between imperfect competition in product markets and labour markets. For example, since the impact of trade liberalisation is to increase the demand elasticity, import competing firms may reduce profit margins and increase their demand for labour. Thus, although we would a priori expect wages to fall in the import competing sector, in the presence of imperfect competition there may be off-setting effects. Recent research by Krishna et al. (2001) using data for India confirms this. In addition, using data for Morocco, Currie and Harrison (1997) show that trade lead to more elastic demand in the product market, smaller mark-ups and higher productivity. Therefore, trade reform with imperfect competition leads to not only a static pro-competitive effect in the product market but also an increase in the demand for labour and higher productivity.

IMPERFECTLY COMPETITIVE VERTICAL COMMODITY CHAINS

Commodity markets are often perceived as being perfectly competitive thus perhaps rationalising why issues relating to market power are inadequately recognised in the literature. Yet, this perception often misses the point that raw commodities are inputs into a vertical commodity chain, such that the raw commodity is only a relatively small proportion of value-added, the downstream stages of which may be imperfectly competitive. This is true of both developed and developing countries. Taking the example of a developed country, farmers account for around 15-20 percent of total value added in the food chain in the UK. In developing countries, commodity exporters also receive a small proportion of the total value. For example, coffee producers account for 10 percent of total value added while processors, roasters and retailers receive between 20-30 percent respectively. In the cocoa market, the data is rather similar with cocoa farmers receiving around 15 percent of the total value of the finished product. Even where the commodity involved does not require much processing, the shares received by commodity producers can be rather small. For example, in the banana sector, the division of value-added is: plantations, 10 percent; international trading companies, 30 percent; ripeners, around 15-20 percent; and retailers as much as 40 percent.

In this context, we also need to recognise the alternative means by which market power can be exerted. For example, if the retail or processing sector is highly concentrated, then there is the possibility of oligopoly power being exerted but, in the context of explicitly recognising the links in the vertical chain, there is also the possibility of buying power where the downstream firms can act as oligopsonists. Where the retail and processing sectors are imperfectly competitive, there is also successive market power that relates to market power exercised at each stage of the food chain. Moreover, even in certain cases where the output market would appear to be competitive, market power can still exist; for example, in a country that exports a raw commodity to a competitive world market, farmers may face domestic market power via a state trading enterprise that acts both as monopolist and monopsonist. Finally, in characterising aspects of the vertical chain, the means by which alternative stages of the vertical chain exchange goods, can also impact on the overall degree of

market power in thee vertical chain. In this context, specific contractual arrangements covering a range of alternatives from spot market sales through to vertical integration also matter in characterising the degree of competition in a vertical chain.

Most of the available evidence on the potential for market power exists for developed countries. In Table 1 below, data is reported in the 3-firm across the food industry for selected countries in the European Union, the key observation being the generally high concentration ratios. US data also show relatively high levels of concentration (in this case, the 4-firm concentration ratios) in the food manufacturing sector as highlighted in Table 2. Moreover, the retail sector is often highly concentrated, as the data in Table 3 shows. These figures relate to the 5 firm concentration ratios in the retailing sector across the European Union. Though there is significant country variation, the overall impression is one where concentration rations are relatively high particularly in the UK, Germany, Finland, the Netherlands and Sweden. Market power is also an important issue in developing countries, in many ways potentially more so, given the relatively small size of the market and the existence of high trade barriers. For example, in Harrison's study of the Ivory Coast (Harrison, op. cit.), the highest price-cost margins were to be found in the food processing sector. Commodity chains that cross international borders can also exhibit the presence of market power with multinational firms dominating commodity chains. Relating to the commodity markets discussed above, the banana industry is known to be concentrated downstream (McCorriston, 2000), while in the coffee sector, three roasters (Philip Morris, Nestlé and Sara Lee) account for just less than 50 percent of the total market (FAO, 2004). In the cocoa market, six chocolate manufacturers account for around 50 percent of total sales. Other commodity sectors exhibit the same features. For example, three global companies account for 80 percent of the total soybean crushing industry in the European Union and 70 percent of the market in the US (FAO, ibid.).

Given these data, the appropriate characterisation of the food chain across many developed and developing countries is one of successive oligopoly where various stages of the downstream food sector are imperfectly competitive[25]. In this rather scant summary of the food sector, there are nevertheless some additional points to be made. First, in recent years, there has been increasing consolidation in the food sector: as documented elsewhere (McCorriston, 2006), mergers and acquisitions have been increasing rapidly since the mid-1980s. This has taken the form of both domestic and international mergers and acquisitions. Moreover, they have not been confined to developed countries (though it counts for the largest proportion of total merger and acquisition activity) but there has also been significant activity of developed country firms acquiring firms in developing countries.

Second, in characterising the overall level of competition in the food sector, the concentration ratios are informative of the potential but not conclusive of the degree of imperfect competition that does exist. As is well-known, numbers does not necessarily equate with behaviour so it may be the case that the firms are behaving competitively despite their small numbers. However, recent surveys relating to the new industrial organisation approach to measuring market power in the food sector do confirm that market power is potential issue (see, for example, Sexton and Lavoie, op. cit. and Sheldon and Sperling, 2003). Third, the means by which firms in alternative stages of the vertical food sector interact is also important in characterising the competitiveness of the food chain. For example, depending on the links between the various stages (ranging from arm's length pricing, a variety of vertical restraints, the way in which contracts are constructed between parties, through to vertical integration) all have an influence as they may, on the one hand lead, to vertical foreclosure (which exacerbates the imperfect competition in the vertical food chain) or, on the other hand, improve competitiveness by ameliorating the double marginalisation problem that characterises successively oligopolistic markets. Fourth, even if a market may appear competitive, geography may result in a fragmented market where market power can be exerted. This is particularly an issue in large developing countries where poor infrastructure or other regional factors may lead to producers being

[25] Of course, numbers do not necessarily translate into the exercise of market power. However, the consensus from the empirical studies measuring the extent of market power cannot reject that market power is exercised across a large number of markets.

able to sell to only a few (regionally concentrated) firms that could exert market power. For example, Osborn (2005) confirms the existence of buying market power in the Ethiopian grains market due to poor roads and inadequate infrastructure that permits market segmentation and the existence of mark-downs excercised by commodity traders[26]. Finally, state trading enterprises (STEs) continue to play an important role in many commodity markets. Though there has been a tendency towards the de-regulation of parastatals in many developing countries (though this process may not be as progressed as commonly believed), in many developed and developing countries, commodity regimes are still characterised by the dominance of STEs. The most notable examples would include, on the export side, Canada, Australia and China and on the import side, Japan, Korea, China and India among many others. Not only do these STEs have the potential to distort trade via the exclusive rights that give them, to varying degrees, monopoly and/or monopsony power (see McCorriston and MacLaren, 2005 and forthcoming) but will also influence how the producers and consumers will respond to trade liberalisation that affects the commodity sectors involved. Moreover, in the context of a vertical chain, they can act as a countervailing power against imperfectly competitive downstream private firms. An equivalent role may arise with the presence of cooperatives and other intermediaries which pursue non-profit maximising objectives.

Taken together, market power seems to be a potentially relevant characteristic of the food sector, the main feature of which being successive market power i.e. where alternative stages of the food chain are characterised by market power. Thus even if one accepts that the raw commodity market is competitive, the raw commodity is an input into the vertical chain which may not be competitive. Second, the high levels of concentration give rise to the possibility of oligopoly power which, even in the absence of buying power, will still have an impact on the upstream sectors of the vertical chain. Of course, oligopsony power is also a possibility where "mark-downs" may coexist with "mark-ups" thus exacerbating the imperfectly competitive aspects of the food sector and their impact on producers. The role of contracts in exacerbating or ameliorating market power becomes important, as do spatial issues (particularly in developing countries) and the role of STEs. In the following section, we discuss how imperfect competition in vertical markets affects the outcome of trade liberalisation.

Finally, in this context, it should be pointed out that one should not read this evidence as relating to a closed economy context. Many of the firms in the food sector (including retail) have an increasing international reach such that the impact of market power in the downstream food sector is not only pertinent for domestic upstream producers but also commodity suppliers in other countries who need to access downstream sectors of the food chain when exporting their commodities.

VERTICAL MARKETS AND TRADE LIBERALISATION

Some of the mechanisms via which imperfect competition can affect the outcome of trade liberalisation are covered in Section 1 but nevertheless there will be important differences. To recall, when imperfect competition exists, trade liberalisation may have a pro-competitive effect and reduce price cost margins and potentially have a scale-related effect. This may affect the gains from trade liberalisation. However, in the context of vertical markets that are characterised by successive market power, the issues may differ. In part, the issue is one of degree in that successive market power compounds the impact of single stage market power and hence the pro-competitive effect may be stronger. However, to fully understand the effects of trade liberalisation throughout the vertical chain, some further issues are involved. First, we need to understand how trade liberalisation at one stage is transmitted throughout the vertical chain. This is important since the policy-makers' concern (or at least the selling of the benefits or costs of trade liberalisation) may relate to the welfare of constituent groups. In the context of this paper, this relates not only to producers and consumers but also the distribution of rents between alternative stages of the vertical chain. Moreover, constituent parts of the

[26] While the link to geographical segmentation and market power may arise in developing countries, it may also be a feature of developed country markets. An alternative approach to market power that captures these features relates to spatial oligopoly/oligopsony.

vertical chain may not exist in the same country hence changes in the distribution of rents may act against the "national interest".

Second, the stage which is directly affected by trade liberalisation matters for the impact on alternative stages in the vertical chain i.e. changes in the distribution of vertical rents may depend on whether trade liberalisation relates to the processed or raw commodity. Third, we should also consider the impact of oligopsony as well as oligopoly power on the trade liberalisation outcome. In sum, while the general economics literature gives us some broad indicators in establishing the links between imperfect competition and trade liberalisation, there are further issues to account for. In this section then, the discussion is divided into three parts covering (a) the mechanics via which trade liberalisation effects are transmitted throughout the vertical chain and the implications that arises for the distribution of vertical rents; (b) an outline of a simple vertical model to capture the effects of trade liberalisation and (c) some results relating to the links between successive market power and trade liberalisation.

Mechanics

Return for a moment to our discussion in Section 1. There we showed that where there are positive mark-ups, trade liberalisation could affect the price cost margin via changing the demand elasticity in the product market such that the sector became more competitive when the intensity of international competition increases. This effect will also exist in vertical markets but we also have to consider the vertically-related aspects to gauge the overall impact. To do this, it is useful to think about price transmission which concerns how price changes occurring at one (imperfectly competitive) stage are transmitted to other stages in the vertical chain and ultimately commodity producers and final consumers. Focussing on this mechanism has several advantages. First, it is easy to benchmark against the competitive outcome; second, the mechanism via which the price transmission effect arises in a vertical context with imperfect competition is essentially the same as the price-cost margin effect in the trade literature discussed above; and third, within this context, we can consider additional concerns that may arise in a vertically-related context.

Consider a vertically-related food industry where the raw commodity enters at an upstream stage and that the technology linking these stages is fixed proportions and there is arm's length pricing. Suppose initially the (single stage) downstream food sector is competitive. Tariff liberalisation relating to raw commodities will reduce the downstream firms' costs. The effect here would be to reduce the retail price the extent of this reduction being equivalent to the share of the raw commodity in the food industry cost function i.e. there would be perfect price transmission. For example, if the share of the raw commodity equals 1, then the retail price would rise by the same amount as the raw commodity price. In other words, in a competitive vertical industry, the downstream sector has no role in affecting the outcome from trade liberalisation and the standard effects we would get in a textbook competitive model would continue to hold.

If, however, the downstream sector is characterised by oligopoly, the results do differ as price transmission will not equal one. There are two effects here: (i) there is a direct effect reflecting the change in costs in the downstream industry's cost function since its costs have now changed due to trade liberalisation but also (ii) the change in costs affects the price cost mark-up for the food industry, the magnitude of this second effect being determined by the *change* in the elasticity of demand in the product market which is exactly the same mechanism outlined in equation (6) (see McCorriston *et al.*, (2001) for a fuller discussion of these issues). Under reasonable conditions, the change in the retail price will be less than the change in the raw commodity price[27]. This discrepancy in the way in which market power affects the changes in the two prices nevertheless has an important implication; if raw commodity prices fall but retail prices fall by less, then the increase in consumer surplus one would expect from trade liberalisation will be diluted. Moreover, the firms that make up the downstream sectors in the food chain will see their rents increase. Finally, in the presence of oligopsony power, trade liberalisation may also moderate the buying power effect thus affecting the change in producer

[27] Specifically that the retail demand function is not too convex. For example, with a constant elasticity demand function, the pro-competitive effects will not hold as the price cost margin will not change. For demand functions that are sufficiently linear, the pro-competitive effects will hold.

surplus. In sum, imperfect competition will affect who gains and by how much from trade liberalisation.

There are still further issues to account for. First, tariff reductions may directly affect alternative downstream stages of the food sector. In this case, we may have to consider the "pass-back" effect with price signals being passed from retail to processors to farmers rather than (or perhaps in addition to, depending on the characterisation of the vertical chain) the "pass-through" effect with the transmission of price signals going the other way. If the food sector is competitive, this "pass-back" effect would be the reciprocal of the "pass-through" effect so that they would be observationally equivalent. However, in the context of imperfect competition, these effects will not be equivalent with the "pass-through" effect being diluted by market power and the "pass-back" effect being exacerbated by market power. Again, this will affect the magnitude of the welfare changes arising in the food sector. Second, as noted in Section 1, scale effects may also be important. Scale also affects the price transmission effects though again it affects the "pass-through" and the "pass-back" effects differentially (see McCorriston *et al*., 2005).

These effects all relate to the role of oligopoly in the downstream industry. Three further considerations. First, to the extent there are successive stages in the vertical chain with oligopoly at each, these effects will be exacerbated. For example, suppose we have oligopoly at the processing and retail stages respectively. The change in the retail price cost mark-up will depend on the elasticity of demand at the final stage but also at the intermediate stage, the change in the elasticity of demand will reflect market power at both the retail and processing stages. Specifically, it will reflect the perceived derived marginal revenue function. In other words, given the inter-linked nature of the vertical market, the price transmission effect (even if focussed on a single part of the vertical chain) will reflect market power throughout the vertical chain as a whole. Second, oligopsony power may also be important and in turn can affect the price transmission effects. This is an issue that has been largely ignored in the general literature. Nevertheless, the mechanism is similar to that which arises with selling power. With oligopsony, the change in the mark-down following trade liberalisation will reflect changes to the elasticity of supply in the raw commodity market (see Weldegebriel, 2004). Finally, relating to our other aspects of market power in commodity markets (i.e. segmented markets or the role of STEs), the effects discussed here will be ameliorated or exacerbated by these features of commodity markets. For example, with STEs, if the aim of the STE is to countervail the impact of buyer power on producers, the oligospony pass-back effect will not arise in this case since the STE will not price along the marginal outlay curve and the mark-down will be zero. To the extent that the market is geographically fragmented, these effects may be exacerbated by regional factors such as poor infrastructure.

The important point to take from this discussion is that the effects of trade liberalisation will be determined by imperfect competition that exists *throughout* the vertical chain. Though the impact of imperfect competition has been recognised in the general economics literature, there are therefore a range of concerns about imperfect competition that are specific to issues that are likely to arise in vertical commodity chains. But the bottom line remains the same. Imperfect competition will potentially determine the welfare impact of trade liberalisation but it will also influence the distribution of the welfare impact throughout the vertical chain. We return to this issue below.

A Simple Vertical Chain with Imperfect Competition

To highlight the effects of imperfect competition in a vertical chain, I outline a simple model. Assume there are three stages which are based in a given country: the raw commodity supply; a downstream processing sector that is imperfectly competitive in that there is both horizontal (oligopoly) power and vertical market power in that firms in this sector may act oligopsonistically via commodity suppliers; finally, there is a retail stage that is also oligopolitistic though we assume arms' length pricing between the manufacturing and retail sectors of the chain. Thus we have successive oligopoly throughout the vertical chain and oligopsony with respect to the commodity market. To ease the exposition, we assume a fixed proportions technology with an input:output coefficient equal to one and firms set quantities to maximise profits. In terms of the introduction of trade, we assume that when trade is liberalised, the processors can procure the raw commodity from the world market thus

reducing the demand for the domestically-produced commodity (though as noted above, the stage at which the trade reform is directed could influence the overall outcome).

As usual with these types of models, we solve the model by backward induction starting with the retail stage thus determining the perceived derived marginal revenue function that the firms in the processing stage face. Since we want an explicit solution, linear functional forms for the retail demand and inverse agricultural supply functions are assumed, as given by:

$$Q = h - bR \qquad (6)$$

$$P = k + gQ \qquad (7)$$

where Q is total availability of the raw commodity.

For a representative retail firm, profits are given by:

$$\pi_i^R = R(Q)q_i - W(Q)q_i - M^R(q_i) \qquad (8)$$

where $R(Q)$ is the inverse retail demand function, $W(Q)$ are costs relating to supplies from the upstream processing stage and M^R are other marketing costs which are assumed to be constant. The first-order condition for profit maximisation gives (and aggregating over n^R firms at the retail stage):

$$R - \left(\frac{\theta^R}{n^R b}\right)Q = M^R + W \qquad (9)$$

The interest here is in the market power parameter θ^R which relates to the conjectural variations of the retail firms. If this parameter is equal to zero, then firms in the retail stage behave competitively and the retail price equals marginal cost. However, the closer this parameter is to 1, then the less competitively firms behave. If $\theta^R = n^R = 1$, we have the monopoly outcome.

The inverse demand curve facing the processing firms is the derived marginal revenue function which is given by:

$$W = R - \frac{\theta^R}{n^R b}Q - M^R \qquad (10)$$

Profits for a representative firm at the processing stage is given by:

$$\pi_i^W = W(Q)q_i - P(Q)q_i - M^W(q_i) \qquad (11)$$

where $P(Q)$ relates to prices of the raw commodity and M^W are other marketing costs which are assumed to be constant. Profit maximisation gives:

$$W - \left(\frac{\theta^R \theta^W}{n^R n^W b}\right)Q = M^W + P + \frac{g\mu}{n^w}Q \qquad (12)$$

where θ^W relates to oligopoly power at the processing stage with the same interpretation as given for θ^R. The parameter μ however relates to oligospony power vis-à-vis commodity suppliers. If $\mu = 0$, there is no oligopsony power and commodity prices are set competitively; if $\mu = 1$ (and $n^W = 1$) then commodity suppliers face a monopsonist.

There are several features to note about this model where we have market power throughout the vertical commodity chain. First, the total amount of vertical rent reflects the nature of competition throughout the vertical chain. Specifically, defining total vertical rent as the gap between retail and processing prices plus the gap between processing and commodity prices, we have:

$$(R-W)+(W-P)=M^R+M^W+\left(\frac{\theta^R}{n^R b}+\frac{\theta^R\theta^W}{n^R n^W b}+\frac{g\mu}{n^W}\right)Q \qquad (13)$$

Note that θ^R, θ^W and μ (as well as n^R and n^W) all play a role in determining the total vertical rent. Second, and related to this, note that the inverse demand curve faced by commodity suppliers relates to the perceived derived marginal revenue functions that also reflect competition throughout the vertical chain and not just at the next stage. This captures the fact that, in the context of vertically-related markets, the stages are explicitly tied together. Specifically, the inverse derived demand function that commodity producers face is given by:

$$P=W-M^W-\left(\frac{\theta^R\theta^W}{n^R n^W b}+\frac{g\mu}{n^W}\right)Q \qquad (14)$$

This is clearly different to the consumer demand function that perfectly competitive models tend to assume. Note that the greater the degree of market power exercised in the downstream sectors (i.e. the closer θ^R, θ^W and/or μ are to 1) and/or the lower the number of competing firms (n^R, n^w) at any stage, the lower the prices likely to be received by farmers. To close the model, we solve out explicitly for Q and related prices. We then consider the changes in the distribution of welfare that may arise following trade liberalisation.

Effects of Trade Liberalisation

The aim is to use the simple model outlined above to highlight the distributional effects of trade liberalisation when the vertical chain is imperfectly competitive. It should be borne in mind that these numbers are essentially "back-of-the-envelope" calculations to highlight the results that may arise out of an imperfectly competitive vertical chain. As such, we assume specific values for each of the parameters, the key purpose of the exercise being to highlight the relative sensitivity of the welfare effects when the market power parameters change. Trade liberalisation is captured by assuming the downstream food sector can access supplies of the raw commodity from world markets. As such, trade liberalisation is seen as an exogenous shock to this vertical food sector and is more typical of an import surge rather than a tariff reduction *per se*[28]. While formally modelling trade in a set-up like this is possible, the simple scenario outlined here is sufficient to highlight the role that vertical market structure may play in determining the overall outcomes of trade reform. The key difference from the competitive case will be two-fold. First, our welfare metric will now include profits for the downstream firms (at both the processing and retailing sectors) as well as consumer and producer surplus. Second, in the presence of market power, the effect of increased trade will be to affect the welfare outcomes of constituents of the vertical chain differentially i.e. trade liberalisation will influence the distribution of downstream rents. This is because, as discussed above, the margins of the downstream firms will also change when faced with imports. The focus here, then, is how this

[28] In principle, the level of imports should be endogenously determined by the tariff and the parameters of the model, so that the effect of tariff reductions can be derived. This would be a straightforward extension of the model.

characterisation of trade reform translates into changes in welfare relative to the competitive outcome. In each case, we assume $n^R = n^W = 1$ and, at least initially, $\theta^R = \theta^W = \mu$.

In Table 4, we show the relationships between total welfare changes and distributional effects and imperfect competition following trade liberalisation. The competitive outcome is the benchmark case with $\theta^R = \theta^W = \mu = 0$. There is a net welfare increase (albeit one that is relatively small) which is comprised of gains to consumers and losses to producers. Note that in this case there is no change in the profits made by firms in the retailing and processing stages since these stages are competitive so that the price-cost mark-up is zero. However, when the vertical chain is imperfectly competitive, the relative change in net welfare is greater particularly for consumers whose welfare rises considerably. Since the impact of imperfect competition throughout the vertical chain is to reduce baseline consumer surplus, the effect of greater imports is considerably more marked. For the numbers used here, the change in producer surplus is similar to the competitive case but there is an increase in profits throughout the vertical chain. Taken together, the increase in net welfare is relatively greater than in the competitive case.

The remaining two lines in Table 4 highlight reductions in the degree of imperfect competition throughout the vertical chain. In the third line, we retain successive monopoly power but remove monopsony power. Finally, in the last entry, we further remove oligopoly at the processing stage but retain it at the retail stage thus moving from a vertical chain characterised by successive monopoly to one of single stage monopoly. The entries follow a common trend. As the degree of market power decreases, the relative effect of trade liberalisation is reduced. The effects continue to go in the same direction (i.e. consumer surplus increases as does rent for the firms involved as well as net welfare) but the relative magnitude of these changes is reduced the more competitive the vertical chain becomes. In sum, as with our discussion covering the general trade literature with imperfect competition, these results would seem to suggest that there is more to be gained from trade liberalisation when industries are imperfectly competitive.

FURTHER ISSUES

The theme running through this paper is straightforward: imperfect competition influences the outcome from trade reform. This is well-known from the trade literature but perhaps less-well recognised in the agricultural economics literature. However, in the context of vertical chains in which commodity markets are a subset, there are further issues to consider though the overall message remains intact. In this context, it is worth asking the question in a slightly broader context: what is the potential cost of omitting issues relating to market power in the vertical chain?

The most obvious is that we do not fully recognise the winners and losers from trade reform as is highlighted from the results presented above. Trade reform is sold on the basis of overall welfare gains and the distribution between constituent groups though usually the measurement of these effects comes from standard, perfectly competitive trade models but this is clearly not the full story as the above example highlights. Related to this is the political economy of liberalisation. Clearly, firms that constitute the vertical chain have an interest in trade reform as their profits will change at the expense of producers and/or consumers. When imperfect competition in the vertical chain matters, we do an inadequate job in fully accounting for the effects of trade liberalisation or indeed what is at stake for the constituents of each stage of the vertical chain.

Moreover, reforming market structure itself can be an important aspect of the reform process either as an end in itself or as a mechanism to complement the reform of more formal trade barriers. For example, McCorriston and MacLaren (2006) show that de-regulation which directly changes the market structure characteristics can be an important aspect of trade reform and lead to significant distributional effects following the reform of the Indonesian STE responsible for imports of rice.

There are, some "real" cases that confirm the role of market structure in influencing policy outcomes. The recent examination of the case of reform in the cashew nut sector in Mozambique is informative in this regard (McMillan *et al*., 2002). They show that despite the claims that reform would be successful, market structure issues were the key to understanding how these reforms were not as successful as hoped. In addition, in the context of the recent focus on trade and poverty, Balat and Porto (2005) show that the success of the cotton sector reforms in Zambia were determined by the emergence of regional monopsonies following the removal of the export parastatal. More recently, Brambilla and Porto (2005) show that trade reform had less to do with increases in agricultural productivity and more to do with changes in market structure.

SUMMARY AND FUTURE RESEARCH ISSUES

The theme running through this paper is that imperfect competition influences the outcome of trade liberalisation. This has been an issue subject to considerable investigation in the general economics literature though it is inadequately recognised when it comes to considering trade reform issues relating to commodity markets. Yet, given that commodities are only one part of a vertically-related chain that may be more appropriately characterised as imperfectly competitive, these issues will also apply here though there will be specific challenges to modelling vertical as opposed to horizontal issues. Moreover, to the extent that the vertical commodity chains are more appropriately characterised as successively oligopolistic and where buying power may also exist with selling power, there are a range of additional challenges to identifying the effects of trade reform in vertically-related, imperfectly competitive markets. Here we have focussed on the mechanism via which imperfect competition may affect the outcome, the additional issues that arise in the context of a vertical chain, and how the distribution of the welfare effects of trade reform may be affected by these factors. To summarise the main message, imperfect competition matters for understanding the outcomes of policy reform more generally and trade liberalisation specifically. At present, these issues are inadequately addressed by those involved in commodity market research.

In light of this, what are the future directions for research? Clearly there are a number of specific issues relating to the theoretical approaches that will apply in order to capture aspects of vertically-related markets. But rather than construct a detailed list, I highlight two generic issues. First, in analysing commodity markets, current research falls short of best practice reflected in the general (and specifically the international) economics literature. There are additional issues in dealing specifically vertical commodity chains but, in general, the analysis of imperfect competition and its effect on policy outcomes remains an activity among a relative minority of commodity market researchers. Yet, it clearly matters and arguably policy-makers and other interested parties have been quicker than the academic community in recognising these issues.

Second, it is also worth highlighting some methodological issues. A common approach to dealing with imperfect competition in trade models is to utilise calibration methods. This is where a theoretical model is set out and where some (limited) data that applies to the specific commodity market is used to compute the equilibrium following which various policy-related scenarios can be conducted. Although the foundations for these models are firm-based, they are nevertheless aggregative in practice. Econometric methods have the advantages of "realism" though are intensive in data requirements. However, recent practice in the economics literature has focussed on firm level data that captures the heterogeneity of firms that characterise an industry and use recent econometric methods to analyse the decision to export, impact on profitability and productivity and so on. Though data intensive and time consuming, this approach gives further insights as to what happens with policy reform and is arguably more informative than the more crude, simulated outcomes. Clearly, in progressing research in this area, researchers should consider the potential of these alternative but complementary methods. A significant and challenging research agenda lies ahead.

REFERENCES

Balat, J.F. & Porto, G.G. (2006) The WTO Doha Round, Cotton Sector Dynamics and Poverty Trends in Zambia In T.W. Hertel and L.A. Winters (eds.) *Putting Development Back into the Doha Agenda: Poverty Impacts of a WTO Agreement.* World Bank, Washington.

Brambilla, I. & Porto, G.G. (2006) *Farm Productivity and Market Structure: Evidence from Cotton Reforms in Zambia*. World Bank

Brander, J.A. (1995) Strategic Trade Policy. *In.* G. Grossman and K. Rogoff (eds.) *Handbook of International Economics*, Vol 3. Elsevier, North-Holland, Amsterdam.

Brander, J.A. & Spencer, B.J. (1984) Trade Warfare: Tariffs and Cartels. *In. Journal of International Economics*, 16: 227-242

Brander, J.A. & Spencer, B.J. (1985) Export Subsidies and Market Share Rivalry. *In. Journal of International Economics*, 18: 83-100

Currie, J. & Harrison, A. (1997) Sharing Costs: The Impact of Trade Reform on Capital and Labor in Morocco. *In. Journal of Labor Economics*, 15: 44-71

Dixit, A. (1988) Optimal Trade and Industrial Policies for the US Automobile Industry In R.C.Feenstra (ed.) *Empirical Methods for International Trade*, MIT Press, Cambridge

Eslava, M., Haltiwanger, J., Gugler, A. & Gugler, M. (2004) The Effect of Structural Reforms on Productivity and Profit Enhancing Reallocation: Evidence from Colombia NBER Working Paper No. 10367.

Feenstra, R.C. (1995) Estimating the Effects of Trade Reform In G. Grossman and K. Rogoff (eds.) *Handbook of International Economics*, Vol 3. Elsevier, North-Holland, Amsterdam.

Francois, J.F., McDonald, B. & Nordstrom, H. (1994) *The Uruguay Round: A Global General Equilibrium Assessment*. CEPR Discussion Paper, No. 1067

Francois, J.F., H. van Meijl & F. von Tongren (2005) Gauging the WTOs Negotiations Potential Gains. *In. Economic Policy*, April: 349-391

Hall, R. (1988) The Relation Between Price and Marginal Cost in US Industry. *In. Journal of Political Economy*, 96: 921-947

Harris, R. G. (1984) Applied General Equilibrium Analysis of Small Open Economies with Scale Economies and Imperfect Competition. *In. American Economic Review*, 74: 1016-1032

Harrison, A. (1994) Productivity, Imperfect Competition and Trade Reform: Theory and Evidence. *In. Journal of International Economics*, 36: 53-73

Helpman, E. & Krugman, P.R. (1985) *Market Structure and Foreign Trade* MIT Press, Cambridge

Ishikawa, Jota & Spencer, Barbara J. (1999) Rent-shifting Export Subsidies with an Imported Intermediate Product. *In. Journal of International Economics* 48, 199-232.

Kambhampati, U., Krishna, P. & Mitra, D. (1997) The Impact of Trade Policy Reforms on Labor Markets: Evidence from India. *In. Journal of International Trade and Economic Development*, 6: 287-299

Karp, L. S. & Perloff, J.M. (2002) A Synthesis of Agricultural Trade Economics *In* B. Gardner and G.C. Rausser (eds.). *Handbook of Agricultural Economics*, Vol.2 Elsevier, North-Holland, Amsterdam.

Krishna, P., Mitra, D. & Chinoy, S. (2001) Trade Liberalisation and Labor Demand Elasticities: Evidence from Turkey. *In. Journal of International Economics*, 55: 391-409.

Levinsohn, J. (1993) Testing the Imports-as-Market-Discipline Hypothesis. *In. Journal of International Economics*, 35: 1-22

MacMillan, M., Rodrik, D. & Welch, K. H. (2002) *When Economic Reform Goes Wrong: Cashews in Mozambique*. NBER Working Paper 9117. NBER Cam. Mass.

McCorriston, S. (2000) Market Structure Issues and the Evaluation of the Reform of the EU Banana Regime. *In. World Economy*, 23: 923-937.

McCorriston, S. (2006) Imperfect Competition and International Agricultural Commodity Markets *In* A. Sarris and D. Hallam (eds.) *Agricultural Commodity Markets and Trade: New Approaches to Analyzing Market Structure and Instabilit*y. Edward Elgar, Glos.

McCorriston, S. & D. MacLaren (2005) The Trade Distorting Effect of State Trading Enterprises in Importing Countries. *In. European Economic Review*, 49: 1693-1715

McCorriston, S. & MacLaren, D. (2007) Do State Trading Exporters Distort Trade? *In. European Economic Review,* 51: 225-246

McCorriston, S. & MacLaren, D. (2006) (Partial) *De-Regulation of State Trading Importers in Selected Developing Countries*. Mimeo, University of Exeter.

McCorriston, S., Morgan, C.W. & Rayner, A.J. (2001) Price Transmission: The Interaction between Market Power and Returns to Scale. *In. European Review of Agricultural Economics*, 28:143-159

McCorriston, S., Morgan, C.W. & Rayner, A.J. (2005) Imperfect Competition and the Shifting of Output and Input Taxes in Vertically-Related Markets. *In. Public Finance*, 54: 73-83

Osborn, T. (2005) Imperfect Competition in Agricultural Markets: Evidence from Ethiopia. *In. Journal of Development Economics*, 76: 405-428.

Messerlin, P.A. (2001) *Measuring the Costs of Protection in Europe*. Institute for International Economics. Washington DC.

Schmalensee, R. Inter-Industry Studies of Structure and Performance. *In.* R. Schmalensee and R. Willig (eds.) *Handbook of Industrial Organisation*, Elsevier, North-Holland, Amsterdam.

Sexton, R.J. & Lavoie, N. (2001) Food Processing and Distribution: An Industrial Organisation Approach. *In.* B. Gardner and G. Rausser (eds.). *Handbook of Agricultural Economics*. Volume 1B North-Holland. Amsterdam.

Sheldon, I.M & Sperling, R. (2003) Estimating the Extent of Imperfect Competition in the Food Industry: What Have We Learned? *In. Journal of Agricultural Economics* 54: 89-110.

Smith, A. & Venables, A. (1988) Completing the Internal Market in the European Community. *In. European Economic Review*, 32: 1501-1525

Weldegebriel, H. T. (2004) Imperfect Price Transmission: Is Market Power Really to Blame? *In. Journal of Agricultural Economics*, 55: 101-114

Table 1: Concentration Ratios[1] by Product in EU Countries

Product	Ireland	Finland	Sweden	Denmark	Italy	France	Spain	UK	Germany	Average
Baby food	98	100	100	99	96	93*	54	78	86	91
Canned soup	100	85	75	91	50	84	--	79	41*	87
Ice cream	--	84	85	90	73*	52	84	45	72	76
Coffee	91	72	71	70	60	100	--	74	67	75
Yoghurt	69	83*	90	99*	36	67	73	50	76	70
Chocolate confectionary	95	74	--	39	93	61	79	74	--	74
Pet food	98	80	84	40	64*	73	53	77	87	79
Breakfast cereals	92	--	52	70	88	70	82	65	67	73
Tea	96	90	63	64	80	82	62	52	55	72
Snack foods	72	70*	80	78	71	50	56	73	48	68
Carbonates	85	50	62	--	60	69	79	55	60*	71
Butter	--	--	--	100	--	32*	--	65	30	65
Pasta	83	97	82	61	51	57	65	37	49	65
Frozen meals	--	--	63	--	90	62	39	39	65	62
Wrapped bread	85	44	47	59	80	70	96	58*	9	59
Biscuits	83	73	51	44	55	61	53	42	50	58
Canned fish	--	70	72	49	68	43*	33	43*	--	55
Mineral water	--	100	74	70	37	--	31	14	22	50
Fruit juice	--	70	50	65*	62	26	38	35	46	48
Canned vegetables	--	68	47	50	36	29	--	--	--	47
Average	89	79	69	69	67	63	61	56	55	68

Source: Cotterill (1999). [1] *3-firm concentration ratios, except * which are 2-firm.*

Table 2: Product Concentration Ratios in US Food Manufacturing[1], 1997

Product	CR4 (%)
Dog and cat food mfg.	63.4
Malt mfg.	66.5
Wet corn milling	73.7
Soybean processing	73.4
Other oilseed processing	72.7
Breakfast cereal mfg.	86.7
Sugar cane mills	61.8
Cane sugar refining	96.4
Beet sugar mfg.	82.7
Chocolate and confectionary mfg.	86.6
Condensed/evaporated dairy mfg.	68.8
Cookie and cracker mfg.	64.6
Snack food mfg.	63.0
Brewing	90.7
Distilling	64.8
Cigarettes	98.0
Average	75.9

Source: US Census Bureau, 2001. [1] Share of value added accounted for by the 4 largest firms.

Table 3: Seller Concentration in US and EU Food Retailing, 1990s

Country	CR5 (%)
Austria	79
Belgium-Luxembourg	57
Denmark	78
Finland	96
France	67
Germany	75
Greece	59
Ireland	50
Italy	30
Netherlands	79
Portugal	52
Spain	38
Sweden	87
UK	67
United States	35

Source: Cotterill (1999), McCorriston (2002), and Hughes (2002).

Table 4: Welfare Effects of Trade Liberalisation with an Imperfectly Competitive Vertical Chain (% Changes)

	Change in Consumer Surplus	Change in Producer Surplus	Change in Vertical Rent	Net Welfare Change
$\theta^R = \theta^W = \mu = 0$	6.6	-12.5	0	0.2
$\theta^R = \theta^W = \mu = 1$	42.4	-12.7	11	12
$\theta^R = \theta^W = 1; \mu = 0$	34.9	-12.5	7.7	9.5
$\theta^R = 1; \theta^W = \mu = 0$	20.3	-12.5	2.6	5.5

[1] *Vertical rent relates to profits at both the retail and wholesale stages. However, in the final entry where the processing sector is set as being competitive, the vertical rent relates to retail profits only.*

The Fall and Rise of Vertical Coordination in Commodity Chains in Developing and Transition Countries

Miet Maertens and Johan F.M. Swinnen[29]

"Private agricultural marketing companies have become dominant providers of smallholder input credit in Sub-Saharan Africa. In various countries of the region, they are today in practice the sole providers of seasonal input advances to the small-scale farming community."
IFAD (2003, p.5)

"Trade credit from private suppliers comprised virtually all of the family farm credit and the biggest share of liabilities of agricultural companies [in Lithuania in 2004]."
World Bank (2005)

"69% of 35 billion $ credit in the Brazilian agri-food system is supply-chain credit"
D. Alcantara, Managing Director, Banco do Brasil (March 2004)

ABSTRACT
Food and agricultural commodity supply chains in developing and transition countries have undergone tremendous changes in the past decades. An important part of these changes is the decline of state-controlled vertical coordination in commodity chains in the 1980s and 1990s and the emergence and spread of private sector driven vertical coordination in more recent years. In this paper we explain the causes of these changes, illustrate their importance, discuss the implications for efficiency and equity, and provide empirical evidence on these effects from several case-studies in developing and transition countries.

INTRODUCTION
Twenty-five years ago, a vast share of the poor and middle income countries, covering a large share of the world's agricultural areas and farmers, were characterized by state-controlled supply chains for agricultural and food commodities. This was most extreme in the Communist world, spreading from Central Europe to East Asia, where the entire agri-food system was under strict control of the state. However, also in many African, Latin-American and South Asian countries the state played a very important role in the agri-food chains. For example, in Brazil and Mexico, wholesale markets were run by the state (Reardon and Swinnen, 2004); in South Asia the state heavily regulated food markets and many African commodity markets and trade regimes were controlled by (para-)state organizations. In many of these countries, the state played an important role in agricultural production and marketing in the decades after independence from colonial power. Governments in Sub Sahara Africa (SSA) and South Asia were heavily involved in agricultural marketing and food processing through the creation of marketing boards, government-controlled cooperatives and parastatal processing units. These

[29] LICOS Centre for Transition Economics & Department of Economics, University of Leuven (KUL)

government institutions were often monopoly buyers of agricultural products, especially for basic food crops and important export crops.[30]

This system of state intervention and control and, with it, the vertical coordination has undergone tremendous changes in the 1980s and the 1990s as a global process of liberalization induced dramatic changes in many of these regions[31]. In the transition world, the liberalization of prices, trade and exchanges, the privatization of the state enterprises etc. removed much of the state control over the commodity chains as well as the vertical coordination in the chains. Similar processes of privatization and liberalization of domestic and international commodity and financial markets reduced the control of the state and vertical coordination in many developing and emerging economies.

Moreover, processes of globalization have at the same time induced changes in the governance structure of food chains. This globalization of the food chains in transition and developing countries has (partly) been driven by the liberalization of the trade and investment regimes in transition and developing countries – policy reforms which often accompanied the privatization and domestic price reforms – and the spread of food standards.

First, trade liberalization caused major changes in trade of agri-food products. For example in Central and Eastern Europe it caused a major reorientation of the agri-food trade from "east to west", i.e. from trade with the former Soviet countries to trade with western Europe, and a shift of the agri-food trade position from net exporters to net importers. Also the participation of developing countries in world agricultural trade has increased. In addition, also the structure of world agriculture trade changed considerably during the past decades. There has been an increase in the share of high-value products -mainly fish and fishery products, and fruits and vegetables – in world agricultural trade. Especially developing countries experienced a sharp increase in such high-value exports while the importance of their traditional tropical export commodities – such as coffee, cocoa, and tea – has decreased (Aksoy, 2005).

Second, the liberalization of the investment regimes induced foreign investments in agribusiness, food industry, and further down the chain, with major implications for farmers (Dries and Swinnen, 2004). Several food sectors in Eastern Europe, such as the sugar, dairy, and retail sector, have received massive amounts of foreign investment, which now holds dominant market shares. A well-advertised example of these investments is the rapid growth of modern retail chains ("supermarkets") in transition and (some) developing countries and which was triggered by the reform process in former state-controlled economies (Reardon and Swinnen, 2004).

Third, associated with these changes is the spread of (private and public) food standards. Consumers are increasingly demanding specific quality attributes of processed and fresh food products and are increasingly aware of food safety issues. Food-standards are increasingly stringent, especially for fresh food products such as fruit and vegetables, meat, dairy products, fish and seafood products, which are prone to food safety risks. These food quality and safety demands are most pronounced in western markets (and increasingly also in urban markets of low-income countries) and affect traders and producers in transition and developing countries through international trade.

---

[30] For example, in Indonesia marketing of rice was controlled by the state through the marketing board BULOG (National Logistical Supply Organization). Similarly, marketing of grain and other basic food crops was controlled and organized by government marketing boards e.g. in Malawi, through ADMARC (Agricultural Development and Marketing Corporation); in Zambia, through NAMBOARD (National Agricultural Marketing Board) and in Kenya through NCPB (National Cereals and Produce Board). Also marketing and processing of major export crops was in many countries state-controlled through state-owned processing and exporting companies and organizations; e.g. for cotton in Malawi, through CMDT (Malawi Textile Development Company), in Cameroon, through SODECOTON, in Ghana, through the Ghana Cotton Development Board and in Kenya through CLSMB (Cotton Lint and Seed Marketing Board); for tea in Kenya, through KTDA (The Kenyan Tea Development Cooperation); for coffee through coffee marketing boards in Uganda, Kenya, Zimbabwe and Ethiopia; etc.

[31] In the so-called Berg report of 1980, the World Bank argued that government marketing organizations should be reformed to operate on a commercial basis and the private sector should be permitted to enter agricultural marketing systems to provide competition and encourage efficiency. This report laid the basis for economic reforms, including privatization and market liberalization, which started in the late 1980s and continued throughout the 1990s in many developing countries. The transition reforms actually started in 1978 in China and after 1989 in Europe.

Following the privatization, liberalization and globalization waves, new, private forms of vertical coordination (VC) have emerged and are growing (Swinnen, 2005, 2006). This paper analyzes and documents the fall of state-controlled VC and the rise of private VC and presents evidence on its effects in transition and developing countries.

SOME CONCEPTS

Vertical coordination can take various forms, which can be thought of as institutional arrangements varying between the two extremes of spot market exchanges (0) and full ownership integration (1). Within this 0-1 interval, there is a large variety of different forms of coordination and an equally vast literature trying to classify and explain these various forms[32]. An often made distinction, which is useful for our purposes, is between marketing contracts and production contracts. *Marketing contracts* are agreements between a contractor and a grower that specifies some form of a price (system) and outlet ex ante. *Production contracts* are more extensive forms of coordination and include detailed production practices, extension services, inputs supplied by the contractor, quality and quantity of a commodity and a price.[33]

Key factors determining the use of various contract forms or other forms of vertical coordination are the costs and uncertainties involved in the transactions, which themselves are affected by the economic and institutional environment, the need for asset- or transaction-specific investments, the frequency of interacting, commodity characteristics such as perishability, costs of measuring and monitoring product characteristics, uncertainty over product quality, or reliability of supplies. [34]

In the literature, VC in state-controlled systems is sometimes referred to as outgrower schemes while private sector VC initiatives are referred to as contract-farming (e.g. Little and Watts, 1994). We roughly stick to this terminology but indicate that the distinction is not always straightforward. The public-private dichotomy is complex: a state-controlled VC scheme may be under private management or a private VC scheme may be supported by subsidies and public extension and research.

A HISTORICAL PERSPECTIVE ON THE FALL AND RISE OF VERTICAL COORDINATION

State-controlled vertical coordination

Vertical coordination (VC) was widespread in state-controlled food supply chains. Again this was most extreme in the Communist system where production at various stages and the exchange of inputs and outputs along the chain was coordinated and determined by the central command system. The agricultural supply system was fully integrated and completely state-controlled (Rozelle and Swinnen, 2004). Production, processing, marketing, the provision of inputs and credit, retailing, etc were all directed by the central planning authorities. Although there were some variations in countries in the extent and scope of control, this was the basic system extending from Central Europe, the Soviet Union to China and Viet Nam.

However also in other regions where the state played an important role in food chains vertical coordination was widespread. For example, many of the African parastatal organizations provided

---

[32] There is a significant literature on supply chains and contracting in food chains, some of it on developing and transition countries (see World Bank (2005) for a survey). There is also a related, mostly theoretical, literature which focuses on optimal contracting and interlinked markets in developing countries (e.g. Bardhan, 1989).

[33] There is important variation within "production contracts". For example production contracts which provide inputs, credit and some extension to farmers is the most common form of state-controlled VC in developing countries, while production contracts in private VC, especially in the case of high-value products, sometimes go much further in their technical assistance and include also certain management decisions (such as timing of planting & harvesting; timing, quantity and type of fertilizer application, etc).

[34] The basic explanations draw often on the seminal work of Ronald Coase and Oliver Williamson. However, in two recent surveys of the literature (Hobbs and Young, 2001; and Rehber, 2000) no less than seven different strands of literature are identified as being important to understand and explain those differences: transaction costs economics, agency theory, competency/capability models, strategic management theory, convention theory, life-cycle theory, and contract economics.

both inputs to farmers and purchased their outputs. Government marketing organizations and parastatal processing companies used VC systems with upstream suppliers. The dominant form of state-controlled VC was that of seasonal input and credit provisions to small farmers in return for supplies of primary produce. In fact, state-controlled VC was often the only source of input and credit provision for peasant farmers (IFAD, 2003). For example, the government marketing boards ADMARC in Malawi and NAMBOARD in Zambia provided seasonal inputs to peasant farmers deducting the value of the inputs from the payment made for marketed output at harvest time (Poulton et al., 1998). Also parastatal cotton companies such as CMDT in Mali, SODECOTON in Cameroon and the Ghana Cotton Development Board in Ghana provided credit and inputs to cotton farmers (Poulton et al., 1998). Also extension services were offered by the government, either implicitly within VC of marketing boards and parastatal processing companies – e.g. the Ghana Cotton Development Board – or through other channels. Also more complex and extensive systems of state-controlled VC existed. For example, the Ghana Cotton Development Board also provided extension services (Poulton, 1998) and the Kenyan Tea Development Cooperation was involved in effective control at all levels of the operation including planting material, production processes, quality control and extension services (Bauman, 2000).

In many SSA countries, state-controlled VC has been particularly important – and still remains important in some countries. For example in Kenya, by the mid-1980's more than 230,000 rural households, or about 16% of the rural population, were involved in outgrower schemes with large parastatal companies and government marketing boards for the production and marketing of tea, sugar, oilseeds and tobacco (Baumann, 2000).

State-controlled VC in centralized agricultural marketing systems in developing and Communist countries was often motivated by political motives and by objectives to provide cheap food for urban markets; the maximization of foreign exchange earnings; the creation of rural employment; ascertaining the viability of certain businesses; etc. State-controlled VC was often viewed as a way to protect peasant farmers and stimulate rural development.

Most analyses point at the deficiencies and inefficiencies of these systems. For example, the inefficiency in the processing, agribusiness, and marketing systems and in the central allocation of production factors are considered one of the primary causes of the inefficiency of the Soviet farming complex (Johnson and Brooks, 1983; Swinnen and Rozelle, 2006). Also in Africa, several studies conclude that state-controlled outgrower schemes were inefficient and poorly managed, which manifested itself, among other things, in low credit repayment rates (Warning and Key, 2002)[35].

Liberalization, privatization, and the break-down of vertical coordination

This system of vertical coordination has undergone tremendous changes in the 1980s and the 1990s. In the transition world, the liberalization of exchange and prices, and the privatization of farms and enterprises caused the collapse of vertical coordination and caused major disruptions in the food chain. These effects occurred most dramatically in the collapse of the state-controlled system in Central and Eastern European countries and the former Soviet Union.[36] Widespread forms of contract problems occurred such as long payment delays, non-payments for delivered products or non-delivery. Payment delays were a major problem for companies in Eastern European countries and caused major drains on much needed cash flow for farmers. Food companies in Eastern Europe in the late 1990s considered late payments one of their most important obstacles to growth (Gorton et al, 2000).

The disruptions in relationships of farms with input suppliers and food companies also resulted in many farms facing serious constraints in accessing essential inputs (feed, fertilizer, seeds, capital,

[35] Some studies also point at successful state-controlled VC. For example, Poulton et al. (1998) point to some large government outgrower schemes in a poor district in Malawi, which were successful in achieving very high repayment rates. Also the outgrower schemes of the Kenyan Tea Development Authority are referred to as a success story, which is attributed to its extensive form of VC (Bauman, 2000).

[36] Interesting, the early Chinese liberalization of the marketing and input supply system also lead to major exchange problems, which caused the Chinese government to make a U-turn on the reforms and reimpose state control on the marketing and fertilizer supply systems, which was then gradually liberalized much later (see Rozelle (1996) for an extensive discussion, and Rozelle and Swinnen (2004) for a summary).

etc.). Also in many developing countries privatization and market liberalization led to the decline of input and credit supply to farms as it disrupted the working of various government-controlled agricultural institutions, cooperative unions and parastatal processing companies.[37] As government marketing boards and cooperatives have ceased to play a major role in the procurement of agricultural produce, so has the provision of credit and agricultural inputs through state-controlled VC. In addition, market liberalization led to the removal of price supports and input subsidies, a reduction in government research and extension services, and a decline in government (subsidized) credit to the agricultural sector.

The emergence of private vertical coordination

However, following privatization and liberalization, new forms of vertical coordination have emerged and are growing (IFAD, 2003; Swinnen, 2006; World Bank, 2005). New forms of vertical coordination are no longer state-controlled but are introduced by private companies. Private traders, retailers, agribusinesses and food processing companies increasingly contract with farms and rural households to whom they provide inputs and services in return for guaranteed and quality supplies. This process of interlinked contracts is growing rapidly in the transition and developing world.

The emergence and spread of private VC is caused by the combination of, on the one hand, an increasing demand for products of high quality and safety standards with private sector investments and increasing consumer incomes and demands (both domestically and through trade) and, on the other hand, the problems which farms face to supply such products reliably, consistently and timely to processors and traders due to a variety of market imperfections and poor public institutions.

Farmers in developing and transition countries face major constraints in realizing high-quality, consistent supplies. These include financial constraints as well as difficulties in input markets, lack of technical and managerial capacity etc. Specifically for high-standards products, farmers might lack the expertise and have no access to crucial inputs such as improved seeds. To guarantee consistent and quality supplies, traders and processors engage in VC to overcome farmers' constraints.

The importance of VC in developing and transition countries is further explained by the lack of efficient institutions and infrastructure to assure consistent, reliable, quality and timely supply through spot market arrangements. VC is in fact a private institutional response to the above described market constraints. To overcome problems of enforcement and constraints on quality supplies, private VC systems are set up by processors, traders, retailers and input suppliers.

Increasing consumer demand for quality and food safety is another driving force behind private VC in transition and developing countries. Investment by modern processors and retailers (supermarket chains) reinforces the need for supplying large and consistent volumes by their use of private standards and requirements of extensive supervision and control of production processes.

Emerging empirical evidence suggests that these new forms of private VC can be an engine of economic growth, rural development and poverty reduction. The next section presents evidence on its effects in transition and developing countries.

The Importance of Private Sector Vertical Coordination

The importance of private VC is increasing in developing and transition countries. At the end of the 1990s, in the Czech Republic, Slovakia and Hungary, 80% of the corporate farms, who dominated farm production in these countries, sold crops on contract, and 60-85% sold animal products on contract; numbers which are considerably higher than the shares of farms in the US and the EU (table 1). A survey of agri-food processors in five CIS countries (Armenia, Georgia, Moldova, Ukraine and Russia) found that food companies which used contracts with suppliers grew from slightly more than one-third in 1997 to almost three-quarters by 2003 (table 2).

[37] For example in Kenya, the economic reforms have led to the collapse of the National Cereals and Produce Marketing Board, the Cotton Lint and Seed Marketing Board, the Kenya Grain Growers Cooperative Union, etc. (IFAD, 2003).

Table 1: Share of farms selling on contract in Central Europe (as % of total)

Type of Contract	Czech		Slovak	Hungary	Bulgaria
	NRIF*	RIF*			
Individual farms					
Selling crop products on contract	4	37	29	8	5
Selling livestock products on contract	1	13	4	10	3
Selling animals on contract	2	7	6	na	na
Selling on contract	5	46	35	17	7
Corporate Farms					
Selling crop products on contract		79	82	86	42
Selling livestock products on contract		73	83	59	23
Selling animals on contract		49	77	na	na
Selling on contract		96	98	94	43

**RIF = Registered individual farms ; NRIF= non-registered individual farms*
Source: Swinnen, 2005

Table 2: Supply relationships in sourcing raw materials in Armenia, Georgia, Moldova, Ukraine and Russia, 1997-2003 (% of companies)

Relationship	1997	1999	2001	2003
Spot Markets				
With all farmers	27.2	43.5	47.1	50
With small farmers	25	41.3	44.2	47.2
With larger farmers	15.6	25.5	25.5	23.1
Contracts				
With all farmers	41.3	61.7	73.1	77.4
With small farmers	36.2	43.8	46.2	49.1
With larger farmers	37	58.3	69.2	73.6
Own farms	6.4	8.3	17.8	26.4
Other agents	16.7	28.6	46.2	49.1

Source: White and Gorton, 2004

Table 3: Farm assistance programs offered by diary companies in Central Europe

Company Name	Credit – specific	Credit - general	Input supply	Extension service	Veterinary service	Bank loan guarantee
POLAND**						
Mlekpol	Y		Y	Y	N	Y
Mleczarnia	N		Y	N	N	Y
Kurpie	Y		Y	Y	N	Y
Mazowsze	Y		Y	Y	N	N
ICC Paslek	Y		Y	Y	N	Y
Warmia Dairy	Y		Y	Y	Y	Y
BULGARIA						
Merone	Y(2000)	N	Y(????)	Y(1992)	N	N
Fama	Y(1994)	N	Y(1994)	N	N	Y(once)
Mlekimex	Y(1997)	Y(1998)	Y(1997)	Y(1999)	Y(1997	Y(1998)
Danone	Y(1997)	N	Y(1998)	Y(2000)	Y(1995)	Y(1999)
Iotovi	N	N	Y(1995)	N	N	Y(1995)
Milky World	Y(1999)	Y(2000)	Y(1999)	Y(1999)	N	Y(1999)
Markelli	Y(1999)	N	Y(1998)	N	N	N
Mandra Obnova	Y(1998)	N	Y(2000)	Y(2000)	N	N
Meggle	Y(2001)	N	Y(2001)	Y(2001)	N	N
PRL	N	N	N	Y(2002)	N	N
Serdika 90	Y(1997)	N	Y(1997)	Y(1997)	N	N
SLOVAKIA						
Liptovska	Y(2000)	N	N	Y(1994)	N	N
Mliekospol	Y(1999)	N	N	Y(1992)	Y(1992)	Y(1992)
Rajo	Y(2001)	N	Y/N	Y(1992)	N	N
Levicka	Y(1998)	N	Y(1998)	Y(0000)	N	Y(1998)
Tatranska	Y(2001)	N	Y(2000)	Y(0000)	N	N
Nutricia Dairy	Y(2000)	N	N	N	N	Y(2000)
ROMANIA						
Danone	Y		Y	Y		Y
Friesland	Y		Y	Y		Y
Promilch	Y		Y	Y		Y
Raraul	N		Y	Y		N

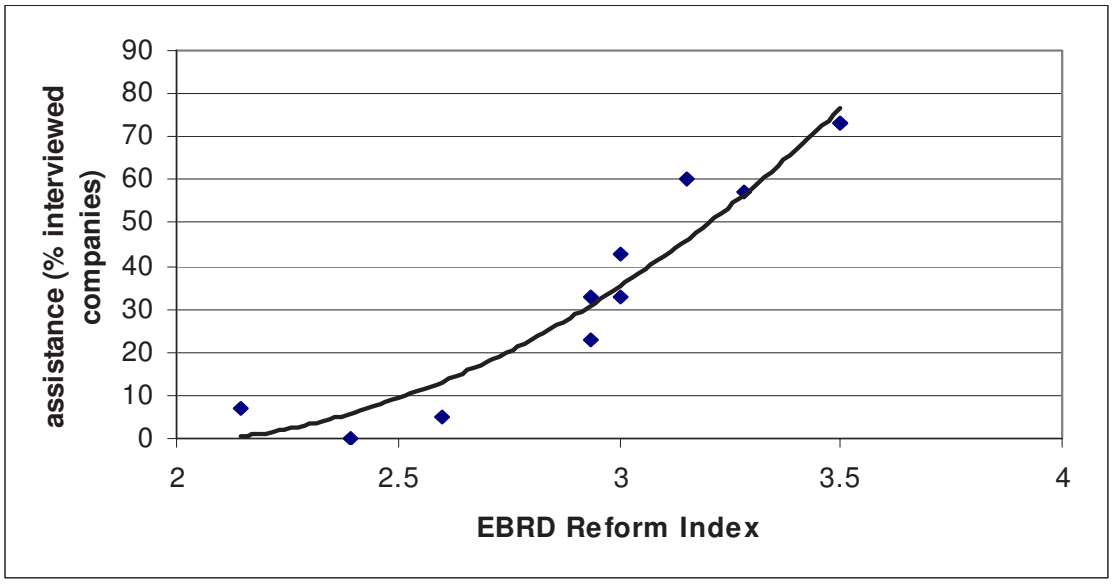
* Either the company provides inputs and the farmer pays back later, or the company offers forward credit, which the farmer uses to buy inputs.

** In Poland no distinction is made between credit for dairy-specific investments and general investments. Farm-level evidence shows that the dairy companies mainly support dairy-specific investments

Source: Swinnen, 2005

There is also significant growth of supplier support measures as part of the contracts and more farms are getting access to these. Credit, inputs, prompt payments, transportation, and quality control are the most commonly offered forms of support. Over 40% of processors in the CIS sample offer credit to at least some of the farms that supply them; and 36% offered inputs, in 2003. In several sectors, including the dairy sector in Poland, Bulgaria, Slovakia and Romania, farm assistance programs offered by private dairy companies are quite extensive and include credit provisions, input supply, extension services, and veterinary services and in some cases bank loan guarantees (table 3). Figure 1 shows how the growth of VC is closely and positively related to the reform process in transition countries.

Figure 1: Impact of economic reforms on vertical coordination (*) in the dairy sector of transition countries (**)



** Share of dairy companies providing substantive assistance to farms as part of production contracts*
*** Data based on surveys in Albania, Bulgaria, Poland, Slovakia (between 1994 and 2004)*
Source: Swinnen, Dries, Germenji and Noev (2005)

In developing countries private VC is emerging and growing in many sectors. In South and Southeast Asia, there has been a sharp increase in VC of primary production with input suppliers and processing/exporting firms during the past 20 years (Gulati et al., 2005). Especially in animal production and dairy farming, VC is widespread. In SSA, private VC has become a dominant system of rural financing. For example, in Mozambique and Zambia it is virtually the only source of finance for agricultural households (IFAD, 2003). In Mozambique, an estimated 400,000 rural households, representing 12% of the rural population, are included in contract-farming (table 4). Also in Kenya and Zambia, a high number of rural households are producing agricultural commodities on contract with agro-industrial firms (table 4). The main crops that are grown under contractual arrangements in SSA include cotton, tobacco and horticulture crops. Also in Latin-America, VC is widespread over many different agricultural commodities and includes various contractual arrangements ranging from purely marketing contracts to production contracts with provision of inputs, credit, technical assistance and marketing assistance (table 5).

Table 4: Contract-farming in Sub Sahara Africa

Country	Commodity	Number of contracted smallholders
Kenya	tea	406,000
	sugar	200,000
	horticulture	15,000 - 20,000
	tobacco	> 10,000
Zambia	cotton	150,000
	tobacco	570
	horticulture	13,500
Mozambique	cotton	270,000
	tobacco	100,000

Source: IFAD, 2003

Finally, while private sector involvement has grown and the role of the government in agricultural production and marketing diminished, in several countries, especially in SSA, the government is still involved in agricultural supply chains, e.g. through minority or majority shares in privatized food processing companies, through state-owned banks and government credit schemes (sometimes as part of multipartite VC), provision of extension services, etc. Zambia is one of the only countries in SSA with almost complete absence of the government in production, marketing, regulation or direct financial contributions to the agricultural sector, although the government continues to play a major role in the distribution of fertilizers (IFAD, 2003).

Table 5: Vertical coordination in Latin-American agri-food chains

Product	Destination	Contracting					Vertical Integration
		Marketing	Technical assistance	Credit	Inputs	Management	
Tomato(paste)							
Nicaragua	Domestic	X					
Paraguay	Domestic						
Ecuador	Domestic						X
Mexico	Domestic	X					X
Peru	Domestic						X
F&V							
Guyana	Domestic	X					
Ecuador	Domestic	X					
Trinidad & T	Domestic	X					
Mexico	Export	X	X	X	X	X	X
Guatemala	Export	X	X	X	X	X	X
El Salvador	Export	X	X	X	X		
Peru	Export	X					X
Chicken							
Trinidad & T	Domestic	X	X	X	X		X
Jamaica	Domestic	X		X			
Tobacco							
Chile	na	X	X	X	X		
Guatemala	na	X	X	X	X		
Sugarcane							
Nicaragua	Exp&Dom	X	X		X		X
Guatemala	Exp&Dom						X
Sesame Seed							
Nicaragua	Export	X		X			
Guatemala	Export	X					
El Salvador	Export						
Malt. barley							
Chile	Domestic	X	X		X		
Peru	Domestic	X		X	X		
Rice							
Trinidad & T	Domestic	X	X		X		
Paraguay	na	X		X			
Dominican R	na	X					
Dairy							
Trinidad & T	Domestic	X	X	X			
Jamaica	Domestic	X					
Ecuador	Domestic	X					

Source: Dirven (1996)

COMMODITY SPECIFIC VERTICAL COORDINATION PATTERNS

In the *dairy* sector, we observe extensive production contracts between dairy processors and farms in transition countries, including the provision of credit, investment loans, animal feed, extension services, bank loan guarantees, etc. (Swinnen et al, 2006). This is different from the West since there is no production contracting going on in countries like the US. In South and Southeast Asia, VC in the milk sector involves contracts with cooperatively owned processing and marketing units, large scale state-owned processing companies and with the emerging private sector (Gulati et al., 2005).

In South and Southeast Asia, typical contract farming schemes in *animal production* involve feed millers who supply young animals, feeds, veterinary services and extension advice on credit to farmers who provide holding sheds, dispose of waste, and provide all required labour, water and electricity (Gulati et al., 2005). In Thailand nearly all commercially produced broilers are produced under contract arrangements with private companies (Gulatie et al., 2005); and for the Philippines this is 80% (Delgado et al., 2003). These contract schemes are either based on fees per unit of product return for the farmer's labour, land, buildings, water and electricity; or on guaranteed prices.

In the *sugar* sector, we find, as in the developed economies, extensive marketing agreements, but the contracts are much more extensive in transition and developing countries, including also input provisions, investment loan assistance, etc. (Swinnen, Gow and Maviglia, 1999).

In *cotton*, the standard model in the US and Australia, two major cotton producers, is that the cotton (from seed to baled cotton) remains in ownership of the producer and the processing is paid for as a service. In transition countries and developing countries, the dominant player in the chain is the gin who typically contracts farms to supply seed cotton and provides them with a variety of inputs. This gin supply chain structure has developed in SSA countries as well as in Central Asia and involves quite extensive forms of private VC, with credit, seeds, irrigation, fertilizer, etc. being provided by the gins (Sadler, 2004). In Ghana e.g., the privatisation of the Ghana Cotton Development Board (who provided production inputs, extension services and guaranteed purchase of the supply to farmers under state-controlled VC) into the Ghana Cotton Company and market liberalization resulting in increased competition in the market has induced more extensive VC. Competing private companies have increased their services to farmers, including timely plowing services, reliable fertilizer and pesticide supplies, prompt payment after harvest and even plowing for farmers' food crops (Poulton, 1998).

In *fresh fruits and vegetables*, the rapid growth of modern retail chains with high demands on quality and timeliness of delivery is changing the supply chains in developing and transition countries. New supplier contracting is developing rapidly as part of retail investment and includes private VC with extensive farm assistance programs. In Africa, particularly in Kenya and Senegal, smallholder horticulture production under private contract arrangements has increased sharply after liberalisation but in recent years smallholder production is decreasing in favour of fully-integrated corporate horticulture farming (Maertens et al, 2006; Humphrey et al., 2004).

Traditional *tropical products* (coffee, tea, cocoa, rubber and oil palm) are traditionally grown on fully integrated large scale plantations because of large economies of scale in both production and marketing of these crops. However, these perennial crops are increasingly being grown by smallholders under contract farming arrangements and outgrower schemes. For example, cocoa in Ghana and Nigeria; rubber in Malaysia, Nigeria and Sri Lanka; coffee on the Ivory Coast, Kenya and Madagascar; oil-palm in West Africa and tea in Kenya and Malawi. In Kenya, half to the coffee is produced by smallholders (Baumann, 2000). Some of the largest outgrower schemes such as palm oil in the Philippines and rubber in Malaysia are state-controlled schemes involving parastatal companies while other schemes involve private VC. Some companies (and parastatals) combine large scale integrated production with contract farming and outgrower schemes in a 'nucleus estate' surrounded by outgrowers, especially when the economies of scale of the processing plant (such as for palm oil) depend on a certain volume of throughput. Contract farming provides farmers with inputs, new

technologies, credit and extension services, either private services or priority treatment from the public extension services as part of multipartite VC.

In *grains* VC is also elaborated and complex. In transition countries, there is extensive contracting going on for malting barley, but the VC is often much more extensive than in western countries, with brewing and malting companies vertically coordinating across several stages of the chain. Moreover, there is a remarkable amount of full vertical integration in wheat production in Russia and Kazakhstan, where large agro-holdings and grain trading companies own several large grain farms in some of the best grain producing regions, sometimes owning 100,000s of hectares. For example, large, vertically integrated grain companies are the dominant types of farming in the north of Kazakhstan. Also in Russia VC in grains has grown rapidly after 1998, but there it was the state which was the driving force behind the vertical coordination.

THE EFFECTS OF EMERGING PRIVATE VERTICAL COORDINATION

The emergence of private VC is often mentioned as a new engine for economic growth, rural development and poverty reduction. In this section we review the empirical evidence on the impact of VC in transition and developing countries. We distinguish between efficiency effects and equity effects.

Efficiency effects

The impact of private VC systems on productivity is difficult to quantify as several other factors affect output simultaneously and as company level information is difficult to obtain. Still, the evidence suggests that successful private VC has important positive effects, both direct and indirect.

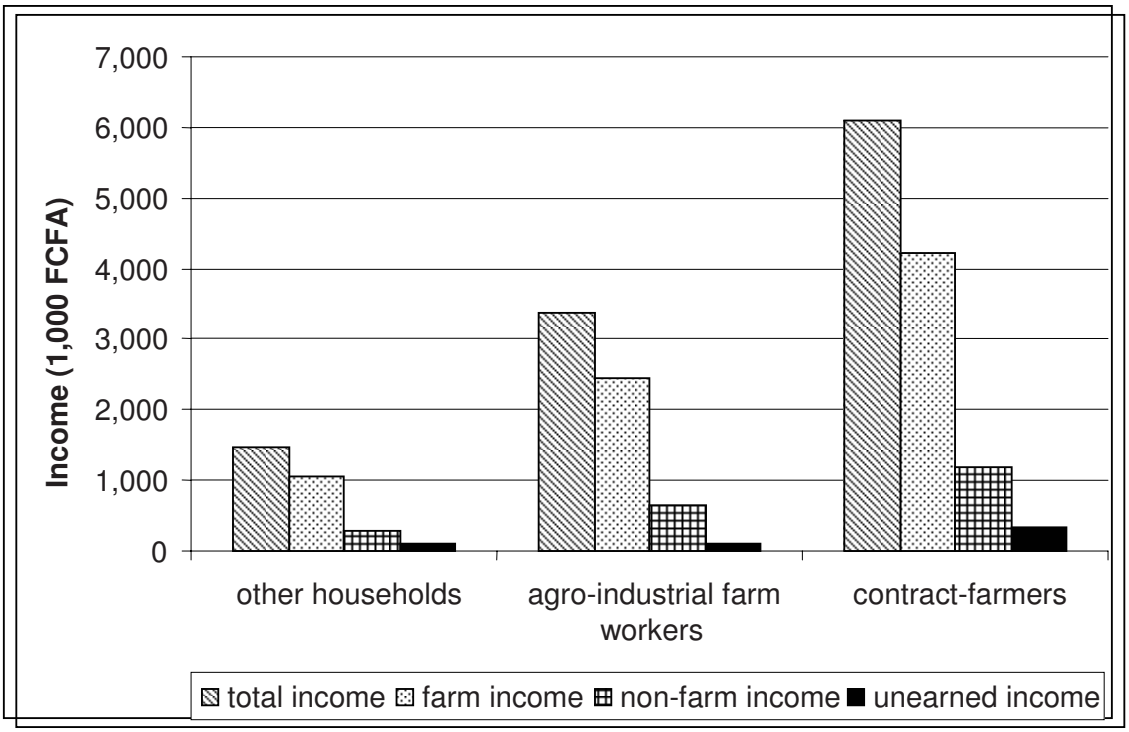
The direct impact is on the output and productivity of the processing company that initiates vertical contracting and of its suppliers involved in VC schemes. Supplying farmers have experienced beneficial effects on output, productivity, and product quality – and ultimately on incomes – through better access to inputs, timely payments, and improved productivity with new investments. Case studies indicate that private VC programs can lead to double digit annual growth in output and productivity. For example, case studies of the sugar and dairy sectors in East Europe show how new private contracts and farm assistance programs caused output, yields, and investments to grow dramatically (Gow et al, 2000; Dries and Swinnen, 2004; Swinnen, 2006). A major IFPRI-FAO study finds that contract broiler farmers are significantly more efficient and produce higher profits than independent farms in the Philippines and Thailand (Gulati et al., 2005). Moreover, farm profits are higher through lower production and marketing costs for contract farms compared to independent smallholders in VC schemes for milk, broilers and FFV in India (table 6). Maertens et al. (2006) find that the benefits from contract-farming in horticulture production in Senegal in terms of higher rural incomes are substantial (figure 2).

Table 6: Production and transaction cost of milk, broiler and vegetable production in contract and non-contract farming in India (Rs/ton)

Commodity	Contract farming			Non-contract farming		
	Production cost	Transaction cost	Total cost	Production cost	Transaction cost	Total cost
Milk	5,586	100	5,686	5,728	1,442	7,170
Broiler*	808	38	846	27,322	90	27,412
Vegetable**	1,485	35	1,520	1,630	437	2,067

Note: For broiler, the firm provides free chicks, feed and medicines to the contract farmers. Vegetable costs refer to spinach.
Source: Birthal, Joshi and Gulati, 2005.

Figure 2: Household income (in 1,000 FCFA) from different sources for contracted and non-contracted horticulture households in Senegal



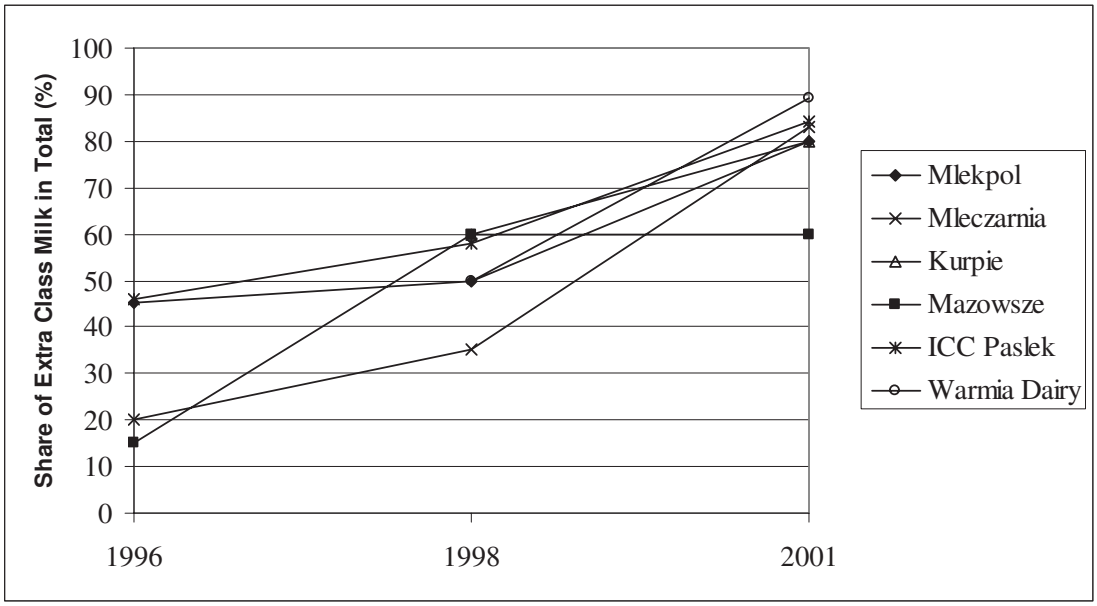
Source: Maertens et al., 2006

In their survey of CIS agri-business enterprise executives, White & Gorton (2004) concluded that various contract support measures had caused (separately) an average increase in yields of around 10 %. The measures with the greatest impact on yields were specialist storage (especially cooling equipment in the dairy sector), veterinary support and physical inputs. Specialist storage in the form of on-farm cooling tanks has been particularly important in raising yields and quality in the dairy sector, an effect also found in other countries (Dries and Swinnen, 2004). Market measures such as prompt payments, guaranteed prices, and market access also had large positive effects.

Quality of output also improved due to these measures. In the case of Polish dairy farms, milk quality rose rapidly following contract innovations by dairy processors in the mid 1990s. The share of the market held by highest quality milk increased from less than 30% on average in 1996 to around 80% on average in 2001 (figure 3). VC loans and loan guarantee programs contributed strongly to this by encouraging farm investments. In the Polish study, more than three quarters (76%) of all farmers in the

survey made investments in the past years, including many small farmers of less than 10 cows (Dries and Swinnen, 2004). Dairy loans are used for investments in enlarging and upgrading the livestock herd (30%) and cooling tanks (56%). Moreover, dairy assistance in the form of guarantees for bank loans helped farm investments. Also, programs which assist farms in accessing inputs (mainly feed) enhance investment indirectly by lowering input costs, or reducing transaction costs in accessing inputs, and consequently, through improved profitability.

Figure 3: Share of extra class milk in total deliveries in Poland*



** Dairy companies in the North East of Poland*
Source: Dries & Swinnen, 2004

Successful state-controlled VC programs exist. However, some case-studies point out that state-controlled VC is generally less effective in realizing farm productivity growth than private VC. For example, in Ghana, liberalisation of the cotton market and privatisation of the Ghana Cotton Company induced more extensive VC programs including timely plowing services, reliable fertilizer and pesticide supplies, prompt payment after harvest and even plowing for farmers' food crops (Poulton, 1998). As a result of improved farm assistance programs cotton production and yields increased dramatically (Poulton, 1998). Another example from the peanut industry in Senegal by Warning and Key (2002) illustrates this further. After independence in 1960 the state began the confectionary peanut program (ABP – *Arachide de Bouche Programme*) which grew into an outgrower scheme with 32,000 farmers providing peanuts destined for direct consumption. The ABP was completely privatised in 1990 and VC was extended from marketing contracts under state-controlled VC to production contracts in which the company handles all aspects of production, including selection and training of contracting farmers, provision of inputs, close monitoring of production, collection and processing of the harvest and export of the produce, mainly to the EU. Comparing the private ABP VC program with the state-controlled VC program of the majority state-owned company SONACAS for oil-peanut processing, reveals that this state-controlled VC program has much lower yields than the private VC program of ABP (800 kg/ha versus 1300 kg/ha) and that they have much lower credit repayment rates (58% compared to 98%). In addition, participation in the ABP program was found to significantly increase the income of farmers and improve their living conditions.

Indirect effects emerge through (1) cross-company spillover effects and (2) household and farm spillover effects.

Cross-company spillovers occur as firms competing for the same suppliers, and their fixed inputs, are forced to offer similar contractual arrangements. For example, in the case of the Slovak sugar sector, competition induced other sugar processors to introduce similar contracts. With some delay, this resulted in increases in productivity in the rest of the sugar sector. Other studies confirm the importance of this competition effect. Noev et al. (2004) and Dries et al. (2004) find that, respectively, in the case of the Bulgarian dairy sector and in contracting by modern retail companies in Croatia, competition for suppliers forces other companies to replicate farm assistance programs in order to secure supplies. This issue of competition and cross-company spillover effects is dealt with more explicitly in Swinnen and Vandeplas (this volume).

Household and farm spillovers occur as households' risk reduces; their access to capital increases and the productivity of non-contracted activities increases. First, VC does not only imply the provision of inputs, working capital and technical assistance to farmers, it also implies guaranteed sales, often at guaranteed prices. This comes down to decreased marketing risk for farmers. In addition, coordinating firms share in the production risk of farmers through ex ante provision of inputs and credit. Reduced production and marketing risks improves stability of farmers' income, which is an important benefit for farmers operating in high risk environments and in the absence of insurance markets[38]. Second, credit arrangements and prompt cash payments after harvest in VC programs improves farmer's cash flow and access to capital. This might ease farmers' financial constraints and benefit investment in other farm and non-farm activities. This effect is particularly important in the case of capital market imperfections. Third, contract-farming can lead to productivity spillovers on other crops, resulting from management advise, access to improved technologies, better input use, etc.

A number of empirical studies provide evidence for these household spillover effects. In a study on VC in South and Southeast Asia, Gulati et al. (2005) show that there is significantly less variation in yields and prices during the year for contract broiler farmers in India because they share risk with the contracted firm. A study on contracted vegetables in Uganda by Henson (2004) shows that there are important benefits for rural households from reduced risk and improved access to credit from vegetables production under contract in Uganda. Govereh and Tayne (2003) find important spillover benefits from VC in contracted cotton production on increased productivity on non-contracted activities.

Another illustrative example comes from Minten et al. (2006) on the FFV sector in Madagascar, one of the poorest countries in the world. The vast majority of FFV export from Madagascar goes through one company, who has regular contracts with five supermarkets chains in Europe. The company buys vegetables form more than 9,000 small farmers based on contracts. The firm provides seeds, fertilizer and pesticides and engages in intensive monitoring and extension advice. Farmers largely benefit from this contract production through a combination of effects. The firm teaches farmers better technologies and management practices, such as the use of compost, and this results in productivity spillovers on rice with yields being 64% higher on plots under contract. In addition, smallholders who participate in contract-farming have higher welfare, more stable incomes and shorter lean periods.

There are a number of studies specifically examining the motivations of farmers to engage in contract-production. These show that guaranteed sales and prices, access to inputs and credit are the most important motivations rather than direct income effects, which further proves the importance of household spillover effects from contract-farming. For example, table 7 shows how the dominant motivation for farms in Central Europe at the end of the 1990s was guaranteed access to markets (52% of the farms listed this as their primary motive) and to a lesser extent guaranteed prices (21%). The motivations for small cotton farmers in southern Kazakhstan to enter into contracts with gins are

[38] Guaranteed prices can also work counterproductive for farmers. For example, Gulati et al. (2005) point out that profits for contracted swine producers in the Philippines and Thailand were much lower than for independent producers in 2002. This was in part due to the strengthening of pork prices during the year, which did not benefit contracted farmers producing at guaranteed fixed prices.

mainly the improved access to credit (table 8). For FFV farmers in Senegal, guaranteed market access and access to inputs are the most important motivations for farmers to sign contracts while in Madagascar this is income stability and shorting of the lean period (table 9).

Table 7: Contract Motivations for farms in Central Europe

Most Important Reason for Contracting (%)	Czech 1999	Slovak 1999	Hungary 1997
Higher prices	9	8	10
Stable prices	7	22	33
Guaranteed sales	64	50	43
Pre-payment	7	13	3
Access to credit	0	0	9
Access to inputs and assistance	7	6	2
Other	6	2	0

Source: Swinnen, 2005

Table 8: Contract Motivations for Cotton Farms in Kazachstan, 2003

Reason for contracting (%)	Yes	No	Most important reason
Guaranteed product sales	9	91	8
Guaranteed price	4	96	3
Access to pre-financing	81	19	75
Access to quality inputs	11	89	10
Access to technical assistance	0	100	0
Other	4	96	3

Source: Swinnen, 2005

Table 9: Contract Motivations for FFV farms in Sub Sahara Africa

Reasons for contracting (%)	Madagascar 2004	Senegal 2005
Stable income	66	30
Stable prices	19	45
Higher income	17	15
Higher prices		11
Guaranteed sales		66
Access to inputs & credit	60	63
Access to new technologies	55	17
Income during the lean period	72	37

Source: Minten et al., 2006; Maertens et al., 2006

Equity Effects

There are two potential equity issues with VC processes. The first concerns the distribution of rents in vertically coordinated food supply chains. The second concerns the participation and exclusion of smallholders and poorer farmers in contract-farming.

First, VC implies sharing risks, costs and benefits between the coordinating firm – mostly food processors, exporters and retail chains – and farmers / suppliers. By introducing an interlinked contract, farms can access credit, inputs, etc. which were unavailable before and processing companies can have access to higher quality and timely supplies. Productivity and therefore income increases for the supply chain as a whole. However, a key question is who benefits from this increase in efficiency and total income? If the supplier and the processor benefit, both parties share in the gains from the institutional innovation, and everybody is better off. However, if the processing firm can set the terms of the contract such that it captures most or all of the rents, the productivity growth may not benefit the farms; and interlinking may even bestow additional monopoly power upon the processing company. Contract-farming has often been criticized as being a tool for agro-industrial firms and food multinationals to exploit unequal power relationships with farmers and extract rents from the chain (Warning and Key, 2002). However, our review of empirical evidence on the effects of VC presented above indicates that farmers do share importantly in the benefits of contract-farming and VC.

Second, the capacity of emerging VC in agri-food supply chains to serve as an engine of pro-poor economic growth critically depends on the types of farmers that are included in contract schemes. VC has the potential to affect the way income is distributed within a rural economy and can exacerbate existing patterns of economic stratification (Warning and Key, 2002). If agro-industrial firms prefer to contract with wealthier farmers, then poorer households will be excluded from direct benefits. There are three important reasons why this might be so. First, transaction costs favour larger farms in supply chains. Second, when some amount of investment is needed in order to contract with or supply to the company, small farms are often more constrained in their financial means for making necessary investments. Third, small farms typically require more assistance from the company per unit of output.

However, there are also reasons why agro-industrial firms do contract with smallholders and poorer farmers. First, the most straightforward reason is that companies have no choice. In some cases, small farmers represent the vast majority of the potential supply base. This is, for example, the case in the dairy sector in Poland and Romania, and in many other sectors in Eastern European countries (Swinnen, 2006). Second, case studies from transition countries suggest that company preferences for contracting with large farms are not as obvious as one may think. While processors may prefer to deal with large farms because of lower transaction costs in *e.g.* collection and administration, contract enforcement may be more problematic, and hence costly, with larger farms. Processors repeatedly emphasized that farms' "willingness to learn, take on board advise, and a professional attitude were more important than size in establishing fruitful farm-processor relationships". Third, in some cases small farms may have substantive cost advantages. This is particularly the case in labour intensive, high maintenance, production activities with relatively small economies of scale. Fourth, processors may prefer a mix of suppliers in order not to become too dependent on a few large suppliers.

Empirical studies and interviews with companies in Central and Eastern Europe and Sub Sahara Africa generally confirm the main hypotheses coming out of global observations: transaction costs and investment constraints are a serious consideration; and companies express a preference for working with relatively fewer, larger, and modern suppliers (Swinnen, 2006; Maertens et al., 2006). However, empirical observations show a very mixed picture of actual contracting, with much more small farms being contracted than predicted based on the arguments above. In fact, surveys in Poland, Romania and CIS find no evidence that small farmers have been excluded over the past six years in developing supply chains. In the CIS, the vast majority of companies have the same or more small suppliers in 2003 than in 1997 (Swinnen, 2006; World Bank, 2005). Also for the peanut sector in Senegal, no evidence was found for a bias in the participation of farmers in contract-schemes towards better-off households (Warning and Key, 2002).

A case-study on FFV exports from Senegal by Maertens et al. (2006) finds that relatively wealthier households have a better access to contracts with agro-exporting firms. However, the overall equity effects of VC are nuanced here. The export of FFV from Senegal to the EU have increased considerably during the past decade but due to increasingly stringent food standards, the VC system is changing since the past couple of years towards fully integrated production on agro-industrial holdings. This has decreased contract-farming and increased employment on agro-industrial farms. The study shows that contract-farming is biased to household with more land, livestock and other assets while employment in the agro-industry is not. The effects on income, from both contract-farming and agro-industrial employment are significantly positive but contract-farming has a large effect (figure 2). This suggest that, as smallholder contract-farming and large-scale industrial farming reach different groups of the poor, mixed VC systems are best suited to reduce adverse equity effects.

REFERENCES

Aksoy, M.A. 2005. The evolution of agricultural trade flows. *In* Aksoy M.A. & J. C. Beghin, eds. *Global Agricultural Trade and Developing Countries*, The World Bank, Washington D.C.

Bardhan, P. 1989. *The Economic Theory of Agrarian Institutions*, Claredon, Paperbacks

Bauman, P. 2000. *Equity and Efficiency in Contract Farming Schemes: the Experience of Agricultural Tree Crops*. Working Paper 139. Overseas Development Institute. London.

Birthal, P.S., Joshi, P.K. & Gulati, A. 2005. Vertical Coordination in High-Value Food Commodities: Implications for Smallholders. MTID Discussion Paper no 85, International Food Policy Research Institute, Washington D.C.

Delgado C., Narrod, C. & Tiongco, M. 2003. Policy, Technical and Environmental Determinants and Implications of the Scaling-up of Livestock Production in Four Fast-Growing developing Countries: A Synthesis. Final Report of IFPRI-FAO Livestock Industrialization Project: Phase II. International Food Policy Research Institute, Washington, D.C.

Dirven, M. 1996. *Agroindustria y pequeňa agricultura. Sintesis comparative de distintas experiencies (LC/R.1663)*. Santioga de Chile, CEPAL.

Dries, L. & Swinnen, J.F.M. 2004. Foreign Direct Investment, Vertical Integration and Local Suppliers: Evidence from the Polish Dairy Sector. *World Development*, 32(9), pp. 1525-1544

Dries, L., Reardon, T. & Swinnen, J.F.M. 2004. The Rapid Rise of Supermarkets in Central and Eastern Europe: Implications for the Agrifood Sector and Rural Development. *Development Policy Review* 22(5), pp 525-556.

Gorton, M., Buckwell, A. & Davidova, S. 2000. *Transfers and Distortioins along CEEC Food Supply Chains. In* Tangermann, S. & M. Banse, eds, *Central and Eastern European Agriculture in an Expanding European Union*. CABI Publishing, Wallingford, Oxon, pp. 89-112.

Govereh, J. & Jayne, T.S. 2003. Cash Cropping and Food Crop Productivity: Synergies or Trade-Offs?. *Agricultural Economics* 28:39-50.

Gow, H., Streeter, D.H. & Swinnen, J.F.M. 2000. How private contract enforcement mechanisms can succeed where public institutions fail: the case of Juhocukor a.s. *Agricultural Economics*, (23) 3: 253-265.

Gulati, A, Minot N., Delgado, C. & Bora, S. 2005. Growth in High-Value Agriculture in Asia and the Emergence of Vertical Links with Farmers. Paper presented at the workshop Linking Small-scale Producers to Markets: Old and New Challenges, The World Bank, Washington D.C.

Henson, S.J. 2004. National Laws, Regulations, and Institutional Capabilities for Standards Development. Paper prepared for World Bank training seminar on Standards and Trade, January 27-28, 2004. Washington, D.C.

Hobbs, J. & Young, L. 2001. Vertical Linkages in Agri-Food Supply Chains in Canada and the United States, Report, Agriculture and Agri-Food Canada.

Humphrey, J., McCulloch, N. & Ota, M. 2004. The impact of European market changes on employment in the Kenyan horticulture sector. *Journal of International Development, 16*(1).

IFAD, 2003. *Agricultural Marketing Companies as Sources of Smallholder Credit in Eastern and Southern Africa. Experiences, Insights and Potential Donor Role*. Rome, December 2003

Johnson, D.G. & Brooks, K.M. 1983. *Prospects for Soviet Agriculture in the 1980s*. Bloomington: Indiana University Press.

Little, P.D. & Watts, M.J. 1994. *Living under contract*. Madison: University of Wisconsin Press.

Maertens, M. & Swinnen, J.F.M. 2006. Trade, Standards and Poverty: the Case of Vegetable Exports from Senegal. *LICOS Discussion Paper 176/2006*, Leuven, Belgium (available at http://www.econ.kuleuven.be/LICOS)

Maertens, M., Dries, L., Dedehouanou F.A. & Swinnen, J.F.M. 2006. High-value Global Supply Chains, EU Food Safety Policy and Smallholders in Developing Countries. A Case-study from the Green Bean Sector in Senegal. *In* Swinnen, J.F.M, ed, *Global Supply Chains, Standards and the Poor*, CABI publishing.

Minten, B., Randrianarison, L. & Swinnen, J.F.M. 2006. Global Retail Chains and Poor Farmers: Evidence from Madagascar. *LICOS Discussion Papers 164/2006*, Leuven, Belgium (available at http://www.econ.kuleuven.be/LICOS)

Noev, N., Dries, L. & Swinnen, J.F.M. 2004. Foreign Investment and the Restructuring of the Dairy Supply Chains in Bulgaria. Working paper, Research Group and Food Policy, Transition and Development, K.U.Leuven, Belgium.

Poulton, C. 1998. Cotton Production and Marketing in Northern Ghana: The Dynamics of Competition in a System of Interlocking Transactions. *In* Dorward, A., Kydd, J. & Poulton, C., eds, *Smallholder Cash Crop Production under Market Liberalisation: A New Institutional Economics Perspective.* CAB International, Oxon, pp. 56–112.

Poulton C., Dorward A., Kydd J., Poole, N. & Smith, L. 1998. A New Institutional Economics Perspective on Current Policy Debates, *In* Dorward, A., Kydd, J. & Poulton, C., eds, *Smallholder Cash Crop Production under Market Liberalisation: A New Institutional Economics Perspective.* CAB International, Oxon, pp. 56–112.

Reardon, T. & Swinnen, J.F.M. 2004. Agrifood Sector Liberalization and the Rise of Supermarkets in Former State-Controlled Economies: Comparison with Other Developing Countries. *Development Policy Review* 22(4): 317-334

Rehber, E. 2000. Vertical Coordination in the Agro-food Industry and Contract-Farming: a Comparative Study of Turkey and the USA. *Food Marketing Policy Center Research Report No25*, University of Connecticut.

Rozelle, S. 1996. Gradual Reform and Institutional Development: The Keys to Success of China's Agricultural Reforms. *In* McMillan, J. & B. Naughton, eds, *Reforming Asian Socialism: The Growth of Market Institutions*. University of Michigan Press, pp. 197-220.

Rozelle, S. & Swinnen, J.F.M. 2004. Success and Failure of Reforms: Insights from Transiation Agriculture. *Journal of Economic Literature* 42(2): 404-56.

Sadler, M. 2004. *Comparative Analysis of Cotton Supply Chains in Central Asia.* Mimeo, The World Bank.

Swinnen, J.F.M. 2006a, *Global Supply Chains, Standards and the Poor.* CAB International Publishing.

Swinnen, J.F.M. 2006b, *The Dynamics of Vertical Coordination in Agrifood Chains in Eastern Europe and Central Asia: Case Studies*, The World Bank, Washington D.C.

Swinnen, J.F.M. 2005. When the Market Comes to You - Or Not. The Dynamics of Vertical Co-ordination in Agro-Food Chains in Europe and Central Asia. *Report*, The World Bank, Washington.

Swinnen, J. F.M. & Rozelle, S. 2006. *From Marx and Mao to the Market. The Economics and Politics of Agricultural Transition*. Oxford University Press, 218 p.

Swinnen, J., Maviglia, I. & Gow, H. 1999, Modest Changes in the West, Radical Reforms in the East, and Government Intervention Everywhere: European Sugar Markets at the Outset of the 21st Century. Paper, Katholieke Universiteit Leuven.

Swinnen, J.F.M., Dries, L., Noev, N. & Germenji, E. 2006. Foreign Investment, Supermarkets, and the Restructuring of Supply Chains: Evidence from Eastern European Dairy Sectors. LICOS Discussion Paper 165/2006, Leuven, Belgium (available at http://www.econ.kuleuven.be/LICOS)

Warning, M. & Key, N. 2002. The Social Performance and Distributional Impact of Contract Farming: An Equilibrium Analysis of the Arachide de Bouche Program in Senegal. *World Development*, 30(2): 255-263.

White, J. & Gorton, M. 2004. *Vertical Coordination in TC Agrifood Chains as an Engine of Private Sector Development: Implications for Policy and Bank Operations.* World Bank, Washington DC.

World Bank. 2006. *The Dynamics of Vertical Coordination in Agrifood Chains in Eastern Europe and Central Asia. Implications for Policy Making and World Bank Operations.* The World Bank, Washington D.C.

Contracting Issues at Various Levels of the Value Chain

Doyle Baker and Carlos Da Silva[39]

INTRODUCTION

Agro-enterprises in most developing countries face severe competitive disadvantages compared to agro-enterprises in developed regions. Sources of primary supply often are unreliable with respect to quality and timeliness, and tend to be inefficient due to small scale of operation and geographical dispersion. Infrastructure services – including from roads, energy, ICT – are costly when even available. Many countries lack publicly supported market information, quality and safety assurance and certification systems. Financial and risk management systems are underdeveloped and the costs of debt investment capital are often high.

To improve efficiency and competitiveness, agro-enterprise firms must be linked together in value chains and clusters so they can coordinate actions to reduce inventories, improve logistics and introduce advanced ICT systems. Competitiveness in high rent chains requires coordinated and tightly aligned actions to support product innovation and differentiation, including branding, as well as traceability and certification systems (Gereffi, Humphrey, Sturgeon, 2003). While the building of competitive value chains depends mostly on inter-firm trust, alliances and information flows (Humphrey and Schmitz, 2001), little is said in the value chain or supply chain management literature about contracting. Nevertheless, contracting – formal and informal – is a key mechanism for inter-firm vertical and horizontal coordination. The more environments are conducive to contracting, the more rapid will be the development of competitive value chains.

Largely because of gains in efficiency and value chain performance, the percentage of agricultural product value produced under contracts is increasing at a rapid pace in developing as well as developed countries. According to Key and MacDonald (2006), the share of farms contracting in the USA has remained stable over the past decade but as of 2003 accounted for 39 percent of the value of agricultural production – up from 11 percent three decades earlier. In Brazil, 75 percent of poultry production is coordinated via contracts; in Viet Nam there are indications that 90 percent of cotton and fresh milk, 50 percent of tea and 40 rice of rice are being purchased by enterprises though contracts (figures reported in Da Silva, 2005).

Thus far, contract farming has received the bulk of attention with respect to contracting in the agricultural sector - particularly in developing countries. Contract farming is not new but it is growing in importance in both developed and developing regions (Da Silva, 2005). A lot of case material has been assembled in order to assess advantages and disadvantages of contract farming, contract models and specifications, motivations for entering into contracts, and factors affecting success and sustainability (e.g. Minot, 1986; Glover, 1994; Key and Runsten, 1999). Little and Watts (1994) is a collection of case studies covering contract farming experiences and issues in sub-Saharan Africa. Glover and Ghee (1992) characterized contract farming in South East Asia [Reported in Eaton and Shepherd (2001)]. Eaton and Shepherd (2001) reviewed contract farming based on case studies from all developing regions, and drew lessons for developing and managing contracts. Singh and Asokan (2005) examined experiences of contracting between agro-processing firms and farmers in India.

While contract farming has received considerable attention in developing regions, notably less attention has been given to policies, programs and institutional frameworks to foster and strengthen contractual relations at various levels of value chains. There is as a consequence a lack of case study materials and empirical assessments to reliably appraise downstream contracting issues.

---

[39] Both authors are from the Agricultural Management, Marketing and Finance Service; Agricultural Support Systems Division, FAO

Between 2000 and 2005, FAO conducted a series of case studies and regional workshops on agribusiness development and farm-agribusiness linkages. While these cases mainly focused on farm-agribusiness linkages, broader policies and institutional support requirements for agribusiness development and business linkages were covered in the case studies and regional workshops. The findings from these cases and workshops point to several specific issues that can be expected to affect the development, success and sustainability of contracting at various levels of value chains in developing regions.

This paper will draw on the findings from the FAO farm-agribusiness linkages study, as well as complementary case studies carried out on contract farming (Eaton and Shepherd, 2001) and a recent report by Da Silva (2005) on the growing role of contract farming in agri-food systems development, to identify important contracting issues in the agricultural value chains of developing regions. Since the case study material mainly relates to farm-agribusiness linkages, the relative importance of issues identified on the basis of these FAO case studies clearly will require further attention and validation. Nevertheless, they should give a first indication on the most important issues from the perspectives of value chain stakeholders in all developing regions.

The structure of the paper is as follows. The second section briefly identifies the sources of FAO case material on contract farming, agribusiness development, and farm-agribusiness linkages. The next three sections identify key issues based on the FAO case material, with cross reference to findings from others studies as appropriate. The first of these sections summarizes the stakeholder views on the main advantages and disadvantages of contracting. The second identifies key success factors and constraints affecting agribusiness linkages. The third identifies four key policy and institutional issues that emerge from all three regions covered by the FAO cases. The penultimate section briefly three identifies issues that did not emerge as major stakeholder concerns in the FAO cases and workshops, but are expected to be critical for contracting among post-production agro-enterprises. Conclusions and recommendations are given in the last section.

FAO CASE STUDIES

Over the past decade, market liberalization and governmental decentralization policies have interfaced with globalization and urbanization trends to dramatically transform social, political, economic and cultural lives. In this context of rapid change, FAO launched two complementary appraisals in 2000. One dealt with the specific issue of contract farming; the other was a cross regional appraisal of strategies and programs for supporting agribusiness development with a particular focus on strengthening farm-agribusiness linkages.

Contract Farming

The appraisal of contract farming was based on a series of case studies covering contract farming arrangements in seven countries: Colombia, Guyana, India, Malawi, Croatia, the Philippines and Kenya. Additional information on contract farming arrangements was provided by agribusiness firms in Malaysia, Thailand and Pakistan. The case studies addressed the advantages and problems of contract farming, conditions for success, contract farming models and the specifications of contracts. Guidelines based on the findings were presented in “Contract Farming: Partnerships for Growth” (Eaton and Shepherd, 2001).

Farm-Agribusiness Linkages

The purpose of the farm-agribusiness linkages cross regional appraisal was to appraise trends, opportunities, and capacity building needs on the basis country case studies and the views of value chain stakeholders actively involved in agribusiness development and linkages in one manner or another.

The cross-regional appraisal started with a series of country studies in Asia (covering Cambodia, India, Indonesia, Malaysia, Nepal, the Philippines, the Republic of Korea and Thailand), followed by regional workshop held in September 2000 in Bangkok, Thailand (FAO, 2000). The main objectives in Asia were to characterize country experiences on the development of agribusiness linkages, and to

develop recommendations on strategies and approaches for strengthening the linkages between farmers and agribusiness firms. The overall picture emerging from the country studies and consultation was that immense opportunities exist for agribusiness in Asia based on stronger partnerships between farmers and processors.

During 2001 and 2002, case studies and a regional workshop on agribusiness linkages were carried out in Latin America (Santacoloma, Suárez, Riveros, 2005). Twelve case studies were carried out in seven countries: Argentina, Chile, Ecuador, Colombia, Costa Rica, Guatemala, El Salvador. Different types of organizations were covered by the cases. Seven of the cases were based on cooperatives, two on somewhat less formal producer associations, two involved privately own processing and marketing businesses, and one was a community-based business. The country cases and workshop in Latin America showed that the strengthening of business linkages and contracts enabled commercial ventures to move forward and adapt in highly competitive environments. A particularly important issue arising in the Latin America cases was the need to improve negotiation and compliance capabilities. A follow up workshop was held to further discuss capacity building priorities and approaches in Peru in late 2003 (Santacoloma and Riveros, 2005).

Work in Africa began in 2002 with preparation of five case studies (Rottger, 2004) covering three or four agribusiness models in each of Kenya, South Africa, Uganda, Ghana and Nigeria. These cases, as well as other contributed cases, were discussed during a regional expert consultation held in early 2003 in Nairobi, Kenya (Rottger, 2005). The purpose of the consultation was to identify opportunities for strengthening farm-agribusiness linkages, and identify possible actions to be implemented by government institutions, private sector organizations and NGOs. The consultation concluded that contracts and formal agreements assist in establishing successful farm-agribusiness linkages – but that building trust and mutual accountability is far more important since in many cases contract enforcement is weak or not cost effective.

STAKEHOLDER ADVANTAGES AND DISADVANTAGES

The FAO agribusiness linkages cases and regional workshops showed that there are strong commonalities in stakeholder views about the advantages and disadvantages of stronger linkages and contracts between farmers and agribusiness firms – mainly agro-processing firms but also exporters. Similar advantages and disadvantages for farmers and the firms contracting with the farmers were identified by Eaton and Shepherd (2001). Da Silva (2005) summarized and further elaborated drawing on other references. The rest of this section is adapted from Da Silva (2005), integrating complementary observations from case material.

Advantages for Farmers

Provision of inputs – Inputs can be provided by agribusiness firms, thereby reducing uncertainties associated with input availability, quality and costs. Failures in input markets can be circumvented and the economies of scale allowed by the larger purchases of inputs by agribusiness firms can be passed on to farmers. Input quality and adequacy is ensured and can result in higher productivity and higher returns.

Provision of services – Mechanization, transportation and other services can be provided by agribusiness firms, often at lower costs than otherwise available to the farmer.

Technical assistance - Technological assistance often is offered by the contracting firm, or is made available through third parties. Farm production and management skills are enhanced by the technical assistance provision, leading to spill-over benefits for other enterprise activities.

Market outlets and prices - A market outlet is secured for the contracted production, and so the uncertainty and the transaction costs involved in the search for markets are reduced. Uncertainty about sales price is often reduced, since contracts typically specify at the beginning of the growing cycle the prices to be paid at product delivery.

Access to credit – Under a resource provision contract, working capital credit is typically supplied in kind via input provision. The contract firm sometimes offers investment credit for the acquisition of machinery, buildings, etc. Financial services often can be guaranteed by the existence of the contract between the borrower and the agribusiness firm.

By-products - By-products and residues from the contracted farming activity can be used in complementary farm enterprises. Increase in household maize production following fertilization of cotton is a common example from West Africa.

Disadvantages for Farmers

Most of disadvantages for farmers stem from the uneven relationship between individual farmers and the agribusiness firm. The firm often exercises power and takes advantage of information asymmetries in defining terms of the transactions.

Contract renegotiation, manipulation and "hold-up" - Substantial variations in the realization of firm expectations can lead firms to force renegotiation or to engage in contractual hold-up, including such actions as rejection of products delivered. In the absence of effective enforcement mechanisms, there is little that farmers can do to avoid the negative impacts of contractual hold-ups.

Technology prescription – One of the advantages of contracting for farmers is improved access to technical advice and inputs. This can also increase dependency on a prescribed technology package, making farmers vulnerable to mistakes or manipulation by agribusiness firms. In many cases firms minimize their risks by specifying higher than necessary levels if inputs, and as a consequence increase the production costs of the farmers.

Price determination – Agribusiness firms often propose the prices paid under the contracts, and in doing so might intentionally avoid transparency in price determination. Formula prices related to quality attributes and hard-to-observe criteria that require laboratory measurement lend themselves to manipulation.

Loss of flexibility - Bound to a crop or livestock enterprise by a contract, farmers cannot adjust production mixes so as to benefit from market opportunities. Over time, farmers also can also lose contacts with other intermediaries, lenders and input providers. Once these linkages are broken, they can be difficult to re-establish leading to dependence on the contract partner and further loss of flexibility.

Social and cultural disruptions – In societies where the division of labour and family responsibilities are shared by males and females in distinctive ways, contracts can significantly impact on gender roles and resources access. Social tensions might arise when the benefits and burdens of contracts differentially affect men and women or particular households within communities.

Dependency - Firms often provide social services and do small favours to farmers beyond the requirements of contracts. Farmers can develop a reliance on the firm to provide such services and favours. This weakens a farmer's bargaining position and reinforces the firm's ability to exercise monopsonistic conduct.

Advantages for Agribusiness Firms

The main potential advantages to agribusiness firms are as follows:

Assured supply – With contracts, firms can schedule deliveries so as to optimally utilize their processing capacity and distribution infrastructure. They can also better coordinate product delivery with the timing of the demands from their own clients. Firms can also gain greater control over conformity to desirable product quality attributes and to safety standards.

Access to land - Access to the large land areas needed by agribusiness enterprises may be precluded by legislation that caps farm sizes or exclude private companies from land ownership. Contracting allows circumventing these limitations.

Improved financial conditions and services - Reduction of risk in a firm's supply chain and the economies of scale associated with contracting operations can improve the conditions available to the

firm from financial institutions. Governments in several countries also provide incentives and subsidies to promote contracting, including tax breaks, profit repatriation flexibility, tariff reduction for imported inputs, etc.

Labour costs - Labour costs, including wages, social benefits, supervision and training, can represent a significant share of production costs in vertically integrated agribusiness firms. Farmers will use family labour and when hiring, they may not be bound to the same labour laws as agribusiness firms. Hence, labour costs tend to be lower under contracting schemes.

Expansion and contraction of production - Without fixed assets in land or specialized housing for animals, for example, agribusiness firms have greater flexibility to expand or reduce operations. This allows better adjustment to market developments.

Disadvantages for agribusiness firms

As for farmers, agribusiness firms incorporate new risk sources in their operations when opting for contractual arrangements with farmers. These risks bring disadvantages for the use of contracts.

Risk of contractual hold-ups - Just as a firm may be prone to renege on contractual terms when market conditions change, a farmer may be compelled to sell all or part of his or her production to a third party when prices are higher outside the contractual bond. This is especially problematic where alternative markets for the crop or livestock grown under contracts are easily accessible and where contractual enforcement is weak. Contractual hold-ups by farmers, known locally under terms such as "pole vaulting" and "side-selling", were identified in the Asian cases as a particularly important risk to firms.

Transaction costs - A contracting firm will typically be linked to large numbers of farmers, scattered over wide regional areas. Managing a commercial relationship with a myriad of partners is a complex task, requiring investments in personnel, in controls and in monitoring systems. The logistical costs tend also to be high when inputs must be distributed and production assembled by the contracting firm.

Inputs diversion - In resource provision contracts, a common problem is use of the distributed inputs in alternative crop and livestock enterprises. Farmers may use fertilizers in their subsistence crops or may feed domestic herds or flocks with feedstuffs provided for the contracted animal rearing.

Support service costs – In many contracts, the costs of extension services, transportation services, financing, quality monitoring and other services are the responsibility of the agribusiness firms. Such new costs must be internalized and can lead to a competitive disadvantage compared to firms that can access supply without paying these costs (e.g. by encouraging side selling).

Loss of flexibility - Bound by a contract, a firm is precluded from sourcing from alternative suppliers when economic conditions would so advise. Contracting firms that honour their contractual commitments and may as a result lose competitiveness.

In summary, there are potential benefits and costs for all partners involved in contract farming. The same is true of all contracts and many of the potential benefits and costs identified above will be relevant to contracting at different levels of value chains. One of the first steps in extending knowledge about contracting in agricultural value chains will be to further clarify benefits and costs for all relevant stakeholders along value chains.

SUCCESS FACTORS AND CONSTRAINTS

The case studies and workshops from Asia, Latin America and Africa identified a large number of success factors and constraints affecting farm-agribusiness linkages. Taken together the factors identified give an illustrative range of issues that would have to be addressed in establishing successful and sustainable contracting along value chains. In many cases, successful contracting might well depend on broader macro policy changes and developmental circumstances.

Success factors
Most of the important success factors identified depended directly on the performance and will of the contracting partners. These included:

- technical upgrading of technologies;
- guaranteed markets for farmers and in many cases better prices;
- awareness creation that farming is a business;
- wide participation in decision making and transparency in management of resources;
- timely delivery of inputs for production;
- prompt payment to farmers for their produce;
- adequate provision of technical and managerial support;
- education on GAP standards and certification of farmers.

Other success factors were beyond the control of the contracting parties:

- solid and expanding domestic markets;
- explicit public and private cooperation policies;
- high levels of education and training;
- extension services provided by non-governmental organizations;
- improvements in road infrastructure.

Constraints
The main constraints to establishing agribusiness linkages identified in Asia, Africa and Latin America related to broader policy and developmental issues. Some of the identified constraints could be addressed, or at least mitigated, through contracts along value chains, while others could not. The constraints that could not easily be addressed through contracts along value chains:

- inconsistent and not transparent business rules and regulations;
- poor tax administration and high levels of corruption;
- poor monetary polices leading to high interest rates and artificial exchange rates;
- poor co-ordination and co-operation between the public and private sectors;
- research and development policies are not co-ordinated with agro-industry policies;
- low levels of education and training among the rural population and limited skilled labour;
- limited capacity to save and invest;
- lack of adequate infrastructure - road, water, electricity, communications, storage.

The broader constraints that could be addressed or at least in part through improved business linkages and contracts along value chains included:

- limited effective demand for products;
- delays in payment to agribusiness firms by their clients;
- insufficient local suppliers of processing equipment, packaging and ingredients;
- not enough space on exporting ships and lack of storage facilities at ports;
- business and industrial development strategies lacking;
- little information on markets, prices, trends, or key market players;
- high cost of raw materials for both farming and processing;
- extension agents lack skills required to increase farmers' business skills;

POLICY AND INSTITUTIONAL ISSUES

The case studies and regional workshops pointed to four cross-cutting considerations and challenges in establishing successful and sustainable business linkages. These would appear to be important issues to address in efforts to promote and support contracting at all stages of agricultural value chains.

Enabling environments

All the case studies and workshop indicated that a fundamental prerequisite for agribusiness development and farm-agribusiness linkages is an enabling environment. No successful contracting scheme can exist or remain sustainable where the institutional and political setting is not conducive to it. The importance of the policy and institutional framework cannot be overemphasized - governments wishing to promote farm-agribusiness linkages via contracts should start by assessing, streamlining and expunging restrictive features (Da Silva, 2005).

Problems relating to enabling environments were particularly stressed in the African case studies and consultation. There was unanimity in the African consultation that government's main role is to create an enabling environment for business development which includes providing macro-economic stability, investment friendly policies, and infrastructure development. The lack of an enabling environment was emphasized in the Nigeria case study. Rother (2004) reported that there is not specific national policy that focuses on development of agribusiness in Nigeria, including issues such as quality standardization, packaging, transport and marketing. Other enabling environment problems reported for Nigeria were the lack of infrastructure, particularly electricity, high cost of funds, uncertainty and lack of confidence about government policies towards the private sector, and a weak and inconsistently applied regulatory framework. While Nigeria often is signalled out, most of the same difficulties are faced by agribusiness firms in other African countries.

Improving the enabling environment also was identified as a top priority in the Asian cases and consultation. The Cambodia case, for example, showed that due to the lack of policy guidelines, farmer contractors are not well protected from disadvantages resulting from the contractual arrangements.

One issue raised in the regional consultations and workshops was the importance of the formal legal framework for contracts among agro-enterprise firms. While the establishment of a legal framework for contracting was considered to be a necessary condition, this was not seen as sufficient since in most cases the contracting parties, particularly farmers, cannot afford to seek enforcement of contracts through judicial systems. The existence of an appropriate legal system for contracts is likely to matter more for contracting among processing, exporting, transport and retail firms than do the legal frameworks for contract farming.

Facilitation and linkage programs

All of the cases showed that programs and mechanisms to bear transactions costs and public goods dimensions of building linkages are extremely important. While the contract farming literature indicates that contracts tend to be initiated by the contract firms, the FAO cases showed that governmental (including donor agency) and non-governmental organizations often play an initiator and facilitator role in the development of linkages.

The Asian cases and consultation showed that both the public and non-profit sectors were playing active roles in the development of business linkages and contracts. The country report from Malaysia described a chili production contract between small farmers and the multinational Nestle in which a farmer organization facilitated the linkage between the farmers and Nestle. In the Philippines, the public sector, non-government organizations (NGOs) and banking institutions were assisting in the development of business linkages and contracts between growers and buyers in poultry, hogs, mangoes, and asparagus, among others. The Thailand report pointed out that active support of the government had contributed to the success of business linkages through support for upgrading, post-harvest handling and packaging of products to meet requirements of agribusiness firms.

The participants in the consultation concluded that there are several ways in which governments and non-governmental organizations might facilitate agribusiness linkages and contracts:

- development of guidelines to encourage companies to invest and at the same time provide protection to the producers;
- information dissemination on proper production and post-production technologies;
- training to strengthen leadership and management in farmers' organizations and cooperatives;
- provision of market infrastructure and information system;
- fiscal incentives for research and development, as well as training.

The Latin American workshop recommended the establishment of explicit policies and programs for the promotion and development of farm-agribusiness linkages. These policies should be oriented towards promoting the linkage formats that have the greatest potential for innovation and for bolstering competitive abilities of the relevant organizations and producers (Santacoloma and Riveros, 2005).

Based on the African case studies, Rottger (2004) concluded that successful farm-agribusiness development depends on the role played by the initiator. In general, linkages are initiated by a business entity or, more traditionally, by a government agency responsible for the development of a particular commodity. Private sector enterprises have proven faster in establishing linkages with the agricultural sector than public institutions. However there is a trade off for profit making entities between developing sustainable relationships and the costs associated with providing farmers with necessary incentives to produce.

Several of the African cases showed that NGOs in particular have proven successful in providing business advisory services including capacity building in farm management and extension services (Rottger, 2004). With under-funded government extension services and limited knowledge, experience and financial strength of many agribusiness companies, NGOs can play a fundamental role in establishing and maintaining farm agribusiness linkages.

The Africa consultation reaffirmed that farmers need to be helped to link with agribusiness as well as be the target for farm-business development interventions. There is a need for partnerships between the private and public sector. NGOs, donors and governments should take their role in support services such as education, training support, support in organising and strengthening farmers' organisations. However, several private sector stakeholders expressed concerns about the business and service activities of NGOs, and strongly advised that NGOs should place their focus on facilitation, and not get involved in operating businesses. NGOs also should be aware of not creating unfair competition by offering subsidised (and hence long-term unsustainable) incentives such as subsidised farm-gate prices, credit, and inputs (Rottger, 2005).

Cutting across all three regions, the FAO agribusiness linkages case studies indicate that the public sector and NGOs can play key roles in fostering contract development and supporting related capacity building activities. There is a need to reinforce public and non-profit sector institutional frameworks and services for promoting and supporting farmer linkages into high rent value chains. Governments should initiate promotional linkage strategies and programmes through public-private sector initiatives and non-governmental organizations (Rottger, 2004).

Farmer organizations

The important roles of farmer groups and organizations in contract farming are recognized in the contract farming literature. Glover (1987) and Glover and Kusterer (1990) indicate that farmer groups can facilitate contract management by dealing with disagreements between growers and contractors and assisting in technology transfer. Through their associations, farmers can have stronger voices in negotiation processes and in this way better protect their interests. Firms, on the other hand, can reduce transactions costs by working through farmer organizations, leaving organizations with the responsibility for organizing and coordinating individual farmers. Coulter et al (2000) argue that providing credit and distributing inputs through groups reinforces peer pressure processes and in this way discourages non-compliance with the obligations individually assumed.

The importance of farmer organizations also emerged as one of the main conclusions of the FAO cases and workshop. The Latin American regional workshop agreed that cooperatives and producer associations can help promote the development of linkages between producers and agribusiness firms. The Africa consultation similarly concluded that farmer organisations should act as intermediaries between smallholders and agribusiness, and that strengthening of such organisations is an essential for sustainable links. They further agreed that it is vital to bring together professionals for self-regulation and standardisation of practices.

Farmer organisations can offer several services to their members that can support farm-business linkages and reduce the costs firms face in working with individual, smallscale farmers. Some of the services found in the FAO cases included:

- collective input procurement,
- saving schemes,
- dissemination of extension messages,
- farm-produce collection centres,
- sorting, grading and bulking services.

Farmer organizations also played a key role in acting as the intermediary with agribusiness firms. When dealing with farmer organizations, agribusiness firms can reduce transaction costs for contract negotiations, which can be done collectively, extension services, which might be delivered to groups, and group lending, which as we saw can reduce the likelihood of default (Da Silva, 2005). Farmer associations also can assist their members in understanding and meeting market requirements through training, technology and inputs acquisition, and co-ordinating harvesting-delivery schedules (Rottger, 2004).

The FAO cases suggest that support to farmer organisations is one of the most important capacity building activities to promote farm-agribusiness linkages. Capacity building programmes are needed to assist groups to define their objectives and develop group coherence. Organizations also need training in specific management and intermediation tasks including management of savings, record keeping, marketing, and preparation of business plans. Governments can also provide accreditation for successful farmer organisations and other service providers.

The Asian and African consultations also concluded that strengthening of inter-professional associations will be critical for supporting agribusiness development as well as strengthening farm-agribusiness linkages. The role of inter-professional associations is likely to be of even greater significance for fostering and supporting linkages contracting among post-production agro-enterprises, including linkages between processors, equipment and input importers, exporters and transnational corporations.

Management capacity building

A common conclusion from all three regional workshops was that participating producers need to be given support for the development of entrepreneurial, management and negotiation skills.

In Latin America, four main areas of capacity building were identified: production planning based on market requirements; collective bargaining for production inputs and advisory services; design and use of risk management mechanisms; appraisal of costs, benefits and priorities for contract negotiations (Santacoloma and Riveros, 2005). At the farmer's level, there is a need for systematic training on quality and quality. At the farmer organization level, there is a need to improve knowledge of production and commercialization costs and prices, as well as trends and requirements in international markets. Capacities need to be reinforced for evaluation of market risks and development of new products.

The Asia consultation also concluded that farmers need adequate and appropriate training on management as well as technical assistance in production and post-harvest operations and effective and efficient market information or intelligence (FAO, 2000).

Rottger (2004) also found that training in farm level production and management skills is one way governments can intervene to develop effective agribusiness linkages. All three cases in Ghana, for example, showed that lack of production skills was major constraint, and that training provided to farmers was instrumental in helping farmers meet contractual requirements.

UNDER-EMPHASIZED ISSUES

The focus of the FAO cases on agribusiness development and farm-agribusiness linkages clearly limits potential insights with respect to the strengthening of linkages and contracts among downstream firms in agricultural value chains. Some of the following issues – not signalled as major issues in the farm-agribusiness linkages case studies but covered somewhat more extensively in the contract farming literature – are expected to be critical issues as contracting increases at all levels of agricultural value chains.

Nature of the product

Rottger (2004) noted that the nature of the product or commodity is a significant factor influencing the nature of the contracts and extent of coordination but differences in coordination and contracting requirements for different types of value chains were not systematically addressed in the FAO cases and workshops. The importance of product traits was emphasized by Da Silva (2005) in his review of the growing role of contracting in agri-food systems. As noted by Da Silva, perishable products require careful handling and synchronization of production, transportation and processing. There are high incentives to all chain actors for strong coordination and contracting. The value chain and supply chain management literature also points to the nature of the product as a critical factor influencing the nature and strength of vertical coordination in value chains. Contracting issues along value chains almost certainly will be different depending on the product and the specific requirements for chain coordination and leadership. This would appear to be an important issue for additional study and clarification.

Risk mitigation and management

One key factor affecting sustainability of contracting will be risk management and who bears the risk under contractual arrangements. Mitigating risk is one of the most important motivations for contracting, while perception of who bears the risk is an important factor affecting the sustainability of contractual relations. The FAO cases identified sources of risk to both farmers and agro-processors but did not systematically address strategies and approaches for risk mitigation in contracts.

Da Silva (2005) notes that some risk sources can be known *a priori* and their sharing among transaction parties can be negotiated, but many sources of risk cannot be foreseen or fully covered by contractual clauses. Strategies are needed to cope with unexpected events that otherwise could undermine the contractual relationship. For example, in the case of known risks, or even in the case of so called “force-majeure” events, insurance mechanisms might be developed to provide the needed compensations. For circumstances that can not be foreseen, arbitration mechanisms need to be put in place to resolve ensuing disputes.

The related issue of mutual asset specificity was mentioned in the South Africa case (Rottger (2004) and was discussed in the African consultation (Rottger, 2005) but was not systematically assessed. Mutual asset specificity mitigates risk of contract hold-out or pole-vaulting but increases risk to changing market and consumer requirements.

Contract specifications

Eaton and Shepherd (2001) provided basic guidelines on contract specification, but the FAO agribusiness linkage cases and workshop discussions were surprisingly silent on the details of contract specifications. This stands in rather stark contrast to much of the contract farming literature, which at least characterizes different types of contract models distinguishing categories such as resources provision contracts, marketing contracts, production control contracts, etc.

Bogetof and Olesen (2002) provide one of the most useful and concise discussions on practical features in contract design. They introduce a “rules of thumb” checklist for contract design based on

lessons from contracting in Danish agriculture. The concise but highly useful examples given make it clear that many of the problems and sources of risk identified in the FAO cases could have been addressed through more innovative and appropriate contract specifications. As Bogetof and Olesen note, many contracts are inappropriate when first developed and are improved through trial and error over a period of several years. They rightly argue that systematic attention is needed to identification of appropriate contract specifications for different needs and circumstances. There would appear to be a related capacity building in contract negotiation and compliance

DISCUSSION AND CONCLUSIONS

Agro-enterprise firms are turning to business alliances and related contracts in order to manage risks, gain access resources, improve logistical efficiency, reduce inventories and, in general, achieve increased control over competitiveness factors that are beyond their firm boundaries. The shift to contracting in developing regions is most evident at the stage of primary product supply – through contract farming. In terms of government policies and programs, less attention is being given to business linkages and contracting all along value chains. Due to the severity and range of competitive disadvantages faced by agro-industries in developing regions, there are several reasons why establishment of enabling environments – policies, services and institutional frameworks – for contracting along value chains could be particularly catalytic to modern agrifood system and agro-industry development.

There is a surprising lack of attention to contracting issues in the value chain and supply chain management literature. Articles and guidelines characterizing the evolution of tightly aligned agricultural value chains tend to identify technological factors such as information and logistical technology, monitoring and measuring technologies, and economies of scale as key drivers or enablers of aligned chains. With respect to governance, much emphasis is given to mutual trust, willingness to accept a collaborative approach, equitable sharing of power and risk, etc. Although most inter-firm relationships within value chains will be governed by formal and formal contracts, contracting is not identified as a central issue.

Policy debates relating to value chains and supply chain management are focusing on national commodity strategies, fostering transparency, upgrading producer organizations, corporate social responsibility, public-private partnerships, managing shocks and risks, enabling environments, etc. With respect to enabling environments, one issue is legislation and operation of the judicial branch to support business operations. Contracting policy and legal frameworks are not specifically targeted as a key priority but it certainly will be one of the first challenges to be tackled.

Perhaps one reason for the relative neglect of contracting issues in the literature is cultural bias, reflecting circumstances in countries where supply chain management issues are being most hotly debated. The critical and pervasive role of contracts is just part of the background landscape; taken for granted and not seen as a key challenge or entry point for the forging of business linkages.

The FAO case studies and consultations on farm-agribusiness linkages point to a number of issues that are likely to affect contracting at all levels of value chains. One of the most important issues is to clarify stakeholder perceived advantages and disadvantages of linkages and contracts. The possibility of forging alliances and corresponding contracts will depend mainly on the gains of the contracting parties. In many cases autonomy and flexibility will be lost, and the contracting parties will need to perceive significant compensating gains (Key and MacDonald, 2006).

The FAO cases further suggest that the contracting firms can through their own actions substantively influence whether successful linkages and contracts can be established, but the cases equally show that many of the constraints on overall performance of the value chain – and therefore competitiveness and sustainability of the value chain - are likely to be beyond control of the firms. Contracting along value chains in developing regions will continue to be affected by the broader circumstances that constrain efficiency and competitiveness in developing regions.

The contract farming literature most often focuses on the contracting partners – farmers and the firms that offer contracts. The FAO agribusiness linkages case studies and consultations indicate that attention to enabling environments, facilitation and linkage programs, to strengthening of farmer and professional organizations, and to building technical and management skills can all play important roles in reinforcing business linkages. There would appear to be an important role for both governmental and non-governmental organizations in developing and reinforcing linkages and contracts among private sector firms. There also are risks of market distortions and unwelcome interferences, and so further attention needs to be given on appropriate value adding roles for governments and NGOs in facilitating alliances, linkages and contracting at various levels of value chains.

Due to the scarcity of information on contracting in the value chain and supply chain management literature, and the specific focus of the FAO agribusiness linkages case studies, the relative importance of different contracting issues at various levels of value chains cannot yet be determined. Appraisals based on real world experiences, such as that carried out Bogetof and Olesen (2002) for Danish agriculture, but focused on contracting among downstream agricultural firms in developing regions are clearly needed. The FAO cases point to some of the issues that require further attention.

REFERENCES

Bogetoft, P. & Olesen, H.B. 2002. Ten rules of thumb in contract design: lessons from Danish agriculture. *European Review of Agricultural Economics* 29(2): 185-204.

Da Silva, C. 2005. The growing role of contract farming in agri-food systems development: drivers, theory and practice. AGSF Working Document 9, Agricultural Support Systems Division, FAO.

Eaton, C. & Shepherd, A.W. 2001. Contract farming: partnerships for growth. FAO Agricultural Services Bulletin 145, FAO, Rome.

FAO. 2000. FAO Regional Expert Consultation on Farm-Agribusiness Linkages, Bangkok, Thailand, 18-21 September 2000 (unpublished).

Gereffi, G., Humphrey, J. & Sturgeon, T. 2003. The governance of global value chains. Draft, forthcoming in Review of International Political Economy

Glover, D. 1994. Contract farming and commercialization of agriculture in developing countries. In J. von Braun & E. Kennedy (eds.), *Agricultural commercialization, economic development and nutrition*. Johns Hopkins, pp 166-75.

Humphrey, J. & Schmitz, H. 2001. Governance in global value chains. *IDS Bulletin* 32(2).

Key, N. & MacDonald, J. 2006. Agricultural contracting: trading autonomy for risk reduction. *Amber Waves* 4(1): 26-31, USDA, ERS.

Key, N. & Runsten, D. 1999. Contract Farming, Smallholders, and Rural Development in Latin America: The Organization of Agroprocessing Firms and the Scale of Outgrower Production. *World Development*, 27 (2) pp. 381-401

Little, P.D. & Watts, M.J. eds. 1994. *Living under contract: contract farming and agrarian transformation in sub-Saharan Africa*. Madison, University of Wisconsin Press.

Minot, N. 1986. Contract farming and is effect on small farmers in less developed countries. Working Paper No. 31, Department of Agricultural Economics, Michigan State University.

Rottger, A. 2005. Strengthening farm-agribusiness linkages in Africa; proceedings of an expert consultation. AGSF Working Document No. 5. Agricultural Support Systems Division, FAO.

Rottger, A. ed. 2004. Strengthening farm agribusiness linkages in Africa: summary results of five country studies in Ghana, Nigeria, Kenya, Uganda and South Africa. AGSF Occasional Paper 6. Agricultural Support Systems Division, FAO.

Santacoloma, P. & Riveros, H. eds. 2005. Alternatives to improve negotiation and market access capabilities of small-scale rural entrepreneurs in Latin America. AGSF Working Document No 4. Agricultural Support Systems Division, FAO.

Santacoloma, P., Suárez, R. & Riveros, H. 2005. Strengthening agribusiness linkages with small-scale farmers. Case studies in Latin America and the Caribbean. AGSF Occasional Paper No 4. Agricultural Support Systems Division, FAO.

Singh, G. & Asokan, S.R. 2005. *Contract farming in India; texts and cases* (CMA Monograph No. 213). New Delhi, Oxford & IBH Publishing Co.

PART 2

INSTITUTIONAL AND STRUCTURAL ISSUES IN COMMODITY MARKETS

Standards and Supply-Chain Coordination - Impact on Small-Scale Producers[40]

Kees van der Meer[41]
Laura Ignacio[42]

INTRODUCTION

Integration of producers and consumers in deepening and broadening markets is a crucial characteristic of development. Governments in most developing countries and development agencies traditionally have given much attention to the functioning of markets for food staples and agricultural export commodities, in particular with respect to access by small-scale farmers and poor consumers. In recent times the rapid growth of demand for high-value products – fruit, vegetables, fish and livestock products – opens a new range of questions about market access. For these products the retail revolution, tightening food safety and quality requirements, emergence of supply chain integration, and possible exclusion of small-scale producers are major issues.

Linking small-scale producers to markets is clearly on the agenda of development agencies. Their question is what kind of interventions will help. Will so-called coordinated supply chains[43] and contract farming offer the solution to market linkage? Would linkage with the rapidly rising supermarket chains provide the solution? For many developing countries where the market share of output of fresh products handled by supermarkets is still small, often not more than a few percent, linkage with supermarket chains is not a solution.

This paper will explain that successful arrangements in the supply chains will greatly vary between different product-market combinations. They are highly dependent on the kind of consumers served and the market outlets used. They differ between countries in response to institutional and policy risks. They also are different for fresh and processed products, for perishables and storable products. Practical solutions depend much on geographic location, available infrastructure and logistics. Would the same solutions work for all small-scale producers? Certainly not; no one size will fit all. There are huge differences among small-scale producers in terms of skills, motivation, location where they live and institutions. This paper discusses various factors that may be of importance when designing practical interventions.

This paper will first discuss major changes in global food markets that have taken place in recent times. Special attention will be given to the role of food scandals, food scares and food safety and quality standards in the emergence of new forms of market organizations, the coordinated supply chains. Different requirements induce market segmentation and supply chain organization that differs between product-market combinations. The paper ends with an assessment of factors for successful participation of smallholders in coordinated supply chains and practical support measures that deserve to be considered.

GLOBAL FOOD MARKETS

In recent years, significant developments have taken place in global food markets[44] arising from greater trade liberalization, the rise of modern retail and logistic systems and contemporaneous

[40] The paper is an expanded version of a presentation made December 15, 2005 at the World Bank, titled "Linking Small-Scale Producers to Markets". http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/TRADE/0,,contentMDK:20803873~pagePK:148956~piPK:216618~theSitePK:239071,00.html.. It also builds on Van der Meer (2007).

[41] Consultant, World Bank

[42] Consultant, World Bank

[43] See Van der Meer (2005) for definition.

[44] For more information on food safety and market dynamics, see Van der Meer (2007).

changes in consumer demand. With higher income and busy lifestyles, consumers are demanding food products with greater variety and more value-added ("prepared", "seasoned", "ready-to-eat", etc.) that offer convenience (always available) and better quality (fresh, "healthy" and "safe" foods). Moreover, social (labour) and environmental issues are becoming increasingly important considerations in food production concerns.

Efforts by the food industries to provide for these varied consumer demands led to developments in the food markets. Food manufacturers offer consumers with attractive processed products; supermarkets present one-place-to-shop; food services such as restaurants, canteens, fast food outlets provide convenience and direct service to consumers disregarding the need for supermarkets. (Indeed, in many countries the growth of food services has surpassed that of supermarkets.) Variety in food products is satisfied by sourcing from global markets which is facilitated by advancements in information technology, logistics, post-harvest technology and food processing. Trade liberalization has allowed for greater international trade in food, especially fruit, vegetables and fisheries products (FAO 2004; World Bank 2005). The growth of food retailers is spurred by the promotion of foreign investments. Thus, there is a dynamic interaction between consumer preferences and evolving food markets.

PUBLIC RESPONSES TO FOOD SCARES

The occurrence of numerous food scandals and food scares in recent years had a tremendous impact on the food market. The incidents involving Mad Cow disease or Bovine Spongiform Encephalopathy (BSE), Listeria, Salmonella, hepatitis, food products found with higher-than-normal levels of residues of pesticides and antibiotics, dioxin and toxic chemicals in the food chain and, more recently, the outbreak of Avian Flu, aggravated by the media attention, highlighted concern on food safety. Together with apprehensions on bio-terrorism there is political pressure to strengthen control on the entire food supply chain. In response, public authorities (for example, in Japan, the EU and USA) have taken the initiative to amend food laws and regulations accordingly.

PRIVATE COMPANY RESPONSES TO FOOD SCARES

It was the private sector that incurred the financial losses as a consequence of the food safety incidents – rejected and destroyed shipments, discontinued supplies and loss of business. To protect themselves from such occurrences, food companies have established rules and standards to ensure food safety. Greater control is observed along the entire food supply chain. Inputs are no longer obtained in the open markets but sourced from suppliers certified to have good agricultural and good manufacturing practices and a tracking and tracing system. The focus is no longer on the quality of outputs only but also on the methods and safety conditions of production and manufacturing processes. More importantly, these safety methods and conditions have to be verified and certified. Thus, food safety may present an important commercial risk but may also be used as a marketing strategy to vie for consumers' attention. These private sector protocols add to the large range of food safety requirements for different countries and market segments.

FACTORS AFFECTING SAFETY AND QUALITY REQUIREMENTS

Food safety and quality requirements and the corresponding appropriate arrangements are highly dependent on the kind of products, consumers served and the market outlets used.

Countries'/buyers' preferences and income

Most countries have distinct characteristics in food culture and local taste. In general, requirements for food safety and quality are low in low-income countries and among the mass of population in middle-income countries. Markets with moderate requirements for food safety and quality are most prevalent in urban areas in middle-income countries, the Middle East and Eastern Europe. Industrial countries are characterized by high requirements. Yet, within the industrial countries there are distinct differences as well. In the USA, microbiological safety draws much attention; Japanese and Korean

consumers are relatively more focused on freshness and appearance; and in Western Europe, consumers are relatively sensitive about chemical residues in food. There are also interesting differences among European markets. The UK market is highly sensitive to quality and safety, the German market is relatively price sensitive and the markets in Southern Europe demand a large assortment and are receptive to innovation of products. And importantly, within each of these markets there is a range of players specializing in particular quality segments. This all means that producers and traders have potentially much choice of market.

Market outlets

Local fresh markets are by far the dominant channel for fruits and vegetables in developing countries, but also still of importance in some places in Western Europe and Japan. These markets are generally characterized by requirements of freshness, low prices, little packing and little value added. Everywhere there are series of specialized small retailers – stores, food kiosks, butchers, bakers, vegetable stores and staple food stores. Recently, they are losing market share to supermarkets and restaurants, where especially value added or large volume with small margins are important. Restaurants are increasingly important channels for food retail. They include fast food chains as well as a range of different restaurants, canteens and food stalls. Well-known restaurants and fast food chains are very sensitive to food scandals and demand-scheduled delivery, but their requirements for volume, appearance and packing are less demanding than for supermarkets. Within retail, the formulae requirements for quality, food safety, quantity, appearance and value added can differ much. On the one hand, there is consolidation of food retail in supermarkets and fast food and restaurant chains, on the other hand, there is increasing differentiation of formulae. In developing countries, supermarkets and restaurants are raising the standards required of the produce, thus, making compliance difficult for the local growers.

Types and nature of products

According to Ammar Siamwalla, the Thai economist, the organization of supply chains and the distribution of power within supply chains depends much on the physical characteristics of the product. In sugar production, sugar barons for example, often are powerful because of their monopsonic power[45] as millers of a homogeneous commodity.

The character of supply chains for fresh product differs much between those that cater for local consumption, spot markets and those for distant consumption. Further differences occur between supply chains for unpacked and packed produce and for products channelled through cold chains, conditioned products and fresh products with post-harvest treatment. Supply chains for frozen, preserved and processed products are generally less sophisticated than those for fresh products because appearance and grading matter less. In particular, food safety control is more difficult for perishable products – the time factor puts a constraint on the testing required for food safety. The level of sophistication increases with distance, investment needed and care required. Yet, quality requirements for certain parameters may be high, especially for branded products. Ready to cook and ready to eat snacks and meals have their own requirements, greatly varying with the kind of product. Bulk commodities that can easily be stored, such as most staples and tropical commodities, often have modest requirements for supply chain control of quality and safety. Food safety risks for some products are much higher than for others. Leafy vegetables are vulnerable to pests and because of possible improper use of pesticides there is a higher risk of problems with residues. Because of this, the Chinese Government allows exports of some “risky” vegetables to Japan from pre-approved companies only; small-scale producers are excluded (World Bank 2006a:81). Fish and many animal products have high food safety risks and many importing countries require pre-approval of imports.

[45] The higher the transport cost of the raw produce and the larger the distance to competing processors, the higher the cost for producers to shift to other buyers (the so-called shifting cost), and the stronger the monopsonic power of the processor. For some other products and situations, shifting costs can be low and traders-by-night may make contract farming arrangements risky. Monopsonic power also exists in cases where economies of scale for traders and transporters results in little competition.

VARYING REQUIREMENTS OF MARKET SEGMENTS

In developing countries, there is a significant difference with regard to the quality and safety of food products in the high-value market relative to food products in the low-value markets. In the industrial countries, the difference is less distinct.

Three-tier market structure

There is an emerging three-tier system of production and marketing in developing countries. At the low end, the traditional local production and market system is easily accessed by small-scale producers, has low prices and displays very little coordination in the supply chain. For the export market in the top tier, there are stricter requirements for quality, safety, value-added and continuous supply. In most cases, therefore, businesses in the export market adopt vertical integration or durable coordination within commercially organized supply chains. Participation of small-scale producers is through contract farming arrangements initiated by the exporters. The middle tier comprises of production for retailing in the domestic modern urban sector where the requirements for quality and safety are higher than those in the low end but less restricting than those in the top end considering that the consumers of this sector are less willing (or, perhaps, less able) to pay for the high export-level quality and safety requirements.

The traditional market is the more significant sector for the majority of the developing countries carrying more than 90 percent of the volume of production; the export sector remains small with a very little percentage share. In middle-income countries, supermarkets are a fast-growing sector (Reardon and Berdegué 2002). The modern urban sector currently has a small percentage share but is expected to eventually grow and take the place of the traditional market, albeit gradually. This growth will depend on the rate of urbanization and growth of consumer income (Traill 2006; Tschirley and Ayieko 2005; World Bank 2006a) which for a number of countries may take several decades, particularly for fruits and vegetables (Shepherd 2005).

Market segments for fruits and vegetables in China

On the basis of the various factors that influence supply chains some stylized types of the markets can be distinguished. From field work in China three market segments were identified for fruit and vegetables (Table 1). Traditional local markets for fruit and vegetables are characterized by low food safety concerns, scattered supply-driven production without much coordination within the supply chain. This market segment still channels more than 90 percent of all produce. Prices are low and every producer has easy access, provided they can compete at low cost levels. Trust plays a limited role in supply chain organization and contract specifications; it may play some role in reducing risk and transaction cost between farmers, local traders and consumers.

Table 1. Characteristics of market segments for fruits and vegetables in China

	Traditional local	*Modern urban*	*Export*
Food safety awareness, compliance	Low	Emerging	High
Supply-chain organization	Scattered, supply driven	Efforts to control by processor, retailer	Demand driven, control by exporter
Price, value added, standardization	Low	Increasing	High
Participation of small-scale producers	No constraint	Constrained by still underdeveloped producer organization	Almost excluded; need for producer organizations
Factors affecting competitiveness	Low cost	Sufficient quantity, consistency	Quality, volume, flexibility, innovation
Trust between buyers and sellers	Not so Important	Emerging role	Crucial factor

Source: World Bank (2007: Table 21.1).

In the export sector, which constitutes at most two percent of the production volume, the situation is much different. Given the perishable characteristic of the products, food safety and quality requirements are high and production methods are specified by the buyer. Products are standardized and receive relatively high prices. Value added for sorting, cleaning, processing, packing, conditioning is high. Access to supply chains is limited to those producers who are accepted for forms of contract farming. Producer organizations can play important roles in reducing transaction cost. Hence, examples are known where buyers actively promote producer organizations. Competitiveness depends on performance in quality, volume, meeting demand specifications and response to changes in the consumer markets. Trust and durable relationships are important factors in these supply chain relations. Independent certification of compliance plays a role, not only in reducing commercial risks, but also as a tool in competitive strategies.

The emerging modern urban retail segment takes in many respects an in-between position. In China the market share in volume is still a few percent only, but increasing rapidly. Buyers need to be assured of regular supply of consistent quality. Food safety concerns and quality requirements are increasing and they want to know where the product is coming from. For this purpose they try to set up more durable relations with preferred suppliers. However, competitive pressure on prices can form a serious constraint on investment in supply chain formation.

Food staples and tropical products

The example of Chinese fruit and vegetable market segments illustrates much of what can be observed in similar markets in other developing countries, although the markets for most food staples and tropical products tend to be simpler (Table 2). These products are not perishable and storage helps to bridge the difference in timing of production and consumption. These markets are even easier to access for small-scale producers. In terms of supply chain organization, however, the characteristics of most local markets for food staples and tropical commodities are roughly similar to those for fruit and vegetables. Although, for modern urban markets, supply chains for these products are relatively simple. Even export supply chains for these products are not very demanding. Generally, production is supply-driven and competition is based on low costs. The exceptions to this are a number of products with food safety risks, such as mycotoxins, and products for which grading is important. Contract farming may play a role for some products based on monopsonic power of processors.

Table 2. Characteristics of market segments for food staples and tropical products

	Traditional local	***Modern urban***	***Export commodities/bulk***	***Export to niche markets, specialties, quality segments***
Food safety awareness, compliance	Low	Low	Low/moderate, few sensitive products	High
Supply-chain organization	Scattered, Supply-driven	Scattered, supply driven	Mainly supply-driven	Demand-driven
Price, value added, standardization	Low	Low/moderate	Low/moderate	Increasing/high
Participation of small-scale producers	No constraint	No constraint	Little constraint	Contract farming, need for producer organization
Factors affecting competitiveness	Low cost	Low cost, some consistency	Low cost, some consistency	Quality, volume, consistency, innovation
Trust between buyers and sellers	Not so Important	Not so Important	Not so Important	Crucial factor

Source: compiled by the authors

Differences in supply chain organization are emerging in markets for raw materials for branded products and specialties, such as quality products, organic production, fair trade, gourmet qualities, etc. In these increasingly important market segments, features of supply chain organization are similar to those in the export segment for fruit and vegetables. These markets are demand driven, pay relatively high prices and demand value added services. Here market requirements are also extensive and product has to be distinguished on the basis of quality, production method and certification of compliance.

PARTICIPATION OF SMALL-SCALE PRODUCERS

The room for small players in global markets has declined because of increased economies of scale in retailing, transport, logistics and processing. As a result there has been rapid concentration among retailers, food services and food processors.

Despite of concentration, there is heavy oligopolistic and monopsonic competition in food markets. Companies try to escape from price competition through strategies of product differentiation, branding of products, and product and market innovation.

Small-scale producers can bring their products to the local markets or those markets with low safety and quality requirements but may not be able to access distant markets or the ones with higher requirements. They have neither the knowledge of technologies and the various safety and quality requirements, nor do they have enough volume to make much difference in the markets and often are unable to coordinate among themselves. Therefore, their access to most markets depends much on traders, processors and exporters and the commercial strategies of these players.

Traders often specialize in certain products, markets and market segments. A trader specialized on supplying local urban markets may not have access to high-end markets in industrial countries. Importers from industrial countries will focus their activities and investment in supply chains on the basis of comparative advantage of suppliers, a seasonal window and, last but not least, on the investment climate. A part of their choice is whether they buy from large-scale or small-scale producers. They will evaluate the advantages and disadvantages of both. Large-scale importers often have long-term joint interests with their suppliers. Many Japanese importers, in particular, have durable relations with their suppliers and often some direct investment participation. (Jonker *et al* 2005) In such cases, technical support from the importer can play an important role in building local capacities. Many European importers similarly value durable supply chain relations with their suppliers and direct investment participation; (Willems *et al* 2005) this is less the case among American importers.

Some traders have strategies with long-term suppliers and direct investment, whereas other traders have an opportunistic strategy and are “footloose”. Fully integrated companies follow long-term strategies, but these companies by nature are not much interested in dealing with small-scale producers.

SUPPLY-CHAIN ORGANIZATION, PARTICIPATION AND INTERVENTION[46]

From the previous discussions, general implications can be drawn about principles for supply chain organization, participation of small-scale producers and possible public intervention.

MARKETS WITH LOW REQUIREMENTS

In markets with low requirements, private investment in supply chain organization is in general not possible as the value added it generates is lower than the necessary transaction cost. The only exceptions are contract farming arrangements by monopsonic buyers, such as for sugar cane, cotton, some food processing and tobacco.

[46] For more details on factors affecting formation of coordinated supply chains, see Van Der Meer (2005).

Possible public interventions
The public sector often plays a dominant role in improving access to these markets for small-scale producers. Justification for public sector intervention should be based on possibilities to mitigate market failure, to achieve net benefits and to improve livelihoods. The main improvements are focused on reduction of transaction cost, securing minimum food safety and improving on-farm technology. Transaction cost can be reduced among others through good governance, better infrastructural services, improved market places, market information and transparency, and sometimes through grading systems and auctioning. Interventions are through the supply side.

MARKETS WITH MODERATE REQUIREMENTS

In markets with moderate requirements, such as emerging modern urban consumer markets in developing countries and less demanding export markets, private investment in supply chain organization may be profitable, i.e. the net return is worth the effort. This usually means that the formation of coordinated supply chains is feasible, especially in cases of monopsonic power, or in cases of sharing value added among chain partners. In some cases the return to the investor and to innovating producers may be much lower than the social benefits, which could justify targeted public support.

Possible public interventions
Public interventions could target support for the formation of coordinated supply chains through process facilitation, improvement of the investment climate, reduction of transaction cost and risk. Examples of the latter are improved infrastructure services and improved phytosanitary services. The intervention can also focus on shared investment in items with public goods characteristics, such as training, applied technology and development of good agricultural practice (GAP). Direct interventions should mostly go through the demand side, i.e. supply chain leaders.

MARKETS WITH HIGH REQUIREMENTS

For markets with high requirements, which are usually high-value export markets, returns from investment in coordinated supply chains will be higher than the transaction cost. Hence, coordinated supply chains are a common feature in this market segment. There is most likely a durable relation between partners in the supply chain and there is a clear chain leader who is in the driver seat.

Possible public interventions
Public intervention in these cases can focus on improved competitiveness through improvement of the investment climate, reduction of transaction cost and risk and co-investment in items with public goods characteristics as mentioned before. Access by small-scale producers deserves special attention. If the case for public support can be made, particular items for support could be process facilitation for supply chain formation and development of good agricultural practice (GAP). Facilitation of market access for small-scale producers should in particular look at creating a level playing field and at costs typical for smallholder producers in organization, technology and training. Direct interventions, such as for applied technology and training, should go through the demand side.

WHEN ARE COORDINATED SUPPLY CHAINS WITH SMALL-SCALE PRODUCERS A SERIOUS OPTION?

From the previous discussions, some conclusions can be drawn about conditions under which coordinated supply chains can be feasible. These are situations with moderate and high market requirements with planned delivery schedules, product consistency, significant volume and safety and quality requirements. This applies to sensitive products, perishables, quality segments, specialties and products with variability in price and quality.

The question on whether small-scale producers can participate in these coordinated supply chains depends on their competitive edge vis-à-vis large-scale producers. There are a number of important issues to that question. Suitable government policies are needed that will help in creating a level-

playing field. Smallholder producers have best chances in labour intensive products. Field observations show that their cost of production can be as much as 40 percent lower than that of large-scale producers with hired labour (World Bank 2006a). In some cases access to land is a competitive strength (World Bank 2006b). Production skills of small-scale producers are an important asset. An investor will be reluctant to introduce contract farming of high value vegetables among farmers who have no experience with vegetable growing. One of the reasons for the dominance of large-scale farms for export in Sub-Saharan Africa could be the relatively limited skills among traditional farmers in Africa compared to Asian countries. Cultural and political conditions may have strong impact also (Van Der Meer 2005). The freedom to organize farmer and producer organizations without interference of government officers is certainly an important asset. Polarized attitudes against private companies may scare investors. Government manipulation and distrust of cooperatives and meddling in markets is likewise a negative factor.

WHEN ARE THE CHANCES FOR PARTICIPATING IN COORDINATED SUPPLY CHAINS SMALL?

In markets with low requirements there is little scope for adding net value through coordinated supply chains. Products and markets with limited price premium for quality don't offer much scope either. The demand for coordinated supply chains is limited for bulk commodities that can be stored. The main exception is perhaps for cases where the control of mycotoxins is becoming important. In some cases, small-scale producers cannot compete with large-scale producers. This is likely the case when economies of scale are important, required investment is high and technology is complex.

Finally, many small-scale farmers will not participate in high-value supply chains because it does not fit their livelihood strategies. Farmers who practice agriculture for safety-net purposes will show little interest in investing in their farms other than for traditional subsistence crops. This is the case for many small-scale farmers who received land from privatizations in Eastern Europe and the former Soviet Union. More generally, farmers who are focused on off-farm sources of income, or are elderly people without a successor, will not be inclined to invest in upgrading for high value production.

CONCLUSION

Significant developments in global food markets have resulted to the promotion of supply chain coordination among producers, processors, traders, exporters and retailers. Participation in these coordinated supply chains, however, poses difficult demands for small-scale producers and enterprises. There is a role for the public sector to enhance linking of small-scale producers to markets. Forms of public intervention include changes in institutions and legislations to create a level playing field for small-scale producers or to mitigate a market failure and incentives to improve the investment climate. However, there is not a straightforward blueprint of technical measures that will do the job. What works will very much depend on a large number of specific product-market characteristics, as well as on investment climate variables and existing market failures. Interventions, therefore, need to be based on strategic analysis.

REFERENCES

FAO. 2004. The market for non-traditional agricultural exports. FAO. Rome.

Jonker, T., Ito, H. & Fujishima, H. 2005. Food Safety and Quality Standards in Japan: Compliance of Suppliers from Developing Countries. Agriculture and Rural Development Department, World Bank, Washington, D.C. (also available at http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Standards/JapanCountrySurveyF.pdf)

Manarungsan, S., Naewbanij, J. & Rerngjakrabhet, T. 2005. Costs of Compliance to SPS Standards: Thailand Case Studies of Shrimp, Fresh Asparagus and Frozen Green Soybeans. Agriculture and Rural Development Department, World Bank, Washington, D.C. (also available at http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Standards/ThailandCountrySurveyF.pdf)

Reardon, T. & Berdegué, J.A. 2002. The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development. *In Development Policy Review*, 20(4), September: 317-34.

Shepherd, A. W. 2005. The implications of supermarket development for horticultural farmers and traditional marketing systems in Asia. Agricultural Management, Marketing and Finance Service, FAO, Rome.

Traill, B. W. 2006. The Rapid Rise of Supermarkets? *Development Policy Review*, March 2006 - Vol. 24 Issue 2 Page 131-236

Tschirley, D. & Ayieko, M. 2005. Changing Horticultural Supply Chains in Africa: Implications for Government and Donor Investments; Evidence from Kenya and Implications for Africa. Presentation made at the World Bank on April 6, 2005.

Van Der Meer, C.L.J. 2005. Exclusion of small-scale farmers from coordinated supply chains: market failure, policy failure or just economies of scale? *In* Rubern, Ruerd, Maja Slingerland & Hans Nijhoff, *Agro-food chains and networks for development*, published by Kluwer/Springer Verlag in cooperation with Frontis - Wageningen International Nucleus for Strategic Expertise, Wageningen. (also available at http://library.wur.nl/frontis/agro-food_chains/index.html)

Van Der Meer, C.L.J. 2007. Building Capacity for Compliance with Evolving Food Safety and Agricultural Health Standards. *In* Swinnen & Johan, F.M., ed. *Global Supply Chains, Standards and the Poor*. CABI Publications, Wallingford Oxon and Cambridge MA.

Willems, S., Roth, E. & van Roekel, J. 2005. Changing European Public and Private Food Safety and Quality Requirements: Challenges for Developing Country Fresh Produce and Fish Exporters. Agriculture and Rural Development Department, World Bank, Washington, D.C. (also available at http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Standards/EUBuyerSurveyF.pdf)

World Bank. 2005. Food Safety and Agricultural Health Standards: Challenges and Opportunities for Developing Country Exports. Report No. 31207. World Bank. Washington, D.C. (also available at http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Standards/standards_challenges_synthesisreport.pdf)

World Bank. 2006a. China's Compliance with Food Safety Requirements for Fruits and Vegetables: Promoting Food Safety, Competitiveness and Poverty Reduction. World Bank, Beijing/Washington D.C. (also available at http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Standards/CHINA_Jan06part1.pdf.)

World Bank. 2006b. The Dynamics of Vertical Coordination in Agrifood Chains in Eastern Europe and Central Asia: Implications for Policy and World Bank Operations. World Bank, Environmentally and Socially Sustainable Development Unit Europe and Central Asia Region, Washington D.C.

Supermarkets, Horticultural Supply Chains, and Small Farmers in Central America

Thomas Reardon[47]*, Julio Berdegué*[48]*,*
Luis Flores, Fernando Balsevich and Ricardo Hernández[49]

ABSTRACT

The retail and processing sectors have consolidated and multinationalized rapidly in the past decade in Central America. This has been spurred by foreign direct investment both by global multinationals, but importantly, also by the multinationalization within the Central American region of supermarket chains, specialized wholesalers, and processors. This paper analyzes the changes thus wrought in the horticulture markets and supply chains, and the effects on farmers, using detailed recent case studies and farm survey evidence from Guatemala and Nicaragua.

This paper is an outcome of and the authors are thankful to a set of donors and projects supporting the collaborative work, citing in no particular order: (1) "Assistance for Trade Capacity Building in Relation to the Application of Sanitary and Phytosanitary Measures" (RAISE-SPS), funded by USAID, primed by DAI and implemented for this project by Michigan State University; (2) "Regoverning Markets, Phase 1", a project coordinated by the International Institute for Environment and Development (IIED), the Royal Tropical Institute (KIT), and Rimisp-Centro Latinoamericano para el Desarrollo Rural, and funded by the Department for International Development (DFID) of the United Kingdom; (3) "Partnerships for Food Industry Development – Fruits and Vegetables" (PFID-FFV), funded by USAID, and implemented by Michigan State University; and (4) The Agribusiness Development Project of the Centro Internacional de Agricultura Tropical (CIAT); (5) The International Livestock Institute (ILRI), funded by the Common Fund for Commodities.

INTRODUCTION

Driven by rising incomes and urbanization, as well as foreign investment and procurement technology change, the share of supermarkets in food retail in Latin America rose from a mere 10-20% in 1990 to 50-60% by the early 2000s, displacing small shops and open-air markets (Reardon and Berdegué, 2002). That trend started somewhat later in Central America and has gone less far (reaching 30-40% of food retail by the early 2000s) but is also developing quickly. One of the poorest in the region, Nicaragua, has shared that trend, with the share reaching 20% today (Berdegué et al., 2005).

Such change downstream in the agrifood system can be hypothesized to be changing market conditions facing farmers. Generally, compared to traditional retailers, supermarkets have different and more demanding product and transaction requirements. However, despite the increasing importance of the rise of supermarkets, there has been little empirical research on supermarket procurement systems, in particular, supply chains from farmers, and the interface between farmers and supermarkets – including the determinants of channel choice of farmers (between supermarket and traditional market channels) and the effects of those choices (on net incomes and technologies).

This chapter synthesizes new research on these topics, from fieldwork done by the authors, spanning 2002-2005. Section 2 synthesizes findings concerning the retail sector in the horticulture product market, both as a marketer, and as a procurer of produce from wholesalers and farmers. This work took place in all the Central American countries save Panama and Belize. It is based on Berdegue et al.

[47] Michigan State University; reardon@msu.edu
[48] Rimisp – Latin American Center for Rural Development, Chile
[49] Michigan State University

(2005). Section 3 synthesizes findings from studies that built on the first study, and dug into the issue of the determinants and effects of grower participation. It is based on Balsevich et al. (2006) on tomato farmers and supermarkets in Nicaragua, Hernandez et al. (2006) on tomatoes in Guatemala, and Flores and Reardon (2006) on lettuce producers and supermarkets in Guatemala. The countries were chosen for variation in degree of supermarket-sector development, and the products were chosen to contrast a bulk basic commodity (roma tomatoes) with a niche product (lettuce).

Retail Sector Change: Diffusion of Supermarkets and Change in Procurement Systems for Horticulture Products in Central America

The findings in this section are a synthesis from Berdegue et al. (2005) of case studies from Costa Rica, Guatemala, El Salvador, Honduras, and Nicaragua – the range being in decreasing order of household income, share of supermarkets in overall food retail, and from strongest to weakest domestic public health standards. The research is based on fieldwork by a team of researchers in November 2002 - May 2003 and March and July 2004, including rapid reconnaissance surveys of supermarket chains, wholesalers, and producers. The questions focused on procurement practices and application of standards, including private enforcement of public standards, and application of private standards.

Diffusion of Supermarkets in Central America and Penetration of Produce Markets

Supermarkets have risen very fast from a negligible niche to a major force in Central American food markets in only a decade. In 2002, supermarkets had a 36% share in the overall food retail in the region, with a high of 50% in Costa Rica and a low of 19% in Nicaragua. There are 600 supermarkets today in the five countries on which we focus here, up from at most a hundred or so in the early 1990s.

Even more relevant to our discussion is the fact that supermarket purchases and sales of local horticultural products are now approaching the importance of the non-traditional exports from the region. FAOSTAT data for 2001 for fresh produce exports (excluding bananas) from these five countries totals around 600 million dollars[50] – while a rough estimate of local supermarket sales of fresh produce is 180 million. Remove export-powerhouse Costa Rica (349 of 599) from the set and the comparison shows exports are double supermarket sales (horticultural products exports are $260 million and supermarkets sales are $116 million). The gap is closing quickly because supermarket sales are growing much faster (36% between 1997 and 2002) than exports (15% between 1997 and 2001).

Procurement system change

Supermarket procurement officers have a dual objective of minimize cost (both product costs and diverse transaction costs) and to maximize quality and product differentiation (SKUs, or stock keeping units). To meet that dual objective, supermarket chains in Central America have been shifting over the past few years away from the old procurement model based on sourcing horticulture products from the traditional wholesalers and the wholesale markets, toward the use of four key pillars of a new kind of procurement system: (1) specialized procurement agents we call “specialized wholesalers” and away from traditional wholesalers; (2) centralized procurement through Distribution Centers (DCs); (3) assured and consistent supply through “preferred suppliers”; (4) high quality and increasingly safe product through private standards imposed on suppliers.

The first three pillars (organizational change in procurement) together make possible the fourth (institutional change in procurement – that is, the rise of private standards first for quality and increasingly for safety of produce). Below, we retake each of these pillars.

First, there has been a substantial shift by supermarkets in the study countries away from reliance on traditional wholesale markets for procurement of produce. The shift is away from traditional wholesalers toward the use of specialized wholesalers who classify product collected from suppliers, sometimes have their own production, and often have semi-contractual relations with “lead suppliers”, discussed further below.

[50] Note that this figure includes intra-regional exports, and many of the latter go to supermarkets, and thus from the point of view of comparison of exports with supermarket sales, the export figure is over-stated.

The shift occurred because the traditional wholesalers: (1) Lack quality standards and, in particular, lack consistency in standards. The traditional wholesalers who used to supply most supermarkets, did serve these demanding clients with the best horticultural products they could find on a given date; such "best" was too often of "below acceptable" quality, according to the procurement officers of the leading supermarket chains that we interviewed. Since traditional wholesalers do not get involved in any sort of production support programs, usually do not enter into long term commercial relationships with selected producers (out-grower schemes), and in general buy and sell on a day-to-day basis (spot market), they often lack the capacity to define, monitor, or enforce a quality or safety standard which goes beyond the norm for the wholesale market (e.g., no rotten horticultural products, basic grading of horticultural products according to size and appearance, weights and measures). Since the vast majority of their sales are done with clients who in turn have no particular quality demands, traditional wholesalers also lack the incentive to develop, monitor, and enforce standards from which they will gain little benefit, if at all. (2) An objective of supermarkets' horticultural products procurement officers is to not find themselves as the weak party in the negotiation process. This is more difficult to achieve with wholesalers than with individual producers, as wholesaling is usually quite concentrated per product rubric.

Second, as an alternative to traditional wholesale markets, supermarket chains in Central America are setting up their own Distribution Centers (DCs) to have centralized procurement of horticultural products. Of course this is implemented only when the chain has passed a certain size in terms of number of stores or throughput to justify this shift. La Fragua in Guatemala has gone from 32% centralized in 2001, to 78% in 2003, to 98% by end 2004. CSU is almost 100% centralized in Costa Rica.

The main reasons for this procurement centralization are as follows. (1) There are major cost savings from reduced coordination costs, and from spending less time ordering and tracking. (2) There are inventory management cost savings, as chains can implement best-practice logistics; centralization creates economies of scale and so justifies investments too expensive for small chains with decentralized distribution. (3) There are supervision cost savings as it is cheaper and more effective for the chain to monitor deliveries at only one point rather than per store[51]. (4) There are savings in transport and other transaction costs for suppliers who formerly had to make the rounds of widely dispersed stores on deliveries. Centralization also allows suppliers to adjust rapidly to the results of the quality control. (5) Centralization helps chains by upgrading their supplier base, as being able to deal in larger volumes without the bother of delivering to many stores makes it more attractive (in sales less transaction costs) for bigger suppliers to sell to the chain. (6) Centralization can bring substantial product cost savings: buying in one place in bulk can mean economies of scale and better bargaining with suppliers. These savings can be substantial.

Third, in Central America the main supermarket chains and/or their dedicated, specialized wholesalers (which we have termed "new-generation wholesalers" as analogous to "new-generation cooperatives" in many ways), are switching to lists of preferred suppliers. In the relationships with these suppliers they use new commercial practices vis-à-vis suppliers that reward consistently high performance in delivery. The reasons for shifting to preferred suppliers are as follows. (1) Supermarket chains need to reduce risk of coming up short on a given item, and want to minimize the costs of putting in place a procurement system that reduces that risk. Having a list of preferred suppliers falls short of issuing formal contracts, but is not so "loose" as to merely engage in spot markets and find whatever is on offer and whoever is selling on a given day. These can in fact be considered "contracts" in the broad sense that includes informal and implicit relationships in which there is some cost (tangible or intangible) to not performing. (2) Constituting the list of preferred suppliers requires an initial act of selection, and that selection screens farmers who cannot meet supermarket requirements (cost, volume, consistency, safety, quality, ease of transaction), and thus reduces search costs. (3) The information exchange linked to a preferred supplier relationship means that the suppliers can

[51] Interviewees familiar with the traditional procurement systems of supermarkets noted that per store deliveries subjected suppliers to arbitrary and inconsistent monitoring and even the need for payments to product receivers. These hurt both the supermarket and the supplier and reduce product quality and ability to enforce standards, and raised costs.

"internalize" the requirements and so supervision costs, and the counterpart, costs of product rejection, can be minimized. (4) In what we call in the next section "active relationships" with preferred suppliers, supermarket chains can resolve problems of generalized or idiosyncratic market failure in factor markets for its suppliers; for example, it can help with credit and agronomic advice. The chain can also resolve the problem of the missing market for management services by helping the supplier establish crop calendars and undertake commercial planning, even planning for income diversification.

Fourth, via the above "procurement system" or combination of the first three pillars, leading Central American supermarket chains are very recently starting to apply tougher and effectively enforced quality standards.

These quality standards, plus the transaction attribute requirements (timing, consistency, volume) imply at least in theory, a set of specific practices and investments by farmers. That in turn suggests that according to their assets and other contextual variables, farmers will differ in their capacity and incentive to participate in the supermarket channel (versus alternative traditional channels), and will condition the impacts of such participation on farmers. We explore that below, but first note some differential application of the above trends as between broad, mass market commodities (in our case here, roma tomatoes present in most Guatemalan and Nicaraguan lunches and/or dinners…) and lettuce (a niche product reserved for some meals and some dishes and with a tendency to be consumed regularly only by the middle class).

Berdegue et al. (2005) give an illustration of differences in procurement practices, and the reasons for them, over the full spectrum of produce, by La Fragua, the main retailer in Guatemala (and El Salvador). We focus on the difference between (roma) tomatoes and lettuce as most germane to our comparison of commodities versus niche products in this chapter.

La Fragua stores source only 20% "centrally", via its DC, in 1999, but by 2004 that figure was 98%. The category "large volume products" constitute 30% of their produce, and include mainly roma tomatoes, potatoes, bell peppers, melons, and watermelons. In 1999, only 40% were procured via the DC, while by 2004 that figure was 100%. The chain sources these commodities from six large wholesalers who in turn source them from thousands of tiny farms scattered over Guatemala. Those wholesalers are in many ways fully "new-generation wholesalers" as they select the commercial-grade product for La Fragua. The latter does not, however, have any direct sourcing from producers, as it does from banana producers or lettuce producers, because tomatoes are not produced in greenhouses and thus can be sourced from a given zone all year, they are quite cheap per unit and yet come from dispersed production, small farmers, and with high transaction and sorting costs, and La Fragua wants large volumes in large lots delivered fresh daily. This spells the need for specialized wholesalers to be intermediaries.

Another category, "medium-volume bulk products", consisting of lettuce, carrots, limes, etc., only 15% of produce sales, also moved from nearly all locally delivered, store by store, in 1999 (when only 20% of lettuce passed through the DC), to 1005 centralization by 2004. In 1999, 70% of the total volume of these products was sourced via large and small intermediaries in the traditional wholesale market – while only 30% today are sourced from the wholesale market; now 70% come from preferred suppliers, some of whom are fully new-generation wholesalers and the others are small own-production companies (basically a handful of medium commercial farmers) and cooperatives and companies with contract schemes.

Both of these categories, one starting on the road to modernization and the other well along in the modernization of the procurement structure, are sharply in contrast to the category for example of fresh herbs, that are still sourced locally or through the traditional wholesale market. These distinctions are important in terms of expected impacts on farmers, in the sense that one expects the rewards to be higher for quality, the signals more direct and clear, and the involvement of intermediaries in the sourcing process more developed in the case of products like lettuce, where the supermarket and direct agents are closely involved, versus roma tomatoes, where the supermarket has agents but agents that are only roughly and incipiently differentiated from the traditional spot market wholesaler, having added selection and boxing and client-specific services.

IMPACTS ON FARMERS

Data and Methods

The surveys took place in 2004 roughly over June-September, in Guatemala and Nicaragua, and in all, involved about 600 farmers. Details of sampling are found in the source papers. The farmers were divided between those selling both to the supermarket and the traditional channel and those selling only to the traditional channel. The questionnaire asked detailed questions about household and farm characteristics, marketing, production, and participation in associations. Supply chain contextual analysis was performed in each country, as were several case studies of firms and associations.

Key Findings by Country and Product

Context

The relations of the Nicaragua and the Guatemala tomato growers with the supermarket chains differ. (1) The CSU chain in Nicaragua is a Costa Rican subsidiary, and uses the procurement method the mother company uses in Costa Rica, as they procure tomatoes via their own (own in the sense that it is literally part of the same holding company) procurement company, Hortifruti. They have direct relations with all the tomato suppliers. Moreover, as we will show, there is a certain bimodality in the preferred supplier set, with a number of very small farmers, working in groups, who participate with the assistance (credit, technical assistance) of NGOs dedicated to helping "business linkages" as such projects are called in current parlance. The other farmers are not assisted by NGOs, and as we show, are still officially small farmers but at the upper end of that stratum and more capitalized. So in the Nicaraguan case there is an interesting four-way stratification by both market channel and NGO-assisted versus not assisted. Moreover, the directness of the relation with the chain makes for a more proximate and direct signaling of the latter of requirements. (2) By contrast, the La Fragua chain, although in the same regional joint venture (then with global chain Ahold, now with Wal-mart), has a different procurement method, working through specialized wholesalers in an approached between fully spot market and fully internalized. While tomato growers may be in associations, they are not grouped for group marketing of tomatoes and are not assisted by NGOs, at least to the degree of the latter being involved in promoting "business linkages" with supermarkets. Moreover, while the chain signals requirements to the few large specialized wholesalers it uses, the latter use those signals to sort product to suit the chains, and signal only indirectly the requirements to the farmers.

The Guatemalan lettuce growers are again in a different configuration relative to the supermarket channel (while the traditional-market-channel growers of lettuce are much like, in marketing terms, their counterparts in tomatoes). Supermarkets have essentially left off sourcing lettuce in the spot market, finding the quality inconsistent and coordination costs high, and have then to sourcing directly from own-production medium farmers or small companies, from contract-farming small companies (who contract small farmers), from farmers associations (who started supplying the spot market then entered regional trade then became suppliers to supermarkets in Guatemala and then suppliers to supermarkets regionally), and from specialized wholesalers of the type used in tomato. Hence there is a unique plethora of sourcing channels, spurred by the high value and quality requirement of lettuce, and that lettuce became part of the "one-stop shopping" package that various groups began offering, only a few years ago, to supermarkets chains to solve their sourcing transaction cost and uncertainty problems.

The following findings concerning differences in characteristics of farmers selling to the supermarket versus traditional channels are summarized in the Table and discussed below.

Asset Correlates

In all three of the cases, while still in the small farmer category (in fact if one excludes scrubby pastureland, the arable farmland is 1-2 ha per farm for lettuce and 2-4 ha per farm for tomato farms), the supermarket-channel growers, relative to the traditional channel growers, have larger farm sizes -roughly twice larger in the case of lettuce in Guatemala, about half larger in the case of tomatoes in Guatemala, and in Nicaragua, a mixed case, with the leading chain actually having smaller farmers (both assisted and non-assisted) than the traditional channel and the secondary chain channel. In every case, the supermarket channel growers tend to be somewhat to a lot more specialized in the product. The size and specialization points taken together mean that the supermarket-channel prefers sufficient

volume per producer from farmers more dedicated to the product, hence presumably less risk for the buyer in terms of finding the needed volumes and quality.

In all three of the cases, the supermarket-channel growers are more "capitalized" than the traditional-channel growers. Irrigation and vehicle ownership are the most important. Supermarket channel growers have twice the share of irrigated land in the case of lettuce, thrice in the case of tomatoes in Guatemala and a quarter more in the case of tomatoes in Nicaragua. Supermarket-channel growers have a greater probability of having a vehicle, or are closer to road, or both. Both these assets reduce transaction costs for the buyers, and increase quality and freshness. While we did not go into detail with the farmers in terms of how they spent their credit, it is very clear that in general, the supermarket channel farmers received more credit; again, for the smallest farmers associated with NGOs, this is influenced by the NGOs; for the other "independent" farmers working with supermarkets, this is probably associated with their being larger, more commercialized, and more specialized, usual factors influencing local informal creditors, the main source of credit. Moreover, receipt of technical assistance is broadly higher for the supermarket channel producers, but not uniformly so: for example, in Nicaragua tomatoes, while the suppliers to the lead chain (CSU) tend to receive much more technical assistance (whether they are assisted by NGOs or not), the farmers selling to the second chain are in the same situation (of less technical assistance) as the traditional growers, reinforcing the image that those selling to the second chain are in more of the traditional situation of selling to brokers rather than in tight, preferred supplier "two way" relationships.

By contrast, several assets that are important in more "technified" agricultural systems are not significant or have mixed results in the case of this essentially smallholder, domestic-market oriented horticulture: tractor or animal traction equipment access (with the exception of the somewhat larger small farms in Nicaragua), education, and greenhouses do not play a clear differentiating role.

Interestingly, while much is made of the need for small farmers to be in associations, this was only a significant factor in two cases: the lettuce producers in Guatemalan (who use the association to market and to enforce standards among themselves for a quality-demanding high value product) and the smallest farmers selling tomatoes to the supermarkets in Nicaragua, who belong to marketing coops that were organized or at least helped by the NGOs. But in all the other cases the associativity rate is low or not different from the traditional channels. This suggests that the collection arrangements used by the wholesalers are at least minimally sufficient to permit small farmers, especially if they have trucks and are relatively specialized, to deliver their produce or have it picked up.

Technology Correlates

The technology story is strikingly consistent across the cases, and is predictable due to the quality and transaction attributes required by the supermarket channel relative to the traditional channel.

In general, supermarket growers use much more non-labor variable inputs (chemicals, fertilizers) than do the traditional growers: for lettuce in Guatemala, 50% more; for tomatoes in Guatemala, 40% more, and for tomatoes in Nicaragua, 35% more. This is correlated with the higher credit and technical assistance (some of the latter is from the input suppliers).

An aside, but one of interest, is to think of these results in light of the debate on chemical use in horticulture. This is a very important issue for Central America as it has a very chemical-intensive horticulture, and Costa Rica is known to have one of the highest rates of stomach cancer in the world, believed to be attributed to use of lots of pesticides. Thrupp (1995) noted that this heavy chemical use was driven by the need for produce quality for export. It is ironic that some years later, international public and private standards are tending to push down the use of chemicals on produce for export to demanding markets like Europe's (Reardon et al. 2001), while the demanding quality (but not yet safety standards, that is only in its incipience for a few products for supermarkets, see Berdegue et al. 2005) of supermarkets, plus perhaps overuse by farmers, is resurrecting the situation of a new market driving heavy chemical use in Central America, but this time it is the modern urban market locally rather than the export market.

Moreover, the supermarket channel producers, as we noted above, use more physical capital (in particular irrigation, but also other items), and more non-labor variable inputs, but in general somewhat less labor on average, compared to the traditional channel producers; in the case of lettuce, it is quite less, in Guatemalan tomatoes, similar, and in Nicaraguan tomatoes, slightly more. This substitution of capital for labor among the more demanding channel producers thus makes sense and emerges as a clear image. The exception interestingly is the smallest farmers, NGO-assisted, in Nicaragua, who use 15% more, presumably substituting labor for their very limited land. Abstracting from the consideration that the latter group is getting so much (implicitly subsidized) help from NGOs and thus donors, it is good news that smaller farmers have some "wiggle room" in the technology needed to meet the requirements of the new market channel, using "sweat equity" to make up for their tiny parcels.

Income Correlates

In Nicaragua, supermarkets pay about 10% more per kg, but recall that input costs are 35% more, and labor costs are similar; however, yields are roughly 40% higher (so the capital and non-labor variable inputs, plus presumably some unobservables in terms of management) compensate for higher costs, to arrive at net income per ha 1.75 times higher. Similar patterns give rise to that differential being near 2 times in Guatemalan lettuce. However, there is no difference between net income per ha for Guatemalan tomato producers in the two channels. Producers informed us that they were compensated by the transactional ease and lower risk of the supermarket channel.

The upshot is that on average, the quality-niche product, lettuce, shows a much clearer advantage in the supermarket versus the traditional channel. This advantage is less in the early supermarketization situation of Nicaragua, and disappears in the more advanced supermarketization stage situation, Guatemala, combined with a procurement system that is still largely intermediated.

CONCLUSIONS AND IMPLICATIONS

Supermarkets are spreading in Central America, and though with a lag compared to processed foods, penetrating progressively the fruit and vegetable markets. The farmers that sell to the supermarkets, relative to traditional-channel farmers, tend to earn higher profits, with the effect much sharper for the niche-quality-differentiated products than for the mass market commodities. This mirrors a similar trend in the U.S.

The lead chains are following trends observed elsewhere of modernizing their procurement systems in terms of organization and standards. These together imply challenges to farmers. The farmers that can meet those challenges are of two types.

The "un-assisted" type, the one that one would probably observe ubiquitously should donors and governments and NGOs not intervene with implicit subsidies and projects, is the upper-tier small farmer. The latter has more capital in the form of irrigation, vehicles, and other equipment. That farmer tends to have a bit more land than the traditional farmer but still be in the "small" category. That farmer tends to use lots of chemical inputs but not as much labor as the traditional farmer. That farmer tends to receive more credit and technical assistance, but not be significantly more organized than others.

By contrast, there is the "assisted" type of farmer, who looks more like a traditional farmer (a smaller small farmer, substituting labor for land, but using somewhat more chemicals than traditional). It is good to see the smallest farmers having access to these opportunities.

Nevertheless, the dilemma facing policymakers, donors, and researchers, as well as farmers, is that in Nicaragua, we calculated that this farmer receives (in terms of NGO project budget per farmer) about eight times more than the Ministry of Agriculture in Nicaragua spends per farmer. In other words, to include the smallest farmers, hyper-subsidization is used. That is very probably not an approach that can be directly and as it is, scaled up to serve the masses of farmers as market modernization progresses in the retail and wholesale sectors.

In the decade ahead, the challenge will be to help farmers upgrade to meet the needs of the supermarket channel, taking over the market, where the farmers have that potential, and to work to create alternative markets or strengthen traditional wholesale markets to provide alternatives for the smallest producers who are too-undercapitalized to make the modern market but want to diversify their crops and markets and not waste away as impoverished grain farmers.

REFERENCES

Balsevich, F., Berdegué, J. & Reardon, T. 2006. *Supermarkets, New-Generation Wholesalers, Tomato Farmers, and NGOs in Nicaragua.* Agricultural Economics Staff Paper 2006-03. East Lansing: Michigan State University.

Berdegue, J.A., Balsevich, F., Flores, L. & Reardon, T. 2005. Central American supermarkets' private standards of quality and safety in procurement of fresh fruits and vegetables. *Food Policy*, Vol 30 Issue 3, June: 254-269.

Flores, L. & Reardon, T. 2006. *Supermarkets, New-Generation Wholesalers, Farmers Organizations, Contract Farming, and Lettuce in Guatemala: Participation by and Effects on Small Farmers.* Agricultural Economics Staff Paper 2006-07. East Lansing: Michigan State University.

Hernández, R., Reardon, T. & Berdegué, J. 2006. *Tomato Farmer Participation in Supermarket Market Channels in Guatemala: Determinants and Technology and Income Effects*. Agricultural Economics Staff Paper 2006-04. East Lansing: Michigan State University.

Reardon, T. & Berdegué, J.A. 2002. The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development. *Development Policy Review*, 20 (4), September: 317-34.

Reardon, T., Codron, J-M., Busch, L., Bingen, J. & Harris, C. 2001. Global Change in Agrifood Grades and Standards: Agribusiness Strategic Responses in Developing Countries. *International Food and Agribusiness Management Review*, 2 (3): 195-205.

Thrupp, L.A. 1995. *Bittersweet Harvest for Global Supermarkets: Challenges in Latin America's Agricultural Export Boom,* Washington: World Resources Institute.

Table 1: Characteristics of Growers Marketing to Supermarkets vs. Traditional Channels

	Lettuce Growers – Guatemala		Tomato Growers – Guatemala		Tomato Growers – Nicaragua	
Variables	**Supermarket Channel**	**Traditional Channel**	**Super. Channel**	**Trad. Channel**	**Super. Chann.**	**Trad. Channel**
Total land per farm (ha, average)	2.5	1.2	9.3	7.8	7.7	9.8
Cropping land per farm (ha, average)	1.7	0.9	4.6	2.5	3.5	3.5
Lettuce/tomato area per farm (ha, average)	0.86	0.21	4.2	1.7	1.6	1.4
Share of farms that have irrigation	67%	46%	80%	35%	97%	94%
Share of lettuce/ Tomato land Irrigated	63%	37%	49%	16%	72%	84%
Yield (1000's kg per ha)	37.3	33.7	44.0	37.0	32.4	23.8
Share of farms receive credit	78%	49%	83%	71%	83	68
Share of farms receive technical Assistance	48%	42%	81%	62%	71	49
Gross income per ha (thousands dollars)	8.9	6.8	12.5	10.1	7.7	5.2
Total cost (excluding family labor)	5.4	4.8	9.1	6.7	3.1	2.4
[subset of cost: hired labor]	[1.0]	[1.4]	[2.2]	[2.1]	[0.522]	[0.541]
[subset of cost: Chemical and fertilizer costs]	[3.3]	[2.2]	[4.9]	[3.5]	[1.43]	[1.04]
Net income per ha (cost excluding own labor) (thousands dollars)	3.6	2.0	3.4	3.4	4.6	2.8
Cost of own labor per ha (imputed at wage rate) (thousands dollars)	0.4	0.5	0.6	0.6	0.237	0.164
Net income per ha (with cost including own labor) (thousands of dollars	3.4	1.7	2.8	2.8	4.3	2.6

Transmission of Price Signals and the Distribution of Revenues along the Commodity Supply Chains: Review and Applications

David Hallam and George Rapsomanikis[52]

ABSTRACT

The presence of market power in commodity supply chains may result in distortions that affect the impact trade liberalisation would have on economic agents. This paper examines empirical methods for identifying and measuring market power in supply chains, focusing on the relationship between prices in different links of the chain or the marketing margin. Time series analysis on price transmission and models that fall within the New Empirical Industrial Organisation literature are examined. Although price transmission models are popular, they lack economic structure and therefore, delays or asymmetries in the pass-through of price changes along the chain cannot be exclusively attributed to market power. Empirical Industrial Organisation models appear to be better suited to measuring market power. An application to the jute market in Bangladesh suggests that the supply chain is competitive with the deviation between market price and marginal cost being approximately one percent.

JEL Codes: L13, C51, Q11.

Keywords: Value chains, Market Structure, Price transmission, New Empirical Industrial Organization

INTRODUCTION

There is broad agreement in the economics profession that trade liberalization and the subsequent integration of developing and least developed countries into the world trading system are potentially important drivers of economic growth. However, the magnitude of the impact of trade reform on economic agents in these countries, as well as the distribution of benefits to population groups will be determined by the structure and characteristics of commodity supply chains. The presence of market power exerted by successive oligopsonies, or oligopolies will result in the impact of trade reform being different from what would be realized under competitive conditions for both exporting and importing developing countries. More importantly, market power affects the distribution of benefits and costs across economic agents, such as producers, processors and consumers. In this context, analysis of the structure of commodity supply chains and the vertical linkages that characterise them is necessary in order to assess the welfare changes of trade reform. In particular, for developing and least developed countries, it is important to examine commodity supply chains, as the abolition of parastatal monopsonistic purchasing agents that operated in the commodity chains in the 1990's have resulted in marketing systems that are characterised by high concentration and market power, especially in cash crops, where volatile prices in conjunction with the need for liquidity favour large trading enterprises.

Market structure and the nature and intensity of competition are intrinsically related to the concept of the marketing margin. The marketing margin consists of the costs of services such as processing, distribution, marketing and retailing, as well as valuations of risk and expectations of how markets will evolve. In general, marketing margins will tend to vary due to factors such as the changing costs of providing services, the introduction of new technologies and changes in the quantity of the product marketed. In the event that the structure of the supply chain beyond the farm-gate is not perfectly competitive, marketing margins will also reflect market power over the consumer (producer) level

[52] The authors are Chief and Economist in the Trade Policy Service at FAO. We are indebted to Steve McCorriston for his valuable comments.

with oligopoly (oligopsony) price distortions that widen the margin by increasing the consumer (producer) price.

In this paper, we examine the empirical approaches that are utilised in identifying and measuring market power in the context of commodity supply chains, where the focus of analysis is the marketing margin, or the relation of prices at different links of the chain, as well as the wedge between price and marginal cost. The analysis of price transmission along commodity chains and New Empirical Industrial Organisation (NEIO) models consist of such approaches. Price transmission is centred around the concept of cointegration and vector autoregression models (VARs). VARs can be thought of as descriptive, rather than structural econometric models. Cointegrating, or restricted VARs, though, are essentially a description of the conditional density of one price, say the producer price, given another price in the chain, for example, the retail price. Unless proper identifying restrictions are imposed in order to transform the model into a relation that is theoretically and economically meaningful, vector autoregressions are consistent with rational economic agents that make plans based on conditional expectations. In contrast, to price transmission and cointegration studies, structural econometric models that focus on price margins, such as the NEIO models can be thought of as statistical descriptions of the data that encompass the characteristics of the economic structure of the supply chain under consideration. Unlike methods that rely on cointegration, where economic theory may be introduced later in the analysis through identification, NEIO researchers start with economic theory that delivers mathematical statements about the causal relationships between variables which, in turn, are transformed into stochastic econometric models and applied to data.

We review these empirical approaches and discuss their usefulness in measuring market power, but also in terms of assessing welfare changes and of providing building blocks for non-spatial partial equilibrium models that are commonly used for policy simulations and the assessment of reform scenarios. The paper is organised as follows. Section 2 examines price transmission studies and their suitability in measuring market power, providing a critical review of the literature and the models utilised. Section 3 discusses NEIO models, their theoretical foundations and estimation methods and illustrates the critical issues that relate to market power measurement. Section 4 presents an empirical examination of the jute market in Bangladesh utilising empirical industrial organisation methods and section 5 draws some conclusions.

PRICE TRANSMISSION ANALYSIS AND MARKET POWER

Price transmission along supply chains has been the focus of a voluminous body of research in agricultural economics. The role of information that is contained in prices and the consequences of asymmetries in such information are issues that have been extensively researched. Movements in prices along the supply chain drive the allocation of resources as they direct individual economic agents to decide on the quantities of goods they produce, or purchase and the factors of production they employ. In an efficiently functioning supply chain, prices are expected to react quickly to new information and adjust within a short period of time, thus resulting in no excess returns for any economic agent in the chain and in an optimal allocation of resources.

The extent of price adjustment and the dynamics and speed by which price changes are transmitted along the supply chain, from producer to wholesale and to retail market levels, provide important information on the nature and the organization of the supply chain, its structure, as well as the conduct of participants at its various links. Price transmission studies are ostensibly empirical exercises. Although, theoretical models provide insights on the nature of vertical price transmission (McCorrison, 2001, Weldegebriel, 2004), they entail causal relationships that rarely can be identified by examining the data. Meyers and von Cramon Taubadel (2004) and Wohlgenant (2001) provide comprehensive surveys of the price transmission empirical literature, focusing on issues related to the nature of price transmission and the empirical methodologies employed.

In general, price transmission analysis is based on three notions, namely the completeness of transmission, the dynamics and the speed that characterize the adjustment of prices in different links of the chain and the asymmetry of this adjustment. Completeness implies that changes in prices in one

link are fully transmitted to the other at all points of time, whilst speed is related to the process by, and rate at which, changes in prices in one link are filtered to the other link. Asymmetry in price adjustments has been the focus of a number of studies and implies that upward and downward movements in prices in one link are asymmetrically transmitted to the other.

The nature of the transmission of price changes along the supply chain and the related transmission notions lend themselves to a cointegration-error correction model testing framework. Cointegration can be thought of as the empirical counterpart of a long-run relationship between variables, whilst error correction models integrate this relationship with short run dynamics. The relation between prices in different links, *f* and *w*, of the chain is empirically expressed as:

$$p_{f,t} = c + \beta p_{w,t} + u_t \qquad (1)$$

where c and β are parameters to be estimated and u_t is an error term. When logarithmic transformations of prices are used, expression (1), is consistent with a marketing margin that is determined by the mark-down hypothesis, thus consisting of a combination of an absolute amount and a proportion of the farm-gate price. Nevertheless, such a relationship between prices is not always theoretically justified.[53] If economic agents at all links of the supply chain behave in a perfectly competitive manner and follow marginal cost pricing, prices are cointegrated and have a tendency to co-move in the long run according to the linear relationship described by expression (1).[54] In the short run, prices may drift apart, as shocks in one link may not be instantaneously transmitted to other links in the chain. Nevertheless, market forces ensure that these divergences from the underlying long run equilibrium relationship are transitory and not permanent, reflecting stationarity of the error term u_t. Thus, tests for non-cointegration, as well as the estimation of the related error correction models shed light on a number of issues related to the notions of price transmission.

Cointegrated prices contain stochastic trends that are proportional in the long-run, with the cointegrating parameter measuring their long run relationship that is determined by this proportionality. This parameter has sometimes been interpreted as the 'elasticity of price transmission', especially when price series are converted into logarithms. Inferences on the completeness of transmission are often based on the parameter's proximity to unity. However, this cointegrating parameter does not identify the elasticity of price transmission and, therefore, the completeness of transmission, particularly well. Cointegration is predominantly a statistical concept and thus *a*theoretical, so the cointegrating parameter may not have any economic interpretation, unlike a parameter of a structural model. For example, McCorriston *et al.* (2001) on the basis of a theoretical oligopoly model suggests that the price transmission elasticity is a function of several parameters including the elasticity of mark-up, reflecting market power, the basic product and marketing output elasticities, reflecting returns to scale and the elasticity of substitution between the basic product and marketing inputs. However the relation implied by expression (1) lacks such formal economic structure and consequently identifying power, as it entails a parametric nonseparability problem where statements about a parameter are not empirically meaningful without providing information about other parameters. The identification of causal relationships within a cointegration-error correction model is attained by using economic theory to provide restrictions that allow the cointegrating relations to be interpreted as economic relationships (Johansen and Juselius, 1994; Pesaran and Shin, 1998). However, without additional data, the underlying economic relationship between prices cannot be identified. In the context of a cointegrating relation between farm-gate and retail prices, the common stochastic trend will result in the cointegrating parameter being equal to one, thus mirroring a proportionality of unity and implying that price transmission is complete. Nevertheless, failure to reject the null of non-cointegration implies that the two prices drift apart in the long run, as they are driven by stochastic trends that are not proportional. In this case, some changes in one price, say producer price, may, up to a certain extent, be transmitted to the retail level. However, other factors,

[53] For more details, see Wohlgenant (2001).

[54] A detailed description of the concept of cointegration is beyond the scope of this paper. Madalla and Kim (1998) provide comprehensive treatment.

such as policies, deviations from marginal cost pricing, or non stationary marketing and retailing costs determine the movements of the retail price, thus resulting in absence of co-movement.

Short run adjustments between cointegrated prices are described by the Vector Error Correction Model (VECM) according to the Granger Representation Theorem (Engle and Granger, 1987). For prices in different links of the supply chain, the VECM is as follows:

$$\begin{pmatrix}\Delta p_{f,t}\\ \Delta p_{w,t}\end{pmatrix}=\begin{pmatrix}\mu_1\\ \mu_2\end{pmatrix}+\begin{pmatrix}\alpha_f\\ \alpha_w\end{pmatrix}(p_{f,t-1}-\beta p_{w,t-1})+\sum_{i=1}^{k}\Gamma_k\begin{pmatrix}\Delta p_{f,t-k}\\ \Delta p_{w,t-k}\end{pmatrix}+\begin{pmatrix}v_{f,t}\\ v_{w,t}\end{pmatrix} \quad (2)$$

where $v_{f,t}$ and $v_{w,t}$ are *iid* disturbances with zero mean and constant finite variance, whilst the operator Δ denotes that the variables have been differenced in order to achieve stationarity. Parameters contained in the 2×2 matrices Γ_k measure the short run effects, whilst the levels of the variables enter the VECM combined as the single entity which reflects the errors, or any divergence from the long run relationship and correspond to the lagged error term of equation (1). The vector $(\alpha_f, \alpha_w)'$ contains parameters, commonly called adjustment coefficients that measure the extent of corrections of the errors that the market initiates by adjusting $p_{f,t}$ and $p_{w,t}$ towards restoring the long run relationship. The speed with which the market returns to its equilibrium depends on the proximity of α_i to one. Within this context, short run adjustments are directed by, and consistent with, the long run relationship, allowing the researcher to assess the speed of adjustment that shapes the relationship between the two prices. Slow adjustment may occur as a consequence of many factors such as storage and inventory holding, delays caused in transportation or processing due to a large number of vertical stages in the supply chain, 'price-leveling' practices, when retailers, or wholesalers, absorb some of the upstream change in the short run in order to minimise re-pricing costs and consumer disruption, the nature of price reporting and collection methods, as well as agricultural policies (Gardner, 1975; Kinnucan and Forker, 1987).

VECMs have also been used in order to detect price leadership in the supply chain on the basis of Granger causality, an important implication of cointegration and the error correction representation. Cointegration between two variables implies the existence of causality, in the Granger sense, between them in at least one direction (Granger, 1988). The presence and direction of Granger causality in the long run can be assessed by testing the null that the adjustment coefficients α_f and α_w in the VECM presented by (2) are equal to zero, a test that also reveals weak exogeneity in the econometric sense. In more detail, under $\alpha_f = 0$, $\alpha_w \neq 0$, $p_{w,t}$ Granger-causes $p_{f,t}$ in the long run, under $\alpha_w = 0$, $\alpha_f \neq 0$, $p_{f,t}$ Granger-causes $p_{w,t}$ in the long run, whilst under $\alpha_1 \neq 0$, $\alpha_2 \neq 0$, both series Granger-cause each other in the long run. Kuiper *et al.* (2003) derive a theoretical framework for vertical price leadership in different maize markets in Benin, in which price leadership depends on several factors including exogenous shifts and parameters of the inverse derived demand. Imposing and testing restrictions on these parameters lead to inference on price leadership. Empirical application is based on tests for non-cointegration between prices at different links of the supply chain, estimation of VECMs and tests for long run Granger causality. Such an approach is again subject to weaknesses related to the lack of identification of the causal relationships. The empirical model is loosely related to the theoretical framework, whilst the tests for Granger causality shed light on price discovery, rather than price leadership. Inference on the latter requires a structure richer than that implied by price transmission VECMs. Moreover, it is important to note that the definition of Granger causality has caused considerable controversy in the literature (see for example Pagan, 1989) as it really indicates precedence, rather than the instantaneous causality that most economists profess.

In addition to the above reasons for deviations from rapid transmission of price shocks along the supply chain, in the short run prices may also respond in an asymmetric manner. In this context, asymmetry occurs when the response of a price at one level of the supply chain, depends on whether the change in prices at other levels of the chain is positive, or negative. The error correction representation also provides a framework for testing for asymmetric and non linear adjustment to a long run equilibrium. Granger and Lee (1989) proposed an asymmetric ECM (AECM) where the speed of the adjustment of the endogenous variable depends on whether the deviation from the long run equilibrium is positive, or negative. The asymmetric ECM is specified as follows:

$$\Delta p_{f,t} = \mu_1 + \alpha^{+}{}_{f}(p_{f,t-1} - \beta p_{w,t-1})^{+} + \alpha^{-}{}_{f}(p_{f,t-1} - \beta p_{w,t-1})^{-} + \sum_{i=1}^{k} \Gamma_{f,i} \begin{pmatrix} \Delta p_{f,t-i} \\ \Delta p_{w,t-i} \end{pmatrix} + v_{f,t} \quad (3)$$

The errors, or divergences from this equilibrium are decomposed in two parts, $(p_{f,t-1} - \beta p_{w,t-1})^{+}$ and $(p_{f,t-1} - \beta p_{w,t-1})^{-}$ reflecting positive and negative disequilibria respectively. Within this context, asymmetry occurs in the event when positive and negative divergences from the long run relationship between $p_{f,t}$ and $p_{w,t}$ result in changes in $p_{f,t}$ that have different magnitude. The null of symmetry against the alternative hypothesis that adjustment is asymmetric is tested by imposing the equality restriction $\alpha^{+}{}_{f} = \alpha^{-}{}_{f}$. AECMs have been extensively applied in price transmission studies both vertical and spatial. However, researchers have been unable to detect formally the causes of asymmetric price adjustment. Nevertheless, there is a degree of consistency in that the majority of authors believe that asymmetric price responses may occur due to imperfectly competitive markets (for example, Kinnucan and Forker, 1987; Powers, 1995; Ward, 1982; Pick *et al.*, 1990). Industry concentration and imperfectly competitive behaviour beyond the farm-gate implies that wholesalers, processors or retailers with power over price, may exercise pricing strategies that result in a complete and immediate transmission of increases in the producer price to prices upstream, as their margins are 'squeezed', but slow and incomplete pass-through of decreases in the producer price, as their margins are stretched.

However, in the short run, asymmetric price transmission may also occur for reasons other than market power. Producer prices may respond asymmetrically to changes in wholesale, or retail prices due to different adjustment costs faced by processors depending on whether prices are rising, or falling. For example, competition between processors with high fixed costs and excess capacity may result in producer prices that increase rapidly when demand for the processed product is high, but decrease at a slower rate when demand is low (Bailey and Brorsen, 1989). Retail prices may respond asymmetrically to changes in wholesale or producer prices due to the perishable nature of the product, such as milk or fresh fruit. For example, retailers may resist increasing retail prices following an increase in producer or wholesale prices, as rising prices may reduce retail sales and increase the incidence of spoilage (Ward, 1982; Pick *et al*., 1990). Retail prices may respond asymmetrically to changes in producer prices in the presence of intervention mechanisms and supply controls. Processors and retailers when observing a decrease in the producer price may not adjust retail prices rapidly, as they expect that decreases in producer prices may be temporary due to market support. However, processors and retailers will adjust retail prices rapidly in response to increases in producer prices.

It is important to note that although a number of researchers concur that asymmetric price response is due to market imperfections, concentration and oligopolistic, or oligopsonistic pricing behaviour, the theoretical underpinnings of this hypothesis (see for example Wohlgenant, 1999), as well as the related empirical evidence are inconclusive. For example, Griffith and Piggot (1994) detected asymmetries in the Australian lamb and beef markets, but not in the pork market in spite of the fact that the Australian pork market is more concentrated than the other meat markets. Peltzman (2000) conducted a wide-ranging price transmission analysis utilizing a large data set consisting of prices from over two hundred product markets. His empirical evidence indicates that asymmetric adjustment is prevalent

with retail prices rising faster, as compared to falling, whilst this asymmetry is not related to inventory costs, menu costs and imperfect competition. Such findings not only suggest that asymmetry is the rule rather than the exception in market price adjustment but raise a number of questions related to the suitability of empirical price-based tests and the conventional theory of prices.

Asymmetric price adjustment implies a temporary pecuniary transfer from agents in one link of the chain to agents in another. This may have important implications on the distribution of welfare along the chain in the event of trade policy reform. Such welfare changes are difficult to estimate as they depend on the time interval necessary for the adjustment to the long run equilibrium relationship, the magnitude of the price change and the transaction volumes involved. In general, price transmission studies assist in the assessment of the functioning of the supply chain, however, in spite of their popularity, such studies do not provide any information on the reasons why supply chains are characterized by slow of asymmetric price adjustment.

NEW EMPIRICAL INDUSTRIAL ORGANIZATION

Early empirical studies focusing on industrial organization and market power were shaped around the structure-conduct-performance paradigm that purports that oligopolistic structure results in a positive relationship between industry profits and concentration. Nevertheless, empirical applications of the paradigm are problematic, as both profits and concentration, often represented by the Lerner and Herfindahl indices respectively, are determined endogenously in the model (Clarke and Davies, 1982). NEIO studies emerged as an alternative method of measuring market power being also based on the general idea that attention should be paid to the underlying economic structure, thus linking economic theory to statistics. This strain of empirical research on market structure centres around the work of Appelbaum (1979, 1982), Breshanan (1982) and Lau (1982) who developed methodologies for identifying the extent of competitiveness in an oligopolistic supply chain based on data on quantities and prices, that are readily observed by the researcher, and imposing specific functional forms on supply and demand. In an oligopoly (oligopsony), supply (demand) reflects aggregations over firm-specific supply (demand) functions that are derived from first-order conditions for profit maximization in which firms mark price up (down) marginal cost.[55]

In the case of oligopsony, for illustrative purposes, assume $i=1,...,n$ firms purchasing quantities q_i of a particular primary commodity with a well-behaved cost function $c_i=c(q_i,m_i)$, where m reflects marketing inputs. Profits are given by the following expression:

$$\pi_i = P_w q_i - P_f q_i - c\left(q_i, m_i\right) \qquad (4)$$

where P_f and P_w are the input and output prices for primary and handled, or processed commodity respectively.[56] Maximisation of (4) with respect to q_i yields the following:

$$\frac{d\pi_i}{dq_i} = P_w - P_f - \frac{\partial P_f}{\partial Q}\frac{\partial Q}{\partial q_i}q_i - \frac{\partial c\left(q_i, m_i\right)}{\partial q_i} = 0 \qquad (5)$$

with Q denoting aggregate supply and $Q = h\left(P_f, X\right)$, where X denotes exogenous shifters. Assuming that a unique inverse function $P_f = h^{-1}\left(Q, X\right)$ exists, relation (5) becomes:

$$P_w - \frac{\partial c\left(q_i, m_i\right)}{\partial q_i} = P_f + \frac{\partial h^{-1}\left(Q, X\right)}{\partial Q}\vartheta q_i \qquad (6)$$

$$\vartheta = \frac{\partial Q}{\partial q_i}$$

[55] Bresnahan (1989) and Kadiyali (2001) provide comprehensive surveys of the NEIO literature.

[56] In this section we denote prices with capital characters. Small case characters are reserved for individual firms, whilst capital characters refer to aggregate quantities and market variables.

where is a conjectural variation parameter reflecting the firm's conjectures on industry's

purchases should the firm increase its purchases by one unit. Expression (6) provides the typical single firm's first order conditions. The left hand side can be interpreted as the value of marginal product, consisting of the output price Pw net of marketing costs. The right hand side reflects marginal expenditure and consists of two terms of which the first is the input price and the second is a mark-down term, with $\frac{\partial h^{-1}(Q,X)}{\partial Q}$ being the inverse of the elasticity of supply of primary commodity and ϑ providing an indication of the firm's conjectures about competitiveness in the supply chain, or the market power firm i is able to exert on primary commodity producers. The values the conduct parameter ϑ takes warrants some further discussion. Economic theory suggests that perfect competition in the supply chain, is ascertained when ϑ is equal to zero, with the input

price being equal to marginal expenditure. Cournot-Nash oligopsonistic equilibrium gives rise to a value equal to unity whilst in the case of monopsony, or perfect collusion ϑ is equal to the number of firms n minus one (Corts, 1999; Reiss and Wolak, 2006; Lavoie, 2005). The estimation of price-cost margins, in terms of the 'conduct' parameter ϑ requires specific assumptions to be made concerning the parametric functional forms of supply and demand. It is evident from expression (6) that one cannot separate the estimation of marginal expenditure from the estimation of the parameter ϑ and, therefore, such assumptions will influence the values ϑ will take. Consider a parameterisation of the supply and the aggregate demand for the commodity.

$$\text{Demand: } P_f = c_0 + c_1 Q + c_2 Z \quad (8)$$

$$\text{Supply: } Q = a_0 + a_1 P_f + a_2 X \quad (9)$$

Given that the condition holds for the whole industry through aggregation across firms, expression (6) can be written as follows:[57]

$$P_w - \frac{\partial C(Q,M)}{\partial Q} = P_f + \left(\frac{1}{a_1}\theta Q\right), \qquad (10)$$

Using (10), the supply and demand functions for the primary commodity become:

$$Q = a_0 + a_1 P_f + a_2 X \quad (11)$$

$$P_f = c_0 + \left(c_1 - \frac{1}{a_1}\theta\right) Q + c_2 Z \quad (12)$$

Estimates of θ can be obtained by estimation of (11) and (12). However, it is evident that parameter θ cannot be identified, or separated from the parameter c_1, unless it is assumed that c_1 is equal to zero, or that marginal expenditure is constant, an assumption that cannot be made when firms have power over the input price. Identification of θ can be achieved, following a procedure by Bresnahan (1982) in which the slope of the supply function is allowed to vary over time in an observable manner. This can be attained by introducing a variable, say technical change, interactively with the input price, implying that the elasticity of supply depends on this variable:

$$Q = a_0 + a_1 P_f + a_2 X + a_3 P_f T \quad (13)$$

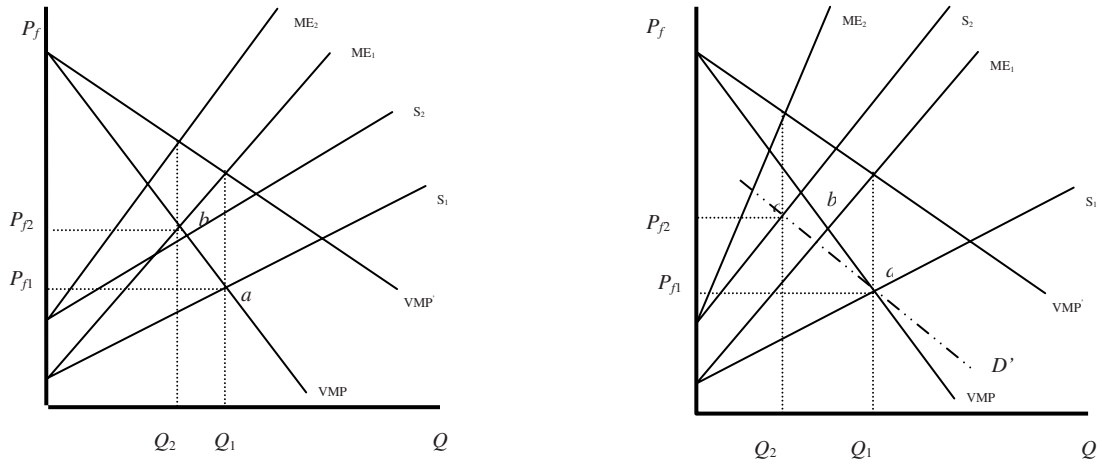
[57] Aggregation across firms implies a number of assumptions that are discussed below.

$$P_f = c_0 + \left(c_1 - \frac{1}{a_1 + a_3 T}\theta \right) Q + c_2 Z \qquad (14)$$

The identification of θ by introducing the interactive term $P_f T$ implies a rotation of the supply curve, as well as a shift. Figure 1 depicts the identification case. In the right panel, a perfectly competitive market equilibrium is attained at point *a* where the value marginal product VMP equals marginal expenditure. The equilibrium corresponds to quantity Q_1 and price P_{f1}. This equilibrium quantity and price are also consistent with an oligopsonistic structure depicted by a value marginal product schedule VMP' and marginal expenditure ME_1. A shift in the supply curve from S_1 to S_2, and in the corresponding marginal expenditure schedule in case of an oligopsonistic structure, moves the equilibrium at point *b* with new equilibrium quantity and price Q_2 and price P_{f2} respectively, which, once more, are consistent with both perfect competition and an oligopsonistic structure. The left panel illustrates that market power can be identified by rotating the supply curve.

Suppose that a change in an exogenous factor causes the supply curve to shift and rotate from S_1 to S_2. The perfectly competitive equilibrium moves from point *a* to point *b*. The shift and the rotation of the marginal expenditure schedule from ME_1 to ME_2 moves the oligopsonistic equilibrium moves to point *c* with equilibrium quantity Q_2 and price P_{f2}, that are consistent only with the oligopolistic structure. In this case, the shift and rotation of the supply curve identify the demand schedule *D'* and the conduct parameter respectively.

Figure 1 Oligopsony power



not identified **identified**

NEIO methodologies have been widely applied to agricultural and food economics. Just and Chern (1980) identified the oligopsony power of tomato processors in the US utilising technical change reflected by the introduction of the mechanical tomato harvester to rotate the supply curve. Schroeter (1988) extended the oligopolistic model by Bresnahan (1982) to include both oligopolistic and oligopsonistic distortions and applied it to the US beef packing industry. Azzam and Pagoulatos (1990) derived a more general model allowing for conduct to differ between the output and the factor markets. Chen and Lent (1992) investigated the comparative statics of the model under oligopsony. Steen and Salvanes (1999) proposed a dynamic reformulation of the model and applied it to the French Salmon market. Richards, Patterson and Acharya (2001) extended the model to encompass collusive oligopoly in a repeated game and applied it to the Washington potato industry.

In spite of the popularity of the NIEO methodology in the assessment of market power, there are a number of important drawbacks relating to the interpretation of the conduct parameter θ. Firstly, empirical models such as that reflected by equations (13) and (14) treat the conduct parameter as taking a continuous value that has to be estimated. Nevertheless, economic theory provides information for specific values for θ that are consistent with static behavioural models, such as perfect competition, Cournot structure and others. Therefore, perfect adherence of the data to the predictions of the theory is not attainable. Rather, results have to be interpreted with caution, where the value of θ indicates departures from a perfectly competitive equilibrium and provides a descriptive measure of the deviation of the price from marginal cost. Secondly, the lack of firm-specific data renders the maximisation of the first-order condition necessary in order to apply the model on industry-level data. Such an aggregation implies a number of assumptions such as that all firms have an identical conduct parameter $\vartheta_i = \theta$ and the same marginal costs. In addition, when time series data are used, aggregation across firms implies that the number of firms is constant during the period spanned by the data.[58] Moreover, Corts (1999) argues, on the basis of analytical, as well as simulation results that conduct parameter estimates measure the marginal and not the average market power in an industry. His simulations suggest that $\theta = 1$ is consistent not only with the Cournot oligopoly equilibrium, but with a number of collusive equilibria, depending on the statistical properties of the data. Thus θ may fail to measure market power precisely, as different oligopoly, or oligopsony models that yield the same degree of market power on average, may generate behaviour that, at the margin, varies with the exogenous shifter in different ways. Nevertheless, assessment of conduct parameter estimation methods, utilising direct measures of marginal costs (Genesove and Mullin, 1998; Clay and Troesken, 2003) suggest that the difference between the estimates is not large, whilst the method performs well for low levels of market power.

OLIGOPSONY POWER IN THE JUTE MARKET IN BANGLADESH

The NEIO conduct parameter model is illustrated analysing the jute market in Bangladesh. Jute is a soft fibre cultivated as a cash crop exclusively in developing countries of East Asia and in some parts of Latin America. Bangladesh, India and Thailand account for over 90 percent of world production. The fibre is processed principally in the producing countries and used for the manufacturing of traditional products such as hessian cloth, food grade bags, carpet backing and other floor covering. Diversified jute products, such as geo-textiles and composites, are also manufactured in relatively small quantities. In spite of its relative unimportance in terms of value of world trade, the cultivation and processing of jute is labour intensive and therefore, provides a livelihood and an important source of income for about three million households in Bangladesh.

Prices offered to producers, at the time of harvest, should reflect expectations formed by traders and processors on the profitability of jute manufacturing. High storage costs and the inability of the smallholders to store the fibre in-house result in relatively low prices during harvest. The producers' eagerness to receive cash soon after the harvest, in conjunction with the reluctance of the primary traders to provide storage for jute for long periods as the rice crop that follows requires storage space exacerbate the trough in prices and enhances the possibility that large traders, or processors may have power over the price. Indeed, Burger and Oostendorp (1996) argue that raw jute prices may have no bearing on pricing in down-stream links of the supply chain. The characteristics of the supply chain suggest that buyer power may exist.[59] First, jute fibre is bulky and subject to high transport costs, restricting the mobility of traders and limiting producers' access to local traders only. Secondly, processors needs are specific, as the possibility of substitution with other inputs is limited. Thirdly,

[58] See Reiss and Wolak (2006), Lavoie (2005) and Muth and Wohlgenant (1999) for the derivation and interpretation of the industry-level aggregate conduct parameters.

[59] Rogers and Sexton (1994) identify a number of structural features that may give rise to oligopsony.

raw fibre supply is relatively inelastic, as jute is cultivated in some form of crop rotation with rice. There are no available data on the number of traders and processors and their capacity. However, articles in the national press frequently suggest that price increases are not passed through to producers. More importantly, Hossain *et al.* (2004), in an analysis of several supply chains in Bangladesh indicate that jute producers receive some 54 percent of the consumer price, as compared to 71 and 66 percent for rice and wheat respectively. In addition, the share of the marketing margin that accrues to intermediaries in the jute supply chain was found to be the highest, as compared to that of rice and wheat.

In order to formally assess the presence of oligopsony power in the jute supply chain we estimate equations (13) and (14) using annual data for the period 1970-2004. We utilize technical change, proxied by the yield per hectare, to rotate the supply curve and identify market power. Over the period under examination jute yields showed a strong upward trend, as a result of new varieties introduced. Augmented Dickey Fuller tests including a linear time trend also suggested that the yield per hectare is stationary around a deterministic trend, rather than containing a unit root and, therefore, the variable can be thought of as providing exogenous shifts to supply.[60]

The supply of jute is estimated as in equation (13):

$$Q_t = a_0 + a_1 P_{f,t} + a_2 P_{r,t} + a_3 P_{f,t} Y_t + \varepsilon_t , \quad (14)$$

where $P_{f,t}$, $P_{r,t}$and Y_t denote the price of jute fibre, the price of rice and the yield per hectare respectively and ε_t is a random error term. The inverse derived demand for jute is specified as follows:

$$P_{f,t} = c_0 + c_1 Q_t + \theta Q_t^* + c_2 P_{p,t} + \eta_t , \qquad (15)$$

where $Q_t^* = Q_t / (a_1 + a_3 Y_t)$, $P_{p,t}$ is the price of synthetic fibres and η_t is a random error term. The conduct parameter θ is identified by the estimated coefficient of the transformed variable Q_t^*. The equations were estimated by OLS and the results are presented in Table 1.

Table 1 Estimates of Supply and Demand Functions

Supply		**Demand**	
α_0	7.2516	c_0	8.0163
	0.5563		*3.1725*
α_1	0.3665	c_1	-0.8359
	0.1382		*0.3983*
α_3	-0.4260	θ	0.0047
	0.1482		*0.0021*
		c_2	0.5466
			0.1983
R^2	0.44	**R^2**	0.72
Durbin Watson	1.96	**Durbin Watson**	2.24
Log Likelihood	28.38	**Log Likelihood**	15.54
F-stat (prob)	0.023	**F-stat (prob)**	0.000

Note: Standard errors in italics

[60] The value of the Augmented Dickey Fuller (ADF) with a linear trend statistic was 7.72 with a critical value at 1 percent level of significance of 4.26, rejecting thus the null of the unit root.

Standard errors indicate that all parameters are statistically significant, at least at the five percent level, whilst the diagnostic tests suggest that the estimated equations are relevant to the observed data. In general, the results are plausible and consistent with theory and *a priori* expectations. The conduct parameter θ is estimated at 0.006, suggesting that the wedge between price and marginal cost, in proportional terms, is very small. This result provides evidence against the presence of oligopsony power in the jute supply chain. It appears that in spite of the structural characteristics of the jute market and the relatively high marketing margins, conduct in the jute supply chain is close to perfect competition.

CONCLUSIONS

This paper discussed empirical methods for detecting and measuring market power in commodity supply chains. Two main strains, that are prevalent in the literature, were examined namely, studies on price transmission that rely on the cointegration-error correction framework and NEIO models. We argued that, although price transmission studies provide information on the functioning of the supply chain in general, inferences on the presence of market power require richer theoretical structure than that provided by cointegrated prices. In other words, the hypotheses that are testable within a cointegration-error correction model are only casually related to hypotheses on market power.

Structural econometric models that focus on price margins, such as the NEIO models are based on economic theory. Nevertheless, the interpretation of the conduct parameter is difficult, as the theory provides information only for specific values of θ. However, there is a wide agreement in the literature that the conduct parameter should be viewed as reflecting departures from a perfectly competitive equilibrium and thus providing a descriptive measure of the deviation of the price from marginal cost.

Although economic theory guides practitioners to specify appropriate models, it is not always possible to translate complicated causal relationships into estimable structural models. The lack of relevant data also enhances this difficulty. NEIO models, though appear to be better suited to estimate welfare effects of trade reform in the presence of oligopolistic, or oligopsonistic distortions. Nevertheless, it is important to note that market power in developing countries is often exercised in small regions and therefore, is localised rather than being exerted nationwide.

REFERENCES

Appelbaum, E. 1982. The Estimation of the Degree of Oligopoly power. *Journal of Econometrics* 19:287-299.

Azzam, A. & Pagoulatos, E. 1990. Testing Oligopolistic andOligopsonisticBehavior: An Application to the US Meat-Packing Industry. *Journal of Agricultural Economics* 41(3):362-370.

Bailey, D. V. & Brorsen, B.W. 1989. Price Asymmerty in Spatial Fed Cattle Markets. *Western Journal of Agricultural Economics* 14:246-252.

Bresnahan, T.F. 1982. The Oligopoly Solution Concept is Identified. *Economic Letters* 10:87-92.

Bresnahan, T.F. 1989. Empirical Studies of Industries with Market Power. *In* R.L. Schmalensee and R.D. Willig, eds., *Handbook of Industrial Organization*, Vol. 2. Amsterdam: Elsevier Science.

Burger, K. & Oostendorp, R. 1996. *A Model for Jute and Jute Products*. Mimeo, Free University of Amsterdam.

Chen, Z. & Lent, **R.** 1992. Supply Analysis in an Oligopsony Model. *American Journal of Agricultural Economics* 74(4):973-979

Clarke, R. & Davies, S. 1982. Market Structure and Price-Cost Margins. *Economica* 49:277-287.

Clay, K.B. & Troesken, W. 2003. Further Tests of Static Oligopoly Models: Whiskey, 1882-1898. *Journal of Industrial Economics* 51:151-166.

Corts, K. 1999. Conduct Parameters and the Measurement of Market Power. *Journal of Econometrics*, 88:227-225.

Engle, R.F. & J. Granger. 1987. Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica* 55:251-276.

Gardner, B.L. 1975. The Farm-Retail Price Spread in a Competitive Food Industry. *American Journal of Agricultural Economics* 59:399-409.

Genesove, D. & Mulli, W.P.1998. Testing Static Oligopoly Models: Conduct and Cost in the Sugar Industry, 1890-1914. *Rand Journal of Economics* 29:355-377.

Granger, C.W.J. & Lee, T.-H. 1989. Investigation of Production, Sales and Inventory Relationships using Multicointegration and Non-Symmetric Error Correction Models. *Journal of Applied Econometrics*, 4:145-159.

Griffith, G. & Piggot, N. 1994. Assymetry in the Beef, Lamb and Pork Farm-Retail Transmission in Australia. *Agricultural Economics* 10:107-316.

Hossain, M.I., Nuda, M.N., Begum, E.A., Khan, A.K. & Rabbani, G. 2004. *Journal of Applied Sciences* 4:513:520.

Johansen, S. & Juselius, K. 1994. Identification of the Long-Run and the Short-Run Structure: An Application to the ISLM Model. *Journal of Econometrics* 63(1):7-36.

Just, R.E. & Chern, W.S. 1980. Tomatoes, Technology, and Oligopsony. *Bell Journal of Economics* 11(2):584-602

Kadiyali, V., Sudhir, K. & Rao, V. R. 2001. Structural Analysis of Competitive Behavior: New Empirical Industrial Organization Methods in Marketing. *International Journal of Research in Marketing* 18:161-186.

Kinnucan, H.W. & Forker, O.D. 1987. Asymmetry in Farm-Retail Price Transmission for Major Dairy Products. *American Journal of Agricultural Economics* 69:285-292.

Kuiper, W.E., Lutz, C. & van Tilburg, A. 2003. Vertical Price Leadership on Local Maize Markets in Benin. *Journal of Development Economics* 71:417-433.

Lau, L.J. 1982. On Identifying the Degree of Competitiveness from Industry Price and Output Data. *Economic Letters* 10:93-99.

Lavoie, N. 2005. Price Behaviour in a Dynamic Oligopsony: Washington Processing Potatoes – A Comment. *American Journal of Agricultural Economics* 87(3):796-801.

Meyers, J. & von Cramon-Taubadel, S. 2004. Asymmetric price Transmission: A Survey. *Journal of Agricultural Economics* 55(3):581-611.

McCorriston, S., Morgan, C.W. & Rayner, A.J.. 2001. Price Transmission: The Interaction between Market Power and Returns to Scale. *European Review of Agricultural Economics* 28(2):143-159.

Muth, M.K. & Wohlgenant, M.K. 1999. A Test for Market Power using Marginal Input and Output Prices with Application to the US Beef Processing Industry. *American Journal of Agricultural Economics* 81(3):638-643.

Pagan, A. 1989. 20 Years After: Econometrics, 1966-1986 *In* B. Cornet and H Tulkens (eds.) *Contributions to OperationsResearch and Econometrics*. Cambridge, MA.: The MIT Press.

Pick, D.H., Karrenbrock, J. & Carman, H.F. 1990. Price Asymmetry and Marketing Margin Behaviour: An Example for California-Arizona Citrus. *Agribusiness*, 6:75-84.

Peltzman, S. 2000. Prices Rise Faster than They Fall. *Journal of Political Economy* 108(3):466-502.

Pesaran, M.H. & Smith, R.P. 1998. Structural Analysis of Cointegrating VARs. *Journal of Economic Surveys* 12:471-506.

Powers, N.J. 1995. Sticky Short Run Prices and Vertical Pricing: Evidence from the Market for Iceberg Lettuce. *Agribusiness*, 11:57-75.

Reiss, P.C. & Wolak, F.A. 2003. Structural Econometric Modelling: Rationales and Examples from Industrial Organisation. Research paper No. 1831, Graduate School of Business, University of Stanford.

Richards, T.J., Patterson, P.M. & Acharya, R.N. 2001. Price Behaviour in a Dynamic Oligopsony: Washington Processing Potatoes. *American Journal of Agricultural Economics* 83:259-271.

Rogers, R.T. & Sexton, R.J. 1994. Assessing the Importance of Oligopsony Power in Agricultural Markets. *American Journal of Agricultural Economics* 76:1143-1150

Schroeter, J.R. 1988. Estimating the Degree of Market Power in the Beef Packing Industry. *Review of Economics and Statistics* 70:158-162.

Steen, F. & Salvanes, K. 1999. Testing for Market Power using a Dynamic Oligopoly Model. *International Journal of Industrial Organization* 17(2):147-177.

Ward, R.W. 1982. Asymmetry in Retail, Wholesale and Shipping Point Prices for Fresh Fruits and Vegetables. *American Journal of Agricultural Economics* 62:205-212.

Weldegebriel, H.T. 2004. Imperfect Price Transmission: Is Market Power Really to Blame? *Journal of Agricultural Economics* 55(1):101:114.

Wohlgenant, M.K. 1999. Product Heterogeneity and the Relationship between Retail and Farm Prices. *European Review of Agricultural Economics* 26:219-227.

Wohlgenant, M.K. 2001. Marketing Margins: Empirical Analysis. *In* Gardner, B.L, and G.C. Rausser (eds) *Handbook of Agricultural Economics*, Volume 1B, Amsterdam: North Holland.

Estimating the Pass-Through of Agricultural Policy Reforms: an Application to Brazilian Commodity Markets

Jonathan Brook[61]*, Olga Melyukhina*[62]*, Alastair Bailey*[63] *and Kelvin Balcombe*[64]*,* [65]

INTRODUCTION

This paper considers the implications of transport and other transfer costs for the estimation of price transmission. The starting premise is that when the price difference between two markets is less than transfer costs (in the broadest sense), there is no incentive for arbitrage between those markets and price transmission should be zero.

The empirical application considers the transmission of world to domestic prices for a range of Brazilian commodities. However, the methods discussed are relevant for both cross-border and internal price transmission, and can be used to estimate the effects of exogenous price changes, policy reforms and reduced transfer costs.

The structure of the paper is as follows: in Section 2 we introduce the logic of price transmission and identify the principle attributes that need to be accommodated in empirical applications. In section 3, we provide a brief review of attempts to provide a suitable estimation procedure, focusing on the use of threshold models. In Section 4 we consider the empirical evidence for several Brazilian commodity markets, while in Section 5 we conclude with some practical suggestions for how the estimation of price transmission can be improved.

PRICE TRANSMISSION IN THE PRESENCE OF TRANSFER COSTS

In order to model price transmission in the presence of transfer costs appropriately, it is helpful to trace through the basic principle of arbitrage. Suppose that a given commodity sells for a price of P_w on world markets, or (more precisely) that this is the traded price facing the country for which we wish to estimate the degree of price transmission.

Take the case where this commodity is a net import first. Suppose that imports face an *ad valorem* tariff of t, as well as transfer costs T_m that may be attributable to both policy factors (including non-tariff barriers of various kinds) and non-policy factors (transport costs, handling charges, and information costs).[66] Then, for homogeneous products in perfect competition, there is an incentive for imports if the following arbitrage condition is met:

$$R_m = P_d - (1 + t)P_w - T_m \geq 0 \quad (1)$$

where Pd is the domestic price of the comparable product and Rm is the associated rent per unit from arbitrage. In the case of an exported product receiving an export subsidy e, with transfer costs of Tx, the equivalent condition for export arbitrage is given by:

$$Rx = Pd(1- e) + Tx - Pw \leq 0 \quad (2)$$

---

[61] OECD and FAO
[62] OECD
[63] Imperial College
[64] University of Reading
[65] The views expressed in this paper are those of the authors and are not necessarily shared by the OECD or its member countries. The authors are grateful to Joe Dewbre, Andrzej Kwiecinski, George Rapsomanikis and Wyatt Thompson for suggestions on an earlier draft, and to Jamie Morrison and other participants at the FAO workshop for their comments. The authors nevertheless remain responsible for the paper errors and shortcomings.
[66] The assumption of constant transactions costs will be restrictive in cases where costs are either increasing or decreasing over time (the latter being the case in Brazil as the country's infrastructure improves).

Another way of restating the arbitrage condition is to note that there is no incentive for arbitrage when world prices fall within the following range, and that within these bounds we would expect price transmission onto domestic markets to be zero:

$$\frac{1}{1+t}\,[\text{Pd} - \text{Tm}] < \text{Pw} < \text{Pd}(1-\text{e}) + \text{Tx} \quad (3)$$

Barrett and Li (2002) make a logical distinction between market integration (where there is an incentive for arbitrage and arbitrage occurs) and competitive equilibrium (where any potential gains from arbitrage are fully exploited). This distinction enables them to categorise four states:

- perfect integration, where there are no rents left to be dissipated (i.e. equations 1 and 2 hold with equality) and arbitraging trade may or may not occur.
- segmented equilibrium, where there is no incentive for arbitrage (i.e. the signs in 1 and 2 are reversed) and so no trade occurs
- imperfect integration, where arbitrage rents exist (i.e. 1 and 2 hold with inequality) and arbitraging trade occurs.
- segmented disequilibrium, where the incentive for arbitrage exists but is not exploited.

In this context, how do we estimate price transmission? A convenient assumption is to rule out case iv, i.e. to assume that trade always occurs if there is sufficient incentive. This is perfectly reasonable, since an absence of arbitrage can always be interpreted as unobserved costs. Now take the case of a product that is periodically imported, and for which the world price falls from P_w^0 to P_w^1 (analogous reasoning follows in the case of a tariff change holding world prices constant, and similar argumentation applies in the case of exports).

Define the following initial rent to import arbitrage:

$$R_0 = P_d^0 - (1+t)P_w^0 - T_m \quad (4)$$

Then we will have the following arbitrage conditions: $M > 0$ when $R \geq 0$ and $M = 0$ when $R < 0$. Note that we can also effectively rule out Barrett and Li's case i by assuming that $M > 0$ when $R = 0$.

Take the equilibrium case where we already have arbitrage and that all rents are dissipated, so that $R_0 = 0$. Then a fall in the world price to P_w^1 creates the following arbitrage rent R_0' at the existing domestic price.P_d^0:

$$R_0' = P_d^0 - (1+t)P_w^1 - T_m > 0 \quad (5)$$

If domestic prices adjust perfectly, such that a fall in the world price yields

$$R_1 = P_d^1 - (1+t)P_w^1 - T_m = 0 \quad (6)$$

then the domestic price change is given by

$$\Delta P_d = (1+t)\,\Delta P_w \quad (7)$$

But what if there is no initial incentive for arbitrage, yet a fall in world prices creates arbitrage rents at *existing* domestic prices, and domestic markets continue to adjust perfectly and instantaneously?

Then the initial condition is given by

$$R_0 = P_d^{\,0} - (1+t)\, P_w^{\,0} - T_m < 0 \qquad (8)$$

In contrast, arbitrage rents open up at the lower world price

$$R_0' = P_d^{\,0} - (1+t)\, P_w^{\,1} - T_m > 0 \qquad (9)$$

and the new equilibrium is given by

$$R_1 = P_d^{\,1} - (1+t)\, P_w^{\,1} - T_m = 0. \qquad (10)$$

In this case, we have

$$\Delta P_d = (1+t)\, \Delta P_w - R_0 \qquad (11)$$

i.e. the domestic price goes down by an amount equal to the tariff markup (1+*t*) times the fall in the world price less the initial level of arbitrage rent R_0.

The key point here is that even in perfectly adjusting markets, we should not always expect policy changes (or world price changes) to be fully passed through. In Table 1 we present comparable expressions for perfect and imperfect arbitrage, as import and export markets adjust to world price movements, and to tariffs and export subsidies changes respectively.

Table 1: Perfect and imperfect price transmission with efficient arbitrage

	Import case		Export case	
Variable changed:	**World price, P_w**	**Tariff, t**	**World price, P_w**	**Export subsidy, e**
Perfect price transmission ΔP_d	$(1+t)\Delta P_w$	$\Delta t\, P_w$	$\left(\frac{1}{1-e}\right) \Delta P_w$	$\left(\frac{P_d \Delta e}{1-e^1}\right)$
Imperfect price transmission ΔP_d	$(1+t)\Delta P_w - R_0$	$\Delta t\, P_w - R_0$	$\left(\frac{1}{1-e}\right)[\Delta P_w + R_0]$	$\left(\frac{P_d \Delta e + R_0}{1-e^1}\right)$

ESTIMATION POSSIBILITIES

What are the options for building the preceding logic into estimates of price transmission?

Since the late 1980s, cointegration techniques have been the standard tool for estimating price transmission. Their use stemmed from the recognition that price data are typically "non-stationary", and so correlations between price series (e.g. Timmer et al., 1983) or regressions of one price series on another, by wrongly attributing co-movements in prices to causality, produce invalid test results. Early applications (e.g. Ardeni, 1989) were used to test the "law of one price", on the assumption that if a good is perfectly tradable, then prices on world and domestic markets should be equal (plus or minus transport costs and other margins) and changes in world prices should be fully translated into changes in domestic prices.[67] But the estimation of an unrestricted cointegration equation often involves "averaging" across periods when there is both an incentive for arbitrage and when there is not. Thus apparently "weak" price transmission may merely reflect price gaps that are narrow relative to transfer costs, rather than inefficiencies in the arbitrage process itself.

Recent studies have attempted to allow for discontinuous price transmission by making use of data not just on prices, but also transactions costs (Baulch, 1997) or transactions costs and trade flow information (Barrett and Li). Aside from more onerous data requirements, these models "rely on inherently arbitrary distributional assumptions in estimation and typically ignore the time series properties of the data, not permitting analysis of the dynamics of inter-temporal adjustment to short-

[67] Ardeni found that the law of one price did not hold for several important commodities in Australia, Canada, the United Kingdom and the United States.

run deviations from long-run equilibrium and potentially important distinctions between short-run and long-run integration" (Barrett, 2005).

A parallel development has been the formulation of "threshold" models that make use only of price data, using prices to reveal changes from one set of arbitrage conditions to another. Specifically, Balke and Fomby (1997) formulated a threshold model that is broadly consistent with the arbitrage argument outlined earlier, with price changes in one market only transmitted to another market when the price difference between the two markets exceeds a threshold level. This type of model has been developed by Hansen and Seo (2003) and Seo (2003), while similar models have been applied to agricultural price transmission by Goodwin and Piggott (2001) and Sephton (2003).

A shortcoming of these models is that they are not capable of discriminating between transactions costs and other possible causes of threshold effects, such as structural breaks and policy shifts.[68] Moreover, as Balcombe (2003) points out, these threshold models all miss a key component of threshold behaviour, namely that there may be two (or more) distinct equilibrium relationships between prices. In the context of transactions costs one would expect two distinct equilibria, with either the upper bound of the threshold the point of attraction or the lower bound – but not the middle as assumed in existing studies.

Accordingly, Balcombe develops a threshold model, elaborated in Bailey, Balcombe and Brooks (henceforth BBB), that allows (but does not require) the boundaries of the thresholds to be the points of attraction. The model considers a homogeneous commodity with price $P_{A,t}$ in market A and price $P_{B,t}$ in market B. In a standard error correction model, where the prices share a stochastic trend (in this case with Granger causality from market B to market A), there is a long run relationship of the form $P_{A,t} = \beta \cdot P_{B,t}$, with long run disequilibrium given by $e_t = P_{A,t} - \beta \cdot P_{B,t}$ (since this relationship will not hold exactly at any point in time). Adjustment to disequilibrium, with the assumption of a single period lag, takes the linear form $F^0(e_{t-1}) = \pi e_{t-1}$, with $\Delta P_{A,t-1} = F^0(e_{t-1}) + v_t$, where v_t is a stationary error, with moments that do not depend on past values of the long run disequilibrium term, e_t. BBB adapt this standard error correction adjustment process as follows:

$$
\begin{aligned}
F^0(e_{t-1}) &= \pi_u(e_{t-1} - \theta\,\lambda) \text{ if } e_{t-1} > \lambda \\
&= \pi_u(e_{t-1} + \theta\,\lambda) \text{ if } e_{t-1} < -\lambda \\
&= \pi_l(e_{t-1}) \text{ if } |e_{t-1}| < \lambda
\end{aligned}
$$

In this formulation, θ is a constant, such that $\theta \in [0,1]$. When $\theta = 1$, price transmission takes a lower value π_l inside a band of width λ (> 0) and a higher rate π_u outside it, and the edges of the bounds are the points of attraction. When $\theta = 0$, the model collapses to the Hansen and Seo formulation, where the point of attraction is the centre of the band. When $\pi_l = 0$ and $\theta = 1$ the model corresponds to the formulation in Section 2, where price transmission switches off completely in the absence of an arbitrage incentive (i.e. when inside the band), and converges on the edge of the bound when outside.

The model is estimated using Bayesian, as opposed to classical, techniques, on the grounds that the latter poses numerous practical difficulties. In particular if maximum likelihood estimation methods are used, the likelihood function is jagged and potentially bimodal, which prevents inference based on derivative methods. For further details, the reader is referred to BBB .

The following section considers how well these improvements in technique can enhance our understanding of price transmission, by (i) employing standard cointegration procedures; (ii)

[68] These studies test for cointegration over the full sample range of the data. In the case where there is a cointegrating relationship, thresholds are estimated as a second step. This approach is not satisfactory as the original tests may find no evidence of a cointegrating relationship simply because there are periods when the price gap is insufficient for arbitrage (trade) to occur.

comparing these results with those obtained over a restricted sub-period of continuous trade; and (iii) gauging the ability of the BBB threshold model to pick out changes in the underlying arbitrage conditions.

EMPIRICAL EVIDENCE FROM BRAZILIAN COMMODITY MARKETS

Price movements and traded volumes

In order to understand the likely degree of price transmission onto Brazilian commodity markets, it is first instructive to examine contemporaneous movements in domestic prices, external (reference) prices, and traded volumes. In the case of Brazil, we are fortunate to have monthly data on all three.

An inspection of high frequency data is valuable because it can reveal discontinuities in trade and reversals in the direction of trade, both of which indicate whether the role of transactions costs is likely to have an impact on price transmission and appropriate estimation procedures. It can also pinpoint other likely structural breaks, which may be important if price-only threshold models are estimated. In the case of Brazil, policy was progressively liberalised from the late 1980s, while the Mercosur Agreement in 1995 led to the elimination of tariffs on agro-imports originating from the Mercosur area and a reduction in the common external tariff.

Figures 1 to 9 in the Annex show domestic prices, relevant (highly traded) international prices, and traded volumes for a range of Brazilian commodities between 1989 and 2003. The product list includes four commodities that have traditionally been imported (wheat, maize, rice and beans) and five that are exported (soybeans, coffee, beef, pigmeat and poultry).

Wheat (Figure 1) is currently Brazil's main imported staple, with the vast majority of these imports coming from Argentina. Liberalisation led to a rapid growth in import volumes, although since 1998 imports have been relatively stable on an annual basis. Domestic prices have become less volatile and have tracked Argentine FOB prices more closely in the post reform period, suggesting that price transmission should be estimated over this interval.

Maize (Figure 2) has traditionally been imported into Brazil, albeit in relatively low volumes (less than one million tonnes per year). However, since 2001 a net export position has emerged, largely due to the opening up of new agricultural areas in the Centre-West. Over the import period, it is notable that domestic prices were typically lower than US or Argentine FOB prices in those months where imports were close to zero, with substantial price gaps emerging in some instances. Hence, maize demonstrates the value of focusing on transactions costs as a determinant of price transmission. Furthermore, the domestic price appears to respond in a subdued manner to Argentine and US price changes (i.e. there is a relatively small adjustment to a large shock). It is not clear where existing price transmission models can capture this phenomenon.

Rice (Figure 3) is another import, again with relatively low traded volumes (typically less than 200,000 tonnes per year). Until 1999, farmgate prices were consistently lower than FOB import prices, suggesting that there was little incentive for imports. As in the case of wheat, there appear to be two distinct phases of price transmission, with domestic price tracking import prices much more closely since 1999.

Brazil imports ***dry beans*** (Figure 4) in relatively low quantities on a seasonal basis. As with rice, there is a tendency for the domestic price to be lower than the FOB import price when imports are close to zero, and for smaller shocks to be more fully transmitted than large ones. Prices have stabilised since 1999, and domestic and import prices have tracked each other more closely, again suggesting two distinct phases of price transmission.

Brazil is the world's second largest exporter of ***soybeans*** (Figure 5). Domestic prices tracked US prices very closely throughout the 1989-2003 period, although there has been some narrowing of price differences. Note that export prices have spiked occasionally when exports are close to zero, which suggests that, for estimation purposes, it may be best to eliminate from the sample those months in which no trade takes place. In addition, the gap between farmgate price and traded prices has

narrowed, probably as a result of lower internal transport costs. This may need to be accommodated via a trend term when estimating the price relationship.

Brazil is the world's largest supplier of ***coffee*** (Figure 6). As in the case of soybeans, Brazilian and world coffee prices show a clear co-movement over the whole period. However, there were world price spikes in 1994-1995 and 1997-1998 that were not matched in the Brazilian market, possibly because of traders withholding some of the benefits to domestic producers.

Poultry (Figure 7) is an increasingly important export product for Brazil. Domestic prices have been more stable and have tracked international prices more closely as exports have grown. It therefore makes sense to limit estimation to more recent years (post 1995).

Pigmeat (Figure 8) has emerged as a significant export in the last few years. Domestic and export prices have moved together quite closely in the post-reform period, and there is evidence of the price gap narrowing progressively over that period, which is again suggestive of a reduction in transport and other transactions costs.

Beef (Figure 9) has shown a similar pattern of development to other meats. Exports, which were of marginal importance until the end of the 1990s, have grown rapidly, while domestic prices demonstrated a greater stability.

COINTEGRATION RESULTS

We examine the degree of international to domestic price transmission for the commodities discussed above using monthly price data from January 1989 to October 2003 (see Annex for data description). The objective of this exercise is not to obtain robust estimates of price transmission, but simply to demonstrate the sensitivity of the results to incorporation of arbitrage incentives. The use of domestic prices implies some conflation of cross-border price transmission with internal price transmission, but that should not undermine these particular insights. Similarly, not all trade occurs on spot markets, but reaction to price signals across these markets is still helpful for demonstrating the importance of thresholds.

In each case, we first applied the standard Augmented Dickey-Fuller (ADF) unit root test, using the Schwarz criteria to select the appropriate number of lags. The test results are reported in Table 2. Most of the price series were found to be non-stationary in levels and stationary in first differences (at a significance level of 5%), although for importables in particular there were some cases where the ADF t-values were at or close to their critical values. Domestic bean prices were an exception, with clear evidence of stationarity in price levels. On the strength of the evidence, it was decided not to proceed with cointegration tests for maize and beans.

Table 2. Results of Augmented Dickey-Fuller Unit Root Test**

	ADF test t-statistic values				Stationarity of series	Johansen co-integration test: perfomed (yes)/not performed (no)
	Series in levels		First-differenced series			
	no time trend	time trend	no time trend	time trend		
WHEAT						
PD	-3.18*	-3.17	-9.29	-9.28	I(0)	yes
PW - Argentina	-2.61	-2.68	-8.44	-8.44	I(1)	
MAIZE						
PD	-2.97*	-3.37	-9.60	-9.57	I(1)	no
PW - Argentina	-3.38*	-3.36	-8.38	-8.36	I(1)	
RICE						
PD	-2.20	-2.20	-3.88	-4.09	I(1)	yes
PW - Tailand	-1.92	-2.75	-7.13	-7.12	I(1)	
BEANS						
PD	-3.65*	-3.84*	-8.71	-8.68	I(0)	no
PW - Brazil import	-2.71	-3.32	-9.70	-9.67	I(1)	
SOYBEANS						
PD	-2.85	-2.83	-10.12	-10.16	I(1)	yes
PW - US CBOT	-2.49	-2.35	-10.45	-10.50	I(1)	
COFFEE						
PD	-1.77	-1.76	-7.26	-7.24	I(1)	yes
PW - ICO composite price	-1.69	-1.74	-6.99	-6.94	I(1)	
POULTRY						
PD	-2.01	3.65*	-5.70	-9.30	I(0)	yes
PW - Brazil export	-1.48	-1.91	-5.57	-5.59	I(1)	
PIGMEAT						
PD	-2.57	-2.98	-6.27	-6.27	I(1)	yes
PW - Brazil export	-1.37	-2.05	-7.44	-7.46	I(1)	
BEEF						
PD	-1.59	-2.19	-5.78	-5.78	I(1)	yes
PW - Australia	-1.65	-1.54	-7.51	-7.52	I(1)	
T-statistic critical values: 5%	-2.88	-3.44	-2.88	-3.44	-	-
10%	-2.57	-3.14	-2.57	-3.14	-	-

PD - Brazilian domestic price; PW - world price

(*) Denotes significance at 5% confidence level

(**) All results relate to full time series from January 1989 to October 2003.

For other products, wheat, rice, soybeans, poultry, pigmeat, and beef we used the Johansen procedure to test for cointegration. Where we found evidence of a cointegrating equation we then estimated the following error correction model:

$$\Delta PD_t = \alpha_0 + \alpha_{11}*\Delta PD_{t-1} + \ldots. \alpha_{1n}*\Delta PD_{t-n} + \alpha_{21}*\Delta PW_{t-1} + \ldots\alpha_{2n}*\Delta PW_{t-n} + \phi*[\, PD_{t-1} - \beta_0 - \beta_1*PW_{t-1}]$$

where *PD* and *PW* are domestic and world prices, α_0 is an intercept, α_1 and α_2 are short-run coefficients, *n* is the number of lags, $PD_t = \beta_0 + \beta_1*PW_t$ is the long-run cointegrating relationship, and ϕ is the speed-of-adjustment parameter.

The results of cointegration test are reported in Tables 3 and 4. In each case we made estimations for the full period, 1989-2003, and for two sub-periods: 1989-1995 and the post-reform period of 1996-2003. The finding of higher significance over the most recent sub-range would appear to support our suggested interpretation of discontinuous price transmission, notwithstanding the loss of degrees of freedom. Where cointegration was present, a Granger causality test was also performed, which in all cases showed that world prices Granger-cause domestic prices.

For *rice* and *beef* we could find no evidence of cointegration over the whole period or the sub-periods. The result for beef seems consistent with the fact that prior to 2000 trade was very small relative to the size of the domestic market (note the 1992-1995 period of interrupted trade). The exposure of the domestic rice market to international price signals appears to have been similarly weak until recently. These results, however, once again confirm the limitations of the traditional estimations of price transmission based on long-run time series. The overall absence of cointegration seems to contradict the casual evidence from and inspection of price movements and trade flows.

For *wheat* and *poultry* we found a cointegrating relation over the whole sample, but this result appears to disguise quite diverging situations before and after 1995, with a cointegrating relationship between domestic and external prices found only for the more recent sub-period. For both products we estimated the VEC equations for the full period and for 1996-2003. In the case of wheat the VEC co-efficients determining the long-run relationship between domestic and world price (β_1) and the speed of adjustment (ϕ) to their long-run equilibrium had almost the same values, showing only a marginally higher speed of adjustment with the restricted sample. However, the tests reveal the difference in the short-run adjustment in that domestic prices appear to respond much stronger to the short-term world price changes when only a recent sub-period is considered. The estimated co-efficients for poultry provide somewhat counter-intuitive evidence showing practically the same speed of adjustment and a stronger long-term price relationship over the full time range than over the recent sub-period. This equates to the greater importance of lags over the restricted period. It may also reflect the fact that domestic export prices, while remaining lower than export prices, have moved closer, so a given absolute degree of price transmission is reflected in a lower elasticity.

Table 3. Results of Johansen Cointegration and Granger Causality Tests (based on logged series)

	Full period: 1989:01 to 2003:10	Sub-period 1: 1989:01 to 1995:12	Sub-period 2: 1996:01 to 2003:10	Granger causality test
WHEAT	X	--	X	PW gc PD
RICE	--	--	--	-
SOYBEANS	X	X	X	PW gc PD
BEEF	--	--	--	-
PIGMEAT	X	X	X	PW gc PD
POULTRY	X	--	X	PW gc PD

PD: Brazilian domestic price; PW: world price

X: series cointegrated; -- : series not cointegrated

PW gc PD: world price Granger-causes domestic price

Table 4. Results of Vector Error Correction Model Estimation (based on logged series)

	α_0	α_1	α_2	β_1	ϕ	β_0
WHEAT						
Full period	0.00	-0.22	-0.03	0.69	0.20	1.48
Sub-period 1	--	--	--	--	--	--
Sub-period 2	0.00	-0.12	0.11	0.68	0.22	1.60
SOYBEANS						
Full period	0.00	-0.11	-0.06	1.15	0.26	0.00
Sub-period 1	0.00	-0.09	0.07	0.58	0.38	-0.00
Sub-period 2	0.00	-0.29	-0.19	1.07	0.16	-0.53
POULTRY						
Full period	0.00	-0.15; 0.07;- 0.00;	0.02; 0.15; 0.08; -	1.52	0.02	-3.85
Sub-period 1	--	--	--	--	--	--
Sub-period 2	0.00	-0.39; 0.17; 0.03; -	-0.07; 0.10; -0.15;	1.18	0.01	-1.69
PIGMEAT						
Full period	0.00	-0.35	-0.03	0.89	0.14	0.14
Sub-period 1	0.00	-0.32	0.04	0.70	0.17	1.63
Sub-period 2	0.00	-0.49	-0.16	0.84	0.14	0.45

Full period corresponds to 1989:01 - 2003:10; sub-period 1 to 1989:01 - 1995:12; and sub-period 2 to 1996:01 - 2003:10.
** Six lags are included in VEC for poultry.*

Overall, the cointegration tests for Brazilian prices support the hypothesis of discontinuous price transmission. In particular, they are suggestive of different regimes following policy reforms in the mid-1990s. Some domestic markets (wheat and poultry) already developed strong links to external markets, while for others (notably rice and beef) this transformation appears to be still underway. Finally, markets historically integrated into international trade (soybeans and pigmeat) became more strongly dependent on world prices in the long and short-run. The cointegration tests revealed the sensitivity of results to the choice of the sample range (i.e., on different arbitrage and policy conditions). The standard price transmission estimates based on time series seem unable to capture these differences and therefore to provide an accurate key for price predictions.

THRESHOLD MODEL RESULTS

BBB limit their attention to the markets for wheat, maize and soybeans. The authors also perform unit root tests and tests for stationarity, finding similarly mixed evidence regarding the existence of unit roots. However, they decide that there is sufficient evidence to proceed under the assumption that such unit roots exist. The tests for cointegration and Granger causality also produce similar results, with weak evidence of cointegration in the case of maize.

Table 5 gives the cointegrating vector estimates for each of the series pairs, including both the posterior means and standard deviations derived from the Bayesian approach, and the standard maximum likelihood estimates obtained using the Johansen procedure.

The Bayesian parameter estimates are not systematically higher or lower than the maximum likelihood estimates. Nor is there any evidence that the standard deviations of the parameter estimates are higher or lower than the corresponding standard errors. The posterior means for the threshold parameter λ are all significantly different from zero, which suggests that threshold effects are present.

The Bayesian estimates with the Brazilian price as the dependent variable show in each case a much faster rate of adjustment when prices are outside the bound given by λ, which provides further support for threshold effects (Table 6). However, in each case the posterior mean of θ is less than one. This

suggests some "overshooting", with prices converging beyond the point at which there are no more arbitrage rents to be exhausted. In other words, the results lie somewhere between those suggested by the Hansen and Seo formulation (where $\theta = 0$ where prices converge absolutely) and those consistent with the principles of arbitrage set out in Section 2. Moreover, while the speed of within threshold adjustment is lower than the out of threshold rate, it is still different from zero.

Table 5. Cointegrating Vectors

Commodity	Explanatory Variable	ML	Threshold
Wheat	**Argentine Price (β)**	**-0.724**	**-0.777**
		(0.159)	(0.149)
	Time	0.0005	0.0009
		(0.0006)	(0.0008)
Wheat	U.S. Price (β)	-0.799	-1.015
		(0.156)	(0.24)
	Time	-0.0014	-0.002
		(0.0007)	(0.001)
Maize	Argentine Price (β)	-1.22	-1.131
		(0.379)	(0.285)
	Time	0.0005	0.0006
		(0.0007)	(0.0007)
Maize	U.S. Price (β)	-0.957	-0.929
		(0.257)	(0.139)
	Time	0.0003	0.0006
		(0.0007)	(0.0005)
Soya	U.S. Price (β)	-1.21	-1.21
		(0.108)	(0.113)
	Time	-0.0014	-0.0014
		(0.0003)	(0.0004)

Source: Balcombe, Bailey and Brooks (2006).
Note that figures in parenthesis are standard errors for ML estimates and standard deviations of the posterior distributions for the Bayes estimates. ML estimation of threshold models does not deliver standard errors.

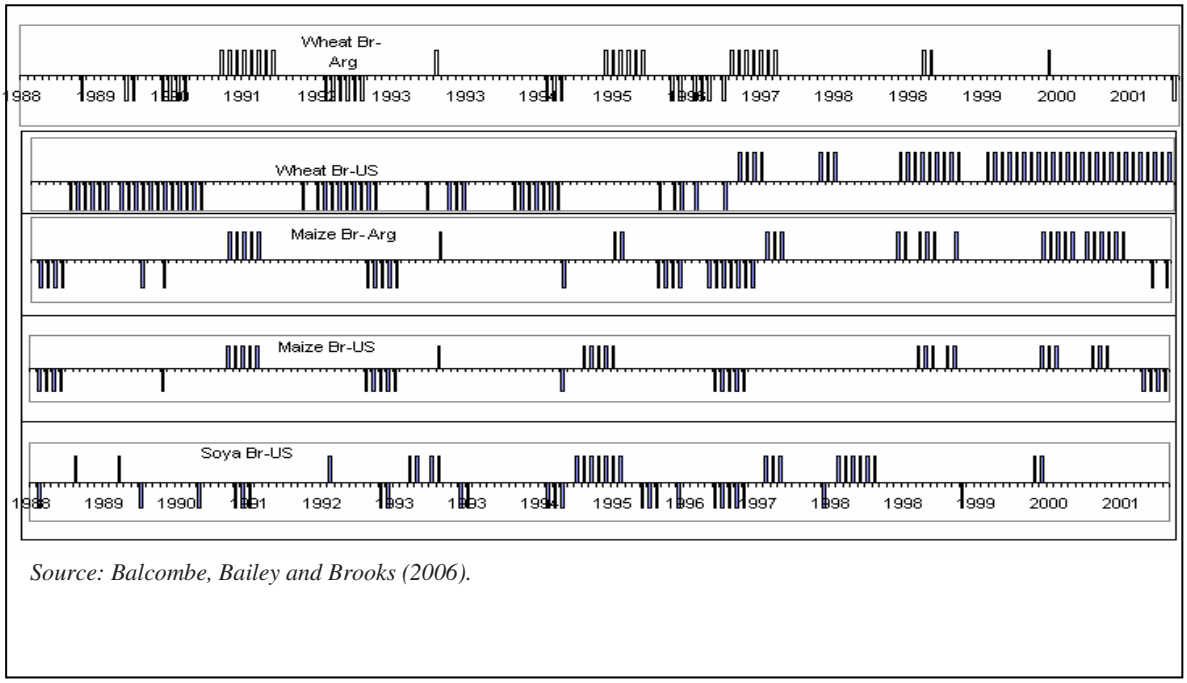
The timing of within and out of threshold adjustments is shown in Figure 10. These results show intermittent periods of in and out of threshold adjustment in the case of Brazilian and Argentine wheat, and a shift from below to above threshold price adjustment in the case of Brazilian and US wheat. The below threshold adjustment is difficult to interpret in this case, since it would suggest exports of wheat from Brazil whereas Brazil has historically been a wheat importer. Similarly in the case of maize and soybeans, there are periods where the Brazilian price converges on the US price from above, and periods where it converges from below. However, Brazil has only recently emerged as a net exporter of maize and has consistently exported soybeans. In short, the thresholds identified by the BBB model are difficult to reconcile with the data on trade flows presented in Figures, 1, 2 and 5.

Table 6. Threshold Parameters and Tests for Thresholds

Commodity / Country	Estimator	Threshold Parameters		Dependant Variable: Brazilian Price		Other Price	
		$\lambda^{(a)}$	$\theta^{(b)}$	π_u -	π_l (c)	π_u -	π_l (d)
Wheat Brazil - Argentina	ML	—	—	-0.18	—	0.05	—
				(0.04)		(0.04)	
	Bayes	0.15	0.73	-0.36	-0.09	0.12	0.06
		(0.04)	(0.23)	(0.14)	(0.06)	(0.06)	(0.04)
Wheat Brazil – US	ML	—	—	-0.20	—	0.02	—
				(0.04)		(0.03)	
	Bayes	0.15	0.68	-0.26	-0.18	0.08	0.04
		(0.05)	(0.24)	(0.08)	(0.08)	(0.04)	(0.03)
Maize Brazil - Argentina	ML	—	—	-0.12	—	0.04	—
				(0.03)		(0.025)	
	Bayes	0.19	0.71	-0.22	-0.11	0.10	0.05
		(0.06)	(0.24)	(0.09)	(0.06)	(0.05)	(0.03)
Maize Brazil – US	ML	—	—	-0.13	—	0.04	—
				(0.03)		(0.023)	
	Bayes	0.20	0.81	-0.36	-0.13	0.17	0.03
		(0.05)	(0.19)	(0.18)	(0.06)	(0.10)	(0.02)
Soya Brazil – US	ML	—	—	-0.29	—	0.07	—
				(0.06)		(0.04)	
	Bayes	0.11	0.86	-0.70	-0.24	0.19	0.08
		(0.02)	(0.13)	(0.20)	(0.11)	(0.09)	(0.05)

Source: Balcombe, Bailey and Brooks (2006).
(a), (b), (c) & (d) as defined in the theoretical section. Note that numbers in parenthesis represent standard deviations of posterior distributions or standard errors of parameters.

Figure 10. Timing of within and out-of threshold episodes



Source: Balcombe, Bailey and Brooks (2006).

CONCLUSIONS

The preceding applications for Brazil suggest some principles which should guide the estimation of price transmission and policy pass-through in applications intended for further disaggregated analysis.

First, in some (but not all) cases, it is important to acknowledge the role of transactions costs. In these cases, standard cointegration techniques are likely to be unsatisfactory.

If threshold models are used in order to accommodate transactions costs, there is a choice to be made between methods that make use of information on both prices and trade quantities (e.g. Barrett and Li; González-Rivera and Helfand) and those which only use price data (e.g. Goodwin and Piggott; Sephton; Balcombe). The former are naturally to be preferred if data on traded quantities are available or can be estimated reliably. One shortcoming of price-only based threshold models, evident from the results in Section 4, is that they cannot distinguish the role of transactions costs from other causes of threshold effects.

Threshold models may provide important insights, but they are difficult to apply and the evidence from Brazil (where price transmission appears to have improved in recent years) suggests that they may not provide good predictions of future price transmission.

One alternative to threshold models is to estimate transfer costs and hence the bounds within which price transmission will occur. This can be done either directly, by collecting data on transport, handling and other observable costs, or indirectly by observing the minimum price gap which is sufficient for arbitrage to occur (an inspection of the data for Brazil suggests that the latter is a difficult task). Price transmission could then be characterised via a switching model which embodies the logic introduced in Section 2. Another approach would be to impute price transmission of zero when the reform is insufficient to create an incentive for arbitrage, but to go back and re-estimate price transmission coefficients over intervals where trade occurs. A further advantage of specifying a switching regime is that it has a clearer economic interpretation.

REFERENCES

Ardeni, P.G. 1989. Does the Law of One Price Really Hold for Commodity Prices? *American Journal of Agricultural Economics*, August: 661-669.

Bailey, A., Balcombe, K. & Brooks, J. 2006. Threshold Effects in Price transmission: The case of Brazilian Wheat, maize and Soya Prices. *American Journal of Agricultural Economics*, forthcoming.

Balcombe K. 2003. Threshold Effects in Price transmission: The case of Brazilian Wheat, maize and Soya Prices. Consultancy paper provided to the OECD Secretariat.

Balcombe K. & Morrison, J. 2002. Commodity Price Transmission: Application to Selected Tropical Export Commodities. A Study for the FAO (ESCR).

Barrett, C. B. 2005. Spatial Market Integration. Entry in L. E. Blume and S. N. Durlauf, editors, *The New Palgrave Dictionary of Economics* (London: Palgrave Macmillan).

Barrett, C. B. & Li, J. R. 2002. Distinguishing Between Equilibrium and Integration in Spatial Analysis. *American Journal of Agricultural Economics* 84 (2): 292-307.

Baulch, B. 1997. Transfer Costs, Spatial Arbitrage and Testing for Food Market Integration. *American Journal of Agricultural Economics* 79 (2): 477-87.

Bautista, R., Robinson, M., Tarp, S. F. & Wobst, P. 1998. Policy Bias and Agriculture: Partial and General Equilibrium Measures. Discussion Paper. Trade and Macroeconomics Division, International Food Policy Research Institute, Washington, DC.

Blake, N. & Fomby, T.B. 1997. Threshold Cointegration. In International Economic Review, V. 38, Issue 3 (August): 627-645.

Brooks, J. & Melyukhina, O. 2003. Estimating the pass-Through of Agricultural Policy Reforms: an Application to Russian Crop Markets With Possible Extensions. Contributed paper, International IATRC Conference, Capri, Italy, 23-26 June, 2003.

Cluff, M. 2003. A Review of Spatial Price Transmission in Major World Multi-Commodity Models. Paper provided to the Aglink Users Group, OECD.

Colman, D. 1995. Problems of Measuring Price Distortions and Price Transmission: A Framework for Analysis. *Oxford Agrarian Studies* 23 (1): 3-13.

González-Rivera, G. & Helfand, S.M. 2001. The Extent, Pattern and Degree of Market Integration: a Multivariate Approach for the Brazilian Rice Market. In *American Journal of Agricultural Economics* August: 576-592.

Goodwin, B., Grennes, T. J. & Wohlgenant, M.K. 1990. A Revised Test of the Law of One Price Using Rational Price Expectations. *American Journal of Agricultural Economics* August: 682-693.

Goodwin, B.K & Pigott, N.E. 2001. Spatial market integration in the Presence of threshold Effects. In *American Journal of Agricultural Economics*, May: 302-317.

Hansen, B.E. & Seo, B. 2002. Testing For Two-Regime Threshold Cointegration in Vector Error-Correction Models. In Journal of Econometrics, V. 110: 293-318.

Helfand, S.M. & Castro de Rezende, G. 2004. The Impact of Sector-Specific and Economy-Wide Policy Reforms on the Agricultural Sector in Brazil: 1980-98. In *Contemporary Economic Policy* V. 22: 194-212.

McCulloch, N. 2002. The Impact of Structural Reforms on Poverty: A Simple Methodology with Extensions. Paper presented at OECD Development Centre Seminar.

Seo, B. 2003. Non Linear Mean Reversion in the Term Structure of Interest Rates. In Journal of Economic Dynamics and Control, V. 23: 2243-2265.

Sephton, P.E. 2003. Spatial Market Arbitrage and Threshold Cointegration. In *American Journal of Agricultural Economics*, 85 (4): 1041-1046.

Sharma, R. 2003. The Transmission of World Price Signals: The Concept, Issues and Some Evidence from Asian Cereal Markets. In *Agricultural Trade and Poverty: Making Policy Analysis Count*. OECD: Paris.

Timmer, C., Falcon, W. & Pearson, S. 1983. Food Policy Analysis. Johns Hopkins University Press.

Annex: Brazilian data description

PRICE SERIES

All series represent monthly prices from January 1989 to October 2003 in USD/MT. All Brazilian domestic prices are from Getulio Vargas Foundation, converted from national currency ($R) into USD using free exchange rates published by the Central Bank of Brazil.

Wheat
Domestic price: Average price received by producers.
World price: Argentina fob Trigo Pan (International Grains Council).

Maize
Domestic price: Average price received by producers.
World price: Argentina fob Rosario (International Grains Council).

Rice
Domestic price: Average price received by producers.
World price: Thai fob Bangkok White Rice 100% B second grade (FAO/ESC world price database).

Beans
Domestic price: Average price received by producers.
World price: Unit fob values of Brazilian import of dry beans (total value of imported dry beans of various varieties, excluding seed beans, divided by total volume of import) (Brazilian Ministry of Development, Industry and Foreign Trade, Alice Web trade database).

Soybeans
Domestic price: Average price received by producers.
World price: US No 1 Yellow (Chicago Board of Trade).

Coffee
Domestic price: Average price received by producers.
World price: Composite green coffee price (International Coffee Organisation).

Beef
Domestic price: Average price received by producers.
World price: Australian boneless beef, cif USA (FAO/ESC world price database).

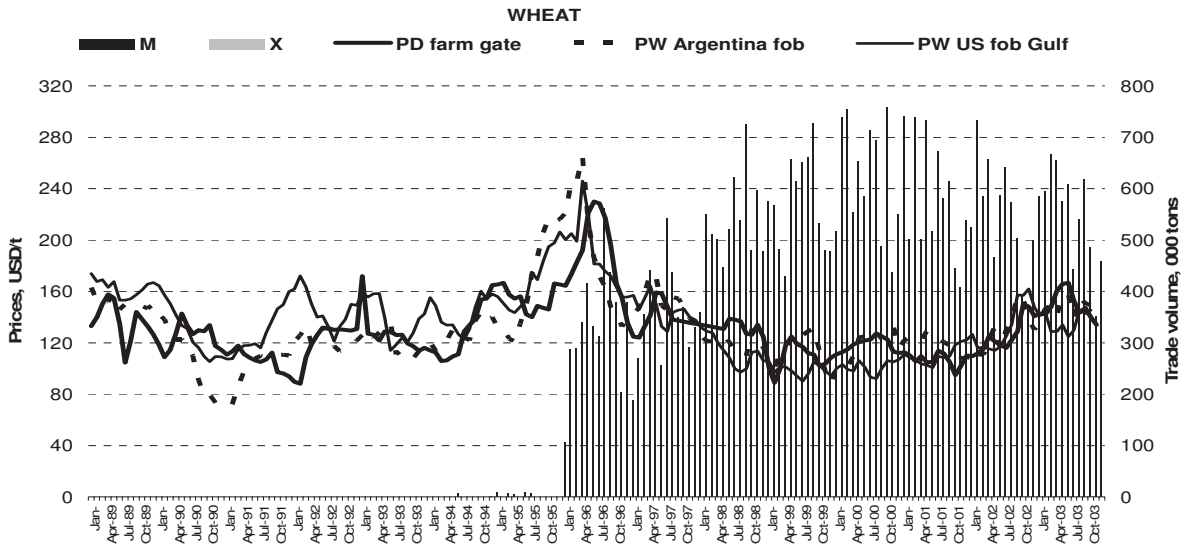
Pigmeat
Domestic price: Average price received by producers.
World price: Unit fob values of Brazilian export of pigmeat (total value of exported pigmeat divided by total volume of export) (Brazilian Ministry of Development, Industry and Foreign Trade, Alice Web trade database).

Poultry
Domestic price: Average price received by producers.
World price: Unit fob values of Brazilian export of poultry meat (total value of exported poultry meat divided by total volume of export) (Brazilian Ministry of Development, Industry and Foreign Trade, Alice Web trade database).

TRADE DATA

All Brazilian trade data is taken from the official *Alice Web* trade database of the Brazilian Ministry of Development, Industry and Foreign Trade. This official source reports both import and export values on a fob basis.

Figure 1. WHEAT : Monthly domestic and import prices



Note: Monthly data on wheat trade flows are not available for the period 1989:01 to 1995:12 .

Figure 2. MAIZE: Monthly domestic and import prices

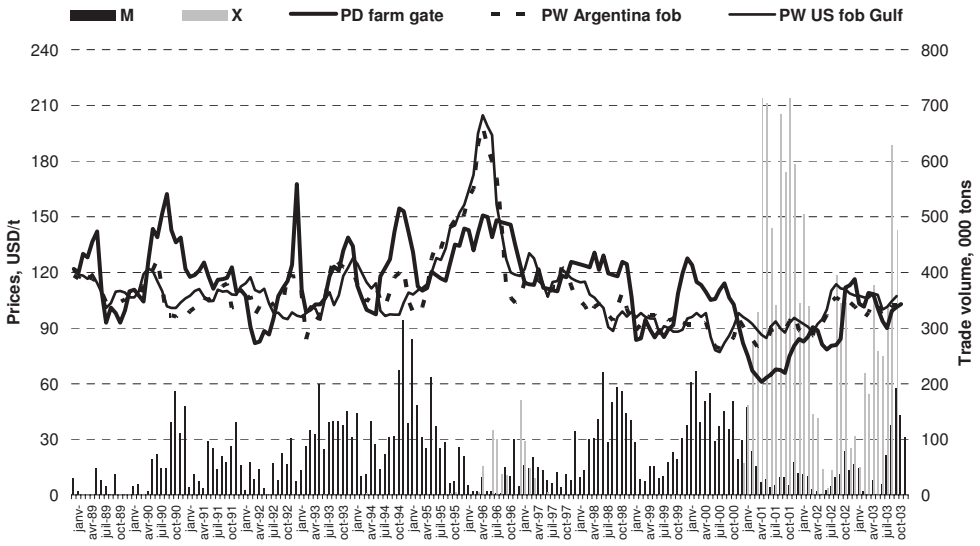


Figure 3. RICE : Monthly domestic and import prices

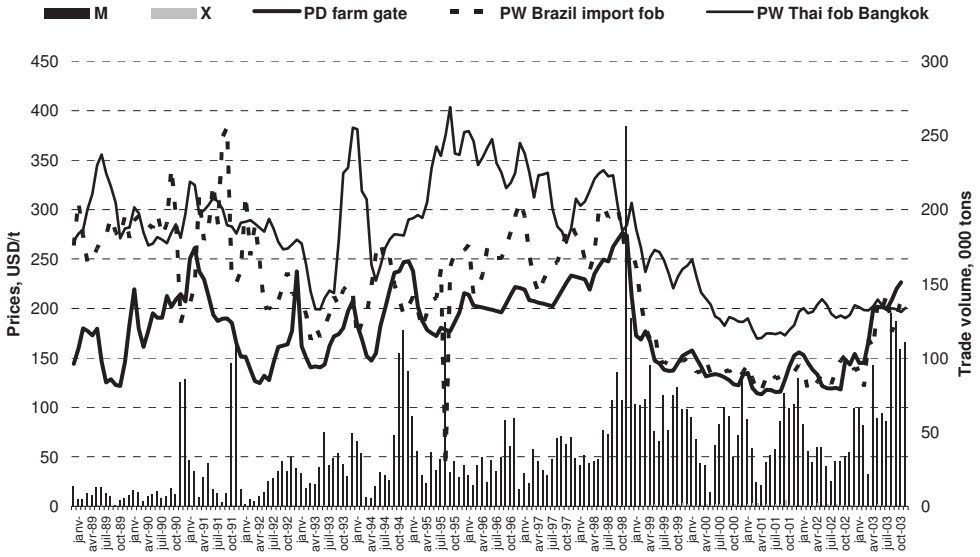


Figure 4. DRY BEANS: Monthly domestic and import prices

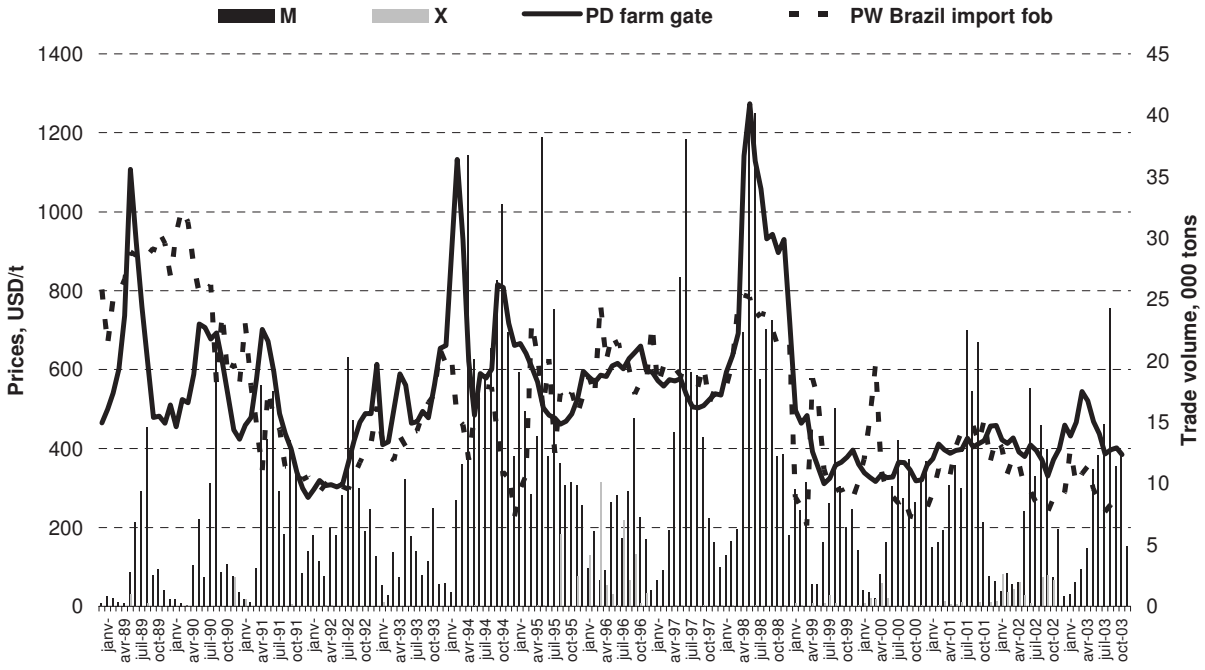


Figure 5. SOYBEANS: Monthly domestic and export prices

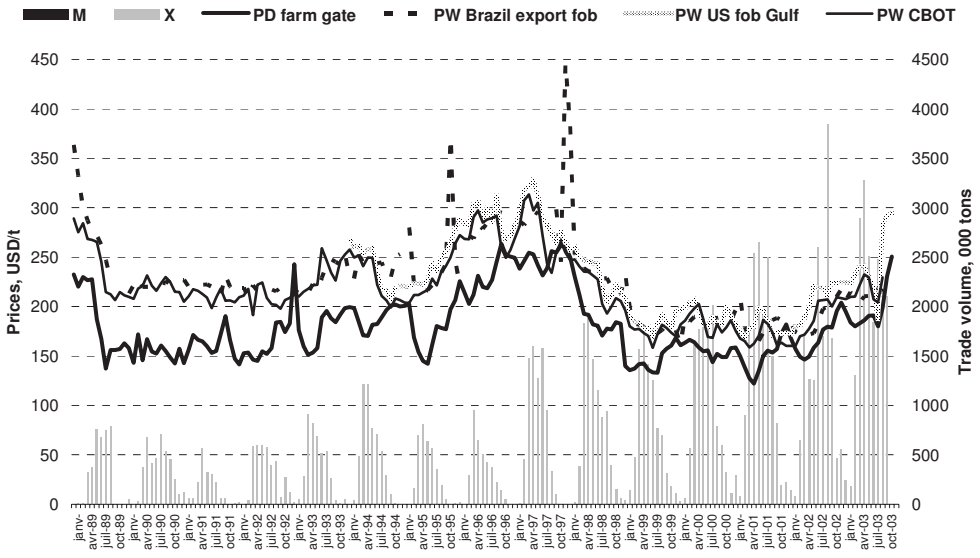


Figure 6. COFFEE (GREEN): Monthly domestic and export prices

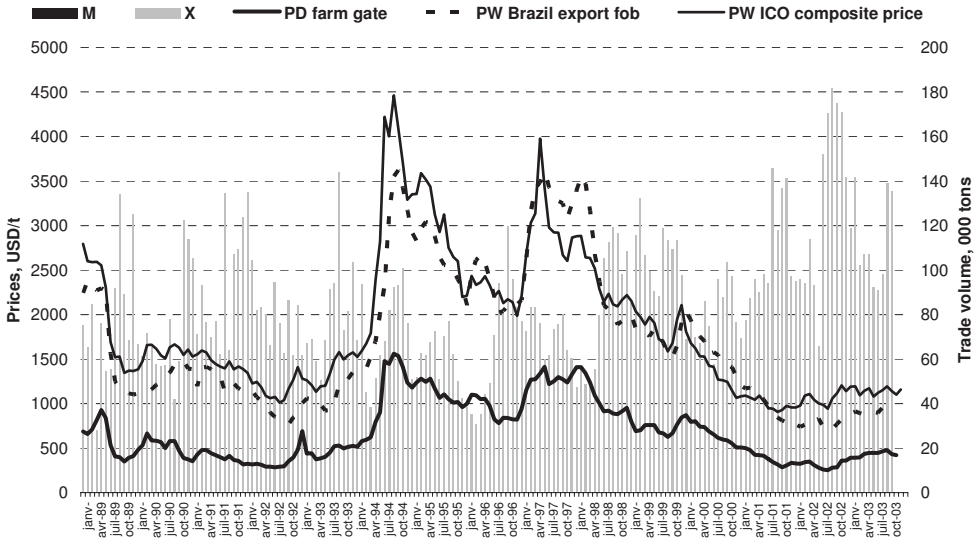


Figure 7. POULTRY : Monthly domestic and export prices

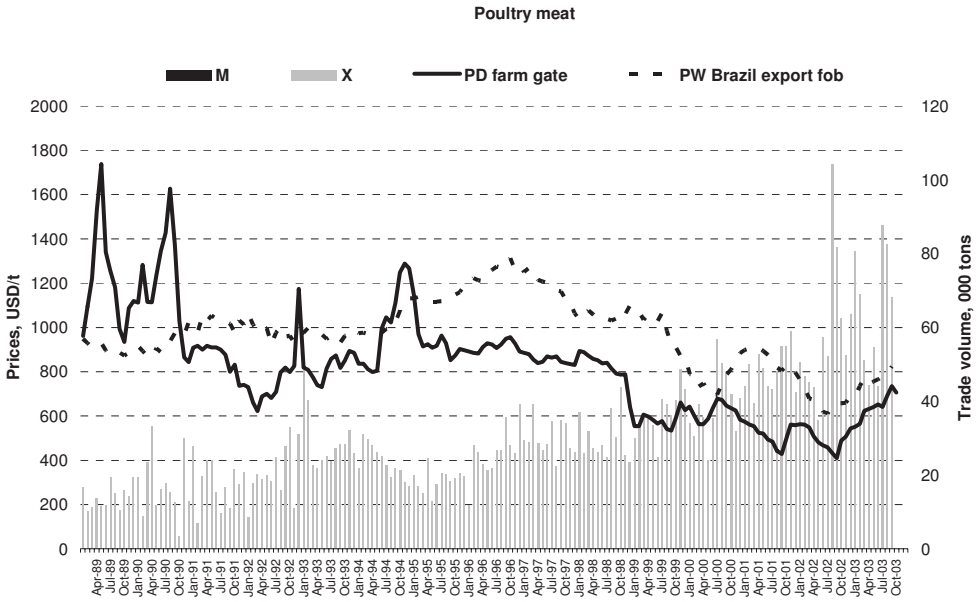


Figure 8. PIGMEAT: Monthly domestic and export prices

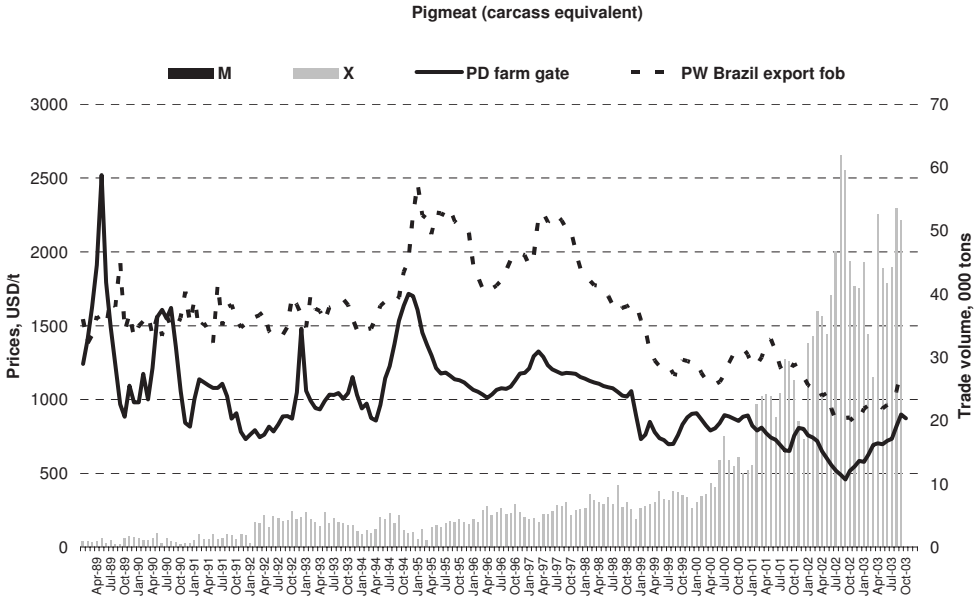
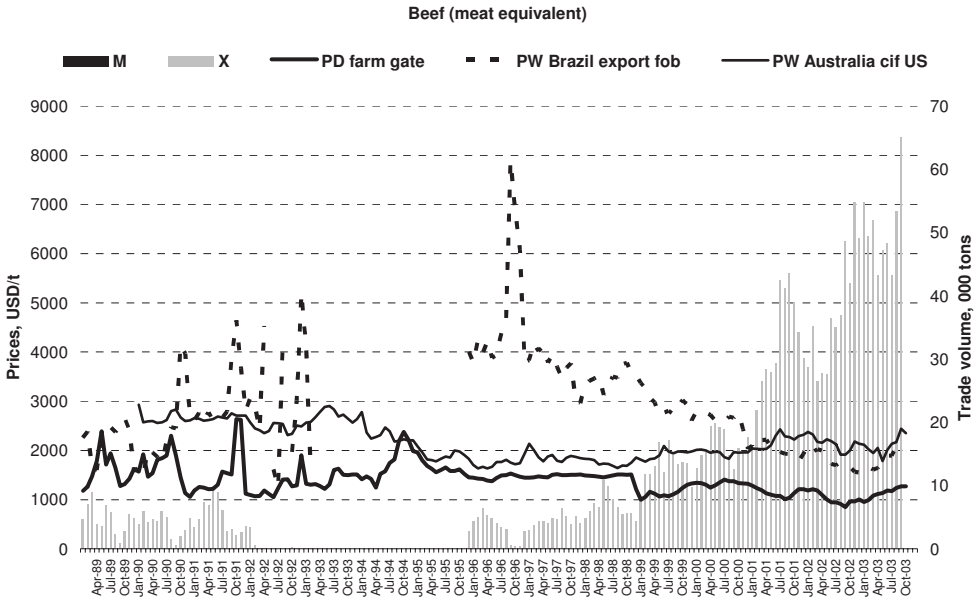


Figure 9. BEEF: Monthly domestic and export prices



PART 3

FARMERS AND COMMODITY DEVELOPMENT

The determinants of investments in coffee trees in Uganda[69]

Ruth Vargas Hill[70]

INTRODUCTION

Commodity prices are, in the words of Deaton and Laroque, characterised by "extreme volatility" [Deaton 1992 and Laroque]. Increasingly the international price of commodities is being passed on to farmers as liberalisation of the domestic marketing of commodities in many countries has replaced marketing boards with private market actors [Shepherd 1999, Sarris 2002, Fafchamps 2003 and others]. The transfer of marketing responsibilities from the state to private agents in developing country commodity markets has enhanced competitiveness in these markets, often allowing producers to receive a larger share of the export price. However increased competitiveness has also increased the extent to which fluctuations in the international price for coffee are passed from exporters to domestic traders to producers. The case of coffee in Uganda is a clear example of this: the coefficient of variation of the farm-gate coffee price increased from 0.38 before liberalisation to 0.62 after whilst the international coefficient of variation stayed constant across these two periods.

A large body of empirical work provides us with a good idea of how this affects welfare and short term production decisions (see Dercon (2000) for a review). It is likely that increases in volatility will affect the welfare of poorer farmers unable to insure consumption in the long run, and there is also some evidence that the increased risk in coffee prices will result in lower levels of effort expended on the risky commodity in the short-run [Dercon 1996, Morduch 1991]. Work on coffee farmers in Uganda suggests that this is indeed the case [methesis]. However, there are fewer empirical studies that indicate what the impact of this uncertainty is on longer term investment decisions, despite the immense theoretical literature on investment under uncertainty. At the microeconomic level OECD firm level data has been used to empirically test models of investment under uncertainty and irreversibility [Caballero 1995, Asano 2002, Nilsen 2003]. Caballero, Engel and Haltiwanger analysed plant level data in the US and Nilsen and Schiantarelli use panel data on Norwegian firms to examine the pattern of capital adjustment. The Asano paper provides a test between different models of investment as set out by Dixit and Pindyck (1994) and Abel and Eberly (1994) by using panel data on firms in the US.

This paper considers what factors affect a household's decision to invest in and abandon coffee trees when this investment is characterised by uncertainty. The decision to invest in tree crops in developing countries has been considered in a number of studies before. Early studies of determinants of investment in tree crops took an essentially neoclassical approach to explaining the investment. Investment was assumed to take place until the marginal cost of investing and the marginal expected discounted net revenue of investing were equal. These models were used to explain investment in coffee trees in Brazil [Wickens 1973], rubber trees in Thailand and Sri-Lanka [Hartley 1987], and cocoa trees in Brazil [Trivedi 1992].

Whilst standard investment theory provides a starting point for the analysis it does not allow for the particular features of an investment problem that can be characterised by uncertainty, irreversibility and the option to wait to invest. Malchow-Møller has highlighted the importance of using insights from the real options literature to understand investment in coffee trees [Moller2002]. This paper

[69] The author is grateful to Chris Mukiza, Robert Waggwa Nsibirwa, Aliziki Kaudha and the Uganda Bureau of Statistics without whom this work would not have been possible. Funding for this study was provided by the Economic and Social Research Council, UK and the Commodity Risk Management program of the World Bank. Many thanks to Marcel Fafchamps, Stefan Dercon, Simon Appleton, Christian Rogg, Sujit Kapadia and participants at the CSAE seminars in Oxford for comments on an earlier draft.

[70] International Food Policy Research Institute, Washington DC, USA, r.v.hill@cgiar.org

empirically tests some of the insights of the real options literature with the purpose of increasing our understanding of how price changes and shocks to the capital stock affect coffee tree holdings. It will use models of investment set out by Dixit and Pindyck and Abel and Eberly that explicitly consider investment under uncertainty and irreversibility, and by Fafchamps and Pender which explicitly allows for the presence of credit constraints to try and explain this decision [Dixit 1994, Abel1994andEberly, Fafchamps 1997].

The next section describes the context of this study: coffee production in Uganda. Section 3 provides a theoretical review of models of investment as they apply to the decision to abandon and invest in coffee production in Uganda and considers how these models can be applied empirically to the available data. Sections 4 and 5 describe the data used and present the empirical results, whilst Section 6 concludes.

CONTEXT OF THE STUDY

Uganda is a land-locked country blessed with fertile soil, sufficient rainfall and plentiful natural resources. As peace established itself after years of civil war Uganda experienced substantial growth. With growth came reductions in urban and rural poverty, both as a result of increased agricultural productivity and increased sources of off-farm income [Appleton 2001, Appleton 2001 edu].

Coffee is Uganda's largest export good, comprising 26% of export earnings in 2000/2001, and providing direct and indirect, partial employment to an estimated 5 million people [BOU 2001, Kempaka 2001]. Robusta coffee accounts for nearly 90% of Uganda's coffee production with the remainder being Arabica, grown in highland areas in the East, on the slopes of Mount Elgon, around the Rwenzori Mountains in the West, and in the West Nile. Robusta is predominantly grown in lowland areas in central Uganda. To date, the total coffee acreage is well in excess of 500,000 acres and the average size of a small-holding is about 0.19 hectares [APSEC1999].

Coffee is usually intercropped with staple crops - often matooke (a banana-like staple), beans, sweet potatoes and maize. Production is characterised by a very low technological level, with a low use of purchased inputs, and limited use of modern farming methods such as irrigation. Under these conditions existing traditional Robusta trees have a yield of only 800 kg/Ha of dry cherries (known as "kiboko"), as opposed to three times as much for Asian producers [APSEC 1999, UCDA 2001]. However, the traditional farming methods used by Ugandan farmers are competitive as the country remains a comparatively low cost producer of Robusta coffee at US$424 per tonne. Its main competitor, Viet Nam, has production costs estimated at about US$520 per tonne.

Like so much commodity crop production in low income countries, production of coffee is concentrated amongst farmers with little access to formal or informal means of insuring themselves. Credit and insurance markets are limited with many households lacking the collateral needed to access credit. Although access to credit improved for many rural households in the 1990s, production decisions have been shown to reflect limited access to credit and many households report limited access to existing micro-finance and credit schemes [Deininger 2001, Smith 2001]. Access to these schemes can only be guaranteed by those who have social links with the influential parties, which effectively excludes the poorest [Smith 2001]. Kiiza and Pederson show that although Ugandan households do save, they have little access to financial institutions in which to place their savings and savings tend to be held in the form of productive assets such as land, building and livestock [Kiiza 2001].

The coffee trees farmed in Uganda are very old - the majority of trees are aged about 40 years and some trees are still being farmed at 70 years - and these trees have experienced many changing fortunes, particularly in the last decade. At the end of the eighties and beginning of the nineties a low international coffee price and an inefficient domestic marketing system kept the farm-gate price of coffee low. By the middle of the 1990s this situation had dramatically changed with a rise in world prices and a new marketing system that ensured farmers received a much higher share of the border price. These good fortunes did not last and the farm-gate price of coffee fell to another low at the turn

of the millennium. In the three year period considered here (2000 to 2003) the producer price of coffee in Uganda fell from $0.47 to $0.26 per kilo.[71] Despite the recent fall in prices, anecdotally, it appears many of the trees have remained in the ground through these changing fortunes and disinvestment is more likely to be shown by neglect than removal. As William Naggaga, Board Secretary of the Uganda Coffee Development Authority states:

"Farmers are not removing their coffee. There are few better alternatives. We encourage them that prices go down, but can come up again. We tell them that though times are bad, we are still low-cost producers in Uganda. And the farmers remember better days, in 1994/95 when the price rose high."

Concurrent with the changing price of coffee, in the past 15 years coffee wilt disease has emerged as a significant risk to coffee yields. This has led to further variation in coffee revenues across farmers and time, and has affected the stock of coffee trees farmers hold. In contrast to other diseases which attack the coffee berry, causing the farmer to lose his income for one season, coffee wilt disease attacks the tree resulting in the trees destruction so that previous investment in this crop, and the source of income it provides, is removed. The disease is thus a considerable threat to the livelihood of farmers who are dependent on coffee for income. The increased incidence of wilt disease has had a large impact on the number of coffee trees farmers own. Recently the Uganda Coffee Development Authority reported the disease had spread to 24 districts with an incidence of infection as high as 75% in one district, and estimated the national economic cost of this disease at US$4 million per annum [UCDA2001]. A survey carried out by a multisectoral team of different government bodies in 2003 revealed the infection had reached almost half of the area planted to Robusta coffee [Munyambonera2004]. Of the 300 farmers interviewed in this survey in 2003, 85% reported experiencing coffee wilt disease in the three years prior to the survey. For many farmers coffee wilt disease has resulted in forced abandonment of this productive asset and it is not clear how many have replaced the trees they lost.

The investment response of these farmers to price falls and shocks to the capital stock given the irreversible nature of investment in coffee trees, the uncertain returns to coffee production and the credit constraints they face is considered here. This paper examines how these factors have affected the investment and abandonment of coffee trees over a three year period. By testing different models of investment with data on Ugandan coffee farmers we find models of investment which allow for irreversibility, uncertainty, fixed costs and liquidity constraints perform well in explaining the abandonment and investment patterns observed.

CHARACTERIZING INVESTMENT IN COFFEE

Changing the stock of coffee trees owned over time - through planting new trees or removing existing trees - reaps benefits over a future period and as such is an investment decision. The stock of coffee trees a household owns is a function of both the number of trees owned by a household and their age. This can be represented by the vector $K_t(v)$ which gives the number of trees of vintage v at time t [Akiyama 1987].

The coffee production potential, Q , of a household in period t , is given by:

$$Q_t = \delta(t-v)K_t(v) \quad (1)$$

where the vintage of the trees, v , runs from $t-1$ to $t-N$, and N is the age of the oldest tree. $\delta_t(t-v)$ is a vector which gives the yield of each tree of age $t-v$.

[71] In constant 2003 US $.

$$Q_t = \sum_{v=t-N}^{t-1} \delta(t-v) K_t(v) \quad (2)$$

A household can increase its coffee production potential by planting new coffee trees. A coffee tree becomes productive three years after it is planted and remains productive for thirty years at which point its productivity declines. The shape of the yearly yield of a coffee tree against its age is described by Figure age-yield.[72] From this figure it is clear that even without changing the number of coffee trees, a household can invest in its coffee production potential by replacing an old coffee tree with a new tree. Replacement of old trees is an investment in the coffee production potential of a household, as once the new tree becomes productive its yield may be two or three times higher than the old tree.

Changes in the tree stock from period t to $t+1$ are given by.

$$K_{t+1}(v) = K_t(v) - M_t(v) + N_t \quad (3)$$

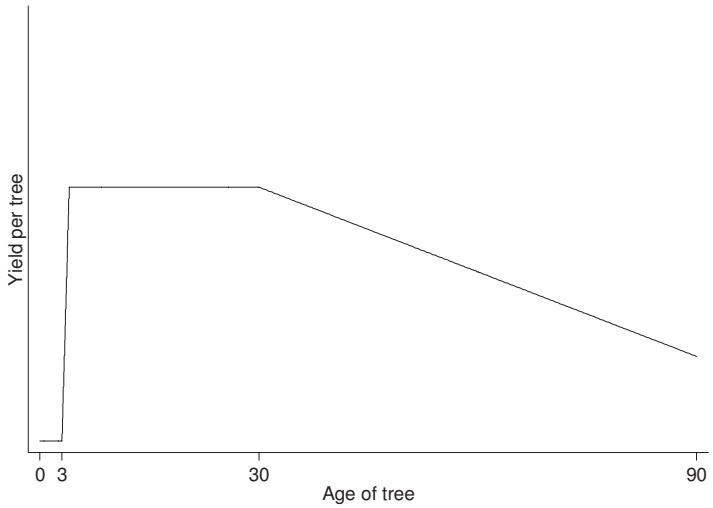
where $M_t(v)$ refers to the number of trees of vintage v removed at time t , and N_t refers to new trees planted. If $N_t = M_t$ the area planted to coffee by a household stays the same, but the household is investing in its coffee production potential while if $N_t > M_t$ the household is not only increasing its coffee production potential but is also increasing the area it plants to coffee. If $N_t < M_t$ the household is reducing the area it plants to coffee.

All coffee farmers own trees and as such have capital stock they can abandon. To the extent farmers own land on which they can plant more coffee trees or can replace some of the old trees they have with new more productive trees, farmers have three courses of action - positive investment, negative investment and zero investment. All of these need to be considered in the models set out.

Four models of investment are considered. The first model sets out a traditional theory of investment as a benchmark case against which to compare the other theories. In reality investment is not as free from friction as this model would suggest because non-constant adjustment costs and uncertain returns influence expansion and contraction of the capital stock. The effect of irreversibility in investment in the face of an uncertain return is considered in model 2 and the nature of adjustment costs and the effect they have on investment decisions are considered in third model. The fourth and final model considers the case of investment under missing markets for credit and insurance.

[72] From information in http://en.wikipedia.org/wiki/Coffee (10th February 2005). http://www.hasbean.co.uk/botany.htm (10th February 2005) and UCTF (2002, p.66).

Figure 1: Age-yield profile of robusta coffee tree



STANDARD INVESTMENT THEORY

As a starting point we consider a standard model of investment as set out by Jorgenson [Jorgenson1963]. This model assumes that there is no constraint to the investment a household can undertake, that investment is fully reversible, and that the return to investment (output, price and cost) is certain and known. When a farmer invests in coffee, he or she undertakes an investment, of cost C which provides a future stream of benefit, denoted by V_t , where

$$V_t = \sum_{s=t+3}^{\infty} \delta^{s-t} q_s (p_s - g_s) \quad (4)$$

and q_t refers to the output of that unit at time t , p_t refers to the per unit price of coffee at time t , g_t is the per unit production cost at time t and δ denotes the per period discount parameter. One part of C is the cost of the coffee tree seedling, but it is the opportunity cost of land lying with no output for three years until the trees bear fruit that makes up the largest part of this cost. The farmer will invest if $V_t(p_t) \geq C$, and the desired level of capital stock Q_t^* will be given by the point at which $V_t = C$. If in any period $Q_t \neq Q_t^*$ the level of capital stock will be adjusted through investment and abandonment as necessary to ensure equality. A household is always at its level of desired capital stock.

Changes in prices and costs will change the desired capital stock and investment / abandonment will result until the desired capital stock is achieved. Any sudden loss in the capital stock as a result of a negative shock (such as losses in coffee trees from wilt disease) will be immediately and completely replaced (other things equal) to ensure the household remains with the optimal level of capital stock.

Implicit in this view is an assumption that the current price is presumed to prevail forever. Changes in prices that do occur come as a surprise and further changes are not assumed. A more natural approach is to assume that farmers have rational expectations about the probabilistic law of motion of their uncertain environment. Likewise full reversibility of investment is a strong assumption that does not often hold, and a model that allows for some degree of irreversibility may be more useful. The next section considers irreversibility and uncertainty in the investment decision.

INVESTMENT UNDER UNCERTAINTY AND IRREVERSIBILITY

One of the features of coffee production is the uncertain price and yield profile a farmer faces and failing to account for this in a model of investment fails to capture an important characteristic of coffee production. Similarly, investment in coffee trees is not fully reversible. The value of the tree cannot be recouped[73], nor can the labour and land invested in its growth. However whilst the value of the tree cannot be recouped, the opportunity cost of the land committed to coffee production that is sunk each period (part of g_t in Equation standard) can be recovered by uprooting coffee trees. As a result complete irreversibility may not accurately capture the investment decision either and a model that allows for some degree of irreversibility in investment is needed.

Dixit and Pindyck [Dixit1994] offer a comprehensive analysis of irreversible investment under uncertainty. The standard Dixit and Pindyck model considers a discrete, irreversible investment undertaken whilst uncertainty surrounding the return to the investment is such that waiting one period will allow the investor to gain information about the future return. The investment can be undertaken this period or in any future period. They show that, for an investment of this nature, it can be optimal to wait before investing even if the present value of investing is equal to the cost of investment. This is because the current value of the return to investment does not cover the additional option value of the investment project that is lost when the investment is made.

The Dixit and Pindyck model introduces uncertainty by assuming the value of the investment follows a geometric Brownian motion such that (in continuous time):

$$dV = \alpha V dt + \sigma V dz \quad (5)$$

where dz is the increment of a Wiener process, α is a parameter that indicates the trend of the process and σ is a parameter reflecting the variance. This law of motion means that although V_t is uncertain, there is some permanence in the return to investment, in that if V_t is high today it is likely to be high tomorrow. In the case of coffee this could come about as a result of uncertainty in the price of coffee, p_t .

Dixit and Pindyck (p.142) show that taking account of the option value of the investment under uncertainty means investment will only take place when

$$V_t \geq \frac{\beta}{(\beta - 1)} C \quad (6)$$

where β (the solution to the fundamental quadratic) is greater than 1 and decreasing in uncertainty, σ . Because $\beta > 1$, the value of the investment that ensures equality in Equation wedge, V_t^{DP} , is greater than the value of the investment, V_t^J , that satisfies $V_t = C$. As uncertainty increases $\frac{\beta}{(\beta-1)}$ increases causing the difference between V_t^{DP} and V_t^J to grow. There is an additional cost to investing under uncertainty, which is the cost of losing the option to wait to learn more about the future price and choosing whether to invest at that point. This option value means there is an incentive to wait to invest as compared to the Jorgenson model.

Whilst the standard Dixit-Pindyck model assumes complete irreversibility of investment the reality probably lies somewhere between this and complete reversibility as in the Jorgenson model. It may be the case that investment can best be characterised by costly reversibility [Abel1996] - abandonment is possible, but it carries a cost. In this case the above result still holds, the option value of waiting is

[73] There are no second hand markets for coffee trees.

present whenever there is any degree of irreversibility (i.e. any difference between the purchase cost, C_I , and the sale value, C_A , of capital)[74]. Abandonment also carries an option value. Abandoning capital stock this period means foregoing the option to disinvest in a future period. Current capital stock can really be viewed as a composite asset - it has a value as a result of the future flow of profit it produces, but it also has value as an option to abandon. This additional option value means the current value of the future flow of profits has to fall below C_A by the value of this option before the capital will be abandoned.

When investment is irreversible to some extent, V_t at which investment and abandonment take place diverge. When, in addition, uncertainty is present, the reluctance to invest in new capital and abandon existing stocks causes the wedge between the price at which investment and abandonment takes place to grow.

For coffee farmers in Uganda the investment decision is a continuous, not a discrete, one - that of how many trees to plant on a given plot of land. The standard Dixit-Pindyck model can be extended to consider the case of incremental investment and capacity choice [Dixit1994] by conceptualizing each successive unit of capital as a distinct investment project. For each conceptually distinct project, values of V_t at which investment and abandonment take place can be derived as in the single discrete project case - these threshold values of V_t take into account the cost of losing the option value of investment and the option value of abandonment. Decreasing returns are usually assumed to exist either as a result of the shape of the production function or as a result of the fact that the producer faces a downward sloping supply curve[75]. Successive units of capital with successively lower marginal products, will thus require higher and higher threshold values. The result is a curve linking the stock of capital and the threshold values of V_t or the stochastic variable - in this case p_t , illustrated in Figure 2.

For a given level of the capital stock, when p_t lies between the investment threshold (p_I) and the abandonment threshold (p_A), such as point A , no investment or abandonment is observed. However if the price rises above p_I to point B , the capital stock is increased to bring the household to the investment threshold. Conversely, if the price falls below p_A to point C , abandonment of the capital stock takes place until the household is at the abandonment threshold. Changes in the price that do not cause the level of capital stock to rise above the investment threshold or below the abandonment threshold do not elicit a change in the capital stock.

This means that for a iven level of capital stock, the investment schedule in Figure 3 is observed. When the price falls between p_A and p_I no investment is undertaken, only for a price above p_I or below p_A is investment or abandonment observed. The option value of investment and abandonment,

---

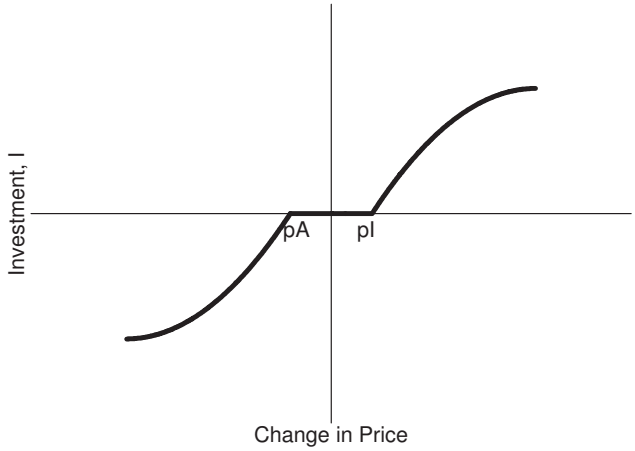
[74] This is likely to be the case for coffee trees. For positive investments in coffee trees the purchase cost (C_I) can be thought of as incorporating the costs of buying the seedlings, the labour of planting the seedlings, and the opportunity cost of the land they are planted on. For negative investment the sale value (C_A) is the opportunity cost of the land the trees are planted on less the labour used in uprooting the trees.

[75] If there are regions of non-decreasing returns, a threshold value that justifies an increase in capital may justify others, and as a result the investment policy will yield some sudden jumps in the stock of capital to cross the regions of constant or increasing returns.

and thus the price range over which inactivity is observed, increases with uncertainty about the price, and increases with the degree of irreversibility (i.e. the greater the gap between C_I and C_A)[76].

Figure 2, also illustrates what happens in the event of a negative shock to the capital stock (such as coffee wilt in the case of coffee trees). If the price is much below p_I for a given level of capital stock, a shock could, other things equal, result in no compensatory investment. The household although not realising a price low enough to merit abandonment, does not realise a price high enough to encourage investment in the capital stock which is what replacing the capital stock lost would amount to. Investment will only take place if the fall in the capital stock is large enough to bring the household above the investment threshold. In that case investment will be undertaken to bring the household back to the threshold. Only if the price is at p_I will there be full replacement of capital stock lost.

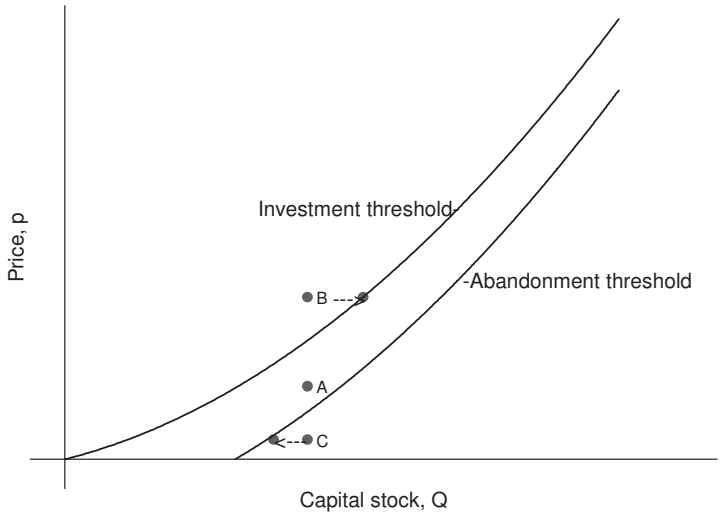
Figure 2: Investment and abandonment treshold for investment decisions made under uncertainty



These first two models offer different predictions about the relationship between prices, shocks and investment. Neither of these models have considered non-linearities that might be present in acquiring or abandoning capital. The implications of such non-linearities are set out in the following section.

[76] In the extreme case of full irreversibility the salvage value of capital stock held is zero. As a result, under full irreversibility, there is no abandonment threshold and the capital stock only changes if the price rises above p_I for a given capital stock.

Figure 3: Investment under uncertainty



INVESTMENT UNDER NON-LINEAR COSTS

Whilst standard investment theory predicts the capital stock will rapidly respond to changing economic conditions, in reality observed investment response is more gradual. Jorgenson suggested an exogenous rate of capital stock adjustment exists limiting the amount of capital stock adjustment that can take place in one period of time. An endogenous rate of capital stock adjustment dependent on the level of the capital stock and the size of the adjustment was introduced by the adjustment cost models of Lucas (1967) and Gould (1968). Adjustment cost models suggest the marginal cost of investment is an increasing function of the rate of investment resulting from the cost of changing the capital stock too rapidly. As a result adjustment costs are convex in ΔQ , increasing as investment increases, and act to limit the amount of investment undertaken in any given period. Some models also assume adjustment costs are lower at higher Q . As a result of the increasing marginal cost of investment, the investment schedule in response to changes in price will look something like Figure 4 or Figure 5 if uncertainty or irreversibility is present[77].

[77] Even if constant marginal returns to capital are present.

Figure 4: Investment with adjustment costs

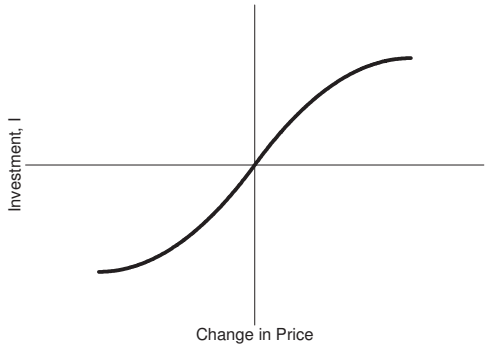
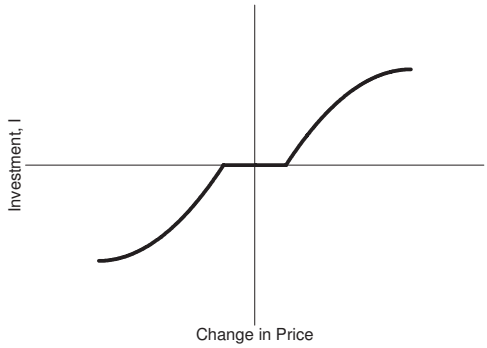


Figure 5: Investment with adjustment costs under uncertainty



A more general model of investment under uncertainty with non-linear costs of investment (which incorporates the possibility of convex adjustment costs as a specific case) was set out by Abel and Eberly [Abel1994andEberly]. They highlight three possible types of costs that are incurred when investment is undertaken: purchase or sale costs, fixed costs and costs of adjustment per unit time. Purchase or sale costs are the costs of buying (C_I) and selling (C_A) a unit of capital.[78] If irreversibility is present $C_I \; ? C_A ? 0$ and:

$$\begin{cases} C_I \Delta Q & \text{if } \Delta Q > 0 \\ -C_A \Delta Q & \text{if } \Delta Q < 0 \end{cases} \quad (7)$$

Fixed costs of investment are non-negative costs, independent of the amount of investment, and incurred whenever investment (positive or negative) is undertaken. Fixed costs of investment (F_I) may differ from fixed costs of abandonment (F_A)

$$\begin{cases} F_I & \text{if } \Delta Q > 0 \\ F_A & \text{if } \Delta Q < 0 \end{cases} \quad (8)$$

The adjustment cost function captures the increasing marginal cost of investment and is given by

[78] For coffee the cost of buying capital comprises the cost of the tree and the cost of the land lying unproductive for three years. The cost of selling a unit of capital is the discounted value of recovering the land sunk into coffee when trees are planted on it.

$$\begin{cases} A_I(Q,\Delta Q)\Delta Q & \text{if } \Delta Q > 0 \\ A_A(Q,\Delta Q)\Delta Q & \text{if } \Delta Q < 0 \end{cases} \quad (9)$$

Adjustment costs may or may not be differentiable at $\Delta Q = 0$ depending on whether adjustment costs are the same for a small increase in investment as they are for a small decrease in investment, i.e. whether $A_I'(Q,0) = A_A'(Q,0)$.[79]

Consider an augmented adjustment cost function which incorporates all three of these types of costs:

$$C(Q,\Delta Q) = \begin{cases} [C_I + A_I(Q,\Delta Q)]\Delta Q + F_I & \text{if } \Delta Q > 0 \\ 0 & \text{if } \Delta Q = 0 \\ [-C_A + A_A(Q,\Delta Q)]\Delta Q + F_A & \text{if } \Delta Q < 0 \end{cases} \quad (10)$$

For a given p and level of uncertainty, the threshold levels, p_A and p_I , are determined by the augmented adjustment cost function. Abel and Eberly show that a range of inaction (i.e. a wedge between p_A and p_I) is caused by two aspects of this augmented cost function. The first is that $C_I + A_I(Q,\Delta Q)$ and $-C_A + A_A(Q,\Delta Q)$ do not approach the same limit as $\Delta Q \to 0$. This results from the presence of uncertainty and irreversibility (as in the above section) and also because $A_I'(Q,0) \neq A_A'(Q,0)$. Non-linear adjustment costs thus compound the range of inaction observed in Figure DPinvestment. Fixed costs are the second cause of inaction. Fixed costs of investment mean that the change in capital stock has to be large enough that the return to increased capital covers the fixed as well as the variable costs. This means the presence of fixed costs increases any range of inaction present as a result of uncertainty and irreversibility, but also changes the nature of the inaction (see Figure FCinvestment) as small amounts of investment do not occur.

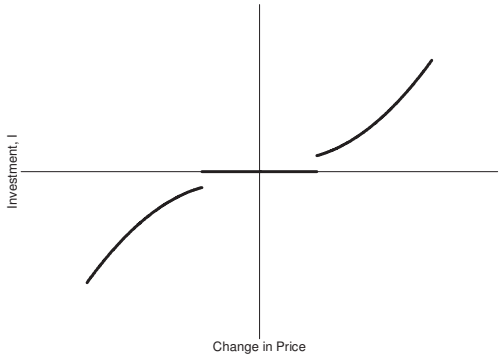
The effect of non-linear costs on adjustment outside of the period of inactivity depends on the nature of adjustment costs. If adjustment costs predominate a large change in the price will be realised in proportionately smaller changes in the stock (as in Figure ACDPinvestment). If fixed costs predominate, small changes in the capital stock will not be made but large enough price changes will be realised in proportionately large changes in the capital stock (as in Figure FCinvestment). Similarly, the effects of adjustment costs on the household's response to a negative shock to the capital stock will depend on the nature of the costs. When convex adjustment costs predominate a concave relationship between the number of trees lost and investment will be observed, whilst when fixed costs predominate the relationship will be convex.

[79] In this context convex costs of adjustment costs might arise as a result of limited availability of seedlings, limits to the amount of money available to spend on purchasing seedlings, limited labour available to cut down trees, or the increasing cost to a household of land lying without a return for three years. An example of a fixed cost of investment for coffee farmers could be the cost of travelling to buy seedlings to plant, or may reflect the finding of much econometric evidence which suggests that behaviour is inertial. Any lumpiness in transaction costs -even implicit costs such as searching for information and prices - can result in the "optimality of usually doing nothing" [Bar-Ilhan1992].

INVESTMENT UNDER LIQUIDITY CONSTRAINTS

The models of investment considered thus far have assumed households are unconstrained in their ability to invest, yet credit constraints have been shown in numerous studies of investment in a developing country context to be a significant determinant of investment. Credit constraints are common among the rural poor and as a result, investment by farmers in developing countries must often be self-financed. To the extent that the ability to self-finance investment varies across households we may see variation across households by wealth with regard to how much they invest. Richer households will be more able to self-finance investment than poorer households and as a result may be more able to invest in coffee trees.

Figure 6: Investment under non-linear costs when fixed ocsts predominate



In addition, in the presence of insurance market failures and the uncertain environment farmers in developing countries face, the need for an irreversible investment to be self-financed runs counter to the need for farmers to maintain savings in liquidable form as a means of self-insurance when times are hard, as the investment is no longer a liquidable asset that can be sold for cash when needed. When the investment being made is indivisible, these conditions create an additional incentive to wait to invest. This was modelled by Fafchamps and Pender to explain the lack of investment in wells in India and is the fourth model of investment considered here [Fafchamps 1997].

Wells are an indivisible and irreversible form of investment. Uncertain returns to investment in wells is assumed, but the model departs from the model of investment under uncertainty set out above in that no additional information about the return to investing in wells is learned by waiting: what is known about the return to well production today is known tomorrow. However, Fafchamps and Pender show that in the presence of credit constraints there is a premium to liquidity that acts as a deterrent to indivisible investment since the agent must accumulate enough savings, not only to finance the cost of the investment itself, but also the amount of liquid wealth it wishes to hold as a precautionary saving. Liquidity constraints thus constrain changes in the capital stock, but they are an asymmetric constraint as they only limit investment, not abandonment. Unlike investment in wells, investment in coffee trees is very divisible. However fixed costs, if present, would impose some form of indivisibility on investment in coffee. In this case we would find an incentive to wait to invest as a result of liquidity constraints also.

This model is agnostic about the effects of price changes on the capital stock, in that the conclusions hold whether or not the uncertain investment return satisfies the properties of a Weiner process. This model predicts that should price changes encourage households to increase their capital stock, it will only be the wealthier households that are able to. This model also suggests that in the presence of a shock to the capital stock, only richer households with high enough liquidity will replace the capital lost.

DISCUSSION: PRICE CHANGES AND SHOCKS TO THE CAPITAL STOCK

The four models of investment presented predict different investment response to changes in prices or shocks to the capital stock. These varying empirical predictions are summarised in Table modelpreds and highlight three questions that need to be answered to determine which model best explains investments in coffee trees: is there an area of inaction, is there evidence of fixed costs of investment, and do poor and rich farmers invest in coffee trees alike?

First we need to determine whether there is an area of inaction commensurate with a model of uncertain and irreversible investment. Whilst standard investment theory (model 1) predicts changes in the cost and return to investment result in immediate changes to the capital stock, immediate changes are not necessarily observed in models that allow for uncertainty and non-linear costs. If changes in the price and shocks to the capital stock of all sizes elicit an investment or abandonment response by the household, the predictions of the standard investment model are correct. However, if there is some area of inaction, in which small price changes do not elicit a change in the capital stock, models 2 or 3 may be correct. This question can be determined by looking at whether changes in the return to investing in coffee and shocks to the number of coffee trees are important in explaining a household's decision to invest in or abandon coffee trees, and by determining whether econometric models that allow for a period of inaction fit the data well.

We begin by estimating the following regression based on the standard investment model:

$$\Delta Q_i = \beta_0 + \beta_z z_i + \beta_p \Delta p_i + \beta_g \Delta g_i + \sum_{j=1}^{N} \beta_j S_{ji} + \beta_Q Q_i + \varepsilon_i \quad (11)$$

where ΔQ_i refers to the net investment in the coffee production potential of the household, z_i represents the number of trees lost to coffee wilt in period t, Δp_i reflects heterogeneity in price changes across households in period t, and Δg_i reflects heterogeneity in the cost of production changes across households (here this is the change in land to labour ratio as coffee is relatively labour intensive). S_i is a vector of household characteristics that might reflect varying costs of investment across households. Because there is a natural limit to the minimum and maximum number of coffee trees that can be planted in a given area (it cannot go below 0 or above about 900 per acre) the initial stock of coffee trees might affect how much investment is undertaken. The initial value of Q, Q_i, is included to control for this. If the standard investment model is correct this model would fully explain abandonment and investment in coffee trees.

Under the standard investment model β_p will be positive and significant and β_g will be negative and significant. In models which allow for uncertainty and non-linear costs of adjustment there may be a range of values for which changes in price do not result in increased or decreased investment and as a result an insignificant β_p and β_g, although not necessarily predicted by these models, would be consistent with their conclusions. We would also expect β_z to be positive and significant, and other things equal, not significantly different from 1 in the standard investment model, whilst an insignificant β_z or a value different from 1 could be explained within models 2 to 4.

Consider Figure friction. The bold line indicates the type of inaction caused by models 2 and 3 whilst the thin line indicates the type of inaction that would be observed in a model of reversible investment under certainty and fixed costs (i.e. model 3b modified to consider a reversible investment in a certain world). As we can see from this figure if any one of models 2, 3a and 3b is correct there will be a shift in the regression line at $\Delta Q_i = 0$.

This allows us to test the standard investment model against models 2 and 3 by running the following regression:

$$\Delta Q_i = \beta_0 + \beta_z z_i + \beta_p \Delta p_i + \beta_g \Delta g_i + \beta_I I_i + \sum_{j=1}^{N} \beta_j S_{ji} + \beta_Q Q_i + \varepsilon_i \quad (12)$$

where I takes the value 1 if $x_i\beta$ is positive and the value 0 if $x_i\beta$ is negative ($x_i\beta$ comes from estimation of the model when β_I is constrained to be zero). If any of models 2, 3a and 3b are correct β_I will be negative and significant. A more correct test comes from using an estimation approach which allows for a positive probability mass in the distribution at zero investment. Almost a quarter of the households studied neither increased or decreased their capital stock so it is important to take account of these zero investment observations in the empirical analysis by using an econometric specification that allows for a positive probability of observing zero. Rosett [Rosett1959] provides a general model of a limited dependent variable in which the positive probability mass can occur at any point along the distribution. This model of "friction" as he calls it, allows us to model a positive probability mass in the distribution at zero investment. A test of the significance of the parameter, c, estimated as part of this model provides a test of friction in the model which is commensurate to testing the relevance of models 2, 3a or 3b for Ugandan coffee farmers' investment in coffee.

Secondly it is important to determine whether there are fixed costs to investment. Consider first the presence of fixed costs as set out in model 3b. The presence of fixed costs increases the range of inaction present and causes small changes in the capital stock not to be observed. The presence of fixed costs can thus be tested by looking at whether the area of inaction present in the data is consistent with a model which does not allow small changes in the capital stock to be observed. A modified version of the Rosett model can be used to estimate investment and abandonment decisions under model 3b.

Also, when fixed costs are present a higher proportion of capital lost will be replaced when losses are larger. In this case the introduction of a squared term of the negative shock would be positive and significant. If convex adjustment costs are present, a smaller proportion of trees lost will be replaced when high numbers of trees are lost. In this case the introduction of a squared term of the shock would be negative and significant.

Thirdly, to determine whether a model of liquidity constraints as relevance to this context, we need to determine whether rich and poor farmers invest in coffee trees alike. If liquidity constraints are present only richer households will be able to invest. Evidence that households in the top wealth decile are more able to undertake positive investments than households in the bottom decile would confirm the presence of liquidity constraints.

Table 2: Emperical predictions of investment models

Model	Price changes	Shocks to the capital stock
(1) Standard model	Any price increase induces investment; any fall in the price results in abandonment.	All capital lost is replaced; other things equal, coefficient of 1 on capital lost.
(2) Irreversibility and uncertainty	An area of inaction is present (see Fig. DPinvestment); beyond this area thee relationship between price and capital stock changes depends on rate of return to capital	An area of inaction is present; other things equal, not all capital lost is replaced; linear relationship between capital lost and replaced.
(3a) Non-linear costs: Convex adjustment costs	An area of inaction is present (see Fig. ACDPinvestment); beyond this area a concave relationship between price and capital stock changes exists.	An area of inaction is present; other things equal, not all capital lost replaced ; concave relationship between capital lost and replaced.
(3b) Non-linear costs; fixed costs (concave)	Samll changes in the capital stock are not observed and area of inaction is increased (see Fig. FCinvestment); beyond this area a convex relationship between price and capital stock changes exists.	Small changes in the capital stock are not observed and area of inaction is increased; other things equal, not all capital lost is replaced; convex relationship between capital lost and replaced.
(4) Liquidity constraints	For price changes that induce investment, investment is only observed in wealthy households; when fixed costs are present a range of inaction exists.	Wealthier households replace a larger share of capital lost; when fixed costs are present a range of inaction exists.

APPLICATION TO DATA

Data on a sample of 300 coffee farmers drawn from four districts of Uganda is used to look at the effects of price changes and capital stock shocks on abandonment and investment in coffee trees. Data was collected by the author with the Uganda Bureau of Statistics at the beginning of 2003 in four districts (Mukono, Luwero, Masaka and Bushenyi) that combined are responsible for about 50 percent of all Robusta coffee produced in Uganda. The sample of coffee producers was drawn randomly from a sampling frame constructed from a national household survey conducted in 1999/2000 which was used to identify coffee farmers. As the period between the baseline and the follow up survey was relatively short, there was little attrition resulting from death or migration. Most households were still in existence within the village and it was relatively easy to trace them.[80] Questions on production and household characteristics that were asked in 1999/2000 were repeated allowing a small panel to be generated. In addition data on the number of coffee trees owned and lost to wilt in the last three years was collected. The majority of coffee grown in Uganda is grown by small holders, and this was true for this sample also, with more than two-thirds of the households owning land less than or equal to five acres. Household heads of coffee-producing households tend to be older than the national average, at 50 years. The mean level of education of household heads is 5 years.

Summary measures of the variables used in the analysis and described below are presented in Table descriptives. As can be seen from the table on average the price of coffee relative to other crops has fallen by over as third, and on average 30 % of trees have been affected by coffee wilt disease. Whilst 95% of farmers reported removing some trees, only 31% of farmers reported removing trees for

[80] The data were collected by a team from the Uganda Bureau of Statistics in collaboration with the Centre for the Study of African Economies at Oxford University. Funding was provided by the World Bank.

reasons other than coffee wilt disease. The proportion of trees removed is also much lower when trees are removed for reasons other than disease. Coffee wilt disease is thus a significant random shock to the number of trees the household holds. The substantial price changes and the high incidence of coffee wilt underlines the importance of understanding households' response to these changes. Table descriptives also shows the number of coffee trees per hectare has fallen from 150 to 101 trees per acre over the last three years (a fall of 32.7%), although this is largely explained by the high numbers of trees lost to coffee wilt, which was on average 45 trees per household. Per capita liquid wealth fell slightly from 1999 to 2002 and the ratio of land to labour increased.

Table 3: Descriptive statistics

	1999	**2002**
Number of trees per acre (average)	150	101
Number of trees lost to coffee wilt, per acre (average)	45	
Future production potential (average)	164	95
Liquid wealth per capita (constant US $) (median)	248	230
Land to labour ratio (median)	1	1.275
Relative price of coffee (median)	1.875	1.194
UCDA programme dummy	0.685	
Share of trees lost to wilt (average)	0.305	

The production potential of a coffee tree depends on its age. A newly planted tree has the most potential, whilst a tree at the end of its productive life has little production potential. The relationship between the productive potential of a tree and its age is shown in Figure age-yield. Whilst detailed data on the age profile of coffee trees held by a household is not known, we know whether they are newly planted or at the end of their productive life which allows the following weighting function to be used loosely corresponding to the age-yield curve ("total" refers total number of trees, and "old" refers to trees classified as at the end of their productive life by the farmer):

$$Q_i = total_i - 0.8 * old_i \quad (13)$$

Using this formula we see the future coffee production potential fell more than the number of trees between 1999 and 2002. The difference in coffee production potential between 1999 and 2002 provides a measure of net investment in coffee production over this three year period. The shock to coffee production potential and the change in relative coffee price are also measured between these two points in time. The measure of wealth used and other characteristics of the household used as controls are values recorded in the 1999/2000 survey.

The number of trees lost to wilt divided by the household's endowment of land provides a measure of shock to the capital stock the household experienced between the two years. The number of trees per acre in 2000 is also included in all regressions to control for any possible effect of the initial stock levels on investment and abandonment undertaken as a result of the natural limit on the minimum and maximum number of trees per acre.

The measure of price, p_t , that is of relevance to the decision of how many trees to hold is the expected future relative price of coffee compared to other crops that could be grown by the household. Reported expected prices were collected for only the latter round of the survey, and so for this analysis current price is used. As it is the relative price of coffee to other crops the household could grow and sell that is of importance, the price used is a ratio of the coffee price to an average per kilo price of other crops grown by the household.

Although technology is assumed constant across households, if coffee production is more or less labour intensive than other crop production and markets are not perfect for either labour or land, technological considerations will be of importance in the household's decision as to how many coffee trees to hold. Changes in this ratio reflect changes in the relative cost of coffee production for the household, and are thus an incentive to change the number of coffee trees held. To allow for this possibility the change in land to labour ratio is included (measured by a ratio of total cultivatable land owned to available household labour[81]) as a measure of changing costs of production for the household.

Per capita liquid wealth is a measure of the household's liquidity. Data on per capita liquid wealth was used to split the sample into wealth percentiles. To examine the effect of liquidity constraints the investment response of households was allowed to vary for households in the bottom 10% and top 10% of the distribution.

The costs of positive investment vary across households in Uganda. The majority of seedlings are procured from three different sources and the costs vary across them. Seedlings can be home-grown, they can be bought from a nearby nursery (if there is one), or they can be provided by the Ugandan government through the Uganda Coffee Development Authority (UCDA). In recent years, in an effort to alleviate poverty and provide assistance to coffee farmers, the Ugandan government and UCDA have established a programme to distribute coffee tree seedlings for free to farmers. The programme does not operate in all areas, but is active in some parts of all regions sampled in the survey. As a result of this programme some coffee farmers have ready access to free seedlings. To control for this variation in costs of investment a dummy is included that takes the value of 1 if a UCDA coffee seedling programme was recorded as being present in the village over the period 1999 - 2002.

Expectations about the quantity of coffee a household will receive from a given tree will vary across regions, and perhaps also with farmer characteristics. To control for this regional dummies and characteristics of the household head - age (in case life-cycle effects impact the discounted return to investment) and years of education (shows agricultural productivity varies across education levels) - are included in the regressions. It is also important to control for the type of tenure security households face in the analysis as households with less secure tenure may face different incentives to invest [Place2002]. A dummy taking the value 1 if the household has security of tenure on the plots of land on which coffee is planted, and 0 if there is not security of tenure (customary land, public land, squatters and leaseholders) was included in all regressions.

[81] Available households labour is calculated as the number of household members older than 14 and able to work multiplied by 312 days.

RESULTS

We begin by examining whether a period of inactivity characterizes the investment response of households. At first we consider this using a standard OLS specification and testing for a shift in the regression line between abandonment and investment. Shifts in the regression line would be commensurate with any models of investment in which uncertainty or irreversibility is present. Table results A reports results for investment as measured using the change in wilt adjusted coffee production potential as the dependent variable. First an OLS regression is run, then we allow for a shift in the regression line between the north east and south west quadrant. The results are shown in the first two columns of Table results A and indicate there is a shift in the regression line as any one of models 2, 3a and 3b would suggest. The dummy reflecting a shift in the regression line is significant at 5%.

Table 4: OLS and Tobit regression results, standard errors are corrected for clustering at the village level in columns 1 to 4 (* denotes significant at 0.01, ** at 0.05, * at 0.1 and ' at 0.15)**

Dependent variable= ΔQ (net of wilt shocks) per acre	**(1) OLS**	**(2)**
Trees lost to wilt per acre	0.207	0.218
	(0.102**)	(0.102**)
Δ relative coffee price	3.783	4.808
	(1.658**)	(1.845**)
Δ ln (land to labour ratio)	-2.445	-3.434
	(1.850)	(2.002*)
UCDA dummy	4.336	4.295
	(4.507)	(4.474)
Stock of trees (per acre)	16.371	18.293
	(12.287)	(12.646)
Age of head	0.1439	0.195
	(0.186)	(0.193)
Education of head	1.735	2.180
	(0.584***)	(0.726***)
Tenure security dummy	-0.096	-1.313
	(2.955)	(3.276)
Constant	-3.067	8.655
	(8.545)	(7.865)
Dummy for $x\beta > 0$		-15.698
		(7.713**)
Regional dummies included, but not shown		
Number of observations	277	277
F-test (or χ^2 for Tobit)	2.04**	1.96**
R-squared	0.2568	0.2667

The results also show the change in price is significant and positive, although whilst the coefficient on the change in land to labour ratio is negative as predicted it is not significant. The shock to coffee trees is significant and positive as the standard investment model would predict. The initial stock of coffee trees is not significant which suggests there is no difference in investment across households as a result of a varying stock of coffee trees. Surprisingly, the UCDA dummy is also insignificant which

implies the cost of investing in coffee production does not vary across villages dependent on whether the UCDA programme is present, suggesting the cost of seedlings is not one of the main costs. The age of household head and a dummy reflecting tenure security are also insignificant, although the coefficient on years of education of the household head is positive and significant.

Results from estimates of models of friction are presented in Table results B. In these models a threshold effect is estimated and the significance of this effect indicates whether a range of inaction is present. These models allow us to consider both a shift in the regression line predicted by models 2, 3a and 3b, and the absence of small changes in the capital stock as predicted by model 3b. Results for a model which allows a shift in the regression line are presented in the first column. The threshold effect is significant indicating a shift is observed and a range of inaction is indeed present. Comparing these results with columns (1) and (2) of Table resultsA shows also that allowing for bunching of values at zero increases the magnitude of coefficient estimates on price change and shocks to the capital stock as we would expect. However the change in land to labour ratio is insignificant and positive. Otherwise the results are unchanged.

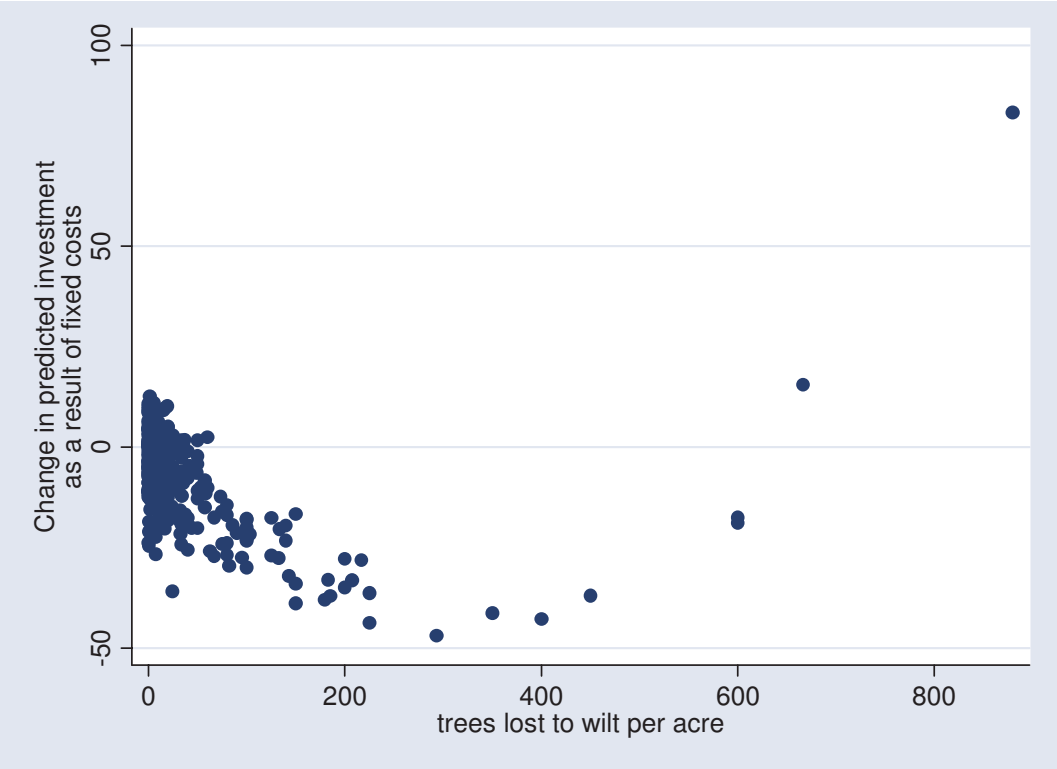
Table 5: Rosett model results model results allowing for a period of inaction, standard errors are corrected for clustering at the village level (* denotes significant at 0.01, ** at 0.05, * at 0.1 and at 0.15)**

Dependent variable = ΔQ (net of wilt shocks) per acre	**(1)**	**(2)**
Trees lost to wilt per acre	0.233	0.238
	(0.099**)	(0.100**)
Δ relative coffee price	5.947	5.822
	(2.48**)	(2.259***)
Δ ln (land to labour ratio)	1.534	-7.752
	(2.724)	(2.922***)
UCDA dummy	8.696	8.084
	(7.319)	(5.686)
Stock of trees (per acre)	21.369	16.921
	(14.170')	(11.493')
Age of head	0.031	0.213
	(0.252)	(0.247)
Education of head	2.603	1.985
	(0.829***)	(0.743***)
Tenure security dummy	-4.107	0.372
	(5.803)	(5.109)
Constant	16.059	17.136
	(14.06)	(9.702*)
Dummy for $x\beta > 0$		-22.253
		(9.784**)
Threshold effect, τ	31.465	314.780
	(7.081***)	(120.72***)
Variance of threshold effect, σ		
Regional dummies included, but not shown		
Number of observations	277	277
Wald χ^2	23.13**	24.88**

Column (2) of Table results B presents results for the threshold model which allows for fixed costs under uncertainty - i.e. allowing for bunching at zero, and a shift in the regression line. The results are very similar to those in the first column. One major difference, though, is that the coefficient on change in the land to labour ratio is significant and negative as predicted. The threshold effect (c) is significant and positive in this model also which indicates fixed costs are present. The significance of the shift dummy indicates that a model of fixed costs with uncertainty and irreversibility is preferred to a model of fixed costs without uncertainty and irreversibility, but as models in columns (1) and (2) are non-nested Vuong's test of non-nested models is needed to determine which of the two models is a better fit. The test was calculated for the model in column (1) against the model in column (2) and was -11.57. The null hypothesis that the two models equally fit the data can thus be rejected in favour of the model in column (2) at 1% degree of significance.

Combined, these results suggest a range of inaction is present in the investment / abandonment response of households. It appears the investment decision can be characterised by irreversibility, uncertainty and fixed costs. To test for the presence of fixed costs further, a squared term of the trees lost to wilt was included in all estimation models. The results are not shown to conserve space but we find that in both an OLS specification, and a specification that allows for bunching at zero, the squared term is significant and positive which is indicative that fixed costs are present. Whilst it is unlikely that such a relationship is present over the entire range of values z_i could take, it seems it is observed in the data here. To get an idea of the impact of fixed costs on the investment decision predicted values from a model with no fixed costs and a model with fixed costs are compared in Figure fc comparison. Whilst for some households allowing for fixed costs does not change predicted investment, for a number of households allowing for fixed costs reduces the amount of investment predicted by the model.

Figure 7: Change in predicted investment in coffee production capacity per acre as a result of allowing for fixed costs in the estimation



The presence of liquidity constraints in limiting the investment response of the household is tested by allowing the household's response to the number of trees lost, change in price and change in cost to vary across wealth levels. Table results D shows these results (OLS results are presented in the first column, the modified Rosett results in the second column). On first inspection the results are somewhat inconclusive. We see that the replacement of trees lost to wilt is lower for the poorest households in our sample, and households in the 10th to 100th percentile replace more trees lost to wilt. However the number of trees replaced by the top decile is not higher than the share of trees replaced by households in the 10th to 90th percentile (in fact, in the first two specifications the number of trees replaced by the top decile is only weakly significantly different from households in the bottom decile) which suggests credit constraints affect mainly the poorest households. The impact of wealth on changes in prices and costs does not support this conclusion however. There is no significant increase in investment response to changes in price by richer households. In fact, in two specifications the data shows richer households respond less to changes in price than poorer households. Given three-quarters of the sample experienced the relative price of coffee falling during this time, and given liquidity constraints do not constrain abandonment, this is perhaps not surprising. Similarly two-thirds of households experienced a rise in the land to labour ratio (and thus the relative cost of producing coffee) during this time. It may be that the best indication of the presence of liquidity constraints is a differential response to coffee wilt disease across households. If this is the case there is some limited support in the data of the presence of liquidity constraints for the poorest households.

Table 6: Testing for the presence of liquidity constraints, standard errors are corrected for clustering at the village level (* denotes significant at 0.01, ** at 0.05, * at 0.1 and ' at 0.15)**

Dependent variable = ΔQ (net of wilt shocks) per acre	(1)	(2)
Trees lost to wilt per acre	-0.313	-0.268
	(0.050***)	(0.062***)
trees lost (10 th - 90 th 'tile)	0.248	0.260
	(0.056***)	(0.064***)
trees lost (90 th - 100 th 'tile)	0.191	0.201
	(0.129')	(0.128')
Square of trees lost to wilt per acre	0.001	0.0005
	(0.0001***)	(0.0001***)
Δ relative coffee price	8.036	7.943
	(2.148***)	(2.552***)
Δ relative coffee price (10 th - 90 th 'tile)	-4.276	-3.633
	(2.009**)	(2.617)
Δ relative coffee price (90 th - 100 th 'tile)	-3.043	-4.302
	(8.076)	(11.036)
Δ ln (land to labour ratio)	-1.109	-1.560
	(2.022)	(2.469)
Δ ln (land to labour) (10 th - 90 th 'tile)	-3.481	-4.505
	(2.233')	(2.751')
Δ ln (land to labour) (90 th - 100 th 'tile)	2.879	-8.632
	(10.52)	(15.920)
UCDA dummy	7.344	8.225
	(4.280*)	(5.665')
Stock of trees (per acre)	13.89	13.253
	(8.936')	(8.660)
Age of household head	-0.020	-0.006
	(0.138)	(0.182)
Education of household head	1.530	1.441
	(0.582***)	(0.711**)
Tenure security dummy	0.818	0.525
	(2.913)	(5.551)
Constant	15.316	18.651
	(8.796*)	(11.27*)
Dummy for $x\beta > 0$	-12.817	-13.90
	(4.415***)	(6.331**)
Threshold effect, τ		207.6
		(35.92***)
Variance of threshold effect, σ		
Regional dummies included, but not shown		
Number of observations	277	277
F-test or Wald χ^2 test	F(19, 62) = 5.47***	χ^2 (19) = 100.95***
R-squared or $\ln L$	0.4995	-975.91523

CONCLUSION

In summary, the empirical results suggest that despite the recent fall in the coffee price households do want to replace some trees lost to coffee wilt disease. However, full replacement is not observed, and it also appears households have responded to falling net returns to coffee by abandoning existing stocks. Overall the results are consistent with a model of investment in which uncertainty and irreversibility characterise the investment decision, and fixed costs of investment are present. In terms of Table modelpreds the data seem broadly consistent with model 3b, and there is some evidence that is consistent with investment behaviour as predicted by model 4.

There is some evidence that poorer households are less able to replace diseased trees despite controlling for the availability of free seedlings, but the results are inconclusive and suggest the need for further research. If it is the case it indicates a significant cost of investment in trees is the cost of land lying with no output for three years. Policies that provide credit or finance to households that undertake investment in trees for these first three years may be crucial in enabling investment for many of these households.

The analysis suggests that were fixed costs reduced, households' investment (and abandonment) in coffee would respond more quickly to changes in the fundamentals. However, further work is needed to identify what these fixed costs are and thus what policy response would appropriate to help alleviate these.

The analysis has also shown there is some friction present in changes made to the capital stock consistent with predictions of a model of irreversible investment under uncertainty. In this paper it has not been possible to determine the extent to which reluctance in household stock adjustment stems from the presence of uncertainty, as opposed to the irreversible nature of investment in coffee, but the observed relationship indicates a policy which allows a household to be more certain of its future return from coffee production may encourage a more responsive investment strategy.

REFERENCES

Abel, A. B. & Eberly, J. C. (1994). A unified model of investment under uncertainty. In. American Economic Review 84 (5), 1369 .1384.

Abel, A. B. & Eberly, J. C. (1996). Optimal investment with costly reversibility. In. Review of Economic Studies 63, 581.593.

Agricultural Policy Secretariat (1999). Report on economics of crops and live-stock production, processing and marketing 1998/99. Agricultural Policy Committee of the Agricultural Policy Secretariat (APSEC), Government of Uganda.

Akiyama, T. & Trivedi, P. K. (1987). A new global tea model: Specification, estimation and simulation. World Bank Staff Commodity Working Papers. No. 17.

Appleton, S. (2001a). Changes in poverty and inequality. In R. Reinikka and P. Collier (Eds.), Uganda.s Recovery: The Role of Farms, Firms, and Government, pp. 83.121. Washington DC: World Bank.

Appleton, S. (2001b). Education, incomes and poverty in Uganda in the 1990s. CREDIT Research Paper No. 01/22.

Appleton, S. & Balihuta, A. (1996). Education and agricultural productivity: Evidence from Uganda. In. Journal of International Development 8 (3), 415. 444.

Asano, H. (2002). Costly reversible investment with fixed costs: An empirical study. In. Journal of Business and Economic Statistics 20 (2), 227.240.

Bank of Uganda (2001). Annual Report 2000 - 2001. Kampala, Uganda. 27

Bar-Ilan, A. & Blinder, A. (1992). Consumer durables: Evidence on the optimality of usually doing nothing. In. Journal of Money, Credit and Banking 24 (2), 258.272.

Caballero, R. J., Engel, E. & Haltiwanger, J. C. (1995). Plant-level adjustment and aggregate investment dynamics. In. Brookings Papers on Economic Activity 1995 (2), 1 .39.

Deaton, A. & Laroque, G. (1992). On the behaviour of commodity prices. In. Review of Economic Studies 59 (1), 154 .192.

Deininger, K. & Okidi, J. (2001). Rural households: Incomes, productivity and non-farm enterprise. In. P. Collier & Reinikka, R. (Eds.), Uganda's Recovery: The Role of Farms, Firms and Government. World Bank.

Dercon, S. (1996). Risk, crop choice and savings: Evidence from Tanzania. In Economic Development and Cultural Change 44 (3), 385.514.

Dercon, S. (2002). Income risk, coping strategies and safety nets. In The World Bank Research Observer 17 (2), 141 .166.

Dixit, A. K. & Pindyck, R. S. (1994). Investment Under Uncertainty. Princeton, NJ: Princeton University Press.

Fafchamps, M., Hill, R. V. Nsibirwa, R. W. & Kaudha, A. (2003). The transmission of international commodity prices to domestic producers. Centre for the Study of African Economies Working Papers WPS/2003-14.

Fafchamps, M. & Pender, J. (1997). Precautionary saving, credit constraints, and irreversible investment: Theory and evidence from semiarid India. *In. Journal of Business and Economic Statistics 15* (2), 180.194.

Gould, J. P. (1968). Adjustment costs in the theory of investment of the firm. *In. Review of Economic Studies 35* (1), 47.55.

Hartley, M. J., Nerlove, M. & Peters, K. R. (1987). An analysis of rubber supply in Sri Lanka. *In. American Journal of Agricultural Economics 69* (4), 755.62.

Hill, R. V. (2005). Risk Production and Poverty: A Study of Coffee in Uganda. Ph. D. thesis, Department of Economics, University of Oxford.

Jorgenson, D. W. (1963). Capital theory and investment behavior. *In. American Economic Review,* Papers and Proceedings 53 (2), 247 .259.

Kempaka, G. (2001). Coffee and its impact and relevance to PEAP (Poverty Eradication Action Plan). In The Coffee Yearbook 2000 - 2001. Uganda Coffee Trade Federation, Kampala, Uganda.

Kiiza, B. & Pederson, G (2001). Household financial savings mobilisation: Empirical evidence from Uganda. *In Journal of African Economies 10* (4),390.409.

Lucas, R. E. (1967). Adjustment costs and the theory of supply. In. Journal of Political Economy 75 (3), 321.334.

Malchow-Møller, N. (2002). Dynamic Behaviour and Agricultural Households in Nicaragua. Ph. D. thesis, University of Aarhus, Denmark.

Morduch, J. (1991). Risk and Welfare in Developing Countries. Ph. D. thesis, Harvard University.

Munyambonera, E. (2004). Socio-economic impact of the coffee wilt disease and implications to coffee production and policy implications for the future. In The Coffee Yearbook 2003 - 2004. Uganda Coffee Trade Federation, Kampala, Uganda.

Nilsen, O. A. & Schiantarelli, F. (2003). Zeros and lumps in investment: Empirical evidence on irreversibilities and non-convexities. *In. Review of Economics and Statistics 85* (4), 1021.1037.

Place, F. & Otsuka, K. (2002). Land tenure systems and their impacts on agricultural investments and productivity in Uganda. In. The Journal of Development Studies 38 (6), 105.128.

Rosett, R. N. (1959). A statistical model of friction in economics. *In. Econometrica 27* (2), 263 .267.

Sarris, A. (2002). The demand for commodity insurance by developing country agricultural producers: Theory and an application to cocoa in Ghana. World Bank Policy Research Working Paper Series No. 2887, Washington DC.

Shepherd, A. &Farol, S. (1999). Export crop liberalisation in Africa: A review. FAO Agricultural Services Bulletin No.135, Rome.

Smith, D. R., Gordon, A., Meadows K. & Zwick, K. (2001). Livelihood diversification in Uganda: Patterns and determinants of change across two household districts. *In. Food Policy 26* (4), 421.35.

Trivedi, P. K. & Akiyama, T. (1992). A framework for evaluating the impact of pricing policies for cocoa and coffee in Cote d.Ivoire. *In. The World Bank Economic Review 6* (2), 307 .330.

Uganda Coffee Development Authority (2001). Annual Report 2000 - 2001. Kampala, Uganda.

Uganda Coffee Trade Federation (2002). The Coffee Yearbook 2001 - 2002. Kampala, Uganda.

Wickens, M. R. & Greenfield, J. N. (1973). The econometrics of agricultural supply: An application to the World coffee market. *In. The Review of Economics and Statistics 55* (4), 433.40.

Market and other Constraints to Smallholder Coffee Development in Tanzania

Alexander Sarris and Sara Savastano [82]

ABSTRACT

The paper uses the results of representative surveys among rural farm households in the Kilimanjaro and Ruvuma regions in Tanzania to explore empirically the structure of coffee production by smallholders in the major coffee producing regions of the country. The results indicate that farm households are differentiated in both asset ownership but mainly through agricultural productivity. Analysis of allocative efficiency concludes that family labour is substantially over utilized, suggesting considerable excess labour on farm households. On the contrary farm households appear to utilize less purchased inputs than would be commensurate with their estimated marginal productivities. The major reason appears to be lack of or inadequate credit to purchase inputs. Analysis of coffee tree investments reveals that such investment is characterized by irreversibility, uncertainty and adjustment costs. The results imply that improvements in land productivity of farmers are affected significantly by access to farm inputs, which can be facilitated by access to credit. Hence considerable effort must be given to policies and institutions that facilitate easier access by farmers to credit for purchased inputs.

Keywords: Coffee sector development. Factor market constraints. Coffee tree investments.

JEL Codes. Q120, Q130, O120

INTRODUCTION AND BACKGROUND

Tanzania is among the world's poorest countries with a per-capita income of about US$280. Agriculture plays a dominant role in the economy, accounting for nearly 45percent of GDP, in 2003 and employing around 70percent of labour force. Agriculture accounts for about three quarters of merchandise exports and represents a source of livelihood to about 80percent of the population. Five commodities[83] account for the bulk of agricultural exports (about 85 percent), albeit they account for only 9 percent of the value of agricultural output, and 12 percent of the value of crop output. Coffee is the most important agricultural export accounting for about 25 percent of total agricultural exports, and about 16 percent of total merchandise exports. Hence coffee is an important crop in the Tanzanian macroeconomic context.

Coffee production and exports have stagnated since the mid 1990s. Part of this is due to world prices, which, after a strong upward surge in the mid 1990s, have followed a declining trend. However, much of the sector's performance relates to the various domestic policies. In Tanzania, from 1993 to present, there has been a continuous reduction of state participation and control over marketing and input supply (i.e. the elimination of the subsidy on fertilizer). The immediate consequence was an increase in the proportion of the market prices received by producers that resulted in a stabilization of production regardless of the fall of the world prices. However, since the late 1990s world and domestic

[82] The authors are respectively, Director, Trade and Markets Division, Food and Agriculture Organization of the United Nations, alexander.sarris@fao.org, and economist at Ministry of Economic Development ssavastano@gmail.com. Contact details. Alexander Sarris, Food and Agriculture Organization of the United Nations, Via Delle Terme di Caracalla, 00100, Rome, Italy, tel. (+39) 06 5705 4201, fax (+39) 06 5705 4495. The authors would like to thank Panayiotis Karfakis for help with several of the empirical results, and Luc Christiaensen, Donald Mmari, Lucas Katera, Danforth Sango, Joseph Semboja, Panos Varangis, and Benno Ndulu for valuable inputs at various earlier stages of the research. This research has been funded partly by the EU Trust Fund on Commodity Management and the Dutch-Japanese Poverty Reduction Strategy Trust Fund in Tanzania. The findings, interpretations, and conclusions expressed are entirely those of the authors, and they do not necessarily represent the views of FAO and its member countries, or the Ministry of Economic Development.

[83] Coffee, cashew nuts, cotton, tobacco and tea.

coffee prices have declined further. With the reforms, however, producers lost the availability of inputs that was tied to output marketing. Since agriculture is still to a large extent dependent on unpaid family labour, particularly of women and children, who perform at least 70 percent of all labour in the agricultural sector, the decline in traditional export crops is affecting the food crop sector in particular and now males are being attracted to commercial food crops such as maize and beans, which were traditionally controlled by women.

The purpose of this study is to examine the structure of coffee production at the microeconomic level in Tanzania, in order to better comprehend both the environment within which the coffee smallholder producers operate, and to understand better the constraints they face. In the process we will try to explore the possibilities for further coffee development as viewed from the micro side.

During most of its post-independence history, Tanzania pursued socialist policies which resulted in extended periods where economic performance was clearly below Tanzania's potential. In the mid-eighties, Tanzania embarked on economic reforms which were not sustained, and after an initial period of economic growth in the late eighties, the early nineties were again characterized by macro-economic disequilibria and poor economic growth. In the mid-nineties, Tanzania resumed its reform course with a clear and sustained commitment to macro-economic stability through sound fiscal and monetary policies as the foundation for economic growth. Macro-economic stabilization was accompanied by wide ranging structural reforms, including privatization of state owned enterprises, liberalization of the agriculture sector, efforts to improve the business environment, and strengthening of public expenditure management. These reforms have been accompanied by sustained high growth, which in the last five years was above five percent annually.

Smallholder farmers characterize Tanzanian agriculture. The average size of land cultivated varies between less than 1 ha to 3 ha of land. The large majority of the crop area is cultivated by hand, while for the remaining, farmers use ploughs and tractors. The main food crops are maize, rice, wheat, sorghum/millet, cassava and beans, and they represent nearly 85% of the area cultivated. Bananas are grown mainly in the Kagera and Kilimanjaro area, and like cassava, have a low value-to-bulk ratio and are generally retained for home consumption.

There are several factors affecting the agriculture sector. First of all it is a rain fed agriculture and therefore unfavourable weather results into poor agriculture performance. In addition to that, low labour and land productivity due to application of poor technology, and dependence on unreliable and irregular weather conditions are further concerns. Both crops and livestock are adversely affected by periodical droughts. Among the factors that contribute to low productivity are: *(i)* low use of inputs; *(ii)* low prices compared to production costs; *(iii)* unfavourable weather conditions; *(iv)* pests and diseases; *(v)* poor knowledge of agronomic practices; *(vi)* low levels of capital especially for small scale farmers. Nevertheless, earlier studies (Government of the URT, World Bank and IFPRI, 2000) found that Tanzania, despite low levels of technology, has comparative advantage in all its export crops, and in several of the main food crops. It also found that there are significant linkages between increased production of exportable and overall rural incomes and growth. Hence, the issue of how to increase agricultural production and incomes of exportable crops is crucial to both growth as well as poverty alleviation.

Poverty levels are high in Tanzania, and poverty reduction during the past decade occurred mainly in urban areas, while rural areas have seen relatively little change. The aggregate poverty level in 2000/01 was 35.7 percent compared to 38.6 percent in 1991/2. Poverty levels are highest in rural areas, where 39.9 percent of households are below the basic needs poverty line according to the 2000/01 National Household Budget Survey (HBS, National Bureau of Statistics, 2002), and they make up about 81 percent of the poor in Tanzania. This high level compares with a poverty level of 42.3 percent in 1991/2 among the same type of agriculture dependent households. Within agriculture, poverty levels are highest among households depending on livestock (59.1 percent), while the poverty levels of those depending on sales of food crops is 40.6 percent, those who depend on cash crops[84]

[84] In Tanzania the terms "cash crops" normally refers to exportable crops grown by farmers for cash, such as coffee, cotton, cashew nuts, tobacco, tea, etc.

38.6 percent, and those who depend on sales of livestock products 33.3 percent. These observations are not so surprising given that the agricultural sector only expanded at 3.5 percent over the past decade or at a rate of less than 1 percent per capita. The poverty profile further suggests that changes in agricultural production and farm gate prices have the potential to significantly impact poverty in Tanzania.

The analysis of the paper will be based on a representative survey of 957 households in 45 villages done in the Kilimanjaro region, in November 2003, and a representative survey of 892 households in 36 villages done in the Ruvuma region in February-March 2004. These two regions are the major coffee producing regions in Tanzania, accounting for slightly over half of the mild arabica coffee production in Tanzania (which constitutes about three quarters of total national coffee production, the remaining being robusta and hard arabica varieties).

Kilimanjaro is a relatively well-off region in north-eastern Tanzania. Its area is only 1.4 percent of the total of Tanzania, but its population of 1.38 million is 4 percent of the Tanzanian total, and it is the region with the third highest population density in Tanzania, after Dar-es-Salaam and Mwanza. The region has four agro ecological zones, namely the Kilimanjaro mountain peak, highland, intermediate and lowland plains zones. Coffee is grown in the intermediate and highland zones (namely between about 900 and 1800 meters altitude). About 75 percent of the population lives in rural areas. Coffee is the main cash crop in the region, and about 70 percent of the coffee area is held by smallholders, the remaining being cultivated by private and public plantations as well as large scale farmers. Coffee production in Kilimanjaro accounts for about 30-35 percent of national Tanzanian mild arabica coffee production, and the main national coffee auction market is in Moshi, which is the largest city in the region. The basic needs headcount poverty rate for Kilimanjaro was 31% in 2000/01, according to the 2000/01 Tanzanian Household Budget Survey, as compared with 36 percent for mainland Tanzania as a whole. The proportion of the population below the food poverty line was 11 percent, compared to 19 percent for mainland Tanzania. This is a predominately rural region, with only 12 percent of people living in urban areas. Kilimanjaro's most important cash crops are coffee, cotton, sugar-cane, sisal, sunflower, beans, and wheat, whereas the most important food crops are maize, bananas, and beans. However, except for coffee all other cash crops (cotton, sugar-cane, sisal, and sunflower) are produced largely by large scale farms and estates.

Ruvuma is the southernmost region of Tanzania, and is much larger than Kilimanjaro, comprising 4.9 times the land area of the latter. Its population, however, is lower than Kilimanjaro at 1.12 million, implying that the region is sparsely populated. In fact it has the second lowest population density among the 20 regions of Tanzania. The region has many agro ecological zones (the 1997 Ruvuma socioeconomic profile identifies 13 such zones, see URT (1997)), and hence can grow a variety of agricultural products. About 90 percent of the population lives in rural areas and agriculture constitutes 77 percent of the regional product. There are three main exportable crops in the region, namely coffee, tobacco, and cashew nuts, each grown in a distinct geographical part of the region. Coffee is the main cash crop followed by cashew nuts. The basic needs headcount poverty rate for Ruvuma in 2000/01 was 41%, and this is considerably higher than the country average of 36%. The proportion of the population below the food poverty line at 27% was much higher than in Kilimanjaro, as well as the Tanzania average. This is acknowledged as one of the poorer regions of Tanzania.

The analysis of these two rural regions, one of the richest and one of the poorest in Tanzania is appropriate in order to see whether there are common factors and issues vis-à-vis Tanzanian coffee smallholder development.

The survey by design was representative of rural farm households, and among them of cash crop (coffee in Kilimanjaro, coffee, tobacco and cashew nuts in Ruvuma) as well as non-cash crop producing households. The survey was not designed to sample the large-scale public and private coffee estates but only the peasant producers. The questionnaire was designed to investigate the complete economic characteristics of households focusing on their vulnerability to a variety or risks. A community-level questionnaire was administered concurrently to village focus groups consisting of

leaders and other knowledgeable members of the community, in order to elicit information about village specific information.

The rest of the paper proceeds as follows. We exhibit in section 2 the characteristics of the rural smallholder coffee producing households in Kilimanjaro and Ruvuma. In section 3 we discuss issues related to the marketing of coffee. In section 4 we explore the allocative efficiency of smallholders. In section 5 we analyse the coffee investment decisions of farmers. The final section summarizes the conclusions and the policy implications.

MAIN CHARACTERISTICS OF FARM HOUSEHOLDS

Tables 1a, 1b present the basic average characteristics of coffee and non-coffee producing households in Kilimanjaro and Ruvuma respectively, as well as their average per capita expenditures and incomes. The tables divide households among poor and non-poor, based on a region specific poverty level adjusted from the 2000/1 National Household Budget Survey (National Bureau of Statistic, 2002). There appears to be significant differences among the average household in Kilimanjaro and Ruvuma, with the former exhibiting better status on most statistics. The average household head in Kilimanjaro is older but less well educated than in Ruvuma (6.3 years of education in Kilimanjaro versus 8.1 in Ruvuma). The average per capita total expenditure is higher in Kilimanjaro (214 versus 162 thousand TSH) and similarly for income (158 versus 148.6 thousand TSH). The average household in Kilimanjaro obtains 43.3 percent of total income from non-cash sources (own production and gifts) while in Ruvuma the share is much higher at 58.5 percent. In both regions the share of non-cash income of coffee producers in higher than the region average, implying that smallholder coffee producers, and especially the poor among them, are more subsistence oriented than non-coffee producers. Similarly, among coffee producers, the share of coffee income in total cash income in Kilimanjaro is much lower (8.7 percent) than in Ruvuma (44 percent).

The share of wages in cash income is higher in Kilimanjaro compared to Ruvuma (21.8percent versus 15.5percent) and similarly for the share of other non-farm income (28.2percent versus 28.2percent). Hence Kilimanjaro farm households are much more cash income oriented, but within their cash income they are much less dependent on exportable cash crops and more dependent on wages and other sources (mainly non-farm enterprises) than in Ruvuma.

Concerning differences between poor and non-poor, the average per capita expenditure of the non-poor appears to be about 2.5 times that of the poor in both regions, and all types of cash crop growers, albeit the levels are lower in Ruvuma for both groups. In both regions the poor appear to have a larger share of non-cash incomes, a larger cash income share from wages, and a smaller cash income share from non-farm sources.

Turning to differences between different types of cash crop producers and non-cash crop producers, in Kilimanjaro the only major difference appears to be the cash income share of wages, which is higher for non-coffee producers. In Ruvuma it clearly appears that cashew nut producers are on average poorer than producers of other cash crops, and have higher cash income shares from wages. Non-cash crop producers appear to have larger cash income shares from wages as well as non-agricultural income. It thus appears that those among our households that do not have adequate agricultural cash income revert to wage activities.

A most interesting observation is that in Kilimanjaro, which is considered to be the main coffee producing region in Tanzania, cash income from coffee appears to be a very small share of total cash income among coffee producing smallholder households (a mere 8.7 percent of total cash income or 5.4 percent of total income of coffee producers). This suggests either that coffee producers have reduced considerably coffee production given the substantial decline of coffee prices in recent years, of that coffee is not as important in farmer income as compared to the importance of the region in national production. This, by contrast does not appear to be the case in Ruvuma, where the shares of the relevant cash crop in total cash income among cash crop producers are much higher (44 percent for coffee producers, 61 percent for tobacco producers, and 37percent for cashew nut producers). Crops

other than cash crops make up a large share of total cash income (27.1 percent in Kilimanjaro and 28.1 percent in Ruvuma).

Farm households appear to be not too diversified in their sources of cash income. The average value of the Herfindahl index of cash income concentration[85] is 0.48 in Kilimanjaro and 0.45 in Ruvuma, with the poor in both regions exhibiting a more concentrated cash income pattern. Cash crop producers appear generally to be more diversified than non-cash crop producers.

Tables 2a and 2b give the average value of wealth of the different classes of households in Kilimanjaro and Ruvuma. This variable is computed by summing the values of different types of productive as well as non-productive assets, such as land, agricultural capital, non-agricultural capital, consumer durables, dwellings, and animals. The prices at which these items are valued are usually median village prices, computed from individual prices reported by households. The value of average household wealth in Ruvuma is only about one quarter of that in Kilimanjaro. The bulk of household wealth in both regions consists of dwellings, consumer durables, and land, followed by animals. It is notable that agricultural and non-agricultural productive capital account for a very small share of total wealth. Hence, it appears that agricultural capital is very meagre in both regions. As expected, the poor are less wealthy than the non-poor in both regions, and coffee producers are generally wealthier than non-coffee producers in both regions. Note, however, that the major difference is between average wealth in Kilimanjaro and Ruvuma, and not between poor and non-poor within each region. The major wealth differentiating factors appear to be housing, the value of consumer durables, land, and animals.

Tables 3a and 3b present a general overview of agricultural production in the two regions. The average size of cultivated land is much larger in Ruvuma, compared to Kilimanjaro, but there appears to be no major difference in the average size of land cultivated among the poor and the non-poor within each region, although the non-poor cultivate somewhat larger land areas. There does not appear to be much difference in land cultivated among coffee producers and non-coffee producers in Kilimanjaro, but in Ruvuma it appears that cash-crop producers cultivate on average larger amounts of land (and cashew nut producers in Ruvuma, seem to cultivate much larger areas). The number of plots cultivated seems quite similar among farm households at around 2 in Kilimanjaro, and at around 2.5-3 in Ruvuma. In Kilimanjaro a significant share of the land (21 percent) is irrigated, while this share is insignificant in Ruvuma (3.9 percent). This may have to do both with the fact that rainfall is less reliable in Kilimanjaro, but also with the difference in wealth between the regions.

The next few lines give the average yields in terms of kg produced per acre, of the major food and cash crops, namely maize, beans, coffee, banana, tobacco and cashew. It can be seen that maize yields differ significantly between poor and non-poor households in both regions, with the latter having much higher yields than the poor (by around 50 percent). The situation with beans is similar, albeit the differences between poor and non-poor are not that pronounced (at least in Kilimanjaro). Coffee and banana yields appear to be higher among the non-poor (and much higher for coffee in Ruvuma) but this does not seem to be the case for cashew nuts. The yields of banana are very high in Kilimanjaro, and seem to be larger among the non-poor, compared to the poor. The enormous difference between banana yields in Kilimanjaro and Ruvuma (more than 15 times larger) is quite striking, and perhaps is due to the higher density of coffee trees in Kilimanjaro (coffee trees are usually shaded by banana trees), or to the higher value of bananas as a food cash crop in the north of Tanzania. This despite the fact that the number of all kinds of trees owned by coffee producers in Ruvuma is much higher (about twice as large) than the number in Kilimanjaro.

[85] The Herfindahl index measures concentration or diversification. It is obtained for each household by the sum of the squared shares of each source of cash income. The higher the index, the more concentrated are the sources of cash income. The maximum value is 1, when only one source of cash income exists, and the minimum value is 1/n, where n is the number of sources of income. The following are the types of cash income considered in deriving H: regular and irregular wages, pensions, non farm business, state assistance, gifts, remittances, sales of maize, beans, coffee and banana, sales of other crops, cash income from other farm activities (largely livestock and animal products).

The next few lines exhibit the incidence of soil quality among the farmers. The incidence of poor soil seems quite small, and most farmers declare that the soil on their farms is either medium or good quality, and poor farmers appear not to have higher incidence of good soil, compared to the non-poor.

The next two lines report the household value added from crop production (which is computed as the gross value of output, minus the value of all purchased inputs, including hired labour). The gross value of output is computed by using the same prices for all producers namely the Kilimanjaro average prices received (from the survey reported prices). This is done in order to measure farm productivity, and to avoid problems arising from different prices received by farmers due to seasonal patterns of sales, etc. Agricultural crop value added per acre appears to be on average more than twice as high in Kilimanjaro than in Ruvuma. Within each region there appears to be significant differences between the productivity of poor and non-poor farmers, with the value added of non-poor farmers about 25 percent higher than that of the poor in Kilimanjaro and 54 percent higher in Ruvuma. Coffee producers seem to have higher overall land productivity than non-coffee producers in both regions. It thus appears that land productivity is a major factor in distinguishing farmers among poor and non-poor, and coffee producers appear to be more productive. Hence raising overall agricultural land productivity appears likely to feature as a major factor in a rural growth and antipoverty strategy. The value of productivity seems related to the value of purchased inputs, as from the table it appears that the average value of utilized purchased inputs per acre is quite different between Kilimanjaro and Ruvuma (more than three times as large in Kilimanjaro) and among poor and non-poor, with the non-poor spending considerably more for inputs compared to the poor.

Interestingly the average value of total agricultural capital per household (value of machines, implements, etc) is only slightly higher in Kilimanjaro compared to Ruvuma, but since the average amount of cultivated land is lower in Kilimanjaro, it is clear that capital/land ratios are much higher in Kilimanjaro. The non-poor have higher agricultural capital than the poor, and coffee producers appear to have higher agricultural capital on average than non-coffee producers in both regions. The value of non-agricultural capital (value of non-farm enterprise) also seems to be much higher in Kilimanjaro, compared to Ruvuma, and as expected, higher among the non-poor. However, it appears that non-cash-crop producers have higher amounts of non-agricultural capital, compared to cash crop producers. Finally the number of total animals owned (in cattle equivalents), as well as the number of cattle is more than twice as high in Kilimanjaro, as compared to Ruvuma.

The picture that emerges is one whereby farm-households in Kilimanjaro are considerably wealthier than those in Ruvuma, despite smaller land cultivated, and despite lower overall levels of education of household heads. Coffee producers appear to be on average better off than non-coffee producers. Furthermore, poorer households own much less capital, both farm as well as non-farm, and use lower amounts of purchased agricultural inputs. The result appears to be significant differences in agricultural land productivity.

Tables 4a and 4b exhibit various credit related information for the households of the survey. A very small share are members of the local credit cooperatives (called Sacco), namely 12.4 percent in Kilimanjaro and 13.6 percent in Ruvuma or have a bank account (12.4 percent in Kilimanjaro and 9.9 percent in Ruvuma). The incidence however is higher among non-poor households in both regions. It is impressive that more than 80 percent of all households, without much differentiation among various groups declared that it was difficult to get seasonal credit from any source, for purchasing inputs, and less than 15 percent declared that it was easy to obtain formal seasonal credit (again except tobacco producers). An even smaller share (8.2 percent in Kilimanjaro and 9.3 percent in Ruvuma) declared that it was easy to obtain credit for farm investments. Between 40 and 60 percent of the households in Kilimanjaro and 30-40 percent in Ruvuma declared that they borrowed from friends or relatives if money was needed for emergency or seasonal inputs. It thus appears that the lack of seasonal credit maybe a serious constraint for the farmers in the survey.

The picture that emerges from the above descriptive analysis is of farm households that have a low overall asset base (total and agricultural), and seem to have very little access to formal credit, both seasonal as well as for investments. There seem to be significant differences between poor and non-

poor households as far as agricultural productivity is concerned, and this seems to be due to differences in overall agricultural and total capital availability, as well as access to farm inputs.

STRUCTURE OF COFFEE PRODUCTION AND MARKETING

Table 5 indicates the average area planted with coffee, the ownership of coffee trees and the age distribution of coffee trees among coffee producers in Kilimanjaro and Ruvuma. In Kilimanjaro the coffee area amounts to about 60 percent of the total cultivated area (re table 3a, while in Ruvuma it amounts to a little less than a third. Households in Ruvuma own many more trees on average (about three times as many) than in Kilimanjaro. This is consistent with the earlier finding that coffee is much more important as a source of income in Ruvuma, than in Kilimanjaro. Another observation is that the proportion of old trees (older than 30 years old) is much higher in Kilimanjaro (70 percent) than in Ruvuma (only 21.6 percent). Similarly the number of young trees (less than 10 years old) is much larger in Ruvuma. This suggests that in Ruvuma farmers responded to the mid 1990s coffee boom by planting many new trees. When examining the density of trees per acre of land cultivated in coffee it can be seen that it is considerably larger in Ruvuma, and in particular with younger and middle aged, hence more productive trees. The difference in the age distribution and density of coffee trees is reflected in production figures. Production of coffee per household, per acre, and per tree are all much higher in Ruvuma, than in Kilimanjaro.

Table 6 indicates the average amount spent on various inputs to coffee production, while table 7 illustrates the labour inputs. The first observation is that the total value of purchased inputs per acre is rather small. In Kilimanjaro inputs for coffee constitute about 10 percent of the cash cost of all farm inputs, which is commensurate with the roughly 9 percent share of coffee in the total value of cash income. In Ruvuma cash inputs for coffee amount to about 25 percent of total purchase farm inputs.

Concerning labour inputs, comparison of coffee labour input with total labour available to the households (calculations not shown) reveals that coffee takes up about 10 percent of family labour supply, but roughly one quarter of the labour devoted to crop production.

Table 8 indicates the real producer prices in Kilimanjaro and Ruvuma from 1981 to 2003, and the Tanzania Coffee Board (TCB) real average price obtained at the Moshi auction. Figure 1 also plots these prices. It can be seen that after the mid-1990s price boom, the real price of coffee has dropped precipitously, due largely to the fall in world price, as the Tanzanian inflation has been rather modest. A most interesting observation however, concerns the difference between the realized average price at the Moshi auction and the producer price of coffee. As can be seen the margin from Kilimanjaro to Moshi, which is a city within Kilimanjaro is often larger than 100 percent. From Ruvuma it is even larger, which is understandable given the large distance from Moshi, coupled with the poor state of roads, and hence large transport costs, and reaches 200 percent some years.

The bulk of coffee producers (CPs) sell their coffee either to the primary society or to private buyers, but not both. Only about 10-12 percent of CPs sell to private buyers, and this highlights the continuing importance of cooperatives. There are only very few who sell to both primary societies as well as private buyers, but this appears to be the exception among the respondents.

The average prices received, including initial as well as any subsequent payments, seem to be similar for all size classes, as well as between those selling to primary societies and private buyers for the year of the survey. However, there is, surprisingly, considerable variation in the prices received by different producers. Figure 2 indicates the distribution of prices received during 2003 by producers in Kilimanjaro and Ruvuma. It can be seen that there is considerable dispersion of received prices. This probably reflects the decision of farmers to market their coffee at different periods in the year, coupled with the fluctuating price of coffee in both the Moshi auctions as well as internationally.

Figure 3 illustrates a statistic designed to capture the degree of coffee price variability to producers. The survey asked about the maximum and minimum coffee prices received by coffee farmers over the last ten years. It also asked about the average prices (from all types of buyers) received in the season of the survey (2003), as well as the two previous seasons (2002 and 2001). The statistic whose

distribution is plotted in figure 3 is defined as the ratio of the difference between the maximum and minimum reported total price during the last decade and the average total weighted (from all buyers) coffee price received over the last three years.

It can be seen from the figure that there is fairly wide spread in this statistic. This implies that there has been very high instability in the price received for coffee by Kilimanjaro coffee producers in the last ten years, but most importantly that the degree of coffee price variability varies considerably among various producers.

Table 9 illustrates the sources from where farmers learn coffee prices. In Kilimanjaro the overwhelming majority of farmers (74.3 percent) learn the price of coffee from the local primary society. Another 11 percent learn it from other farmers or friends, and less than 5 percent learn it from private buyers. By contrast in Ruvuma, 25 percent of the CPS learn price information primarily from private buyers. Most farmers do not form expectations about next year's coffee price when planning production. This is illustrated in table 10, where it is seen that 91 percent of CPs in Kilimanjaro and 83 percent of CPs in Ruvuma do not form any kind of price expectations. Among those that do form price expectations the majority seem to form them on the basis of last year's realized price, in other words they hold what is termed in the literature "naïve" expectations.

Coffee income seems to be the most unstable income source of farmers, as table 11 illustrates. Among the various income sources, coffee income is the one that exhibited the largest incidence of large shortfalls.

DETERMINANTS OF ALLOCATIVE EFFICIENCY AMONG CASH CROP PRODUCERS

Allocative efficiency relates to the issue of whether farmers use resources in line with market signals. Allocative efficiency refers to the use of inputs (labour, capital) that provides a given quantity of output at a minimum cost or maximum profit. Thus, allocative efficiency determines whether the factors of production are used in proportions that ensure maximum output given the prices for output and inputs. To explore allocative efficiency we use the estimated production functions to calculate the value of marginal product of factors i (VMP_i) as in Lerman and Grazhdaninova (2005) and Carter and Wiebe (1990).

For each farmer (we omit an index of the farmer to simplify notation) the marginal product of factor X_i can be calculated as follow:

$$MPX = \frac{\partial Q}{\partial X_i} = \left(\frac{\partial \ln Q}{\partial \ln X_i}\right)\frac{Q}{X_i} = \beta_i \frac{Q}{X_i} \quad (1)$$

Where β_i is the estimated coefficient for factor X_i from a Cobb-Douglas production function.

Allocative efficiency is determined by comparing the value of marginal product of factor X_i (VMP_i) with the marginal factor cost (MFC_i). We assume that farmers are price takers in input markets, so that the price of factor $X_i (P_i)$ approximates MFC_i. If $VMP_i > P_i$, factor i is underused and farm profits or efficiency can be raised by increasing the use of this factor. If, conversely, $VMP_i < P_i$, the input is overused and to raise farm profits its use should be reduced. The point of allocative efficiency (and maximum profit or minimum cost) is reached when $VMP_i = P_i$.

To analyze farm production we fit a standard Cobb-Douglas production function, using instrumental variables for the endogenously determined right hand variables[86]. We introduce a variety of potential productivity determining variables in the right hand side in order to explore the determinants of TFP. Our estimations use the following general form

[86] We also tried more flexible functional forms such as translog, but there was no significance in any of the higher order explanatory variables.

$$\ln Q = \alpha + \sum \beta_i \log X_i + \sum \gamma_j Z_j + u \qquad (2)$$

Where Q is a measure of the value of production of the farm, X_i is a set of factors of production such as land, labour and inputs, β_i are the estimated coefficients of each factor (the elasticities, if the log specification is chosen), Z_j is a vector of TFP determinants such as household characteristics, and u is an *i.i.d.* error term.

In our setting, explanatory variables such as inputs of land and labour, for example, may be considered as endogenous variables and jointly determined with Q and thus are dependent on the stochastic disturbance. To avoid biases in the estimates we will use instrumental variables to estimate the endogenous ones.

For the production function analysis, we use several sets of explanatory variables. First we utilize the standard factors of production, namely land, labour, capital, and purchased inputs. We also use a dummy variable which is equal to 1 if the household hires labour for crop production. This variable is supposed to capture whether the household is facing supervision constraints in hired labour. If this is the case the sign of this variable should be negative.

Secondly we utilize household and farm characteristics such as age and education of the head, land quality variables such as soil quality, proportion of the land cultivated that is irrigated, etc. Third we control for current and past shock variables that may have affected current farm production. Such variable include the household assessment of whether rainfall in the plot was below normal, and whether the household has experienced different types of shocks in the past few years.

To control for endogeneity of purchased inputs, land and labour, we have used, as a set of instruments, lagged values of these factors, such as the size of land cultivated three years ago, number of months spent by household members and hired labours working on the farm the previous year, and a dummy indicating whether fertilizers were used the previous year; two dummies for specific cash crop production, and, finally, variables related to credit access, as credit constraints have been hypothesized for a long time to affect production and size (Feder, 1995; Eswaran and Kotwal, 1986). The basic assumption used in all studies is that assets, including land, affect positively the availability of credit and through this the availability of inputs and hired labour, and hence they should affect positively land and agricultural productivity. The capital factor, being a fixed factor, has not been instrumented and is not considered endogenous.

Tables 12 and 13 indicate the IV estimation of the production functions (for both crop and livestock) for Kilimanjaro and the OLS estimation Ruvuma. The test for endogeneity in both Kilimanjaro suggest that the OLS model is rejected by both the Durbin-Wu-Hausman test, as well as the Wu-Hausman test, and hence the IV procedure is valid. For Ruvuma, the same tests do not reject the OLS model for the village effects model. The dependent variable is equal to the gross value of total agricultural output, where we have used for each household the unique median producer price of Kilimanjaro and Ruvuma respectively, same for all producers. In this fashion we account only for differences in quantities of production and avoid differences in value of production due to differences in realized prices due to seasonality, and also value all production utilized for home production at the same prices.

For Kilimanjaro, all factors of production are significant with the expected signs. The dummy for whether the household hires labour is negative and significant in Kilimanjaro. This dummy is supposed to test whether there are supervision constraints by the farm household, and the results appear to suggest that such constraints may exist, despite the observation that the amount of hired labour is quite small. Note that the F test for the hypothesis that the sum of the coefficients on the land, inputs, labour and capital variables is equal to 1 is strongly rejected, and the sum of these coefficients is larger than 1, suggesting increasing economies of scale.

In Kilimanjaro, age and education do not appear to be significant. Production seems to be affected by some of the land quality or improvement variables and is also affected negatively by bad rainfall, as

expected. The inclusion of major shocks such as major illness and death in the household in the five years before the survey do not seem to have affected crop production. These results on the negative influence of bad weather are compatible with the significant and positive impact of the irrigation variable, which measures the share of land irrigated, and which is substantial in Kilimanjaro.

The results for Ruvuma in table 13 indicate significance with the expected signs for all basic factors of production, land, labour, purchased inputs, and capital. Note also, just as in Kilimanjaro, that the sum of the coefficients of the four main variables (land, inputs, labour, and capital) is significantly larger than 1, suggesting again economies of scale.

Education of head here is a significant positive determinant of crop production. Land improvement variables appear to be not significant, as in Kilimanjaro, but soil quality here appears to affect negatively crop production. This is a bit surprising and it may have something to do with overuse of good quality land. The current rainfall variables do not seem to affect current crop production, and this is compatible with the general impression in the region that rainfall is much more reliable compared to Kilimanjaro. Shocks also do not seem to affect crop production, in contrast to Kilimanjaro. However, the dummy for a drought shock since 1998 affects positively crop production, which seems counterintuitive.

The results confirm the expected role of standard production primary inputs. Concerning TFP, they partially point towards the role of education and irrigation in TFP improvement, the negative and potentially lasting role of weather shocks, the role of education and formal credit in purchased inputs, and the importance (positive or negative) of specific types of cash or food crop growing in affecting the total value of output. This latter effect maybe reflects historical reasons or institutional reasons pertaining to producers of specific crops.

From these results we can compute the marginal products of the four basic factors of production for each household and compare them with the respective market prices. Tables 14 and 15 report the averages of these marginal products for Kilimanjaro and Ruvuma, and the comparisons with the respective market values. Concerning land, we use the average crop value added per acre as reported in table 1. It would have been more appropriate to use land rental values, or land sales prices multiplied by some discount rate, but there are no rentals reported in the survey, and very few land sales reported in the survey, and hence averaging these would not be reliable. In any case the land market in Tanzania operates largely under a traditional tenure system, where sales and purchases are not common. Concerning purchased inputs the marginal products must be compared to 1, as the variables used for inputs and capital are expressed in ‘000 TSH, and so is output. Concerning labour we have direct observations from each household concerning the wage rates they pay for hired labour (both in cash and in kind, which we average). Finally concerning capital we must compare the marginal product of capital to the capital rental value. We do not have such information, but we can compare the marginal products so some hypothesized discount rate, which for the purposes of this paper we (rather arbitrarily) assume to be equal to 0.1.

The results suggest that the agricultural households in Tanzania are utilizing some resources efficiently but some others very inefficiently. The marginal product of land in Kilimanjaro is on average as well as for all different groups of households, larger than its “optimal” value as proxied by the crop value added per acre, and much more so for non-poor households and for coffee producers. This suggests that there must be some constraints in expanding land cultivation in Kilimanjaro, and this is consistent with the general view in Tanzania, that good productive land in Kilimanjaro is in short supply.

In Ruvuma the average marginal products of land for all, as well as separately for all classes of households are below the optimal market values. This suggests that households use more land than what is justified. These results seem to be in line with conventional wisdom in Tanzania, whereby good agricultural land is more abundant in Ruvuma. They also suggest that land is not a constraint among farm households in Ruvuma, but it is a constraint in Kilimanjaro.

As expected and as suggested by the earlier descriptive tables the marginal product of land is much higher in Kilimanjaro than in Ruvuma (about four times higher on average) and the same holds for the estimated value added per acre (in Kilimanjaro it is a little more than twice as large as the value in Ruvuma). This difference between the ratios of the marginal product of land seems consistent with the higher scarcity of productive and cash crop land in Kilimanjaro.

Concerning purchased inputs, the marginal products for all groups and in both regions are substantially larger than 1, which suggests that purchased inputs are used much below their optimum amount, and in fact the results suggest that there is considerable room for input use expansion to boost farm production. The results indicate that this financing constraint maybe a serious one. This result raises issues concerning the interlinking of input purchases with other contracting arrangements. In Tanzania the government abolished all the various export marketing Boards, that used to link the purchase of the output of exportable crops with advance financing and provision of inputs by farmers, and now the farmers must finance whatever inputs they purchase from own sources, or borrow them. Given the very low incidence of borrowing or even participation in formal financial institutions, it may be that because this link, between marketing and finance, was broken, farmers have reduced the amount of inputs utilized. While we do not have data on earlier use of inputs, namely during the period of the functioning of the marketing boards, the very low current use of productive inputs, and the inefficiency revealed by the above analysis, support such a hypothesis.

Concerning labour, the results show that the marginal products of labour used on the farms are much lower than the market wages, which suggests excess labour use in farm production. This suggests considerable “excess labour” in farm production. In fact the average amount of family labour days spend by households on their farms is very high. The average farm household in Kilimanjaro has 2.6 workers, and this is almost identical to the average farm household in Ruvuma (2.5 workers), with very little differentiation among different types of households. We consider as potential labour supply per household in months the product of the number of workers and 12. This turns out to be around 31 months per household in line with the average number of workers.

For all households the main activity of most workers is agriculture on own farm, and the average time spent on the main activity (whether it is agriculture or not) is about half of total potential work time (15.5 months per year per household in Kilimanjaro and 16.8 months per year per household in Ruvuma). Almost all of this primary activity time is for agriculture. The time spent on the second most important activity of most household workers (which in most cases is also agriculture, for the members that do not have agriculture as a main activity), is much larger in Kilimanjaro (9.9 months per year) compared to Ruvuma (5 months). The sum of the time spent on agriculture as primary or secondary activity (which is equal to 25.1 months in Kilimanjaro, and 21 months in Ruvuma) seems to leave considerable time for other activities in both regions, but more so in Ruvuma.

An estimate of the amount of time spent on other activities based on non-farm activities, indicated that the average household in Kilimanjaro spends 3.9 months of labour of active members on wage and non-farm non-wage cash earning activities, while in Ruvuma the average household spends an average of 3.1 months on such activities. When we add these to the amount of time spent on agriculture, we obtain that an (over)estimate of the total amount of time spend by all active household members per household in all activities is 29 months in Kilimanjaro, and 24.1 months in Ruvuma. When we compare these with the 31 months of available per household labour time, these figures suggest that there is some but not much excess labour in Kilimanjaro, but much more in Ruvuma. These results are consistent with the results on the inefficiency of labour use reported above. The excess family labour may be the result of lack of off-farm wage earning opportunities, or credit constraints in expanding labour intensive production.

Concerning the marginal product of capital the overall average marginal product appears to be slightly larger than 1 in Kilimanjaro, which is much larger than any discount rate smaller than 1, suggesting that capital is used inefficiently, and in fact at levels much below what could be considered optimal. The same is observed in Ruvuma. There are significant differences among poor and non-poor farmers,

with the average marginal product of capital for the non-poor much larger than that for the non-poor in both regions. It thus appears that there are strongest capital accumulation constraints among the poor.

These results, namely that inputs and capital appear on average to be inefficiently utilized in Kilimanjaro and Ruvuma, and in particular the very low values of utilization of both, suggests accumulation and seasonal working capital constraints.

COFFEE PRODUCER INVESTMENT IN COFFEE TREES

In the context of declining real coffee prices, it is interesting to inquire whether coffee farmers still have a desire to invest in coffee, and whether they are doing it. The purpose of this section is to examine this issue. The first question we ask is how CPS view coffee investment in the context of all the other choice for investments that are available to them. Tables 16 and 17 indicate the responses to the hypothetical question of which would be the most important use of substantial extra income (a windfall of more than 50 percent of current income). In Kilimanjaro the most important investment, as measured by the proportion of households that declare it as most desirable, would be in additional food production. Non-farm enterprise and house improvements are next in importance and children's education comes close after. Investment in livestock production and coffee come next. However, among coffee producers, investment in coffee production is the second most desirable investment after food crops. In Ruvuma, the results are similar, except that among coffee producers investment in coffee production is ranked first among most desirable investments. Hence, despite the coffee price declines coffee investments are ranked high in importance among coffee producers.

Table 18 indicates the number of CPS that planted trees in the year of the survey without any uprooting (only planters), the number of those that only uprooted, the number of those that did both but were net planters, the number of net uprooters, and those that did not change their number of coffee trees. The first observation is that in Kilimanjaro the net uprooting farmers outnumber the net planting farmers by about 4 to 1. In Ruvuma, however, the net planters outnumber net uprooters by more than 20 to 1. This is consistent with the earlier results (re. table 5) concerning the age distribution of coffee trees. Combining the results of table 18 with table 5, we obtain a picture of CPs in Ruvuma that are much more responsive and more optimistic on coffee compared to those in Kilimanjaro.

Reviewing the figures in the bottom of table 18 it also becomes clear that CPs in Ruvuma have not significantly changed on average the number of their coffee trees over the three year period before the survey, despite the declining prices, while producers in Kilimanjaro seem to have decreased them.

To explore the determinants of coffee tree plantings we utilize the methodology proposed by Hill (2006). The hypothesis tested with her methodology is that coffee tree investments are subject to irreversibility and uncertainties, as well as adjustment costs, and liquidity constraints. All these are issues that have been highlighted by various investment theories. To test for the presence of these effects, Hill runs a regression based on standard investment determining variables, and then constructs on index variable that is equal to 1 if the predicted value of the investment based on the standard model is positive. She then adds this variable to the same regression equation, and tests whether the coefficient of this variable is negative. If it is, then this supports the hypothesis of irreversibility, uncertainty and fixed costs of adjustment.

Following this approach we estimate a regression model of the following type, where T denotes the number of trees at time t.

$$\frac{\Delta T_t}{T_{t-1}} = \beta_0 + \beta X_t + \varepsilon_t = \beta_0 + \beta_M \mathrm{M}_t + \beta_F F_t + \beta_H H_t + \beta_C C_t + \varepsilon_t \qquad (3)$$

In the above equation the vector X is composed of the following types of variables. M denotes market related variables, the vector F denotes farm structure related variables, the vector H denotes household characteristic variables, and the vector C denotes shocks and coping mechanism variables. The indicator variable I is included in the second run of the model, namely when the estimated value of

βX_t is positive. If the estimated value of γ is negative, then this implies that coffee tree investment is not governed by the standard investment model.

Table 19 indicates the coffee tree investment regressions for Kilimanjaro and Ruvuma. The dependent variable is the ratio of net plantings of coffee trees over the stock of coffee trees in the previous year. Net plantings can be negative in the case of uprootings. The market variables included are the proportional change in this year's coffee price from last year, the expected coffee price next year (a question of this type was included in the questionnaire), the previous range of coffee prices received in the last ten years over the recent three year price average (this variable was already discussed earlier), The farm structural variables included are the previous year stock of coffee trees, and its square, the share of old (older than 30 years old) coffee trees in total, the amount of total cultivated land, the Herfindahl index of crop diversification, and various land characteristic and improvement variables. The personal characteristics include age and education of the head, as well as the size of the household. We include a variety of shock variables, such as whether the household experienced rainfall below or much below normal, or whether it experienced various shocks in last five years. Finally we include a variety of credit access variables such as whether the household belongs to the local credit cooperative, sacco, or it has a bank account, or it has easy access to seasonal credit.

The first column of the estimations under each region reports the standard investment model, while the second reports the augmented model that tests for irreversibility and adjustment costs.

In Kilimanjaro net plantings seem to be responsive to current market conditions, while in Ruvuma they are not. The lagged number of coffee trees seems to affect negatively the new plantings, with a declining trend and the proportion of old trees seem to affect positively the new net plantings, as expected. Education seems to affect positively new plantings in Kilimanjaro but age affects them negatively. Some of the land improvement and shock variables seem to have some impact on new coffee tree investments. Similarly the credit access variables seem to affect positively investments.

The coefficient of the predicted planting dummy (the I variable in equation (3)) is negative and significant, and this implies that coffee tree investment is affected by irreversibility, uncertainty and adjustment costs. Notice that the values of the coefficients suggest that producers in Kilimanjaro are more responsive to economic signals than producers in Ruvuma, as indicated in previous tables.

SUMMARY AND CONCLUSIONS

The results of this paper suggest that coffee production is not uniform even within the same country. The structure of coffee production seems to depend considerably on the overall economic level of producers. We found that in the poorer region of Tanzania coffee is a much more important income source, and producers seem to be insensitive to market signals, as far as coffee tree investments are concerned. This may have something to do with the availability of alternatives in the poorer region.

It appears that coffee farm households in Kilimanjaro are differentiated. In other words there appear to be substantial differences in average incomes among households that can be classified as poor or non-poor. However, there also does not appear to be substantial differences among groups in a variety of other attributes.

Overall asset ownership among coffee producing households in Tanzania is quite low, but not much different than that of non-coffee producing households. This holds not only in terms of human capital, but also in terms of physical capital. Education levels are very low. The main differentiating factor among rural households in both Kilimanjaro as well as Ruvuma is farm land productivity. These results suggest that a pro-poor rural development strategy in Tanzania may need to be anchored around improvements in land productivity, including coffee productivity.

The analysis of allocative efficiency concluded that family labour is substantially over utilized, suggesting considerable excess labour on farm households. On the contrary farm households appear to utilize substantially smaller amounts of purchased inputs than would be commensurate with their estimated marginal productivities. These results suggest that there are unexploited economies of scale

in peasant farm production, and that the main reason for not achieving optimum use of resources is financial constraints that prevent farmers to utilize the optimum amounts of inputs, given their own asset ownership. The financial constraint story is also supported by the portfolio preferences of farm household heads. It is notable that the highest preference among the farm households when asked on where they would like to invest excess savings is to increase agricultural production. Clearly farm households perceive unrealized investment opportunities in farming.

Finally we found that coffee tree investments are subject to irreversibility, uncertainty and adjustment costs, apart from standard investment determining variables.

The empirical results highlighted in this paper lead to the following policy conclusions. First, it appears that the major pro-poor interventions should be improvements in land productivity of farmers. The latter in turn seems to be affected significantly by access to farm inputs. Hence considerable effort must be given to policies and institutions that facilitate easier access by farmers to purchased inputs. Such policies may include wider use of credit cooperatives, promotion of other membership type of organizations like cooperatives that can facilitate access to credit by farmers, and promotion of contractual types of arrangements that can be combined with easier access to productive inputs.

Second it appears that there is considerable room for improvements in allocative efficiency by better access to off farm activities, so that farmers do not utilize labour so inefficiently. An alternative maybe easier access to credit for expansion of land cultivation in areas with land expansion potential like Ruvuma, so as to utilize more efficiently the excess family labour.

The above results may have something to do with the institutional framework of coffee production in Tanzania. While the coffee cooperative have been weakened over the years, with the various types of government interventions and changes in marketing systems, primary societies that are closest to the farmer seem to provide the main source of information to the farmer. Similarly the lack of inputs and credit maybe tied to the weak linkages between input provision and output marketing. Thus the institutional system of coffee marketing and input supply must receive considerable emphasis if Tanzania is to develop further its smallholder coffee sector.

REFERENCES

Carter M.R. & Wiebe, K.D. 1990, Access to Capital and its Impact on Agrarian Structure and Productivity in Kenya, American Journal of Agricultural Economics, 72(6): 1146-50.

Feder, G. 1985, The Relation between Farm Size and Farm Productivity: The Role of Family Labor, Supervision and Credit Constraints, Journal of Development Economics 18:297-313.

Government of the United Republic of Tanzania, The World Bank, and International Food Policy Research Institute, 2000. Agriculture in Tanzania since 1986: Follower or Leader of Growth?. A World Bank country study.

Hill, R. Vargas. 2006, The Determinants of Investments in Coffee Trees in Uganda, paper presented at the workshop on "Governance, Coordination and Distribution along Commodity Value Chains" organized by the FAO Commodities and Trade Division, in Rome on March 4-5, 2006.

Lerman, Z., & Grazhdaninova, M. 2005, Allocative and Technical Efficiency of Corporate Farms in Russia, Comparative Economic Studies, 47, 200–213.

Levin, J., & Mbamba, R. 2004, Economic growth, sectoral linkages and poverty reduction in Tanzania, World Bank, background paper for the Tanzania CEM.

National Bureau of Statistics. 2002. Household Budget Survey 2000/01, Dar es Salaam.

United Republic of Tanzania (1997). Ruvuma Region Socio-Economic Profile. Joint Publication by the Planning Commission Dar-es-Salaam, and Regional Commissioner's office Ruvuma.

Table 1a: Kilimanjaro: General household characteristics

		ALL	*Coffee Producers*			*Non Coffee Producers*		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Number of households	Unit	190744	115858	38639	77219	74886	24278	50608
Share of hh	Percent		60.74	33.35	66.65	39.26	32.42	67.58
Age of the head	years	53.5	55.6	51.8	57.4	50.3	49.2	50.9
Education of the head	years	6.3	6.1	5.8	6.3	6.2	5.8	6.3
Household size	number	5.3	5.4	6.6	4.8	5.2	6.4	4.6
Number of adult equivalents	number	4.4	4.5	5.4	4.1	4.3	5.2	3.9
Annual per capita total expenditure	'000 TSH/pc	214	211	105	265	219	106	274
Annual per capita cash expenditure	'000 TSH/pc	162	155	73	196	173	77	219
Annual per capita non cash expenditure	'000 TSH/pc	52	56	31	69	46	28	55
Share of food (cash and noncash) in total expenditure	Percent	73	73	75	72	72	76	69
Annual per capita total income	'000 TSH/pc	158	165	84	206	160	74	201
Annual per capita cash income	'000 TSH/pc	105	109	53	136	114	46	146
Annual per capita non cash income	'000 TSH/pc	52	56	31	69	46	28	55
Share of non-cash income in total income	Percent	43.30	45.75	48.06	44.58	39.49	43.94	37.34
Share in total cash income								
Coffee	Percent	5.4	8.7	10.5	7.9	0.1	0	0.1
Other crops	Percent	27.1	28.1	21.1	31.6	25.7	25.2	25.9
Non-crop agriculture	Percent	14.6	15.0	13.4	15.8	14.1	10.6	15.7
Wages	Percent	21.8	19.9	29.1	15.2	24.9	25.5	24.7
Other non-farm income	Percent	31.0	28.3	25.9	29.6	35.3	38.7	33.7
Herfindhal Index of cash income diversification	Index 0 to 1	0.4831	0.4633	0.5134	0.4382	0.5137	0.5496	0.4966
Average distance from parcels to hh compound	Km	7.07	7.542197	4.74	8.95	6.4	5.3	6.88
Average distance from parcels to road	Km	1.36	1.176271	1.24	1.15	1.7	1.9	1.53

Source. Authors'computations

Table 1b: Ruvuma: General household characteristics

		All	Coffee Producers			Cashew nuts Producers			Non cash crop producers		
	Unit		***All***	***Poor***	***Non Poor***	***All***	***Poor***	***Non Poor***	***All***	***Poor***	***Non Poor***
Number of households		173921	52924	24096	28828	43932	29839	14094	71255	38699	32557
Share of households	Percent		30.43	45.53	54.47	25.26	67.92	32.08	40.97	54.31	45.69
Age of the head	years	43.37	42.29	42.01	42.54	43.19	44.15	41.21	44.24	45.07	45.07
Education of the head	years	8.14	7.45	7.27	7.59	9.18	9.40	8.73	8.08	8.13	8.13
Household size	number	5.21	5.37	6.26	4.62	5.1	5.50	4.24	5.13	5.48	5.48
Number of adult equivalents	number	4.24	4.39	5.09	3.81	4.13	4.42	3.49	4.17	4.41	4.41
Annual per capita total expenditure	'000 TSH/pc	162	192	100	268	125	83	216	165	94	94
Annual per capita cash expenditure	'000 TSH/pc	88	94	42	138	73	42	136	94	46	46
Annual per capita non cash expenditure	'000 TSH/pc	74	97	58	130	53	40	79	71	47	47
Share of food (cash and non cash) in total expenditure	Percent	73.8	74.2	74.7	73.7	74	74.8	72.3	73.8	74.9	74.9
Annual per capita total income	'000 TSH/pc	148.6	173.1	87.2	244.9	115.6	77.2	196.8	151.6	87.1	87.1
Annual per capita cash income	'000 TSH/pc	74.5	75.6	29.0	114.6	62.9	37.1	117.6	80.3	39.7	39.7
Annual per capita non cash income	'000 TSH/pc	74.2	97.5	58.2	130.3	52.7	40.1	79.3	71.2	47.4	47.4
Share of non-cash income in total income	Percent	58.5	64.7	69	61	55	59	47	57.5	60	60
Share in total cash income											
Coffee	Percent	13.5	44	48.0	40.7	0.4	0.4	0.5	0	0.0	0.0

		All	Coffee Producers			Cashew nuts Producers			Non cash crop producers		
	Unit		*All*	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Tobacco	Percent	2.4	0	0	0	1.1	1	1	0	0	0
Cashew nuts	Percent	9.2	0	0	0	36.8	42	25	0	0	0
Other crops	Percent	28.1	18.4	17.8	18.9	23.3	21.9	26.1	38.9	36.6	36.6
Non-crop agriculture	Percent	3	4.8	5.6	4.1	1.6	1.6	1.5	2.8	3.3	3.3
Wages	Percent	15.5	8.3	10.1	6.8	17.6	17.0	18.9	20.7	25.5	25.5
Other non-farm income	Percent	28.2	24.5	18.5	29.5	19.2	15.7	26.6	37.6	34.6	34.6
Herfindhal Index of cash income diversification	Index 0 to 1	0.4598	0.3852	0.3793	0.3903	0.4621	0.4620	0.4624	0.5144	0.5023	0.5288
Average distance from parcels to hh compound	Km	17.8	12.77	12.24	13.22	31.74	29.65	36.19	13.1	9.63	9.63
Average distance from parcels to road	Km	2.03	1.45	1.37	1.52	2.86	2.62	3.37	1.8	1.87	1.87

Source. Computed by authors

Table 2a. Kilimanjaro: Value of household wealth

	Unit	*ALL*	*Coffee Producers*			*Non Coffee Producers*		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Value of wealth (1)	000 Tsh	3375	3402	2446	3880	2797	1779	3286
Value of agriculture capital	000 Tsh	50	55	26	70	42	9.35	58
Value of non agriculture capital	000 Tsh	60	60	60.5	59.8	61	9.04	85
Value of consumer durables (2)	000 Tsh	867	752	386	934	1045	394	1358
Value of land (2)	000 Tsh	662	474	244	590	391	355	409
Value of dwellings (2)	000 Tsh	1504	1845	1551	1992	977	795	1063
Value of animals (3)	000 Tsh	453	216	178	235	281	216	312
Share in total wealth								
Share of agriculture capital	Percent	1.6	1.7	1.4	1.8	1.0	0.5	1.3
Share of non agriculture capital	Percent	1.4	1.3	1.3	1.3	1.2	0.4	1.7
Share of consumer durables	Percent	28	21.1	16.8	23.3	30.3	24.7	32.9
Share of land	Percent	18.4	8.4	7.6	8.8	15.2	18.6	13.5
Share of dwelling	Percent	58.2	59.4	64	57.1	41.9	46.0	39.9
Share of animals	Percent	10.2	8.1	8.9	7.7	10.5	9.8	10.8
Herfindhal Index of wealth diversification	Index from 0 to 1	0.4940	0.4989	0.5264	0.4851	0.4864	0.4935	0.483

Source. Computed by authors.
(1)Value of wealth is sum of the following variables: value of ag capital, value of non ag capital, value of consumer durables, value of land, value of dwellings, value of animals.
(2) Using median prices at village level
(3) Using regional prices

Table 2b. Ruvuma: Value of household wealth

		All	Coffee Producers			Cashew Nut Producers			Non Cash Crop Producers		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Value of wealth (1)	000 Tsh	820	1388	1241	1512	521	471	627	613	497	753
Value of agriculture capital	000 Tsh	46	107	94	119	16	9	31	22	7	39
Value of non agriculture capital	000 Tsh	14	7	69	200	11	102	315	23	123	351
Value of consumer durables (2)	000 Tsh	147	204	114	278	103	84	144	133	95	177
Value of land (2)	000 Tsh	289	488	508	473	218	226	205	162	146	179
Value of dwellings (2)	000 Tsh	300	475	460	488	166	166	165	260	235	289
Value of animals (3)	000 Tsh	81	142	95	182	43	29	72	64	54	75
Share in total wealth											
Share of agriculture capital	Percent	2.9	6.3	6.0	6.6	1.1	0.7	1.9	1.7	0.6	2.9
Share of non agriculture capital	Percent	1	0.5	0.4	0.6	0.7	0.3	1.5	1.6	1.3	1.9
Share of consumer durables	Percent	17.3	10.4	8.8	11.9	19.5	19.1	20.6	20.2	19.2	21.3
Share of land	Percent	23.3	32.5	35.6	30.0	29.7	30.0	29.0	13.5	13.5	13.7
Share of dwelling	Percent	45	39.8	41.1	38.7	42.1	44.1	38.1	52.3	55.0	49.1
Share of animals	Percent	9.5	10.3	8.1	12.2	6.8	5.8	8.9	10.8	10.5	11.1
Herfindhal Index of wealth diversification	Index from 0 to 1	0.4233	0.3786	0.3984	0.3622	0.4311	0.4475	0.3964	0.4518	0.4642	0.4372

Source. Computed by authors.
(1)Value of wealth is sum of the following variables: value of ag capital, value of non ag capital, value of consumer durables, value of land, value of dwellings, value of animals.
(2) Using median prices at village level
(3) Using regional prices

Table 3a. Kilimanjaro. Agricultural production

	Unit	*All*	*Coffee Producers*			*Non CoffeeProducers*		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Area of land cultivated	acres	2.66	2.66	2.20	2.89	2.66	2.62	2.68
Number of plots cultivated	number	1.96	2.01	1.97	2.03	1.88	1.88	1.89
Share of land irrigated		20.7	17.2	14.8	18.4	26.3	22.0	28.3
Yield from maize	Kg/acre	217	190	134	218	258	202	285
Yield from beans	Kg/acre	41	27	29	26	63	59	64
Yield from coffee	Kg/acre	20	20	17	21	31	0	40
Yield from banana	Kg/acre	756	950	822	1013	455	574	398
Number of banana trees	number	392	459	292	541	215	104	275
Number of coffee trees	number	440	442	263	532	0	0	
Soil is poor quality	Percent	4.31	3.5	4.5	3.0	5.6	7.2	4.8
Soil is medium quality	Percent	46.8	47.7	53.9	44.6	45.3	40.9	47.4
Soil is good quality	Percent	48.9	48.8	41.7	52.4	49.1	51.9	47.7
Value added from crop production/acre (1)	'000 TSH/acre	84	90	71	99	76	80	73
Value of input for crop production/acre	'000 TSH/acre	32	32	28	34	31	19	37
Has used fertilizers		78.3	90.0	90.6	89.8	60.1	55.4	62.4
Has used chemicals		31.8	34.7	25.6	39.3	27.3	18.4	31.6
Value of agric. capital	'000 TSH	50	55	26	70	42	9	58
Value of non agric. capital	'000 TSH	60	60	60	60	61	9	85
Number of equivalent animals in cattle equivalent (2)	number	2.43	2.13	1.85	2.28	2.89	2.17	3.24
Number of oxen, cows and male cattle	number	1.88	1.57	1.24	1.73	2.38	1.68	2.71

Source. Computed by authors.
(1) Estimated at unique regional price
*(2) Number of equivalent animals = number of oxen +Number of cows + 0.3*number of pigs +0.2*(number of sheep + number of goats)*

Table 3b. Ruvuma Agricultural production

		All	Coffee producers			Cashew Nuts Producers			Non Cash Crop Producers		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Area of land cultivated	acres	6.1	5.8	5.6	5.9	9.1	9.1	9.1	4.6	4.0	5.3
Number of plots cultivated	number	2.6	3	2.9	3.0	2.5	2.6	2.4	2.4	2.4	2.5
Share of land irrigated	Percent	3.9	3.8	5.5	2.4	1.5	1.7	1.2	5.5	4.2	7.1
Yield from maize	kg/acre	203	158	140	173	69	56	96	313	261	375
Yield from beans	kg/acre	13	18	13	22	4	3	6	16	12	20
Yield from coffee	kg/acre	17	54	37	69	0	0	1	0	0	0
Yield from banana	kg/acre	45	92	87	96	12	6	24	35	17	55
Yield from tobacco	kg/acre	3	0	0	0	1	1	1	0	0	0
Yield from cashew	kg/acre	6	0	0	0	23	21	27	0	0	0
Number of banana trees	*number*	72	98	96	100	31	28	36	58	35	81
Number of coffee trees	*number*	1258	1292	1265	1316	650	300	1000	834	1155	453
Number of cashew trees	*number*	310	9	8	10	310	301	332	49		49
Soil is poor quality	Percent	5.2	4.4	5.2	3.6	6.4	9.0	1.0	5.6	5.9	5.2
Soil is medium quality	Percent	37.7	37.1	33.4	40.2	41.1	44.9	33.0	36.3	41.1	30.5
Soil is good quality	Percent	57.1	58.5	61.3	56.2	52.4	46.0	66.0	58.1	53.0	64.3
Value added from crop production/acre (1)	'000 TSH/acre	37	48	47.1	64.3	19	19.0	31.4	40	46.8	62.2

		All	Coffee producers			Cashew Nuts Producers			Non Cash Crop Producers		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Value of input for crop production/acre	'000 TSH/acre	9.76	8.36	4.4	11.6	3.89	2.9	6.0	13.7	9.1	19.1
Has used fertilizers	Percent	53.5	60.5	56.8	63.6	35.2	32.3	41.3	55.4	47.1	65.2
Has used chemicals	Percent	9.6	16.9	16.6	17.2	9.1	7.8	12.0	4.7	2.0	8.0
Value of agric. capital	'000 TSH	45	107	94	119	16	9	31	21	7	39
Value of non agric. capital	'000 TSH	14	7	69	200	11	102	315	23	123	351
Number of equivalent animals in cattle equivalent	number	1.04	1.84	1.21	2.37	0.556	0.40	0.89	0.803	0.74	0.88
Number of oxen, cows and male cattle	number	0.391	0.922	0.56	1.22	0.162	0.05	0.40	0.171	0.16	0.19

Source. Computed by authors.
(1) Estimated at unique regional price
*(2) Number of equivalent animals = number of oxen +Number of cows + 0.3*number of pigs +0.2*(number of sheep + number of goats)*

Table 4a. Kilimanjaro Access to finance and credit by rural farm households

	Unit	*ALL*	Coffee Producers			*Non Coffee Producers*		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Belongs to sacco	Percent	12.4	11.7	9.8	12.7	13.5	11.6	14.4
Has a banking account	Percent	12.4	13.6	6.8	16.9	10.6	4.4	13.6
Difficult to get seasonal credit for inputs on the farm	Percent	84.4	84.9	91.9	81.4	85.1	89.1	83.2
Easy access to formal credit for inputs from banks & other institutions	Percent	13.2	13.5	8.6	15.9	12.9	10.9	13.8
Easy to get credit for farm investment	Percent	8.2	9.3	8.0	9.9	6.5	3.5	8.0
Borrow from relatives & friends if money needed for emergency	Percent	49.5	49.3	53.8	47.0	50.4	58.6	46.5
Borrow from relatives & friends if money is needed for seasonal credit for inputs on the farm	Percent	58.3	58.3	59.4	57.7	58.8	63.8	56.4

Source. Computed by authors.

Table 4b:RUVUMA: Access to Finance and Credit by Rural hh

		All	Coffee Producers			Cashew Nut Producers			Non Cash Crop Producers		
			All	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*	*All*	*Poor*	*Non Poor*
Belongs to sacco	Percent	13.6	13.5	12.5	14.4	5.2	4.5	6.7	15.2	6.9	25.1
Has a banking account	Percent	9.9	13.6	10.1	16.5	5.2	4.0	7.6	8.7	4.8	13.3
Difficult to get seasonal credit for inputs on the farm	Percent	79.8	78.4	75.1	81.2	87	86.8	87.4	79.2	81.3	76.6
Easy access to formal credit for inputs from banks & other institutions	Percent	11.4	10.7	15.6	6.6	8.6	8.8	8.3	11.6	8.1	15.7
Easy to get credit for farm investment	Percent	9.3	8.8	14.6	4.0	6.5	5.6	8.2	11.2	7.5	15.5
Borrow from relatives & friends if money needed for emergency	Percent	40.9	39.9	35.5	43.7	45.3	45.5	45.0	39.6	42.1	36.6
Borrow from relatives & friends if money is needed for seasonal credit for inputs on the farm	Percent	29.5	27.7	24.6	30.3	33.3	32.9	34.1	29.5	25.8	33.8

Source. Computed by authors.

Table 5. Average area cultivated by coffee and ownership of coffee trees in Kilimanjaro and Ruvuma.

Area cultivated to coffee						
	Kilimanjaro			**Ruvuma**		
	Non poor	**Poor**	**All**	**Non Poor**	**Poor**	**All**
Total size of coffee area	1.75	1.37	1.62	2.19	2.12	2.16
Average number of plots	1.06	1.01	1.04	1.04	1.06	1.04
Number of Coffee trees per household						
	Kilimanjaro			**Ruvuma**		
	Non poor	**Poor**	**All**	**Non Poor**	**Poor**	**All**
Less than 10 years old	28	18	25	330	314	323
Between 10 and 30 years	123	61	102	633	669	650
Older than 30 years old	361	185	302	273	263	268
Total number of trees	511	272	431	1237	1246	1241
Percentage of trees of different ages						
Less than 10 years old	5.4	6.6	5.7	26.7	25.2	26.0
Between 10 and 30 years	24.0	22.6	23.7	51.2	53.7	52.4
Older than 30 years old	70.5	68.1	70.0	22.1	21.1	21.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of Coffee trees per acre.						
	Kilimanjaro			**Ruvuma**		
	Non poor	**Poor**	**All**	**Non Poor**	**Poor**	**All**
Less than 10 years old	10.0	8.4	9.5	69.3	70.4	69.8
Between 10 and 30 years	52.5	34.1	46.4	122.5	135.8	128.7
Older than 30 years old	135.4	98.9	123.1	42.6	49.7	45.9
Total number of trees	197.9	148.3	181.3	234.4	255.9	244.3
Percentage of trees of different ages						
Less than 10 years old	5.1	5.7	5.2	29.6	27.5	28.6
Between 10 and 30 years	26.5	23.0	25.6	52.3	53.1	52.7
Older than 30 years old	68.4	66.7	67.9	18.2	19.4	18.8
Total	100	100	100	100	100	100
Coffee production						
	Kilimanjaro			**Ruvuma**		
	Non poor	**Poor**	**All**	**Non Poor**	**Poor**	**All**
Coffee production per hh (kg)	54.5	29.8	46.2	355.0	173.4	271.1
Coffee production (kg / acre)	21.0	16.6	19.5	64.6	33.9	50.4
Coffee production (kg / tree)	0.177	0.165	0.173	0.283	0.160	0.227

Source. Computed by authors.

Table 6. Input costs for coffee production in Kilimanjaro and Ruvuma.

		Kilimanjaro			Ruvuma		
	Unit	**Non Poor**	**Poor**	**All**	**Non Poor**	**Poor**	**All**
Fertiliser applied to coffee	000sh/acre	0.42	0.38	0.41	0.53	0.13	0.31
Spraying chemicals to coffee	000sh/acre	1.13	0.74	1.00	1.15	0.42	0.74
Various services to coffee	000sh/acre	0.40	0.06	0.29	0.12	0.00	0.06
Interest paid on loans for coffee	000sh/acre	0.01	0.01	0.01	0.01	0.00	0.01
Hired labour for coffee	000sh/acre	1.44	0.75	1.21	0.52	0.08	0.28
Total input value to coffee	000sh/acre	3.40	1.94	2.92	2.34	0.63	1.39

Source. Computed by authors.

Table 7. Labour input in coffee production in Kilimanjaro and Ruvuma.

		Kilimanjaro			Ruvuma		
	Unit	***Non Poor***	***Poor***	***All***	***Non Poor***	***Poor***	***All***
Family labour days	days/year	79.0	75.2	77.7	109.6	112.4	110.9
Family labour days	days/year/acre	38.5	54.4	43.9	22.7	25.1	23.8
Family labour days	days/year/tree	0.63	0.87	0.71	0.13	0.18	0.15
Hired labour days	days/year	7.5	2.3	5.7	8.6	3.4	6.2
Hired labour days	days/year/acre	2.5	1.0	2.0	1.8	0.6	1.2
Hired labour days	days/year/tree	0.02	0.02	0.02	0.01	0.00	0.01

Source. Computed by authors.

Table 8. Real producer coffee prices, and real prices obtained in the Moshi auctions (In Tsh /kg base 2000)

	Kilimanjaro (farmers price)	Ruvuma (farmers price)	TCB Mild Arabic	Exchange rate (Tsh/Us $)	Tanzanian CPI
1981/82	1042.0	1042.0		8.28	1.43
1982/83	820.0	820.0		9.28	1.85
1983/84	973.2	973.2		11.14	2.35
1984/85	927.5	927.5		15.29	3.2
1985/86	1318.5	1318.5		17.47	4.26
1986/87	1039.5	1039.5		32.7	5.65
1987/88	1326.0	1326.0		64.26	7.34
1988/89	1559.1	1559.1		99.29	9.63
1989/90	1270.5	1270.5	3430.7	143.38	12.12
1990/91	941.7	941.7	1946.5	195.06	16.46
1991/92	1085.9	1085.9	1369.0	219.16	21.18
1992/93	1224.8	1224.8	1578.1	297.71	25.8
1993/94	2601.3	2601.3	2328.2	405.27	32.33
1994/95	2789.4	2789.4	4224.8	509.63	43.02
1995/96	2172.7	1810.6	2956.5	574.76	55.23
1996/97	1197.2	890.5	2325.6	579.98	66.82
1997/98	1933.7	838.0	2780.1	612.12	77.57
1998/99	1485.7	742.9	1850.4	664.67	87.5
1999/00	889.7	741.4	1419.7	744.76	94.41
2000/01	520.0	549.0	957.3	800.41	100
2001/02	475.6	285.4	817.9	876.41	105.13
2002/03	470.9	282.6	957.2	966.58	106.17

Source. Computed by authors from Tanzania Coffee Board (TCB) and IMF data.

Table 9. Sources from which coffee producers learn prices

		Kilimanjaro			Ruvuma		
	Unit	*Non Poor*	*Poor*	*All*	*Non Poor*	*Poor*	*All*
Private local buyer/agents	%	3.07	8.25	4.81	23.19	26.65	24.79
Primary society	%	77.39	68.21	74.31	62.71	63.02	62.85
Other farmers or friends/relatives	%	10.46	11.20	10.71	5.88	3.46	4.76
Radio	%	1.50	2.64	1.89	1.83	2.35	2.07
Other	%	0.26	0.43	0.32			
None	%	1.25	0.58	1.02			
NA	%	6.05	8.68	6.94	6.39	4.53	5.53
Total number of households		77,964	39,335	117,299	30,784	26,429	57,213

Source. Computed by authors

Table 10. Do farmers form price expectations for coffee prices?

Do you generally try to use some estimate of next season's prices of coffee for your production planning?							
		Kilimanjaro			**Ruvuma**		
	Unit	***Non Poor***	***Poor***	***All***	***Non Poor***	***Poor***	***All***
yes	%	7.3	4.2	5.4	10.2	10.9	10.6
no	%	91.0	89.5	90.5	82.1	84.5	83.2
NA	%	1.7	6.3	4.4	7.6	4.6	6.2
If yes where do you base your estimate?							
On latest year realized local prices	%	4.4	2.8	3.9	8.8	10.9	9.8
Latest year realized Moshi auction price	%	2.2		1.5	0.7		0.4
Latest year realized international spot	%	0.2	0.9	0.5	0.8		0.4
On the realized local prices of few recent years	%	0.5		0.3			
The realized Moshi auction prices of few past	%		0.5	0.2			
NA	%	92.7	95.8	93.7	89.8	89.1	89.4
Total number of households		**77,964**	**39,335**	**117,299**	**30,784**	**26,429**	**57,213**

Source. Computed by authors

Table 11. Income instability of coffee in Kilimanjaro compared to instability of other types of income.

Number of years out of the past 10 years, when income from the following categories was more than 50% below average				
		Kilimanjaro CPs		
	Unit	***Non Poor***	***Poor***	***All***
Total household income	number	2.0	1.9	1.9
Cash income from sale of food crops	number	1.6	1.4	1.5
Cash income from sale of vegetables	number	0.1	0.0	0.1
Cash income from coffee	number	2.4	2.0	2.2
Cash income from sale of other non-food cash crops	number	0.1	0.1	0.1
Cash income from sale of livestock	number	0.2	0.2	0.2
Food products produced on own farm and consumed at home	number	1.5	1.7	1.6
Wages	number	0.1	0.2	0.2
Income from food and other agricultural processing activities	number	0.0	0.0	0.0
Income from family enterprises	number	0.2	0.2	0.2
Income from gifts and remittances	number	0.1	0.2	0.1
Not available for Ruvuma				

Source. Computed by authors

Table 12: KILIMANJARO Estimation of agricultural production function

Dependent variable: Log Gross Value Total Ag. Production	
	IV Regression With Village Dummies
Log acres of land cultivated (1)	0.649***
	(4.08)
Log value of total inputs used (1)	0.420***
	(3.72)
Log Total (hired family) labour (number of days) (1)	0.334**
	(2.51)
Dummy for hired labour	-0.278*
	(1.87)
Log value of agricult. capital	0.047**
	(2.14)
Log age of the head	0.162
	(1.10)
Log mean years of education of the head	0.015
	(0.23)
Share of land improved with rock bund	0.354
	(1.38)
Share of land improved with soil bund	0.281**
	(1.99)
Share of land improved with mulching	0.224
	(1.56)
Share of land improved with terraces	-0.061
	(0.35)
Share of land improved with grass lines	-0.066
	(0.44)
Share of land with soil of medium good quality	0.058
	(0.32)
Share of land with gentle or steep slope	0.457*
	(1.78)
Dummy: 1=death since 1998 affected living conditions	0.042
	(0.46)
Dummy: 1=illnes since 1998 affected living conditions	0.075
	(0.81)
Dummy Average rain on parcel is below normal	-0.394***
	(4.69)
Dummy Average rain on parcel is much below normal	-0.483***
	(4.36)
Dummy: 1=drought since 1998 affected living conditions	-0.115
	(1.21)
Proportion of land irrigated	0.233*
	(1.88)
Constant	0.575
	(0.60)
Observations	925
R-squared	0.39

Dependent variable: Log Gross Value Total Ag. Production	
	IV Regression With Village Dummies
Test H0= land + inputs + total labour + ag. Capital = 1	
F-value	10.14
P value	0.0015
Wu-Hausman	
F Test	2.53307
P-Value	0.05578
Durbin-Wu-Hausman	
Chi-sq test Chi-sq(3)	8.13010
P-Value	0.04340

Source. Computed by authors
Robust t statistics in parentheses
** significant at 10%; ** significant at 5%; *** significant at 1%*
In column 1: Dummies for ward estimated but not reported
(1) Variables instrumented, using as instruments the following variables: Log size of land 3 years ago, log total labour lagged, Dummy for coffee production, Dummy for banana production, Dummy for chemical fertilizer used lagged, Dummy for Chemicals used lagged, Dummy for improved seeds used lagged, Dummy for coffee production lagged, dummy for banana production lagged, Dummy belong to sacco, dummy has a banking account, Dummy formal credit availability, dummies for ward (the latter only for column one)

Table 13: RUVUMA Estimation of agricultural production function.

Dependent variable: Log Gross Value Total Ag. Production	
	OLS with Village Dummies
Log acres of land cultivated	0.493***
	(8.19)
Log total inputs used	0.225***
	(9.02)
log total labour on farm	0.421***
	(5.16)
Dummy hired labour	-0.045
	(0.66)
Log value of capital	0.061***
	(4.15)
Log age of the head	0.003
	(0.03)
Dummy for corrections on age of the head (1)	-0.102
	(0.43)
Log average years of education of head	0.090*
	(1.94)
Share of land improved with rock bund	0.641*
	(1.82)
Share of land improved with soil bund	0.104
	(1.18)
Share of land improved with mulching	0.143
	(0.84)
Share of land improved with terraces	-0.060
	(1.05)
Share of land improved with grass lines	-0.265
	(1.38)
Share of land with soil of medium good quality	-0.155***
	(2.94)
Share of land with gentle or steep slope	0.004
	(0.06)
Dummy: 1=death shock since 1998	0.102
	(1.50)
Dummy: 1=illness shock since 1998	-0.023
	(0.35)
Dummy average rain on parcel is below normal	0.032
	(0.45)
Dummy average rain on parcel is much below normal	0.034
	(0.43)
Dummy: 1=drought shock since 1998	0.230**
	(2.57)
Proportion of land irrigated	0.302
	(1.62)
Constant	1.057
	(1.64)

Dependent variable: Log Gross Value Total Ag. Production	
	OLS with Village Dummies
R-squared	0.58
Test for Returns to scale	
Test H0= land + inputs + total labour + ag. Capital = 1	
F-value	6.17
P value	0.0132

Source. Computed by authors
Robust t statistics in parentheses
** significant at 10%; ** significant at 5%; *** significant at 1%*
Column 1- Dummies for villages estimated but not reported
(1) To recover 11 missing observations on age of the head we have replaced the age of the head with the average head's age of the sample and added a dummy for the observations that we have changed.

Table 14. KILIMANJARO Marginal products of production factors compared to market prices of the factors (means across the reported groups)

	Unit	All	Coffee			Non Coffee		
			All	***Poor***	***Non Poor***	***All***	***Poor***	***Non Poor***
Marginal Product of Land		130.6	134.0	110.6	145.7	125.4	95.0	140.0
Value Added Crop Prod./acre	*'000 TSH/acre*	84.5	90.0	71.2	99.5	75.8	80.4	73.6
Marginal Product of	Compared to 1	13.9	9.2	12.2	7.7	21.1	15.6	23.8
Marginal Product of Labour	'000 Tsh/day/man day	0.64	0.54	0.42	0.60	0.80	0.60	0.90
Market Price of Labour	*'000 Tsh/day/man*	1.56	1.50	1.46	1.50	1.67	1.12	1.79
Marginal Product of Capital	Compared to 0.1	1.11	0.98	1.12	0.94	1.47	1.56	1.43

Source. Computed by authors

Table 15. RUVUMA Marginal products of production factors compared to market prices of the factors (means across the reported groups)

	Unit	All	Coffee Producers			Non Coffee Producers		
			All	***Poor***	***Non Poor***	***All***	***Poor***	***Non Poor***
Marginal Product of Land	'000 Ts/acre	29.5	35.7	29.0	41.4	26.7	20.9	35.6
Value Added Crop Prod./acre	*'000 TSH/acre*	36.7	48.1	42.7	52.6	31.7	27.7	37.8
Marginal Product of Purchased Inputs	> =< 1	5.1	5.6	5.8	5.4	4.8	5.4	4.0
Marginal Product of Labour	'000 Tsh/	0.29	0.28	0.22	0.33	0.29	0.21	0.41
Market Price of Labour	*'000 Tsh/*	1.10	0.94	0.94	0.94	1.17	1.15	1.20
Marginal product of capital	*Compared to 0.1*	2.22	1.42	2.36	0.69	3.91	8.80	1.77

Source. Computed by authors

Table 16. KILIMANJARO. Most important desired use of an increase by 50 percent of annual income (percent of households in given class)

	All	*Poor*	*Non Poor*	*Coffee Producers*	*Non Coffee Producers*
Increase agricultural food production	23.61	19.43	25.79	20.97	27.72
Increase coffee production	8.91	6.03	10.33	14.62	0.00
Increase production of non-food cash crops beside coffee	4.70	5.95	4.09	1.90	9.07
Increase livestock production	10.39	10.69	10.51	11.77	8.24
Increase farm processing activity	0.68	0.33	0.86	0.61	0.81
Increase storage capacity or other farm buildings	0.09	0.27	0.00	0.14	0.00
Invest in non-farm enterprise	15.41	16.41	14.78	13.41	18.53
Improve house	13.56	15.93	12.39	12.11	15.83
Buy bicycle, motorcycle	0.25	0.00	0.38	0.00	0.64
Buy food or other consumer goods	5.04	5.85	4.64	5.47	4.36
Pay children's education	11.29	14.43	9.75	13.87	7.26
Buy household appliances	0.63	1.56	0.18	0.54	0.78
Put in savings account	2.51	0.81	3.35	2.21	2.99

Source. Computed by authors.

Table 17. RUVUMA: Most important desired use of an increase by 50 percent of annual income (percent of households in given class)

		All	Coffee	Non cash	Non	Poor
Increase agricultural food production	Percent	22.8	12.4	24.3	21.6	21.6
Increase coffee production	Percent	6.9	20.5	7.6	6.4	6.4
Increase production of non-food cash crops beside coffee	Percent	3.1	1.6	2.3	3.7	3.7
Increase livestock production	Percent	8.0	15.2	9.6	6.6	6.6
Increase farm processing activity	Percent	0.1	0	0	0.2	0.2
Increase storage capacity or other farm buildings	Percent	0.1	0.4	0	0.2	0.2
Invest in non-farm enterprise	Percent	16.8	18.3	19.1	15.0	15.0
Improve house	Percent	20.2	13.2	17.0	22.8	22.8
Buy bicycle, motorcycle	Percent	0.9	0.8	1.6	0.3	0.3
Buy food or other consumer goods	Percent	3.6	6.4	3.4	3.8	3.8
Pay children's education	Percent	3.8	2.4	3.1	4.5	4.5
Buy household appliances	Percent	2.2	1.6	2.3	2.2	2.2
Put in savings Account	Percent	3.6	5.2	5.3	2.3	2.3

Source. Computed by authors.

Table 18. Coffee plantings and uprootings, and number of trees planted and uprooted.

	Kilimanjaro			Ruvuma		
	Non Poor	***Poor***	***All***	***Non Poor***	***Poor***	***All***
Only planted	3,886	2,228	6,114	5,829	3,341	9,170
Only uprooted	16,021	8,296	24,317	228	608	836
Doing both but net planters	1,680	193	1,873	228	211	439
Doing both but net uprooters	2,624	987	3,611			
Doing both but net result is zero	4,223	1,321	5,544	1,251	1,083	2,333
Doing nothing	49,530	26,310	75,840	23,249	21,185	44,435
	77,964	39,335	117,299	30,784	26,429	57,213
Average number of trees...						
Only planted	69	78	73	179	306	226
Only uprooted	-166	-170	-167	-300	-53	-120
Doing both but net planters	199	5	179	40	80	59
Doing both but net uprooters	-149	-163	-152			
Coffee trees year before survey	543	307	464	1205	1208	1206
Coffee trees the survey year	511	272	431	1237	1246	1241
Coffee trees 3 years ago	579	302	486	1215	1177	1197

Source. Computed by authors.

Table 19. Determinants of coffee tree investments

	Kilimanjaro		Ruvuma	
	(1)	(2)	(3)	(4)
	Prop change in coffee trees	Prop change in coffee trees	Prop change in coffee trees	Prop change in coffee trees
Proportional change in coffee price (2003-02)	0.044	0.063	0.010	0.020
	(2.13)*	(2.73)**	(0.79)	(1.41)
Expected coffee price	-0.000	-0.000	-0.000	-0.000
	(0.28)	(0.33)	(0.45)	(0.76)
Previous relative max-min price range	-0.000	-0.000	-0.000	-0.000
	(1.14)	(1.44)	(0.61)	(0.76)
Coffee trees in t-1	-0.000	-0.000	-0.000	-0.000
	(2.64)**	(3.19)**	(2.09)*	(2.42)*
No of coffee trees sq in t-1	0.000	0.000	0.000	0.000
	(2.78)**	(3.38)**	(1.96)	(2.37)*
Prop of old coffee trees	0.139	0.192	-0.015	-0.025
	(2.82)**	(3.67)**	(0.65)	(1.00)
Cultivated land (acres)	-0.000	0.002	0.006	0.008
	(0.01)	(0.23)	(0.92)	(1.17)
Herfindhal index of crop diversification	0.001	0.001	-0.000	-0.000
	(1.28)	(1.63)	(0.65)	(0.78)
Proportion of gently sloped land	-0.283	-0.449	0.041	0.077
	(2.08)*	(2.96)**	(1.08)	(1.68)
Proportion of steep land	-0.360	-0.560	0.011	0.015
	(2.70)**	(3.48)**	(0.24)	(0.35)
Proportion of good quality land	0.011	0.008	0.002	0.003
	(0.33)	(0.24)	(0.06)	(0.10)
Proportion of poor quality land	-0.084	-0.098	0.074	0.120
	(1.23)	(1.49)	(0.79)	(1.30)
Proportion of land with rock or soil bound	-0.015	-0.020	0.013	0.030
	(0.29)	(0.40)	(0.34)	(0.83)
Proportion of land with mulching improvements	-0.013	-0.022	-0.036	-0.063
	(0.34)	(0.56)	(0.96)	(1.60)
Proportion of land with terraces	0.067	0.085	0.028	0.041

Table 19. Determinants of coffee tree investments

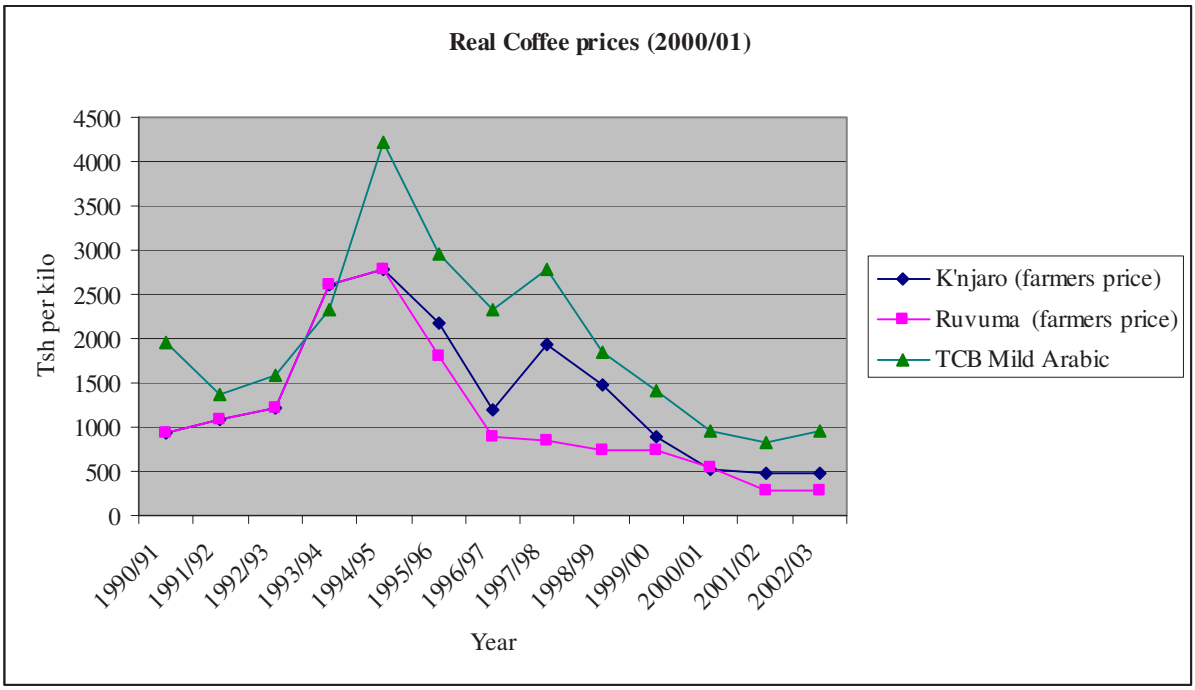
	Kilimanjaro		Ruvuma	
	(1)	(2)	(3)	(4)
	Prop change in coffee trees	Prop change in coffee trees	Prop change in coffee trees	Prop change in coffee trees
	(0.82)	(1.02)	(0.61)	(0.85)
Proportion of irrigated land weighted by relative	-0.019	-0.011	-0.049	-0.100
	(0.35)	(0.20)	(1.01)	(1.44)
Education level in years	0.008	0.010	0.002	0.003
	(1.85)	(2.45)*	(0.35)	(0.57)
Age	-0.010	-0.014	0.007	0.013
	(1.88)	(2.46)*	(1.24)	(1.70)
Age*2	0.000	0.000	-0.000	-0.000
	(1.90)	(2.50)*	(1.46)	(1.90)
Adult equiv. per acre	-0.001	0.000	-0.011	-0.022
	(0.13)	(0.10)	(0.39)	(0.82)
Value of wealth	0.000	0.000	-0.000	-0.000
	(0.04)	(0.24)	(1.18)	(1.86)
Rain on land was below normal	0.061	0.074	-0.048	-0.085
	(2.08)*	(2.41)*	(1.42)	(2.00)*
Rain on land was much below normal	0.063	0.085	-0.054	-0.124
	(1.45)	(1.82)	(0.49)	(1.22)
Dummy: 1=drought shock since 1998	-0.007	-0.014	-0.123	-0.203
	(0.19)	(0.38)	(0.84)	(1.44)
Dummy: 1=illness shock since 1998	-0.027	-0.035	-0.009	-0.015
	(1.05)	(1.34)	(0.25)	(0.42)
Dummy: 1=death shock since 1998	-0.049	-0.069	-0.022	-0.050
	(1.66)	(2.14)*	(1.01)	(1.94)
Dummy: 1=belong to sacco	0.059	0.073	-0.021	-0.029
	(1.81)	(2.30)*	(0.97)	(1.21)
Dummy: 1=have bank account	0.086	0.113	0.014	0.019
	(1.36)	(1.71)	(0.44)	(0.63)
Access to seasonal credit	0.072	0.101	0.031	0.056
	(2.14)*	(2.86)**	(1.03)	(1.85)
Predicted planting dummy		-0.128		-0.123

Table 19. Determinants of coffee tree investments

	Kilimanjaro		Ruvuma	
	(1)	(2)	(3)	(4)
	Prop change in coffee trees	Prop change in coffee trees	Prop change in coffee trees	Prop change in coffee trees
		(3.30)**		(2.22)*
Constant	0.434	0.732	-0.101	0.072
	(1.73)	(2.53)*	(0.72)	(0.53)
Observations	548	548	270	270
R-squared	0.20	0.22	0.12	0.16

Robust t statistics in parentheses
** significant at 5%; ** significant at 1%*

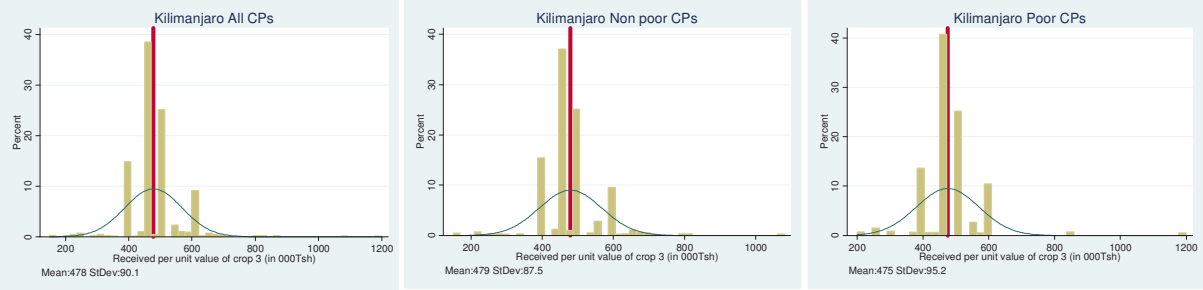
Figure 1. Real producer prices in Kilimanjaro and Ruvuma, and TCB auction prices



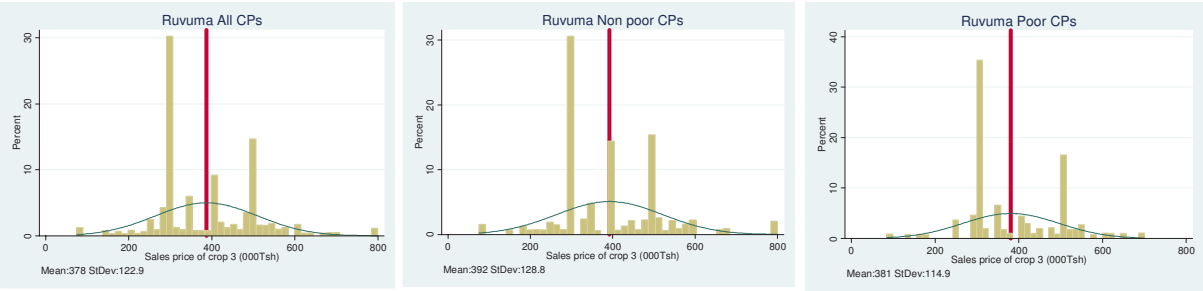
Source. Authors' computations from data in table 8.

Figure 2. Distribution of coffee prices received prices received by producers in Kilimanjaro and Ruvuma in 2003

A. Kilimanjaro



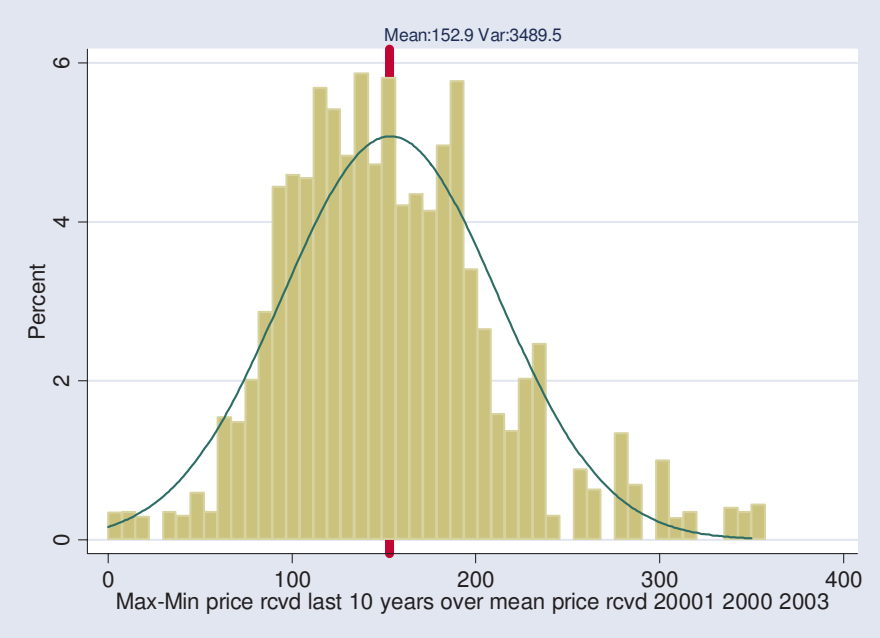
B. Ruvuma



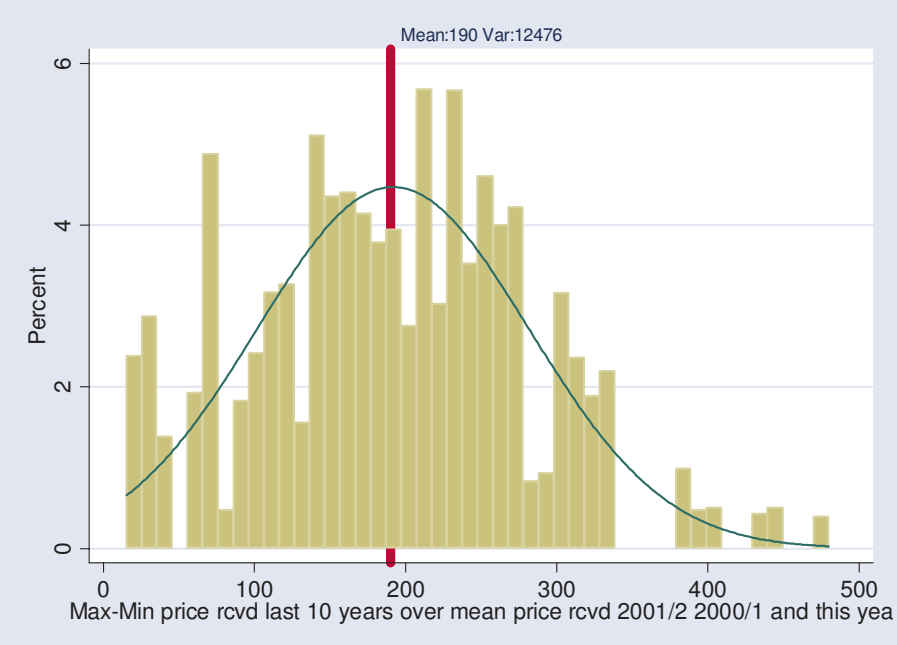
Source. Authors' computations

Figure 3. Variability of nominal prices received for coffee in Kilimanjaro and Ruvuma over the previous 10 years.

3A. Kilimanjaro



3B. Ruvuma



Source. Authors' calculations

Assessing Small-holder Participation in Value Chains: the case of vegetables in Honduras and El Salvador[87]

Mark Lundy[88], *Roberto Banegas*[89], *Lourdes Centeño*[90], *Iván Rodríguez*[91], *Manuel Alfaro*[92], *Santos Hernández*[93] *and José Ángel Cruz*[94].

ABSTRACT

The growth of supermarkets in the developing world has attracted the attention of social science researchers over the last few years. Of major concern is the role that rapid changes in supermarket and other procurement systems are having on smallholder livelihoods. Evidences suggests that while some smallholders are able to organize themselves and access the relatively more lucrative supermarket channels, the majority of smallholder farmers in the developing world faced significant barriers in this regard. This paper examines the case of vegetable chains in Honduras and El Salvador in an attempt to gain further insight into this dynamic. Fieldwork was carried out with a total of five smallholder organizations and a range of supermarket buyers. Results indicate that the existing supply chain suffers from several limitations including: (a) relatively low levels of collective action and organization among smallholders; (b) a paucity of collaborative fora linking actors along the chain, and; (c) public policies that fail to keep pace with the rapid change occurring in the retail sector. Based on these findings, the paper suggests strategies for chain development focused on collaborative actions between chain actors. Key areas of intervention include the development and testing of more widely replicable and sustainable organizational models for smallholders; development and trialing of diverse methods of chain governance and coordination, and; the institutionalization of public-sector policies based on more complete monitoring of the social, environmental and economic impacts all the rapid changes occurring in the food retail sector in Central America.

BACKGROUND

The retail sector throughout the world has seen rapid changes over the past decade. These changes are evidenced by the growing participation of what can be considered modern marketing channels for the delivery of food products to increasingly urban populations (Reardon Food Policy). Hallmarks of this rapid change include a shift from traditional supply chains and markets (e.g. wholesale or wet markets) towards increasingly close systems of supply through which final retailers exercise a much greater degree of control not only over the quality and quantity of product but also over the governance of the entire supply chain. The Central American region is no exception to the rule as is evidenced by previous work carried out in the region on this topic by Balsevich, Berdegué and Reardon (2006), Reardon and Berdegué (2002), Jano et. al (2004) among others.

Work carried out by the research teams in Honduras and El Salvador supports the trends highlighted by existing literature. In the case of El Salvador, supermarkets have grown 14.7% during the last 10 years to a total of 132 retail outlets at a national level that manage approximately 39% of the overall market for food (CRS, 2005). Additional characteristics in El Salvador include the fact that nearly

[86] This work was financed by a grant from the ESAE Division of the Food and Agriculture Organization of the United Nations (FAO) and carried out within the context of a regional learning alliance on rural enterprise development (www.alianzasdeaprendizaje.org).

[87] Senior Research Fellow, Rural Agroenterprise Development Project, CIAT (m.lundy@cgiar.org)
[89] Consultant, Agropyme Program, Swisscontact Honduras
[90] Technician, Agriculture and Environment Program, Catholic Relief Services El Salvador.
[91] Advisor, Agropyme Program, Swisscontact Honduras
[92] Technician, Agriculture and Environment Program, Catholic Relief Services El Salvador.
[93] Technician, Agriculture and Environment Program, Catholic Relief Services El Salvador.
[94] Manager, Agriculture and Environment Program, Catholic Relief Services El Salvador.

65% of the products currently sold in supermarkets are imported, principally from the United States or from other Central American countries with total agricultural imports totaling approximately 33.1 million US dollars in 2002 (ibid). Recent studies carried out by USDA estimate a total value for supermarket sales in El Salvador between 276 and $375 million yearly. Across the border in Honduras the situation is similar. During the period at of 1999 to 2003, USDA reports that supermarkets expanded from 41 to 51 outlets, with total sales moving from 142 million to 267 million US dollars and the overall participation of supermarkets in the food sector reaching 43% (USDA, 2003 cited in Agropyme, 2005).

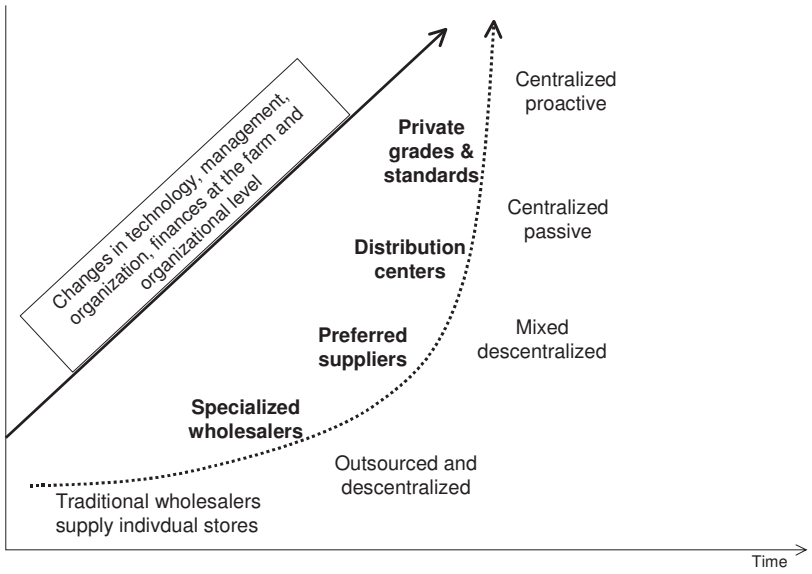
In both countries one of the major supermarket players is the Central American Retail Holding Corporation (CARHCO) composed by two national supermarket chains in Costa Rica and Guatemala and an international firm. According to the CARHCO web site, the holding company currently possesses 354 supermarkets across the isthmus making it by far and away the dominant player in this market. During the period of study, the previous international supermarket chain -- Ahold from the Netherlands -- sold its 33% share in CARHCO to Wal-Mart from the United States. Under its initial configuration, CARHCO initiated processes focused on modernizing and centralizing their procurement activities. Among the initiatives undertaken were the expansion of specialized wholesalers into both Honduras and El Salvador, the identification of suppliers willing and able to meet CARHCO standards and some activities focused on building of those players capacities. As this process has evolved, the number of overall suppliers selling into the CARHCO network has declined while, at the same time, focusing on producers and producer organizations with the capacity to make increasingly important investments in technology, organization and logistics sufficient to meet increasing quality and consistency standards.

This process is not unique for Central America and has been described by Berdegué and others in diverse contexts throughout Latin America, Africa, Asia and Eastern Europe (Berdegué, 2005 and Regoverning Markets, 2004). The process of market modernization is characterized by a shift to centralized distribution systems, specialized wholesalers, selected producers, increasingly stringent private standards and labels and increasing use of international suppliers (see Graphic 1 below). This process implies important technological, organizational, logistical and financial hurdles for producers who wish to maintain their participation in this channel. In much of the developed world, this process has taken place over a span of 30 to 50 years. In the developing world, this process is taking place in anywhere from eight to 12 years. The default result of this collision between producer skills and capabilities and rapid changes in the market dynamic tends to be exclusion especially of the smaller or less organized producers.

The results of the desk study in both Honduras and El Salvador clearly show how this process is moving in both countries. The active participation of the general manager for Hortifruti in Honduras during the research process allowed a glimpse of how this process is playing out as part of a business strategy being employed by CARHCO through the identification and development of specialized producer organizations. In this case it is important to highlight that the implementation of a modernization strategy by supermarket actors is not driven by a desire to exclude small producers but rather by economic logic that favors the development of a relatively small number of highly qualified suppliers able to meet supermarket demands on a consistent basis.

Graphic 1 – Evolution of supermarket supply systems

Berdegué, 2005



The remainder of the paper is structured as follows: (a) a section on the objectives of the research; (b) a brief overview of the methods employed at the field level, and; (c) a review of relevant results from the field. The paper concludes with a section focusing on the critical points of the supply chain, possible strategic options to improve the participation of smallholder farmers in dynamic markets as well as reflections on the use of participatory methods and links between natural resource management and dynamic markets.

OBJECTIVES

The research carried out in El Salvador and Honduras had the following objectives. Firstly, a desk study to analyse the relative rate of expansion of supermarkets in both countries and the effects that their purchase practices are having on markets for specific vegetable crops, and, in particular key entry barriers that limit smallholder participation in these markets. Secondly, a participatory review of the supply chain for cucumber, bell pepper, tomato, broccoli, potato and lettuce focusing on prices, margins, transaction costs, logistical and storage needs and quality standards. Thirdly, the identification of possible strategies to facilitate the participation of smallholder producers in vegetable supply chains linked to supermarkets bearing in mind the previously mentioned entry barriers.

This work was carried out in a participatory fashion through the existing Learning Alliance network in Central America with the intention of providing development partners with access and the needed skills to carry out supply chain analysis in both Honduras and El Salvador.

METHODOLOGY

The method used for the participatory analysis of vegetable supply chains was adapted from work carried out previously by the Netherlands Development Organisation (SNV) as published in Van der Heyden and Camacho (2004). This method consists of three phases of analysis. In the preliminary phase of analysis, the research team defines the objectives of the study, selects the product or products to focus on and it defines the reach or scope of the analysis. In the central phase of the method, the research team analyzes the history of the supply chain, the context in which the supply chain operates, the participating direct and indirect actors, the relationships between actors and their organizations, current and projected market conditions and, finally, the economic and financial data along the chain. The final phase of the method focuses on analysis of the resulting data, the identification of critical points and competitive advantages and the development of action strategies to improve the functioning of the supply chain.

While the use of the specific SNV method represented a departure for the field team in Central America, both the Agropyme program in Honduras and the CRS office in El Salvador have had previous experience with subsector and supply chain analysis. As a result, adaptations and improvements were made during the field application that resulted in minor changes to the overall method. A key difference in this regard, was the relative level of participation among the diverse chain actors. In Honduras, given existing links between the Agropyme program and several of the participating supermarkets, it was feasible to develop a steering committee in which there was significant participation from the leading supermarket chain as well as relevant government actors. In the case of El Salvador, this was not feasible.

OUTCOMES

History

The production of vegetable crops by smallholders in Central America on a significant scale can be traced back to approximately the decade of the 1970s. Increasing urbanization and resulting demand for vegetable crops is the main driver for the expansion of these crops throughout the isthmus. Recently this process has been accelerated through an increasing focus on the use of fresh or healthy ingredients by urban populations which in many cases has been actively promoted by the supermarkets themselves through the use of various promotional strategies focused on increasing overall vegetable consumption. Despite the increasing importance of these crops for the retail sector, large-scale commercial cultivation is principally confined to Guatemala and to a lesser extent Costa Rica. As mentioned previously, the lack of consistent availability of high-quality vegetable crops leads to imports by supermarkets at a regional scale and beyond.

As demand has increased, interest by smallholders and their organizations has also grown. It would be remiss, however, not to mention the important role of international development organizations in this process. Development agencies and projects have, in many cases, actively promoted the expansion or establishment of what they consider "higher value" crops to complement existing food security options such as maize and beans. This focus has increased in importance as national governments and international donor agencies have turned their attention to a poverty reduction agenda particularly in countries such as Honduras and Nicaragua.

A final factor that explains the relatively rapid expansion of vegetable crops in the hands of small producers is the existence of sufficient technical knowledge at a national level. In this area, work carried out by the Honduran Foundation for Agricultural Research (FHIA), the National Center for Agricultural and Forestry Technology of El Salvador (CENTA), the Pan American Agricultural School Zamorano and, to a lesser extent, national extension programs has been important. In addition to the adaptative research carried out by the aforementioned organizations, Central America also possesses a relatively well-developed network of private technology providers who facilitate farmer access to seed varieties, fertilizers, pesticides, irrigation systems and, in some cases, greenhouse supplies.

Both countries possess relatively well-defined areas of smallholder vegetable production based on land tenure patterns and existing natural advantages presented by hillside environments. Smallholder vegetable production in hillside environments benefits from a slightly lower incidence of pest and disease problems, slightly improved access to year-round water supplies and, as a result, is less expensive in these environments. It is important to note, however, that need to large-scale visual production also occurs in lower line valleys in both countries. These regions were not included in the current study principally because producers there tend to be large-scale commercial operations.

Context

The vegetable production chain in Honduras and El Salvador operates within a context defined by public policies, access and control of infrastructure and environmental considerations. Of relevance to the present study are existing public policies in both Honduras and El Salvador focusing on the agricultural sector. In El Salvador, the Ministry of Agriculture and Ranching (MAG) has two specific policy areas that should be kept in mind: a focus on producer association and a focus on technological innovation. In the first area, the Ministry seeks to promote associations of producers who are both profitable and competitive while, with the second, it hopes to increase the access of these associations and other producers to innovative production and post harvest technologies. Both policies are supported by activities carried out by CENTA.

In the case of Honduras, a key piece of legislature is the Agri-food and Rural Environment Strategy of Honduras for the period of 2003 to 2021. Within this policy, a framework to improve the competitiveness of the horticultural agri-food chain was sanctioned in December of 2004. As part of this framework, the horticultural agri-food chain of Honduras was assigned a coordinator paid for by the Ministry of Agriculture and Ranching. Other laws exist on the books -- such as that focused on food safety -- but the implementation on a day-to-day basis in activities concerning the horticultural agri-food chain is limited.

In addition to existing national policies focused on rural development and the horticultural agri-food chain in particular, both Honduras and El Salvador are signatories of the recently approved Central American Free Trade Agreement (CAFTA) with the United States. Initially actors from the horticultural agri-food chains in both countries felt that the approval of CAFTA was a step forward in terms of competitiveness. However, CAFTA also opens the door for potential agricultural imports -- including vegetables -- from Mexico and even the United States itself. While the full impact of CAFTA remains to be seen, this treaty more than any national level policy will define the future for many horticultural producers in the region.

In terms of infrastructure, El Salvador has reasonable road and electrical coverage as well as a larger number of functioning warehouse and distribution centers. While Honduras is behind in all these areas, the majority of the show for producing areas are reasonably well connected to markets. A major limitation for higher-quality products in Honduras is the relative lack of warehouse and specialized transportation available. Traditionally both countries suffered from limited communications facilities linking rural communities with major markets, however, this has changed rapidly in the last five years with the expansion of cellular phone service to many rural communities. A strong local value added or processing industry for vegetable crops exists in neither country. Farmer organizations or the supermarkets themselves carry out what little value adding does occur in the horticultural supply-chain.

Finally, the production of high-quality vegetables year-round has significant implications for the environment. Producers need access to soils capable of sustaining intensive production systems as well as a year-round supply of water for irrigation. In many cases, the achievement of adequate production conditions in existing environmental niches is far from easy. As a result significant investments continue to be made not only in small-scale drip irrigation systems but also in more appropriate soil and crop management approaches. The paper will return to the nexus between smallholders, vegetables and dynamic markets in the conclusion.

CHAIN ACTORS

Actors in the horticultural agri-food chain can be divided between direct participants and indirect participants. Direct participants include producers, producer organizations, marketing and retail actors and the final consumers. Indirect participants include technical and business assistance providers, researchers, banks and micro finance institutions, transportation providers and input suppliers. The principal focus of this research was on the direct actors in the chain and their relationships.

Producers in the chain were subdivided into three categories for this study. These categories are unorganized small producers, small producers organized in producer associations and independent producers with a secure market. The discovery of a distinct business model promoted by the CARHCO group -- focused on the development of business networks around the lead farmer -- led to the inclusion of the third category. The principal characteristics of each type of small vegetable producer in Honduras and El Salvador are shown below in Table 1.

Direct fieldwork was carried out to assess the cost structures and benefits achieved by the types of small holders by selling to supermarkets. Relatively more time and effort was dedicated to studying the second type of smallholder producers, those that are organized in formal producer associations (e.g. cooperatives, associations or farmer owned businesses) given in the predominance of this model within the rural development community in both Honduras and El Salvador. As a result, a total of five formal producer associations -- three in El Salvador and two in Honduras -- were reviewed in detail. Initial work was carried on the third typology of smallholder, but given the relatively late appearance of this category there remain significant questions to be answered.

An important caveat to this work is the relative scope of farm organization in the horticultural agri-food chain in both Honduras and El Salvador. In both countries care was exercised to identify and study the most relevant and/or representative group of formal farmer associations active in this chain. However, when the total number of participating farmers in these organizations is compared to existing data on the total number of farmers who participate in the horticultural agri-food chain, it becomes clear that the default condition for smallholder vegetable production is no organization. These results are summarized in Table 2.

Table 1. Principal characteristics of small-scale vegetable producers in Honduras and El Salvador

Variables	Unorganized small producers	Small producers in formal organisations	Independent producers with a secure markets
Access to technology			
Inputs[95]	Low	Medium	Medium
Use of seed beds or greenhouses[96]	Low	Medium	Low
Irrigation	Low	Appropriate	Appropriate
Market access conditions			
Packing houses	No	Yes	No
Transport from the field to the packing house	Can not pay costs	Can pay local transportation	Owns vehicle
Market information	No access	Limited access, limited knowledge	Good access, good knowledge
Price conditions	Low and instable prices	Good and stable prices	Good and stable prices
Use of quality standards	No	Yes	Yes
Type of packaging	Sacks	Plastic trays	Plastic trays
Technical assistance			
Production	No access, limited knowledge	Access, good knowledge	No access but good knowledge based on experience.
Business organization	No access, limited knowledge	Access, good knowledge	No access but good knowledge based on experience.
Resources used			
Land	Own land, small parcels	Own and rented	Own and rented, production in partnership with others
Labor	Family	Mostly family with some outside help.	Some family but principally hired labors.
Capital, inputs	Informal lenders	Personal capital and credit	Personal capital and credit

Source: Agropyme, 2005: 25 y CRS, 2005: 25

[95] Seeds, fertilizer, pesticides.

[96] The use of seedbeds in greenhouses is not necessary for carrots and potatoes. A low score implies that the seedbed is prepared next to the final plot with minimum control exercised over plant development.

Table 2. Total number of horticultural producers in Honduras and El Salvador compared to total membership of farm organizations studied.

Country	Total number of horticultural producers	Total number of member in producer organizations	Percentage of total farmers in producer organizations
Honduras	15.000 [a]	395	2,6%
El Salvador	8.000 [b]	236	3,0%

Source: Authors calculations based on Agropyme, 2005 y CRS, 2005.
Number of vegetable producers according to the National Agricultural Census of Honduras, 1993.
Number of producers in the horticultural agri-food chain according to BMI/Technoserve, 2004 (cited in CRS, 2005: 25)
Total number of producers involved in producer organizations focused on vegetable production in Honduras and El Salvador, Agropyme, 2005 y CRS, 2005.

The farmer organizations covered by this study are presented in Table 3.

Table 3. Producer organizations included in the study.

Organization	Country	Number of farmers	Annual sales (thousands USD)	Products	Market channels
ACOPO	El Salvador	23	140 [a]	Lettuce, baby carrots, radishes	Supermarkets, hotels and restaurants
AGROLEMPA	El Salvador	70	177 [b]	Tomato, bell pepper, cucumber	Supermarkets, hospitals, processors and restaurants
APRHOFI	Honduras	110	184 [c]	Carrots, lettuce, broccoli, potatoes	Suplidores especializados, supermercados, restaurantes, mercados mayoristas
COHORSIL	Honduras	285	89 [c]	Tomato, bell pepper	Specialized wholesalers, supermarkets, wholesale markets and local markets
PHOC	El Salvador	143	96 [c]	Tomato, bell pepper, cucumber	Supermarkets and farmers markets

Source: Author calculations based on Agropyme, 2005 y CRS, 2005.
Data from 2003 including vegetable sales and other income [CRS, 2005: 28].
Average over the last three years [CRS, 2005: 31]
Annual sales calculated based on monthly averages (Agropyme, 2005: 34-37; CRS, 2005: 36).

Other direct actors in the horticultural agri-food chain include traders and retailers. In both Honduras and El Salvador a wide range of individuals as well as formal business are active in the chain. Several different channels for product can be identified. The more traditional market channel is comprised principally of networks of informal traders that link areas of production with regional and national markets. This market channel is characterized by cash payments, limited quality demands, important levels of social capital between actors and the trader usually sells the final product in urban wholesale markets (e.g. wet markets) although some product is sold to smaller supermarkets as well. Some traditional traders have developed the necessary skills and knowledge to sell a portion of their produce to specialized wholesalers and, in some cases, to supermarkets and restaurants directly. This channel represents a midpoint between the traditional system and the modern retail system. The modern retail system is comprised of diverse types of former organization -- ranging from formal associations to the lead farmer model -- linked into specialized wholesalers and/or directly into supermarkets, restaurants and hotels. A certain degree of competition exists between formal farmer organizations and some of the more progressive traders as both seek to sort, pack and, in some cases, add value to the horticultural products that they sell.

The final direct actor in the chain is the consumer. While both countries boast a wide range of consumer types, the present study focused on consumers who purchase horticultural products from supermarkets. Table 4 provides an idea of the characteristics of this kind of consumer in the case of Honduras.

Table 4. Consumer characteristics for Honduras

Variable	Results
Location	Tegucigalpa and the Valle de Sula (the San Pedro Sula metropolitan area) concentrate more than 2 million inhabitants who demand quality fresh vegetables. Approximately 30% of the total population purchase vegetables in supermarkets.
Criteria of purchase location	Security, location and hygiene.
Income level (Lps / month)	>22,000=22%, 12,000-20,000=19%, , 8,000-12,000=23%, 5,000-8,000=6%, <5,000=30%
Demographics	50% older than 40, 28% between 31 and 40, 15% between 21 and 30, 7% under 20 years of age
Market segments	Low, middle and upper class with income above 3,000 Lps / month.
Reasons for purchases	Physiological needs and life style focused on healthy living. Recognize that the consumption of fresh produce contributes the family diet and reduces overall budget expenditures on food.
Frequency of purchases	Every 15 days or weekly in the afternoons
Factors that influence purchases	Price, quality (fresh and unblemished), hygiene.
Types of products demanded	The majority of demand is concentrated on fresh produce sold loose but there is demand for different presentations (tomatoes in foam trays, mini potatoes in mesh, various heads of lettuce in bags, bagged carrots, baby carrots in foam trays, peeled carrots, etc.).

Source: Agropyme, 2005: 28.

In addition to direct actors, there are indirect actors who provide support services necessary for the functioning of the agri-food chain. These actors include technical and business assistance providers -- NGOs, development projects and producer organization themselves. In the majority of cases the technical assistance provided is focused on recommendations for crop management, post harvest processing and social and organizational aspects as well. The coverage and quality of these services is often less than optimal. In addition to these subsidized service providers, some marketing actors also provide technical assistance to farmers who supply them. This is the case when supermarkets focus on supplier development as a key factor to increase the competitiveness of their supply chains. Other indirect actors in the chain include specialized research organizations such as FHIA and Zamorano in Honduras and CENTA in El Salvador. The relatively low level of research investment in the horticulture agri-food chain is focused principally on adaptive research linked to development activities.

Finally, additional indirect service providers include micro finance and formal banks, transport services and input suppliers. The provision of credit to the horticultural agri-food chain in both Honduras and El Salvador is deficient as is the case for many, if not all, rural enterprise activities. Transportation services exist in the majority of vegetable producing areas, however the quality and the costs of these services vary. It is important to note that only farmers involved in producer organizations can count on access to specialized -- e.g. refrigerated -- transportation that helps guarantee the quality of their product. In both countries, there is widespread access to basic production inputs such as seeds, fertilizers and pesticides. Some more specific technologies such as drip irrigation and simple greenhouses are more difficult or costly to come by and tend to reach the small holders only through producer organizations.

An important differentiating factor between services provided by development actors and those provided by chain actors themselves is the relative importance of external subsidies to cover costs. Normally the provision of services by development actors requires significant and ongoing subsidies. Services provided by chain actors directly (e.g. embedded services) are paid for directly or indirectly by the chain itself.

MARKETS

The vegetable crops included in the study are highly dynamic. Comparisons can be made between markets for tomatoes and bell peppers in Honduras and El Salvador while, in Honduras, additional work was carried out on other horticultural crops such as carrots, broccoli, lettuce, and potatoes. The divergence between crop study in the two countries is based principally on the importance of these crops in the supermarket supply chain. A brief review of tomatoes and bell peppers shows the following market information.

For tomatoes the apparent consumption in El Salvador is nearly 80,000 metric tons per year. Of this total, 66.7% are sold through informal market channels, 11.3% through supermarkets and the remainder consumed by the institutional and processed food markets. Approximately 65% of all tomato consumed in El Salvador is imported from neighboring countries such as Guatemala and Honduras. Imports increased at an annual rate of 37% over the last three years indicating the insufficiency of local supply (CRS, 2005). In Honduras, the members of the supply chain analysis steering committee considered tomato to be a high risk crop for small holders. According to the general manager of COHORSIL, one of the formal farm associations included in the study, only medium to large producers with significant access to capital can produce this crop successfully. Demand for tomato in Honduras is approximately 6,000 metric tons per year. Supermarkets account for 25% of that total (Agropyme, 2005).

In the case of bell pepper, the Salvadoran market consumes 16,000 metric tons yearly. A total of 78.9% of this product is sold through informal market channels while 9% is sold through supermarkets. The remaining percentage is sold through prepared food. The dominant actor in this supply chain is the wholesaler who manages approximately 96% of all national consumption. Approximately 59% of all bell pepper consumed in El Salvador is produced nationally while 41% is imported from neighboring countries (CRS, 2005). In Honduras, 5,000 metric tons of bell peppers are consumed yearly with 25% being sold by supermarkets (Agropyme, 2005).

In both countries the majority of tomatoes and bell peppers are sold individually but there is an increasing tendency for specialized wholesalers and producer organizations to explore the possibility of selling prepackaged trays of both products. In addition there are attempts at branding these products in both countries. The grades and standards that are applied to these products by supermarkets vary depending on, among other factors, the availability of the product in the market, the relationship with the supplier and the going price. Interviews with producer organizations support the idea that supermarkets actively adjust their grades and standards to their benefit.

ECONOMIC ANALYSIS

The economic analysis focused on the distribution of returns on investment among actors along the supply chain and the relative differences between diverse marketing channels. Tables 5 and 6 show some of the returns on investment in El Salvador and Honduras. One of the producer organizations in El Salvador -- ACOPO -- is not included in this analysis because the products they sell the supermarkets are different -- baby carrots, lettuce and radishes -- as well as being marketed as organic. The data in both tables is presented in US dollars per kilo of product.

In general terms, the chain dynamics during the period of study showed the relative proximity of prices among different chain actors acted in diverse market channels. The local trader who buys at the field level is competing with the producer organization while the specialized wholesaler/supermarket channel competes with the traditional wholesaler in urban centers. Despite the apparent competition, each commercial channel has varying demands in terms of quality and consistency. Specialized wholesalers are able to demand a higher price from supermarkets for similar product principally due to investments in refrigeration, grades and standards and consistent supply. While there is not a clear shift to only use specialized wholesalers, the data indicates that the tendency in both Honduras and El Salvador is for supermarkets to move in this direction.

Table 5. Return on investment for producer organizations in El Salvador (year 2004)

	Products (prices in USD/Kg.)				
	Agrolempa [97]			PHOC	
Variable	**Bell pepper**	**Cucumber**	**Tomato**	**Bell pepper**	**Cucumber**
Production costs	0.064	0.088	0.24	0.055	0.068
Sales price to producer organization	0.108	0.115	0.29	0.066	0.084
Net profit for farmer	0.044	0.027	0.04	0.011	0.015
Marketing costs	0.022	0.022	0.04	0.011	0.015
Sales price to supermarket	0.154	0.154	0.35	0.139	0.112
Net profit for producer organization	0.024	0.018	0.02	0.061	0.013
Supermarket retail price	0.40	0.17	1.12	0.40	0.17
Gross profit for supermarket	0.246	0.216	0.77	0.261	0.258

Source: CRS, 2005: 30, 33

[97] Data for tomatoes sold by Agrolempa are not included in this table because this organization did not sell this product to supermarkets during the period of the study.

Table 6. Return on investment for producer organizations in Honduras (year 2005)

	Products (prices in USD/Kg.)					
Variable	**Tomatoes**	**Bell pepper**	**Potato**	**Broccoli**	**Lettuce**	**Carrots**
Production costs [98]	0.19	0.26	0.17	0.12	0.11	0.13
Purchase price paid by local traders	0.45	0.40	0.17	0.20	0.20	0.23
Net farmer income for sale to local trader	0.26	0.14	(0.00)	0.08	0.09	0.10
Transportation costs from farm local market [99]	0.05	0.14	0.01	0.03	0.04	0.01
Local market sale price	0.40	0.34	0.11	0.17	0.17	0.17
Net farmer income for sale at local market [100]	0.16	(0.06)	(0.07)	0.02	0.02	0.03
Transportation costs from farm to producer organization packing house	0.05	0.14	0.01	0.03	0.04	0.01
Sales price to producer organization	0.47	0.40	0.35	0.27	0.26	0.24
Net farmer income for sale to producer organization	0.23	0.00	0.17	0.12	0.11	0.10
Transportation costs to Tegucigalpa or San Pedro Sula	0.02	0.02	0.01	0.03	0.03	0.01
Wholesaler purchase price	0.40	0.34	0.34	0.28	0.28	0.28
Net income for sale to wholesaler in Tegucigalpa or San Pedro Sula	0.14	(0.08)	0.15	0.10	0.10	0.13
Wholesaler sales prices	0.59	0.80	0.34	0.35	0.38	0.52
Gross income for wholesaler	0.19	0.46	-	0.07	0.10	0.24
Specialized wholesaler purchase price	0.54	0.46	0.38	0.31	0.30	0.29
Net income from sale to specialized wholesaler	0.28	0.04	0.19	0.13	0.12	0.14
Specialized wholesaler sales price to supermarket	0.84	0.85	0.50	0.57	0.44	0.55
Gross income specialized wholesaler for sale to supermarket	0.30	0.39	0.12	0.26	0.14	0.26
Supermarket retail price	1.20	1.21	0.71	0.81	0.63	0.79
Gross income for supermarket	0.36	0.36	0.21	0.24	0.19	0.24
Production (Kg./ha)	40,492	20,408	21,379	21,056	20,732	29,024

Source: Agropyme, 2005: 68.

Working back from the final price paid by consumers for products in supermarkets in both Honduras and El Salvador, we can identify the following division among supply chain actors (see tables 7 and 8).

[98] Based on average producer crop yields (see last line of Table 6).

[99] Transportation costs from farms to Siguatepeque (tomato and bell pepper) and from farms to La Esperanza (other products), normally in pick up trucks.

[100] The administrative cost of sales is not included here, only transportation and production costs.

Table 7. Distribution of final consumer price among supply chain actors in Honduras.

	Products						
Variables	**Tomatoes**	**Bell pepper**	**Potato**	**Broccoli**	**Lettuce**	**Carrots**	**Average**
Production costs.	15%	22%	24%	15%	17%	17%	18%
Farm to packing shed transportation costs	4%	12%	1%	4%	6%	1%	5%
Net farmer income for sale to producers organization	20%	0%	24%	14%	18%	12%	14%
Transportation costs to Tegucigalpa or San Pedro Sula	2%	2%	1%	4%	5%	1%	2%
Net producer organization income for sale to specialized wholesaler in Tegucigalpa or San Pedro Sula	4%	3%	3%	1%	2%	5%	3%
Gross profit for specialized wholesaler for sale to supermarket	25%	32%	16%	32%	22%	33%	27%
Gross profit for supermarket	30%	30%	30%	30%	30%	30%	30%
Retail price paid by final consumer	100%	100%	100%	100%	100%	100%	100%

Source: Agropyme, 2005: 75

Table 8. Distribution of final consumer price among supply chain actors in El Salvador.

	Agrolempa		**PHOC**			**Average**
Variable	**Bell peppers**	**Cucumber**	**Tomato**	**Bell peppers**	**Cucumber**	
Production costs	16%	24%	21%	14%	18%	19%
Net farmer income for sale to producers organization	11%	7%	4%	3%	4%	6%
Market costs (transportation and sales)	6%	6%	4%	3%	4%	4%
Net producer organization income for sale to supermarket	6%	5%	2%	16%	4%	6%
Gross profit for supermarket	62%	58%	69%	65%	70%	65%
Retail price paid by final consumer	100%	100%	100%	100%	100%	100%

The preceding data should be treated carefully as it was not possible during the study to identify the net margins for supermarkets and specialized wholesalers. As a result the apparent lion's share of the final consumer price that they receive may not be entirely accurate due to product perishability and other factors. During workshops with supermarket buyers in Honduras, spoilage of between 8 to 10% for tomato and peppers was considered average (Agropyme, 2005: 104-5).

What is interesting to highlight in these tables, is the relatively low level of participation in the final consumer price of producer organizations: in Honduras, 4% of the final price and in El Salvador 6%. Reflecting on these results with members of the supply chains themselves, the question of the economic viability of existing producer organization models was raised. The combination of relatively low volumes of product plus low margins means that many of the farmer organizations included in the study require ongoing subsidies to cover operational costs despite significant support from donor and development agencies over long periods of time.

CRITICAL POINTS IN THE SUPPLY CHAIN

At the end of the preceding analysis critical points in the supply chain were identified by participating actors. For each apparent critical point, a problem tree was developed to analyze the causes and effects that this issue had on supply chain competitiveness and sustainability. After much discussion, three

major critical points were identified: (a) low levels of producer organization in the chain; (b) limited spaces for coordination and consultation among chain actors, and; (c) public policies out of step with market realities.

The identification of the low level of producer organization apparent in the chain as a critical point was motivated by the fact that, despite significant investments of time and financial resources, existing producer organizations in both Honduras and El Salvador encompass significantly less than 5% of total horticultural producers in each country. Possible causes identified for the situation include limited business skills within existing producer organizations, nonreplicable organizational models (e.g. too costly in terms of time and financial resources with limited benefits) for linking small holders to dynamic markets and a general uncertainty about the benefits that small holders can expect from the supermarket channel.

A second critical point was the general lack of coordination among chain actors. This generates a skewed governance structure in which the rules of the game are developed and imposed by the stronger members of the supply chain (e.g. the retailers) while other members have little or no choice but to accept. In many cases, even the more powerful actors poorly understand the effects of these rules on the long-term sustainability of the chain in the system. In addition, the low-level of coordination along the chain results in the provision of less than adequate business and enterprise development services to the chain actors themselves. A key issue in this area is the dearth of adequate financial services (e.g. credit, leasing, rapid payment, etc.) to meet the demands of the chain.

A final critical point focuses on public-sector policies. As mentioned earlier in this article, both Honduras and El Salvador possess policies focused on rural and agricultural development. However, through the analysis of the supply chain it became clear that these policies are not adapting to the rapidly changing market conditions seen in both countries. Public decision-makers have little or no access to consistent and up-to-date data regarding the economic, social and environmental effects that these changes are having on rural development in their nations. As a result, policies change slowly, if at all, in a rapidly changing market environment. The key issue identified here was the need for public policy interventions focused on generating and maintaining not only food safety standards to protect consumers but also fair marketing practice standards to protect weaker members of an increasingly concentrated supply-chain.

Based on these critical points, possible strategies for supply chain upgrading were developed. Table 9 sums up the causes for each of these critical points based on data gathered during the supply chain analysis as well as the proposed strategies.

A principal focus of chain upgrading in both countries is development of more effective organizational models to link small holders to dynamic markets. The producer organizations included this study are an important starting point for this analysis, however, these development driven approaches should be mixed with private-sector activities focused on supplier development. A key element here is the CARHCO model of lead farmer networks. The objective of this work should be to involve both developments and retail actors in the design of organizational models that lead to specialization among chain actors, increased transparent links between these actors, processes of horizontal and vertical strengthening between enterprises, the development of minimum administrative capacities capable of meeting chain demands and, finally, the development of a clear set of incentives to promote smallholder involvement in these agri-food chains. This work should be carried out with the participation of producer organizations, NGOs, specialized wholesalers, supermarkets and, where necessary, state agencies.

Table 9. Critical points identified in the horticultural agri-food chain in Honduras and El Salvador.

Critical points	Principal causes	Proposed upgrading strategies
Low levels of organization among small holder producers	Limited business management skills in existing producer organisations	Development of strategic alliances between producer organisations. Dialogue with supermarkets to include producer organisations in existing preferred supplier development programs.
	Non-replicable organizational models based on time and costs	Design and pilot alternative organizational models with the active participation of producer organisations, supermarkets, NGOs and the public sector.
	Incentives for small holder participation in the supermarket channel are not clear	Identify and quantify benefits for small holders across diverse market channels and disseminate the findings.
Lack of coordination among supply chain actors	Rules of the game are imposed and not discussed among actors (exclusionary governance structure)	Strengthen coordination among chain actors and discuss appropriate rules of the game / governance structures to improve chain competitiveness and equity profile.
	Limited coordination between support service supply and demand (ineffective and missing services)	Promote spaces for increased dialogue and coordination between chain actors and service providers for improved service design and provision.
Public policies out of step with chain reality	Limited information access for policy makers in regards to the effects of this chain on public interests.	Establish a monitoring and evaluation function for the chain focused on environmental, social and economic effects linked to other spaces of coordination to inform policy development and adaptation.

Source: Author with inputs from Agropyme, 2005: 80; CRS, 2005: 51-52.

A second major strategy for chain improvement is the development of improved governance structures among chain actors. The objective of these governance structures is to increase the competitiveness of the chain while, at the same time, improving the equity profile among the actors. The principal activity in this area is the development mechanisms to improve information flow among actors, provide spaces for coordination and collaboration and identify demands for enterprise development services. This process requires professional, neutral facilitation -- provided perhaps by government actors -- in attempts to identify common areas of interest among actors, define roles and responsibilities and help identify areas which need improved public, private or donor policy interventions. The existing legal framework in Honduras is amenable to this while a similar framework does not currently exist in El Salvador.

A final strategy is focused on the development of public policies based on sufficient and timely information. It is suggested that policymakers play an important role in the first and second strategies mentioned previously and, as a result, develop the capacity to carry out or contract ongoing monitoring and evaluation of the agri-food chain. Key areas of observation for the development of adequate public policies include equity among chain actors, the social effects of supply-chain development and the environmental spin-offs from higher value horticultural crops. The adoption of such a strategy by public policy makers would imply a much more proactive stance than that currently employed by either government.

CONCLUSIONS

The present study has reviewed the current state of the horticultural agri-food chain in Honduras and El Salvador. Results indicate that the existing supply chain faces important challenges in terms of organization, governance and public policy. Actions to remedy the situation are suggested. These include the development of participatory governance structures focused on increasing coordination and consultation among supply chain members, the design and pilot testing of replicable and sustainable organizational models for linking small holders to dynamic markets, increased coordination between the needs of the supply chain and the supply of specific business development services and, the development adaptation of adequate public policies. In addition, the implementation of the Central American Free Trade Agreement requires that all actors involved in the agri-food system explore ways to work together to develop more effective and sustainable intervention strategies to improve the competitiveness not only of the vegetable supply chain but also of other agricultural supply chains where a significant number of producers participate.

Based on work carried out in this study, several areas of additional research are recommended. First, additional work should be carried out to clearly understand the benefits derived from private sector led organizational strategies (e.g. lead farmer models promoted by CARHCO) and how these compare to benefits achieved by existing producer organizations. Second, research on how innovation occurs among actors involved in higher value or dynamic supply chains and how this process might be facilitated would be welcome. Finally, while supermarket growth in Central America is certainly impressive, additional work should be carried out to clearly identify and quantify the importance of this shift in terms of the overall food market for these countries and what this means in terms of smallholder participation in food production.

REFERENCES

Agropyme. 2005. Análisis de la cadena de valor para tomate de mesa, chile dulce, brócoli, lechuga, zanahoria y papa producida por pequeños productores, con enfoque en la comercialización a través de supermercados, Agropyme, Agencia Suiza para el Desarrollo y la Cooperación (COSUDE) y Swisscontact, Tegucigalpa, Octubre.

Balsevich, F., Berdegué, J.A. & Reardon, T. 2006. Supermarkets, New-Generation Wholesalers, Tomato Farmers and NGOs in Nicaragua. Staff Paper 2006-003. Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, January.

Berdegué, J., Balsevich F., Flores L. & Reardon, T. 2005. The Rise of Supermarkets in Central America: Implications for Private Standards for Quality and Safety of Fruits and Vegetables, *Food Policy*, 30 (3): 254-269.

Catholic Relief Services. 2005. Caso El Salvador. Inserción de pequeños productores a los supermercados bajo el enfoque de cadena agroempresarial con los productos tomate, chile y pepino, Programa de Agricultura, Catholic Relief Services El Salvador, San Salvador, Octubre.

CIAT, Agropyme & CRS. 2006. Vínculos entre Productores de Hortalizas de Pequeña Escala y Supermercados en Centroamérica: Casos Honduras y El Salvador, International Center for Tropical Agriculture, Rural Agro-enterprise Development Project, Cali, Colombia, Enero.

Jano, P., Balsevich, F., Lundy, M. & Reardon, T. 2004. Estudio del caso de la Cooperativa de Producción y Comercialización (COOPROCOM R.L.), Nicaragua, Regoverning Markets Program, Program for Food Industry Development (PFID) and the International Livestock Research Institute, Managua, Nicaragua, September.

Reardon, T. & Berdegué, J.A. 2002. The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development, *Development Policy Review*, 20 (4), 317-34.

PART 4

CHANGING MARKET STRUCTURES AND DISTRIBUTIONAL ISSUES

Contracting, Competition and Rent Distribution in Commodity Value Chains

Johan F.M. Swinnen and Anneleen Vandeplas[101]

INTRODUCTION

Vertical coordination in agrifood supply chains, often induced by foreign investment, plays an important role in overcoming market imperfections. In many developing and transition countries, farmers have difficulties accessing technology, inputs, credit to produce the commodities which processors and traders want to purchase. As a result, in many of these countries, processing, trading and input supplying companies have engaged in a variety of, sometimes quite unconventional, forms of contracting with farms (Swinnen, 2006). In many cases, processors introduced programs to improve farms' access to inputs. For example, in Kenya, contract farming is widely practised, as input finance is crucial for the production of many high value and export crops (Ruotsi, 2003). The same is found in other African countries, e.g. in the cotton sector (Poulton *et al*., 2004). In the Philippines, Hendriks (1994) notes that wholesale traders provide credit to farmers for fertilizers, pesticides and seeds in order to secure supply. According to Shepherd (2004), supplier assistance programs are a feature of most agricultural marketing systems in Asia, in order to secure supply, guarantee markets and reduce transaction costs.

Effectively, what these companies do is a form of what is described in the development economics literature as "interlinking markets" (see e.g. Bardhan and Udry, 1999). A typical example of this traditional literature is a landlord in a developing country who uses his/her better access to credit to act as an intermediary between an outside loan market and his/her tenants, in addition to their "normal" interaction in the land market. Enforcement of the loans is possible because of the landlord's dominant market position in the land relationship. Another example of this model is the trader-farmer relationship in distant villages. Here, the farmer is dependent on the trader for access to the output markets, while the trader acts as a financial intermediary, allowing the farmer better access to credit. Here, enforcement of the credit transaction (loan and repayment) occurs through the output market.

Similar interlinking is occurring in high-value commodity chains in many developing and transition countries where processors and retailers offer interlinked contracts to local producers. Interlinking markets can bring farm investment and production closer to optimal levels by circumventing imperfections in credit, input, and output markets. In fact, there is substantial empirical evidence that these contracts are having important positive effects on efficiency, productivity and investment (e.g. Dries and Swinnen, 2004).

However, in trying to understand the microfoundations of these new institutions, we should not be blind for their potentially adverse consequences. For example, the very nature of rationale for the emergence of these interlinked transactions may at the same time act as an important barrier to entry for other agents and may give the dominant partner in a transaction some additional leverage. As Bardhan and Udry (1999: 111) remark, "the thin line between *understanding* an institution and *justifying* it is often blurred, particular by careless interpreters of the theory."

The objective of this paper is (a) to analyze the equity and efficiency effects of interlinking in high-value supply chains, and (b) to investigate what the impact of competition is on these effects. Section 2 of the paper presents a conceptual model of interlinking and competition, in order to identify the effects on equity and efficiency. Section 3 reviews some empirical evidence available, including our study of the Central Asian cotton supply chains. Section 4 suggests some observed institutional arrangements that can mitigate potential perverse effects of competition. The final section concludes.

[101] LICOS, Centre for Transition Economics & Department of Economics, K.U.Leuven

THEORY

A Conceptual Framework of Efficiency and Equity with Interlinking

To understand the relationship between equity and efficiency with interlinking markets, consider a contract between a supplying farm (F), with welfare represented by expected utility U^F, and a processing company (C), with expected utility U^C. Figure 1 illustrates the pre- and post-contracting welfare of the agents. Without interlinked contracts the utility possibility frontier is U_0U_0. Assume that actual pre-contract utility is at (U^F_0, U^C_0), represented by point A.

By introducing an interlinked contract, farms can access credit, inputs, etc. which were unavailable before and companies can have access to higher quality and timely supplies. Total welfare increases and the utility possibility frontier shifts to U_1U_1. The question is who benefits from the welfare increase: both agents or only one? In other words, will the new equilibrium be at point W, B, or E? At point E, both parties share in the gains from the institutional innovation, and everybody is better off. At point B, the processing firm extracts all the rents of the innovation. The answer critically depends on each party's bargaining power within the contract.

There are several models in the development economics literature explaining how one can arrive at point B. For example if company C has monopsony powers and can thus set the conditions of the contract, supplier F will accept the contract as long as it is as least as good as his outside option. Hence, at the margin, it will be optimal for C to offer F a contract with conditions which provide F with an expected utility equal to U^F_0, F's reservation utility or outside option. This is the case represented by point B. In output-credit market interlinkages (trader-farmer) C typically does this by subsidizing credits (lower interest rates) and taxing outputs (lower output prices) (Bardhan and Udry, 1999).

If F's bargaining power increases relative to C's, the relationship surplus may be shared more equally, like in E. Genicot and Ray (2006) indicate that in contractual relationships two notions of power can be distinguished: the first is determined by the outside options, the second one occurs in markets with frictions and involves a bilateral notion of power. Although we also take outside options into account, it is this second notion of power that we define as "bargaining power" in our model and which is denoted as β. This is clarified in Figure 2.

In a Nash bargaining framework, utility will be distributed among the bargaining agents so as to maximize collective utility, subject to the prevailing participation constraints of both agents. The participation constraints are given by the agents' respective outside options: in our case, the utility obtained by each in locus A. Every locus on and at the left of the vertical line through A yields F at least his utility in A. In B, his participation constraint is binding. Every locus on and above the horizontal through A yields C at least its utility in A. In D, its participation constraint is binding.

The combined preferences of C and F are represented by the collective indifference curves. The weights of the utility of both agents in these collective preferences are determined by their bargaining power. Figure 2 shows that for preferences represented by the indifference curve I_1I_1 (and parallels), more weight is given to C's utility than for those reflected by I_2I_2. This reflects that C's bargaining power is higher in case of collective preferences I_1I_1 than in case of collective preferences I_2I_2. Preferences represented by I_2I_2 result in a more equal utility distribution. Hence, the equilibrium position between B and D along the frontier is determined by the relative bargaining power.

So far we have argued that the farmer can never be worse off with the contract. However, Bell (1988) shows how in a Nash bargaining framework a peasant may be worse off in dealing with a landlord with interlinked transactions than with separate bilateral bargains because the interlinking of transactions may actually bestow additional monopoly power upon C. Personalized and interlinked transactions can weaken the collective bargaining strengths of workers vis-à-vis employers (Bardhan, 1989). In these cases, one may end up at point W, where F's utility is actually lower after the contract innovations, despite the fact that total welfare has improved significantly.

Hence, an important – and very much an outstanding – issue is how to obtain the efficiency gains without negative equity effects from these institutional innovations, and what role competition plays in this framework.

Available empirical evidence indicates that in many developing and transition countries, positive equity effects seem to have occurred in many cases (Swinnen, 2006; World Bank, 2005). In transition countries, the collapse of farm output and livestock numbers created a gap between processing capacity and supply, and an excess demand based on processing capacity, especially for high quality. This makes it a "suppliers' market" in most of Eastern Europe and Central Asia and this supports the farms' bargaining position in the supply chain. Similarly, in many developing countries there is a shortage of quality supplies for processing and retail companies in high value chains (e.g. Codron *et al*., 2004).

It is important to note that in this paper, we do not to analyze which types of suppliers are participating in interlinked contracts. There is an extensive debate on the likelihood of exclusion of small farmers in this process. This issue is addressed in another paper (see e.g. the paper by Maertens and Swinnen in this volume). The analysis in this paper focuses only on how the surplus that is created through interlinking is divided among the processors (traders, retailers, …) on the one hand and the farms (suppliers) on the other hand, and how competition affects this.

The Role of Competition

Intuitively, one would expect that competition on the demand side among processors and retailers plays an important role in the rent distribution. However, competition will not only affect the rent distribution (equity impact) but also the total amount of rents (efficiency). This is illustrated in Figure 3. First, competition can have a positive equity effect by ensuring suppliers a larger share of the gains from an interlinked contract, as it prevents companies from exercising monopoly power in the setting of the contract conditions. As a result, one ends up somewhere to the right of B, say at point E.

Second, competition can have a positive efficiency effect by inducing buyers to compete not only on prices, but also on services. As a result, if one processor decides to introduce a supplier assistance program, this may induce (or force) other processors to do the same. This may lead to a further spread of assistance programs among competing processors, inducing a shift from U_1U_1 to U_2U_2 and hence from E to H.

Third, competition could also induce opportunistic behaviour of suppliers. A supplier may use the delivered inputs for other crops, not under contract, or sell them to another farmer. As a result, his output will not comply with the agreed quality norms, and the supplier will have to sell his output to another processor at the low-value market. Alternatively, the supplier could apply the delivered inputs according to the contracted processor's indications but sell his output afterwards at a higher price to a competing processor. The competing processor may be able to offer a higher price since the contracting processor takes into account the cost of the delivered inputs in determining the producer's price. If the supplier "side-sells" in this way, interlinking becomes a loss-making operation for the processor who provided the suppliers' inputs, and this firm may have to close down its input program.

Competition increases the likelihood of sideselling in two different ways. First of all, because the threat of cut-off from future credit arrangements is less stringent when there are other credit providers available (Hoff and Stiglitz, 1998); secondly because reputation effects are less prevalent in a competitive market where buyers are less likely to coordinated and share information. This will make it easier for the supplier to find an alternative buyer. Local information-sharing networks work less well when the number of agents expands, as it costs more effort, money and/or time to let information spread among a larger group of agents (Hoff and Stiglitz, 1998). As the penalty from contract breach becomes lighter, the incidence of sideselling will be higher. As a result, processing firms will cease their input provision programs.

The discontinuation of interlinking arrangements will have a negative efficiency effect, causing the utility possibility frontier to fall back from U_2 to U_0, where we end up in point G. This phenomenon is also described in the labour economics literature: Hall and Soskice (2001) show that with more

interfirm competition, firms will invest less in their employees' human capital, taking into account the risk that other firms might freeride, enticing the employees to work at their company after being trained.

EMPIRICAL EVIDENCE

The literature provides case studies and evidence that support each of the arguments made above. Empirical evidence reveals that contract terms improve with more competition, but also that input and credit programs have collapsed because of (too much) competition and opportunistic behaviour by farmers. First, some studies show that more competition leads to a necessity for support programmes, and a concomitant willingness to provide them. Second, they show that competition increases the suppliers' bargaining position, inducing a shift in producer prices or forcing buyers to provide more extensive farm support. Third, empirical evidence confirms that many input programs have collapsed due to competition.

Competition improves contract terms for farmers

First, there is considerable evidence that increased competition following price and trade liberalization increased prices for farmers in Asia and Africa. For example, in Tanzania, the parastatal monopoly of the Cotton Board was eliminated in 1994 (Baffes, 2004). As a result of the increasing competition in cotton marketing and ginning, suppliers received an average share of 51% of export prices compared with 41% before liberalization. In Zimbabwe, cotton producer prices improved as well when new companies entered the market: before liberalization, the average producer price was 42% of the world market price (Larsen, 2002). After liberalization, it reached 53% on average. However, there is a huge year-to-year variability in producer prices. Liberalization boosted producer incentives in Zambia as well (Boughton et al. 2003). National cotton production peered from 20,000 tons to an average of 80,000 tons. Over the period 1995-2000, Zambia paid the highest average producer price share of Sub-Saharan Africa, amounting to 56% of the export price. Also in Pakistan, price liberalization, privatized export trade and the elimination of export restrictions and taxes have all contributed to higher prices and greater production incentives for cotton growers under interlinked arrangements (Smith *et al*., 1999). Opportunities for rent extraction are minimized as farmers can shift easily between lenders, according to the price and quality of the services offered.

Second, several studies report that competition leads to a higher bargaining power of the suppliers who may threat to deliver to other buyers if no input or credit is extended to them. This is found to be the case in Africa, Latin-America, Asia, and in several transition countries (Fisman and Raturi, 2004; Conning, 2000; World Bank, 2005). In Zimbabwe, although price competition among cotton ginners is weak, ginners compete on the services they offer to farmers, more specifically with respect to input and credit provision (Larsen, 2002). In Eastern Europe, competition among dairy and sugar processors contributed to the spreading of farm assistance programs (Gow *et al*., 2000; World Bank, 2005). In the Pakistani cotton market, more competition amongst buyers has lead to a tighter supply market, and credit was the only way to ensure availability of supply (Smith *et al.* 1999). Also in Pakistan, Stockbridge *et al.* (1998) indicate that many sugar mills are working below capacity. In order to attract supplies, some mills are improving the terms and conditions they offer to farmers, including more attractive prices and easier access to credit. The converse has been observed with respect to cotton ginneries in the Mirpurkhas district of Pakistan. There, because of the good cotton crops achieved in recent years, ginneries have been operating at full capacity. As a consequence, many have ceased to provide credit to their suppliers, as competing for scarce cotton supplies is no longer necessary.

It is also interesting to note that in the Zambian cotton sector, where after liberalization a high degree of concentration remained, smallholders receive credit packages of about US$43 each in the framework of interlinked contracts. Conversely, Mozambican (monopolistic) concession holding cotton companies use credit packages of only US$10-15 per hectare. Nevertheless, input prices are much higher in the latter country. At this low credit and input level, yields have remained low in Mozambique. This illustrates again that more competitive (although still relatively concentrated)

markets like Zambia already offer better contract terms to farmers than purely monopolistic markets like Mozambique.

More evidence on how competition can improve contract terms for farmers, is revealed by a comparative study of the cotton sector in 4 Central Asian countries by Swinnen *et al.* (2006).

In Uzbekistan, Tajikistan, Kyrgyzstan, and Kazakhstan, vertical coordination, including contracting and interlinking, is widespread in the cotton supply chains. Interlinking arrangements are used to overcome important constraints faced by farms, in particular access to credit, cotton seeds, and irrigation. However, the nature of the contracts and their effects on equity and efficiency differ dramatically among the countries. The reason is the different policies of the governments concerning privatization and, in particular, competition. In Kyrgyzstan and Kazakhstan, where the government has allowed the private gins to develop and to compete, farms have benefited from the reforms and from vertical coordination, with strong competition, resulting in high prices and strong cotton growth (see Table 1). On the other hand, in Uzbekistan and Tajikistan, governments actively control (directly or indirectly) input supplies, production, processing and marketing in the cotton chain. Due to the absence of competition, vertical coordination is characterized by depressed prices and stagnating cotton production, and major rent extraction of cotton farms.

Cotton exports are a major source of government revenue in Uzbekistan and the state has continued to impose strict controls on the cotton chain, including through government-controlled interlinking. Market reform has been slow. Nearly all gins remain under government ownership, and even the privately owned gins are subject to government control. Cotton farm financing is in practice only available through a single form of contracting offered by the state through the two main state banks. Inputs are provided through a centralized system of state controlled enterprises. The government re-instituted a state monopoly on the purchase of cotton in 1995, with prices fixed at low levels, based on estimated production costs[102].

Also in Tajikistan, the government continues to be heavily involved in the cotton chain. Cotton gins are jointly owned by the government and so-called "investors" which are financial institutions with (informal) links to the government. Gins operate as monopolists in clearly delineated areas, and prevent farms from delivering to other gins. The "investors" provide crop finance and sales contracts to the farms, and control also the processing of the cotton. This monopolized system leads to rent extraction from farmers with low seed cotton prices and inflated input. No alternatives are available to cotton producers.

The situation is entirely different in Kazakhstan, where interlinked contracting is also widespread in cotton production, but where both producers and processors have been freed from government control since a few years. Gins were fully privatized by 1998 and, since then, many new gins have been established. The resulting competition and reduced transport costs have benefited (small) farms. Gins provide crop finance, as well as inputs, irrigation (water) and some agricultural services (Figure 4). Large penalties have prevented opportunistic behaviour by farmers, as the perceived loss clearly exceeds the potential gains from side-selling. In case of default, a farmer has to repay his outstanding debts, incurs a penalty of 15% of the value of seed cotton not delivered under the contract and an increase in the cost of finance from 18% to 35%[103].

The situation in Kyrgyzstan is more complex. Privatization, removal of government control, and competition seem to have induced a rapid expansion of the Kyrgyz cotton sector, albeit from a very small base, with similar effects as in Kazakhstan for farms. Cotton production and processing continue to expand strongly, partly based on smuggled Uzbek cotton, induced by the large price gap for seed cotton between Uzbekistan and Kyrgyzstan. Many new gins have been constructed in recent years. Locally produced cotton is based on pre-finance contracts by the gins. However, a poor supporting

[102] For the past two years, however, important reforms have been taking place. Input provisions are being privatized, and fever restrictions are being imposed on finance.

[103] However, reforms are being carried through at present. The new Cotton Law dictates that cotton gins no longer invest in farms. This will certainly have important percussions on interlinked systems in the near future.

infrastructure and contract breaches with international traders a few years ago have negatively affected the growth of the cotton chain and contracting. Fund provision by international traders to ginneries has largely ceased. As a result, ginners have to provide financing out of their own cash reserves and this hampers their ability to finance large amounts of seed cotton.

In summary, two important effects of competition can be distinguished from this study of the Central Asian cotton sector. First, competition induced the spread of assistance programs throughout the sector. If one processor introduces an assistance program, other processors are forced to introduce similar supplier assistance programs. Suppliers may not want to deliver unless they get similar conditions. This finding confirms our general conclusion that competition is a key factor for encouraging innovation and productivity and that technological development is primarily encouraged through the presence of competition[104].

Second, competition prevents farmers from being "exploited" and allows farmers to get better conditions by improving their outside option. The only places where we find clear evidence that farmers are consistently exploited are in government-controlled monopolized systems, such as the cotton system in Uzbekistan, Tajikistan (and Turkmenistan). In contrast, in Kazakhstan and Kyrgyzstan, the cotton chain is characterized by strong competition among private gins buying cotton seeds from small farms for processing, with much better conditions for farmers. Table 1 illustrates that prices for Kazakh cotton farmers are *two to three times* higher than those in Uzbekistan or Tajikistan, where competition does not exist.

While there remain important problems in the Kazakh and Kyrgyz cotton systems, compared with the situation in Uzbekistan and Tajikistan, their situation seems to be considerably more favourable in terms of both equity and efficiency. Hence, competition plays a very important role in the cotton supply chains by inducing both beneficial equity and efficiency effects.

Competition undermines input and credit program enforcement

However, there is also considerable evidence that competition undermines the sustainability of input and credit programs. For example, in Chile, credit provision programs from traders in traditional small farmer crops like wheat, maize and beans have been given up, because of the numerous alternative marketing channels for these crops and the concomitant frequency of opportunistic sales by suppliers (Conning, 2000).

In Kenya's horticultural sector, companies without a dominant market share are subject to vigorous side-selling (Ruotsi, 2003). Frigoken, a French bean exporter, loses around 20% of its production to its competitors. Honey Care Africa, a fair trade honey exporter and Kenya Nut Ltd, a cashew and macadamia nut processor, closed down their credit provision programs because of the losses due to "pirate sales".

In the Zambian paprika sector, Cheetah Zambia reports that approximately 30-40% of total production ends up at its competitors (Ruotsi, 2003). Omnia Ltd, a leading fertilizer producer and manufacturer in Zambia, closed down its credit scheme as well due to serious credit losses. The main reason for non-repayment appeared that smallholders did not expect the company to take serious action against defaulters.

Moreover, while the liberalization process in Asia and Africa improved prices for farms, it also undermined some of the traditional input supply systems. For example, in the Tanzanian cotton sector, inputs became more expensive and less available as they were no longer provided by the Cotton Board. In fact, both input and credit provision collapsed. In fact, some authors argue that the main reason why input and credit supply chain programs are still functioning in some countries is because of the limited competition, due to state intervention. The evidence on this is mostly limited to the cotton sector (see also Poulton *et al.,* 2004).

[104] These are key conclusions in the World Bank 2005 World Development Report on "Improving the Investment Climate for Growth and Poverty Reduction".

In the Zimbabwean cotton sector, input credit provision remains viable, thanks to limited competition. There are only three major players: Cottco, the former parastatal, who continues to assume price leadership, Cargill, the US multinational, and Cotpro, in which Cottco has a 60% stake, and the remaining 40% is French. Cottco's loan recovery rate amounts up to 98%. Cottco and Cotpro are providing input credit. Suppliers deliver the contracted amounts to Cottco and Cotpro; the production surplus is sold to Cargill at more attractive rates. Up to now, input provision has remained viable, but competition is intensifying in the sector: Cottco's market share decreased from 79% (2000) to 58% (2004). At the same time, the producer share of the export price increased to 78% over the same period (Hanyani-Mlambo *et al.*, 2005)

A high degree of concentration remained after liberalization in the Zambian cotton sector as well: two dominant cotton ginneries, Dunavant and Clark Cotton, hold together a market share of 80-90% in the cotton sector. Dunavant's recovery rate for its input credit programs was around 85% in 2001.

Mozambican cotton companies work under government-allocated land concessions, forging local monopoly conditions (Boughton *et al.*, 2003; Ruotsi, 2003). Cotton companies in Mozambique are obliged to provide input credit to all producers. Foreign owned firms purchasing tobacco and maize from small farmers also benefit from such concessions. Companies without monopolistic concessions do not provide input credit, as this is perceived as unsustainable. The other side of the picture is that Mozambican producer price shares for cotton are the lowest in the region: under 40% of the export price.

MAKING INTERLINKING SUSTAINABLE UNDER COMPETITION

Our analysis shows that farms benefit from price competition between buyers. More competition leads to more equal rent sharing. But if competition gets too vigorous in the interlinked input and credit market, coordination may break down, and farmers may undermine their own productivity through strategic defaulting.

Fortunately, there is evidence that institutional arrangements can prevent, or at least mitigate the sustainability problems of input programs in a competitive environment. This way, perverse effects of buyer competition are circumvented, such that competition can lead to higher efficiency and more equitable rent sharing.

A first and obvious strategy to avoid side-selling, is to offer reliable and attractive contract terms. In Zimbabwe, incentive premiums are awarded to loyal farmers by Cottco and Cotpro, while defaulting farmers are effectively penalized (Larsen, 2002).

A second strategy is to build an informal, personal relationship between buyer and supplier: frequent monitoring and field contact appears to contribute substantially to the reduction of pirate sales as well. Intensive monitoring is an important element of the high-value interlinked vegetable chains in Madagascar (Minten *et al*., 2006)

Buyers can coordinate in order to avoid strategic default by suppliers. Conning (2000) cites an example from the fruit export sector in Chile, where lenders in fairly competitive environments create informal cartel-like arrangements to exchange information about their borrowers and to avoid side-selling. In Uganda, ginners and exporters have formed an association (UGEA) with compulsory membership of all cotton ginners (Gordon, 2000). Credit is provided by a parastatal, the Cotton Development Organization. Ginners are responsible for credit repayment, based on levies charged to the suppliers. Suppliers are free to sell their cotton to any ginner, as they are all paying the same prices and charging the same levies. Meanwhile, farmers' share in world prices rose from below 50% to 70% in the period 1995/96 to 2003/04. A similar strategy is applied in Benin, where the CSPR (Centrale de Sécurisation des Paiements et des Recouvrements) was established in 2000 to insure recovery of input credit and producer payment without delay (Goreux and Macrae, 2003). Since many ginneries are operating below capacity, the CSPR allocates quota to each ginnery in terms how the maximum amount of seed cotton they are allowed to buy. The system appears to work, but meanwhile, it remains heavily regulated.

However, such coordination may also lead to collusion, with undesirable effects. For example, in Ghana, following liberalization, private cotton companies colluded with respect to prices, such that suppliers were offered relatively low producer prices, but there was no coordination in the interlinked credit market (Poulton, 1998). Incidental side-selling resulted in low credit recovery. To make things worse, the Ministry of Agriculture was then urged to implement a local monopoly system, where each company was allowed the exclusive right of purchasing cotton in a certain zone. Similar developments occurred in Tajikistan (see above). These actions contribute to rent extraction, instead of alleviating it.

Another way of avoiding side-selling to competing buyers is to reinforce reputation effects. By making information on opportunistic behaviour publicly available, reputation losses can be severe, and violation of agreements is strongly discouraged. This mechanism is not restricted to developing countries; Bernstein (2001) describes the US cotton industry, where buyers' associations are deliberately making reputation-related information available. Members who do not comply with the rules of the association, may be suspended or expelled, and will have their names publicized. The profitability of their future business will be seriously affected this way. In Pakistan, some farmers clearly have a stronger bargaining position at harvest time than at the time the interlinked contract is originally negotiated – but a farmer that depends on the same lender for credit the following season would not exploit this advantage (Stockbridge *et al*., 1998). The threat of withdrawing future access to credit and especially publicly labelling the offending party as "a defaulter" is the lender's main instrument in the enforcement of loan repayments.

In Kenya, side-selling of part of the harvest to competitors at more attractive prices was avoided by conditioning future credit limits on past sales records (Jayne *et al.* 2004). This system also discourages suppliers to divert received fertilizer and chemicals to other crops.

A final example is to use alternative, informal mechanisms of contract enforcement. For example, in Zimbabwe, as noted above, input provision by Cottco and Cotpro remains viable, in spite of side-selling to Cargill (Larsen, 2002). Apart from other techniques formerly mentioned, microfinance group lending techniques are applied, similar to the Grameen banking principle as described by Stiglitz (1990). Interlinked contracts are assigned to groups of 5-30 suppliers. If one of them defaults, the whole group is penalized. In this way, local information is used in the process of self-selection of supplier groups. Other strategies based on peer monitoring were adapted by Pakistani agricultural traders (Smith *et al.*, 1999). New suppliers of cotton need to put forward a "guarantor" in order to be eligible for input credit provision. In Tanzania (Poulton, 1998), "Local Information Networks" were addressed to intermediate in supplier selection for input provision programs. This way, a supplier's reputation is used as "social collateral" to obtain a loan: an elegant way to overcome capital constraints. Information sharing may allow suppliers to benefit from competition between traders, whilst still having access to credit, as the risk of default by suppliers is reduced. According to Stockbridge *et al.* (1998), the effectiveness of such informal information exchange is partly a function of culture, but also depends on the available local transport and telecommunication infrastructure. An example may be the concentration of businesses of the same trade in one street or location, facilitating information exchange between traders.

CONCLUDING COMMENTS

Vertical coordination in agrifood supply chains plays an important role in overcoming market imperfections in transition and developing countries. Processing, marketing and input supplying companies have engaged in different types of contracts with farms. Processors engaged in input provision in order to secure their supply, while input supplying firms engaged in output marketing, in order to increase their sales volume and ensure repayment of provided credit. This system of "interlinking markets" has the potential to bring farm investment and production closer to their optimal levels.

This paper analyzes the equity and efficiency effects of interlinking in supply chains, and the impact of competition upon those. By introducing an interlinked contract, farms can access credit, inputs etc. which were unavailable before, and processing companies have access to higher quality and timely

supplies. Total welfare increases. It is not sure, however, that both parties gain from this transaction. That depends, amongst other factors, on the availability of supply, the degree of competition between firms, and both parties' relative bargaining strength.

Empirical evidence reveals that competition has positive equity effects, but may have either positive or negative efficiency effects. In general, farmers benefit from competition between processing firms. More competition leads to more equal rent sharing, reflected in higher producer prices. More competition can also lead to competition on the services processing firms provide to farmers. As a result, farm assistance programs may become widespread, resulting in positive efficiency effects. But if competition becomes too vigorous in the interlinked input and credit market, coordination may break down. Farmers may undermine their own long run productivity through strategic defaulting in the short run. Many case studies report of input programs that collapsed due to competition, proving empirical support of negative efficiency effects of competition. In other cases, input programs remained sustainable under competition as a result of special institutional arrangements like frequent monitoring, buyer coordination, or local information networks.

REFERENCES

Baffes, J. 2004, Tanzania's Cotton Sector: Reforms, Constraints and Challenges. *Development Policy Review* 22(1), 75–96.

Bardhan, P. 1989, *The Economic Theory of Agrarian Institutions*. Clarendon Paperbacks, Oxford.

Bardhan, P. & Udry, C. 1999, *Development Microeconomics.* Oxford University Press, Oxford.

Bell, C. 1988, Credit Markets and Interlinked Transactions. *In* Chenery, H.B. & Srinivasan, T.N. (eds) *Handbook of Development Economics*. North-Holland, Amsterdam.

Bernstein, L. 2001, Private Commercial Law in the Cotton Industry: Creating Cooperation through Rules, Norms and Institutions. John M. Olin Law and Economics Working Paper No.133. The Law School, University of Chicago.

Boughton, D., Tschirley, D., Zulu, B., Ofio, A. O. & Marrule, H. 2003, *Cotton Sector Policies and Performance in Sub-Saharan Africa: Lessons Behind the Numbers in Mozambique and Zambia*. Paper prepared for presentation at the 25th International Conference of Agricultural Economists, August 16-22, 2003, Durban, South Africa.

Codron, J.M., Bouhsina, Z., Fort, F., Coudel, E. & Puech, A. 2004, Supermarkets in Low-income Mediterranean Countries: Impacts on Horticulture Systems. *Development Policy Review* 22(5), 587-602.

Conning, J. 2000, Of Pirates and Moneylenders: Product market competition and the depth of lending relationships. Working Paper Department of Economics, Williams College, Williamstown.

Dries, L. & Swinnen, J. F. 2004, Foreign Direct Investment, Vertical Coordination, and Local Suppliers: Evidence from the Polish Dairy Sector, *World Development*, 32(9), 1525–1544.

Fisman, R. & Raturi, M. 2004, Does Competition Encourage Credit Provision? Evidence from African Trade Credit Relationships. *The Review of Economics and Statistics* 86(1), 345–352.

Genicot, G. & Ray, D. 2006, Bargaining power and enforcement in credit markets. *Journal of Development Economics,* 79, 398-412.

Gordon, A. 2000, Improving Smallholder Access to Purchased Inputs in Sub-Saharan Africa. *Policy Series* 7. Natural Resources Institute, Chatham, UK.

Goreux, L. & Macrae, J. 2003, *Reforming the Cotton Sector in Sub-Saharan Africa.* Africa Region Working Paper Series No. 47. The World Bank, Washington.

Gow, H., Streeter, D. & Swinnen, J. F. 2000, How private contract enforcement mechanisms can succeed where public institutions fail: The Case of Juhocukor, *Agricultural Economics*, 23(3), 253–265.

Hall, P. & Soskice D. 2001, *An Introduction to Varieties of Capitalism, in Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*, ed. by P. Hall, and D. Soskice. Oxford: Oxford University Press.

Hanyani-Mlambo, B.T., Poulton, C. & Larsen, M.N. 2005, *Competition and Coordination in the Zimbabwe Cotton Sector 2001-2004*. Presentation at the Cross-Country Workshop, February 2005, Lusaka, Zimbabwe.

Hendriks, M. 1994, Trade Arrangements and Interlinked Credit in the Philippines. In Bouman and Hospes, eds. Financial landscapes reconstructed – the fine art of mapping development. Boulder: Westview Press.

Hoff, K. & Stiglitz, J. E. 1998, Moneylenders and bankers: price increasing subsidies in a monopolistically competitive market. *Journal of Development Economics*, 55, 485–518.

Jayne, T. S., Yamano, T. & Nyoro, J. 2004, Interlinked Credit and Farm Intensification: Evidence from Kenya. *Agricultural Economics*, 31, 209-218.

Larsen, M. N. 2002, Is Oligopoly a Condition of Successful Privatization? The Case of Cotton in Zimbabwe. *Journal of Agrarian Change 2* (2), 185–205.

Minten, B., Randrianarison, L. & Swinnen, J. F. 2006, *Global Retail Chains and Poor Farmers: Evidence from Madagascar*, LICOS Discussion Paper 164/2006.

Poulton, C. 1998, Cotton Production and Marketing in Northern Ghana: The Dynamics of Competition in a System of Interlocking Transactions. *In* Dorward, A., Kydd, J. and Poulton, C. (eds) *Smallholder Cash Crop Production under Market Liberalisation: A New Institutional Economics Perspective*. CAB International, Oxon, pp. 56–112.

Poulton, C., Gibbon, P., Hanyani-Mlambo, B., Kydd, J., Maro, W., Larsen, M. N., Osorio, A., Tschirley, D. & Zulu, B. 2004, Competition and Coordination in Liberalized African Cotton Market Systems, *World Development*, 32(3), 519–536.

Ruotsi, J. 2003, *Agricultural Marketing Companies as Sources of Smallholder Credit in Eastern and Southern Africa: Experiences, Insights and Potential Donor Role*. IFAD Eastern and Southern Africa Division, Rome, Italy.

Shepherd, A. W. 2004, *Financing Agricultural Marketing: the Asian Experience*, AGSF Occasional Paper, Rome: Food and Agriculture Organization.

Smith, L., Stockbridge, M. & Lohano, H. 1999, Facilitating the Provision of Farm Credit: The Role of Interlocking Transactions Between Traders and Zamindars in Crop Marketing Systems in Sindh. *World Development 27,* (2), 403–418.

Stiglitz, J. 1990, Peer Monitoring and Credit Markets. *World Bank Economic Review,* 4(3), 351-366.

Stockbridge, M.S. L. & Lohano, H. R. 1998, Cotton and Wheat Marketing and the Provision of Pre-harvest Services in Sindh Province, Pakistan. *In* ed. by Dorward, A., Kydd, J. & Poulton, C. *Smallholder Cash Crop Production under Market Liberalisation: A New Institutional Economics Perspective*, pp. 177–239. Oxon: CAB International.

Swinnen, J.F.M. 2006, *Global Supply Chains, Standards, and the Poor*. CABI Publications, forthcoming.

Swinnen, J. F.M., Sadler, M. & Vandeplas, A. 2006, *Contracting, Competition and Rent Distribution in Supply Chains: Theory and Empirical Evidence from Central Asia. In* Swinnen, J. (ed.) *Global Supply Chains, Standards, and the Poor*. CABI Publications, forthcoming.

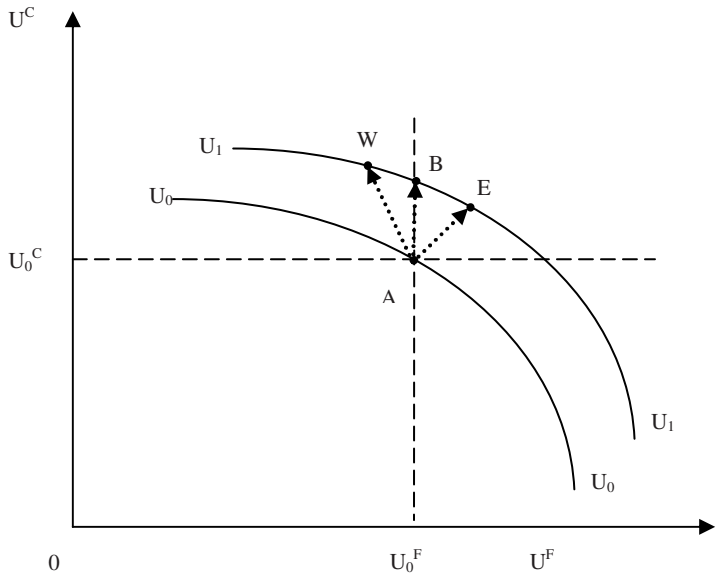
World Bank. 2005, The Dynamics of Vertical Co-ordination in Agro-Food Chains in Europe and Central Asia. *Report*, The World Bank, Washington.

Table 1: Variations in Central Asian Cotton Production, 1992 – 2003[105]

Measure	Kazakhstan	Kyrgyzstan	Uzbekistan	Tajikistan
Annual Growth Rate Harvested Area (Ha)				
1993 – 1998	12.3	6.0	-1.7	3.7
1993 - 2003	5.8	7.6	-1.7	-0.1
Seed Cotton Production (1000 MTs)				
1993 – 1998	26.7	11	-2.3	8.4
1993 - 2003	8.9	11.5	-2.8	0.1
Baled Cotton Production (1000 MTs)				
1993 – 1998	12.6	20.4	-2.7	0.4
1993 - 2003	5.4	25.9	-2.6	-3.5
Seed Cotton Price per MT, 2003	$550.00	$450.00	$200.00	$165.00

Source: Swinnen et al., 2006

Figure 1: Possible effects of interlinking on efficiency and equity



[105] There are significant differences in seed cotton production and baled cotton production. The most important reason for these differences is probably smuggling of seed cotton from Uzbekistan and Tajikistan to Kazakhstan and Kyrgyzstan, although there is no hard data to quantify the amounts of smuggled seed cotton.

Figure 2: Bargaining power and the utility distribution

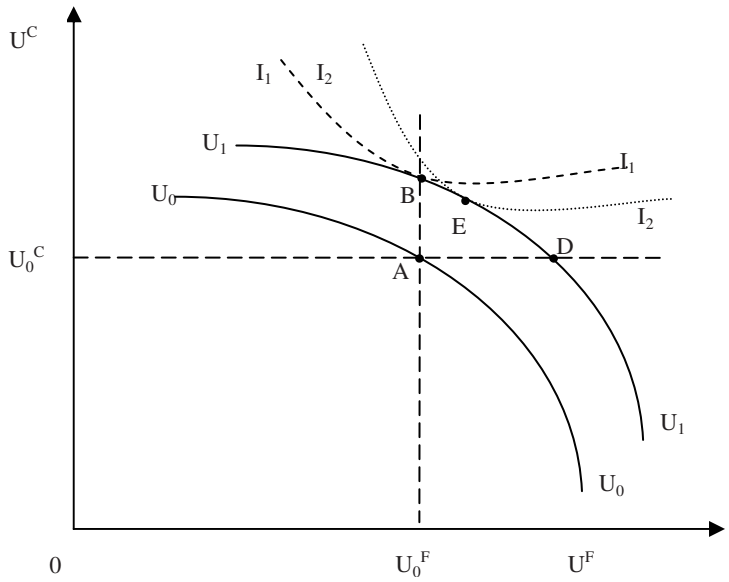


Figure 3: Effects of competition on interlinking markets

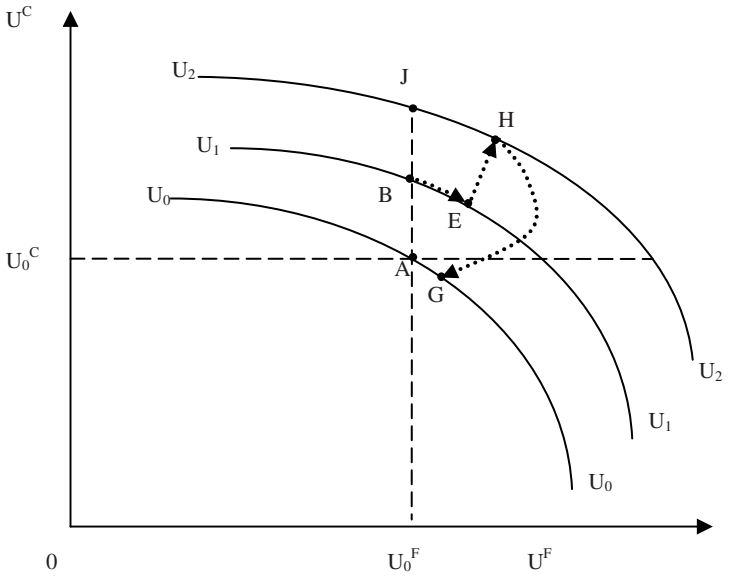
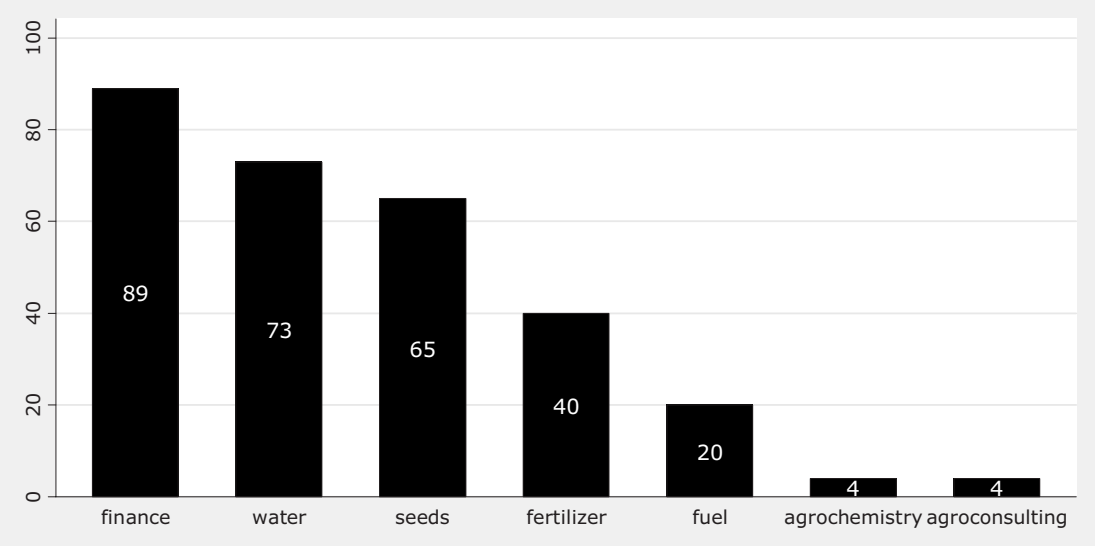


Figure 4: Share of farmers receiving specific farm assistance from cotton gins in Kazakhstan, 2003 (in %)



Source: WB Survey

Domestic traders versus global retail chains: Evidence from Madagascar

Bart Minten[106]

ABSTRACT

Global retail companies ("supermarkets") have a growing influence on agricultural markets in developing countries and increasingly replace traditional marketing systems. By using primary data gathered from a domestic agricultural trader survey and from interviews of representatives of global retail chains and the farmers they work with, we contrast the functioning of both supply chains in the case of Madagascar. Traditional marketing is done by a myriad of small traders who offer little trade credit, use no forward ordering and do on the spot transactions driven by poor market institutions, high search costs and imperfect and asymmetric information. Larger traders rely more on relationships and social capital to partly overcome these problems. Given their desire for quality produce and their larger supply base needed, global retail chains put different systems in place. They procure their goods through micro-contracts, fixing the price in advance and supplying seeds, fertilizers and chemicals on credit. These contracts are further characterized by extensive farm assistance and supervision programs. In the case study and the business model presented here, there is no evidence that this would be a bad development for poor farmers.

INTRODUCTION

Modern retailing companies increasingly dominate international and local markets and set the standards for food quality and safety in this sector (Reardon et al., 2003; Reardon and Berdegué, 2002; Reardon and Swinnen, 2004; Weatherspoon and Reardon, 2003; Reardon and Barrett, 2000; Jaffee and Henson, 2004). There is therefore considerable debate and uncertainty on the impacts of these developments on agricultural trade, farmers and rural poverty in developing countries. For example, available evidence on Africa points mostly at negative implications for small farmers as several studies indicate that small farmers are left behind in the supermarket-driven marketing and trade (Key and Runsten, 1999; Reardon and Barrett, 2000; Kirsten and Sartorius, 2002; Delgado, 1999; Weatherspoon et al., 2001; Weatherspoon and Reardon, 2003; Gibbon, 2003; Dolan and Humphrey; 2001; Humphrey et al., 2004; D'Haese and Van Huylenbroeck, 2005).

Using primary data from Madagascar, one of the poorest countries in Africa, this article contributes to this literature and indicates why these shifts are taking place away from the existing traditional marketing systems. It also presents a case study of how poor farmers are able to participate in these emerging chains. First, this study looks at selling and buying practices of domestic traders in a market environment characterized by poor market institutions, high search costs and imperfect information. Second, the study analyzes the contracting for global retail chains of almost 10,000 small farmers in the Highlands of Madagascar. We document the contract mechanisms used in these supply chains and analyze their effects on farming practices and on welfare of the local farmers.

The structure of the paper is as follows. First, we describe the data used and the methodology. In section three, some background information on agricultural marketing in Madagascar is given. Section four discusses the results of the domestic trader survey. Section five presents the results of the survey with contract farmers and of interviews with representatives of global retailers. We finish with the conclusions.

[106] Corresponding author: BP 6317, Antananarivo 101, Madagascar; e-mail: bminten@iris.mg. I would like to thank Marcel Fafchamps, Lalaina Randrianarison and Johan Swinnen as this article draws significantly on joint collaborative work in this area.

DATA AND METHODOLOGY

The study relies on data from two primary surveys, i.e. traders in the traditional marketing system and interviews with suppliers for global retail chains and the farmers that work for them. First, the agricultural trading survey was organized at the end of 1998. Survey work was undertaken in collaboration between Cornell University, Oxford University, and the local Ministry of Scientific research (FOFIFA). Three main agricultural regions in Madagascar were selected (Fianarantsoa, Mahajanga, and Antananarivo). The sample design was constructed so as to be as representative as possible of all the traders involved in the whole food marketing chain from producer to consumer, wherever located.

The traders were surveyed in three different types of location: (a) Traders operating in big and small urban markets in the main town of every province (*faritany*) and district (*fivondronana*). These traders are mostly wholesalers, semi-wholesalers, and retailers; (b) Urban traders located outside the regular markets. These often are bigger traders, processors (e.g., rice millers), and wholesalers; (c) Traders operating on rural markets at the level of the rural county (*firaisana*). These are mostly big and small assemblers and itinerant traders. Rural firaisanas were selected through stratified sampling based on agro-ecological characteristics to represent the various kind of marketed products and marketing seasons. The questionnaire covered the following main areas: (a) characteristics of the trader and trading enterprise; (b) factors of production and operating costs; (c) trading activities and marketing costs; (d) relationships and coordination costs. Data were also collected on search behavior and costs, quality inspection, contact enforcement and dispute settlement, information gathering and property rights enforcement.

The survey focused on traders that marketed locally consumed staples such as rice, cassava, potatoes, beans, and peanuts. The different forms in which these products are marketed were taken into consideration, i.e., paddy and milled rice, maize and maize flour, etc. Most surveyed traders (67%) report rice as the agricultural product they trade most intensively. This reflects the importance of rice as the main staple food in the country[107]. Other most actively traded products are beans and lentils (18%), cassava (5%), potatoes (5%), peanuts (4%), and maize (2%).

Second, the analysis of the global retail chain is based on interviews at various levels of the supply chain and a representative supplier (farm household) survey. At the processing and marketing level, several interviews were held with the managers of the main processing company regarding their strategy, activities, the value chain of the products that they sell and purchase, the constraints that they face in a very poor developing country such as Madagascar, the type of contracts that they put in place, the requirements of supermarkets and how it has changed over time, and its impact on their functioning and their management structure. We also discussed with them in advance the design and the sampling frame of a primary survey that we organized with their contract farmers. During a debriefing session, the results were presented and further discussed.

A supplier (farm household) survey was further organized during the months of June and July 2004. Two-hundred farmers that supply products for the global retail chains were selected based on a stratified sampling frame. A comprehensive survey was implemented where questions were asked on the demographic situation of the household, land assets, the nature of the contract, the relationships with the firm, control and supervision practices of the firm, the benefits and disadvantages of working with contracts, the perceived effects on welfare, and the level of inputs and output on the contracted plots.

BACKGROUND ON AGRICULTURAL MARKETS IN MADAGASCAR

Madagascar, an island country with 16 million inhabitants, located off the coast of Africa has similar economic and social characteristics as most African countries. Poverty is high and especially so in

[107] It is estimated at the national level that rice makes up half of the calorie intake of the population in rural areas. However, the percentage is significantly higher in the regions in the survey as the province of Toliara characterized by a significantly drier climate and therefore different agricultural production and consumption habits than the rest of the country was not included in the sample.

rural areas: while the overall poverty headcount ratio was evaluated at 70% in 2001, it was as high as 77% in rural areas compared to 44% in urban areas. Education levels are low and it is estimated that only about half of the population is able to read and write. Malnutrition levels are equally high and 45% of the children under three are growth-retarded (Instat, 2005). Madagascar is largely an agricultural economy: agriculture counted for about a quarter of GDP and 80% of employment in 2002.

After Madagascar obtained its independence from France, the government initially increased the intervention of the state in agricultural markets such that by the end of the 1970s, most trade in agricultural products and inputs was in the hands of the state. A reversal of policy took place in the 1980s with a transition from a state food marketing and distribution system to a liberalized market. This transition, however, was very gradual.

During the First Republic (1960-1972) small traders together with a parastatal organized the marketing of staples. This parastatal fixed minimum and maximum prices, provided credit to farmers, and organized rural associations. During this era, agricultural policies were focused on increasing the agricultural area through large irrigation infrastructure schemes. This was combined with agricultural extension efforts focused on the use of modern inputs (fertilizer, pesticides) and improved equipment.

In the beginning of the 70s, the new socialistic government wanted to get rid of the private marketing sector that was perceived to be predatory. Thus, the government created a national monopolistic parastatal, the "Société d'Intérêt National des Produits Agricoles" (SINPA), that was responsible for assembly, transformation, and marketing of agricultural products. A tax system, as well as economic barriers, were put in place in order to allow each fokontany to benefit from agricultural production and to control product movements. While the idea was to stabilize the prices of export crops (especially coffee, vanilla, and cloves), the system that was actually put in place penalized these crops. For example, from 1975 to 1983, coffee producers only received 40% of the world price and those of vanilla and cloves 25%.

On the other hand, domestic food prices were subsidized and artificially kept low which led to low domestic production and a surge in food imports. As the government was unable to continue to pay for food subsidies, internal liberalization began in 1983 when the state officially abandoned its monopoly on the commerce of agricultural products. However, the state still intervened heavily in markets in the beginning. Additional liberal agricultural policies were put into place in the 1990s. For example, the import licensing system was abolished, export taxes for cash crops were gradually eliminated, and the state disengaged of the maintenance of major irrigation areas, transferring responsibility to producer organizations.

The current situation in agricultural markets can be described as one in which private traders have been given free rein to set prices and move agricultural products around the country and in which there is little state intervention. More recently, foreign retailers have made a series of investments in supermarkets in Madagascar, particular in the capital Antananarivo and in some regional capitals. Foreign retail investors include the South-African chain Shoprite and the French chains Leaderprice and Score.

DOMESTIC TRADERS

Descriptive statistics

Generally, Malagasy traders are of average age - about 37 years - mostly male, and married with three children (Table 1). Trading in agricultural crops is often the main activity and most traders deal in different crops. Rice accounts for the largest portion of total sales amounting to 43 percent of total revenue. Surveyed traders have on average spent 6 years trading agricultural products. Malagasy traders employ very few people other than themselves. Permanent and temporary workers account for nearly half the total number of man months used by the trader while the other half is family and own labor. The labor use differs by category. 65 % of total labor used by wholesalers and assemblers is

hired and outside labor while retailers rely heavily on own and family labor. In this case, outside labor makes up only between 5 and 20% of the total labor force.

Table 1: Characteristics of agricultural traders in Madagascar

	Unit	Wholesaler	Retailer with fixed selling point	Retailer w/o fixed selling point	Assembler	Total
A. Sample distribution						
Aggregate	%	30	44	15	11	100
	Number	226	328	91	80	725
Antananarivo	Number	83	36	7	11	130
Vakinankaratra	Number	40	75	13	24	146
Fianarantsoa - Hauts Plateaux	Number	48	99	2	19	179
Fianarantsoa - Cote/Falaise	Number	22	60	26	8	84
Majunga - Plaines	Number	24	31	43	18	89
Majunga - Hauts Plateaux	Number	9	27	91	80	97
B. Human capital						
Average age	years	38	37	33	40	37
% male	%	68	48	30	69	54
% married	%	83	77	59	87	79
Highest educational attainment (%)						
- Primary - Secondary I schooling	%	53	65	66	46	60
- Secondary II to higher schooling	%	47	35	34	54	40
Average number of years in business	years	8	6	3	7	6
C. Labor						
Total number of man months:		67	27	12	57	40
Owner	man-months	11	11	10	9	11
Family	man-months	13	10	2	11	10
Permanent	man-months	27	4	1	27	13
Temporary	man-months	16	1	0	10	7
D. Characteristics operation						
Traders in rice						
who purchase from less than 25 km	%	54	79	84	49	57
who purchase from more than 100 km	%	9	2	1	15	9
Working capital	$	3656	566	209	6366	2109
Vehicles	Number	0.19	0.05	0.01	0.47	0.14
Storage capacity	MT	37	8	3	94	26
Equipment value	$	651	53	11	1308	372
Monthly value sales	$	5545	1310	390	8713	3294
Monthly value purchases	$	4349	1259	320	7560	2815
Gross margin per month	$	813	130	75	1872	489

Marketing is highly localized, interregional trade is small and market coverage is limited in Madagascar. Almost 60% of the traders buy their products within a radius of 25km. This is understandable for the retailers who buy mostly from traders who bring the products to retail markets. However, even wholesalers and assemblers do not travel very far. Only 15% of the assemblers and 9% of the wholesalers purchase rice from an area further than 100 km. This low regional product specialization - and lack of market integration (Badiane et al., 1998; Moser et al., 2005) - seems partly due to the high transportation costs and less to lack of transport available as most traders report to have access to some means of transportation.

The surveyed businesses are fairly small and unsophisticated. Average working capital is around $2,000 – a large number compared to the annual GDP of Madagascar which was 230 US dollars in 1997 but very small compared to the turnover of grain trading companies in the US or Europe. Few of the traders possess their own means of transport and investment in equipment is low compared to working capital. Most of the working capital seems to be tied up in the product itself. The size distribution among traders is quite significant. Assemblers make the highest gross margin per month, i.e. over $1800, compared to only $75 for the retailers without selling points. Moreover, Fafchamps and Minten (1999) show that traders in the upper tercile of the firm size distribution use 15 times more working capital and two times more labor but they obtain almost fifty times more gross margin than traders in the lower tercile. Hence, large traders have a much higher total factor productivity than the small ones.

Table 2 illustrates the importance of different factors for success in business as evaluated by the traders themselves. Relationships are by far the most important factor for succes as 71% of the traders regard reputation and relationships as “very important”. This percentage is much higher than for the other reasons that were suggested: access to credit, granting credit, the level of purchase or sales price, and access to transport equipment. While a surprising result at first, these relationships can have multiple advantages for the trader. Small traders use relationships and social capital to overcome three obstacles typical of commodity markets in developing countries: (1) poor market institutions, (2) high search costs, and (3) imperfect and asymmetric information.

Table 2: Factors important for success as perceived by the traders (cumulative %)

A. Personal reputation and relationships	
Very important	71
Important	85
A little bit important	95
Not important	100
B. Access to credit	
Very important	11
Important	30
A little bit important	61
Not important	100
C. Granting credit	
Very important	3
Important	18
A little bit important	50
Not important	100
D. Purchase price	
Very important	30
Important	74
A little bit important	95
Not important	100
E. Sales price	
Very important	35
Important	83
A little bit important	98
Not important	100
F. Transport equipment	
Very important	27
Important	51
A little bit important	68
Not important	100
Number of observations	729

POOR MARKET INSTITUTIONS

Credit

The use of trade credit by traders is extremely limited. 89% of the traders report that they use only their own funds to support their business operation (Table 3). A mere 4% of the traders has ever asked for credit from a formal institution (Fafchamps and Minten, 1999). The major reasons given for non-application are ignorance, high interest rates, complicated application procedures, and lack of collateral. In the case that there is some element of credit, the funds come from the informal market. However, informal credit does not substitute for lack of formal credit: only one trader out of ten derives part of its working capital from informal credit sources.

Table 3: Use and access to finance and credit

A. Main source of funding (%):	
own funds	89
formal credit	0
informal credit	2
own funds and formal credit	1
own funds and informal credit	7
Total	100
B. Use of bank or financial institution	
% of traders who have bank account	16
% of traders who have line of credit	1
% of traders who have savings account	10
% of traders member of "tontine"	1
% of purchases by check	0
% of sales by check	0
C. Use of credit	
% of purchases on credit	16
% of purchases cash	82
% of purchases with forward ordering	2
% of sales on credit	14
% of sales cash	86
% of sales after deposit	1
Number of observations	729

The minor importance of formal institutions in traders' operations is further illustrated by the fact that only 15% of the surveyed traders has a bank account, 10% a savings account, and 1% a bank line of credit. Hence, it is not surprising that traders use no checks (less than 0.5% of the traders). Most of the agricultural trade - sales as well as purchases - takes place without orders (only 2% of the purchases) and without credit and are cash-and-carry transactions. Therefore, search and supervision costs are higher than they should be and massive amounts of currency constantly circulate in the countryside – an invitation to theft and a perfect target for an inflation tax.

Contract enforcement

As for credit, the use of formal institutions is also extremely rare for contract enforcement. Only 5% of the traders ever used police, lawyers or courts since the start of their business (Table 4). The dominant response to conflict resolution is negotiation with the other party or sometimes use of a third party as mediator. However, not using legal institutions does not imply that contracts are not enforced. Most of the disputes are resolved and trade continues. Contractual disputes are resolved through negotiation seemingly because the traders want to continue the relationship. A relationship is valuable as a majority of traders report that it would be fairly or very difficult to find a new supplier if they lost one. Hence, conflicts have to be solved and it is shown that conflicts are more often resolved when suppliers (clients) have a longer term relationships with the trader (see Fafchamps and Minten, 2001).

Table 4: The use of institutions for resolution of problems

Traders that used this institution since the start of business	**N**	% of traders
1. Third person/mediator	729	14.0
2. Police	729	4.0
3. Lawyer	729	0.5
4. Court	729	0.7
Conflict resolution technique for last incidence	N	% of traders
1. theft		
went to the police after theft	56	37.5
went to court after theft	56	10.7
2. contractual problem with supplier		
Direct negotiation with supplier	178	86.0
Seek help of mediator	178	3.4
Seek help of lawyer	178	0.0
Threat to go to the police	178	0.0
Threat to go to court	178	0.6
3. contractual problem with client		
Direct negotiation with client	220	93.6
Seek help of mediator	220	9.1
Seek help of lawyer	220	0.5
Threat to go to the police	220	3.6
Threat to go to court	220	0.9

Insurance

Commodity trade is characterized by high variability and is subject to all kinds of risks. Co-variate risks such as bad road infrastructure, high level of insecurity, climatic calamities, and high price fluctuations and idiosyncratic risks such as non and late payment and the non-detection of bad quality hinder agricultural trade and might all be the cause of financial stress for small trading companies. A system of risk and insurance sharing might mitigate the consequences of adverse outcomes or might even allow traders to pursue higher return but more risky activities. In the absence of formal institutions, social capital might play this role.

The overwhelmingly majority of the traders are involved in some kind of informal insurance mechanism (Fafchamps and Minten, 1999). Moreover, larger traders are more involved in solidarity networks than their smaller competitors. They also perceive relationships differently. Large traders believe that they will be helped more by family and by others when they need it and they are more likely to help others if needed. Larger traders also perceive family and friends less as a burden than smaller traders. Not surprisingly, smaller traders are more proud of their own achievements without help. Consequently, they are also more dependent of the success of their business for their own survival as they seem to have less social fallback.

Social capital matters when market institutions fail. Social capital can be a source of trade credit in an environment where formal credit is rare, it can be used for insurance through risk sharing, and it can be a substitute for contract enforcement in an environment where formal institutions are not effective. The results presented here resemble those studied and observed in similar situations, i.e. a mild impact of breach of contracts (e.g., Fafchamps, 1998; Greif, 1993, 1994; Kandori, 1992) and a low reliance on legal institutions (Fafchamps, 1996; Bigsten et al., 2000).

HIGH SEARCH COSTS

Suppliers

44% of the traders report that they have occasionally problems finding suppliers. This is line with the fact that 55% of the traders have little choice between suppliers. Hence, there is an incentive for traders to assure regularity in supply. The traders that have the highest number of regular suppliers are also the ones that have least problems to assure a regular supply (Fafchamps and Minten, 1999). Overall, almost 60% of the traders report that they buy from regular suppliers, accounting for almost 40% of their purchases. The importance of regular suppliers increases significantly with the size of the firm: 37% of the small traders buy from regular suppliers while 71% of the big traders do. The relationship between traders and regular suppliers is in the majority of the cases exclusively based on commercial grounds.

Regular relationships with suppliers also allow the trader to engage in forward ordering. It is more commonplace among larger traders to do so: almost 19% of large traders place orders compared to only 7% of small traders. Apart from regularity in supply, relationships between suppliers and traders also help to avoid losses due to bad quality products. Large traders are better able to get replacement for their products or to get refunds when a problem occurs while small traders have to deal relatively more with the quality problem on their own. The quality uncertainty might be one of the major reasons why 20% of the traders even refuse to buy from unknown suppliers.

Customers

Finding clients seems less difficult than finding suppliers. However, the same trends in the relationship between trader-supplier and trader-client are noticed. Only 16% of the traders often do not find clients while almost 60% of the traders report to always have the choice between clients – significantly higher than the percentages on the supplier side. Hence, the incentive to develop regularity with clients is significantly lower than for purchases. There are lots more contacts with clients than with suppliers. The small traders serve 57 clients with the quantity purchased from one supplier compared to only 25 in the case of large traders. Hence, small traders have many more contacts with clients and make them therefore less regular. Larger traders apparently face more problems of finding clients and therefore, the pay-off for the development of regular relationships is much higher. Overall, 54% of the traders sell to regular clients, representing 27% of the value of sales. However, almost three quarter of the bigger traders sell to regular clients while only one third of the smaller traders do so. The regularity leads possibly to more chance for refunds if quality turns out to be a problem. In the case that smaller traders have regular clients, this relation is more often based on family, religious, or ethnic relationships than in the case of bigger traders. Few of the traders see problems selling to an unknown client.

IMPERFECT AND ASYMMETRIC INFORMATION

Traders face imperfect and asymmetric information on the market situation, on suppliers and clients, and on products. In the absence of public information services, the development of social capital might produce the necessary insights in the situation of demand and supply. Given weak market institutions, traders might become more efficient through the development of a credible supplier and client network that allows more sophisticated ways of trade: granting and receiving credit, forward ordering, and less quality checking.

Market situation

Malagasy traders have imperfect access to modern means of communication as the great majority of the traders do not have a phone or fax for their business (Table 5). Although that the majority of traders report they would be able to have access to a phone, few actually use it. Information on the market situation is obtained through personal contacts with other traders, suppliers, clients, or through messengers while the role of public sources such as newspapers, radio, and public services is extremely marginal. The various types of information are obtained from different sources. 66 percent of the traders obtain information about price changes from fellow traders while only 19 and 16 percent

do this for market demand and supply respectively. In the last case, information is gotten from suppliers and customers directly. Retailers rely relatively more on information from fellow traders than assemblers or wholesalers.

Table 5: Access and sources of market intelligence and market news

% of traders who have a phone	5
% of traders who have access to a phone	57
% of traders who do never use a phone for business	84
% of traders who have a fax	1
% of traders who have access to a fax	22
% of traders who do never use a fax for business	99
Main sources of information (%):	
With respect to prices	
Suppliers	24
Other traders	60
Clients	4
Messengers	9
With respect to demand	
Customers	76
Other traders	16
With respect to supply	
Suppliers	66
Other traders	23
Number of observations	729

Credibility of suppliers and clients

If traders want to engage in more sophisticated ways of trading – forward ordering, granting and receiving credit, no checking of quality for every transaction – they need to establish a system of information on the credibility of clients and suppliers to better enable contract enforcement. Table 6 illustrates the manner in which traders evaluate credibility. Overall, there is a great similarity in the way suppliers treat surveyed traders and traders treat their own clients. More sophistication in transactions is achieved through the development of long-term relationships. Forms, recommendations by other traders or bank guaranties are seldom used as ways to verify credibility. Most traders report that they will never grant/receive credit or order forward when they deal with a trading partner for the first time. They will only start doing so after a minimal number of transactions (between 9 and 13 transactions on average). There seems to be little reward for immediate payment of a transaction as prices are on average only reduced by 1.5%. However, given that the delay for the payment is only between six and thirteen days, this still constitutes an extremely high yearly interest rate (compounded between 150% and 250%).

Table 6: Credibility of clients/suppliers

		Type of transaction beyond cash-and-carry transactions[1]		
		Credit from supplier	Forward ordering from supplier	Credit to client
A. Requirements to go beyond				
% of traders that would never use this mode on the first transaction	%	92	84	95
% of traders that require the following conditions:				
- Form	%	1	2	2
- Recommendation	%	11	22	17
- Collateral	%	2	2	2
- frequent number of transactions	%	80	65	71
-Others	%	19	45	40
Number of transactions required if frequent number is required	Number	9	11	13
B. Conditions of deal				
Discount if paid in cash (%)	%	2	-	2
Delay offered (in days)	Number	6	7	13
The trader settles the deal later than agreed upon:				
Never	%	17	29	19
Seldom	%	24	53	35
Sometimes	%	39	12	34
Often	%	20	6	12
The trader has to settle the previous deal before obtaining new one	%	78	78	63
Stop in supplies after particular limit	%	60	100	87
C. Implications in case of problems				
Threat to go to the police in case of problems	%	2	6	5
Threat to go to court in case of problems	%	1	0	2
If traders have problems with one, others will refuse to deal with him:				
- None of the other traders	%	11	39	21
- Some of the other traders	%	40	37	58
- Most of the other traders	%	31	10	15
- All of the other traders	%	17	14	5
Ease to find a new supplier of the same services if you lose one:				
Very easy	%	8	-	25
Rather easy	%	16	-	50
Rather difficult	%	44	-	19
Very difficult	%	31	-	6
Number of observations		194	49	339

[1] *For the traders that use this mode of transaction*

However, more sophisticated transactions lead to a higher incidence of problems (Fafchamps and Minten, 2001). A significant number of traders are regularly not able to settle their accounts in the time required. If they are not able to do so, they will mostly not obtain new supplies[108]. A threat of using the police or court to settle the problem is almost unheard of, let alone that one actually uses these institutions. The non-payment of one supplier does not seem to have an impact on credit or forward ordering by other ones. On the other hand, the majority of the traders believe that it is rather or very hard to find suppliers that are willing to extend credit. So, it seems that once the trader is on good terms with one particular supplier, he has an incentive to want to preserve that good relationship. It seems easier to find a new client to whom to grant credit. This might be due to the higher number of clients the trader interacts with compared to suppliers[109].

[108] Similar findings are reported by Fafchamps (1996) in Ghana.

[109] Greater choice between clients per se is illustrated by the fact that 68% and 18% of the traders face an "infinite" number of clients and suppliers respectively.

Products

Most traders possess and use balances to check quantities during transactions (Mendoza and Randrianarisoa, 1998) which implies that quality is the big unknown in the transactions of products. Quality of products shows significant variation in Madagascar between regions as well as within regions: only 6% and 7% of the traders report that quality never varies between regions and within regions respectively (Table 7). The Green Revolution did not happen in Madagascar due to a variety of reasons (Badiane et al., 1998). Therefore, a multitude of local non-improved varieties with inherently different quality characteristics are found in local markets. Hence, verification of the quality of the product is important and necessary: 85% of traders and clients report that they *always* inspect the quality of the product before the purchase. Moreover, prices depend on it – only 7% declares that prices of products do not vary with quality.

Table 7: Quality variation and verification

	% of traders
A. Variation of quality	
Quality of products varies systematically by geographical origin (%)	
A lot	37
A little bit	57
Not at all	6
Total	100
Quality of products within region varies (%)	
Never	7
Seldom	37
Sometimes	37
Often	14
Always	5
Total	100
Price of product varies with quality (%)	
A lot	33
A little bit	61
Not at all	6
Total	100
B. Quality verification	
Trader *always* verifies quality before purchase (%)	84
Client *always* verifies quality before purchase (%)	86
Person responsible for the verification of quality (%)	
Owner/manager himself	93
Family aide	4
Employee	1
Agent collector	1
Nobody	1
Total	100
Number of observations	729

It can be assumed that given the multi-layered nature of agricultural trade and the large number of transactions, the checking of quality is an important cost in the spread between producer and consumer prices. Moreover, quality inspection is hardly delegated (93% of the traders report to check the quality themselves). This suggests that quality checking is perceived to be critical for firm performance. As traders want to assure quality, they often have to do numerous trips to supply areas, some of which are for nothing since traders do not use telephones, can not or will not place or take orders, and must search for buyers and sellers once they are on location. In such an environment the development of reliable social capital must singularly reduce the costs of doing business. If a trader is not able to develop this social capital, his firm might show limits to growth (Fafchamps and Minten, 2002).

THE GLOBAL RETAIL CHAIN

The supply chain

The vast majority of high value vegetable exports from Madagascar go through one company, Lecofruit, the firm that we study.[110] Two-thirds of the products handled by the company are sold in European supermarkets. Half of this is sold directly by the company to seven main supermarket chains in France, Belgium and the Netherlands. The company has regularly contracts with five of these chains. The other half is sold through industrial distributors which then organize the sales to supermarkets. One-third of the produce is directly sold to retail outlets and restaurants - mostly in the neighborhood of Paris - through European wholesalers. Sales and distribution within Europe are organized by an independent firm that is paid a margin of the final price as to provide these services.

In recent years, Lecofruit has tried to sell its fresh, high standard, vegetables to the emerging modern retail outlets in Madagascar. However, the company was not competitive with local informal suppliers. The managers of the firm feel that the local supermarkets do not value quality as much as they do in Europe. In addition, the local supermarkets were hesitant to engage in contracts which the firm needs for their planning. As a result, the firm has, for the moment, almost abandoned the modern local retail market.

Lecofruit itself buys vegetables from more than 9,000 small farmers based on contracts. The total household area cultivated by contracted farmers is a little below 1 hectare on average in the survey (Table 8), about the national average farm size in Madagascar (Minten et al., 2003). One-third of the total household area is in the more valuable lowland used for rice cultivation. On average, households own 3 rice plots of which 1.3 lowland plots are under contract with the firm while 1.7 lowland plots are not under contract.

Table 8: Farm and farmer's characteristics

Variable	Unit	No of obs.	Mean	St.dev.
Head of household				
Age	years	200	37.5	10.6
Sex	% male	200	93%	
Member of a farmer's organization	%	200	27%	
Education				
% that did not finish primary school	%		36%	
% that finished at most primary education	%		34%	
% that studied more than primary education	%		30%	
Composition household				
number of males age <15	number	199	1.3	1.1
number of males age between 15-64	number	199	1.3	1.1
number of males age >64	number	196	0.0	0.2
number of females age <15	number	199	1.4	1.2
number of females age between 15-64	number	199	1.4	1.0
number of females age >64	number	194	0.0	0.2
Land area				
Total area cultivated	are	196	96.2	296.1
Lowland area cultivated	are	196	35.4	35.6
Contracts				
total number of plots with contract	number	200	2.9	1.4
Members of the hh with contract	number	200	1.1	0.4
Members outside hh with contract	number	200	0.4	1.0
Number of years that farmers work with the firm	number	199	8.2	4.1
Proportion of the farmers where interruption of contract	share	197	0.2	

[110] Légumineuses Condiments Fruits de Madagascar SA.

The contracting farm households in the survey have on average six members (Table 8). Half of the members are less than 15 years old. 7% of the households are female-headed. The average age of the household head is 37 years. The households that have contracts with the firm are considerably higher educated than the average Malagasy household: 64% of them had finished primary schools, and only 1% of them did not do any studies at all. This compares to almost half of the national population that is analphabet (Razafindravonona et al., 2001).[111] 27% of the contractors are member of a farmers' organization. The selected household has on average 8 years of experience with contract farming.

The company rule is that an area under contract should be approximately 1 are (0.01 hectare). Different contracts can be done on the same plot over the year given the relatively short production cycle. In general, there is only one contractor in the household but households sometimes subcontract land to people outside the households. A contracting agent can only have one contract at a time. However, different members of the same household are allowed to take on and bear responsibility for a contract. During the agricultural season 2003-2004, farmers in the survey had on average 5 ares (0.05 hectares) under contract in total over the whole year (Table 9). This was equal to about the same number of contracts and indicates that the rule of the firm that an area under contract should be about 1 are is respected. The contracted crop was in most cases French beans. 97% of the farmers declared to have grown this crop over the last agricultural season. To a lesser extent, the contract involved gherkins (87%). Leek, peas and other crops were relatively less important.

Table 9: Characteristics of the contract

	Unit	No. of obs.	Mean	St.dev.
Season 2003-2004				
Area under contract	ares	199	5.41	2.74
Number of contracts	number	197	4.53	2.93
Number of products cultivated under contract	number	199	2.07	0.68
Proportion of farmers…				
… that grew beans under contract	share	199	0.97	
… that grew gherkins under contract	share	199	0.86	
… that grew leek under contract	share	199	0.17	
… that grew peas under contract	share	199	0.05	
… that grew another crop under contract	share	199	0.02	
Inputs - credit				
Value of chemical fertilizer/pesticides per contract	Ariary	405	10115	1958
Kgs of the product to be paid back for the credit	kgs	406	31.1	6.1
Other material obtained from the firm (not to be paid back)	Ariary	174	7058	25558
Proportion of farmers that will pay back the full credit this year	share	200	98%	
Proportion of farmers that can find same quality seeds themselves	share	200	57%	
In case you do not pay back advances				
… the firm will not work with me anymore	%	200	62%	
… there will pressure from the 'chef de zone' to pay	%	200	99%	
… there will be social pressure to pay	%	200	22%	
… there will be judicial implications	%	200	0%	

SUPERMARKETS, STANDARDS, AND CONTRACTS

(a) Contracting

The firm signs a yearly contract in advance with most clients in Europe in which the delivery conditions and product standards are specified for the year as a whole (minimum quantity, prices, time of delivery, and payment dates). As is increasingly common in international trade (Jaffee and Henson, 2004), the firm is obliged to stick to the requirements of the clients through private protocols ('*cahier de charges*'). The requirements in these protocols differ by client but concern demands related to the

[111] However, analysis of national census data of 1993 of the fivondronana where the contracting farmers are located indicates that 'only' 39% of the people did not finish primary school, similar to the numbers of our survey. This illustrates the long-standing well-known bias in education investments towards the Highlands.

quality of the product (length of the beans, color, etc.) but also ethical standards (no use of child labor for example), employment practices as well as hygiene instructions in the processing plant.

Controlling and enforcing of the food safety and agricultural health standards imposed in the protocols is done at several levels. First, the firm does itself regular controls of its produce as to ensure that the norms on phyto-sanitary conditions, the absence of foreign objects, etc. are met. Second, each European client also hires private auditors which come to Madagascar for follow-up on these conditions and for inspection at least once a year. These auditing controls have become more frequent and more stringent in the last five years, due to the food chain problems related to the dioxine crisis and crazy cow diseases in Europe.

In addition, the firm has set up an elaborate system of contracting and on-farm monitoring of the vegetable production. With a vegetable supplier base of more than 9,000 small farmers, the imposition of the product and process standards and requirements requires a major organization in terms of monitoring and control. The institutional arrangements between the firm and the farmers are set-up as micro-contracts. The written contracts are standardized with identical inputs, credit conditions and prices by product. Once a contract is signed, the farmers are then required to follow the rigid instructions of the firm. They have to labor the land in time and have to apply two card-loads of compost on the plot before the planting. As part of the contract, seeds, fertilizer and pesticides are distributed by the firm and have to be paid back in kind. Farmers might also receive, under conditions of good performance, other material that has not to be paid back.

Monitoring and supervision

To monitor the correct implementation of the supplier contracts, the firm has put in place a strict hierarchical system of around 300 extension agents who are permanently on the payroll of the company. Every extension agent, the *chef de culture,* is responsible for about thirty farmers. To supervise these, (s)he coordinates five or six extension assistants (*assistant de culture*) that live in the village itself. The *chef de culture* has a permanent salary paid by the firm.[112] On top of the people in the field, another 200 people are employed at the processing plant located in Antananarivo, the capital of Madagascar.

During the cultivation period of the vegetables under contract, the contractor is visited on average more than once (1.3 times) a week (Table 10). This intensive monitoring is to ensure correct production management as well as to avoid 'side-selling' (for more details, see Minten et al., 2005). The intensity of the monitoring is illustrated by statements of the farmers: 99% of the farmers say that the firm knows the exact location of the plot; 92% of the farmers say that the firm will even know approximately or exactly the number of plants that are on the plot.

[112] It is interesting to note that export farmers in Kenya developed to a similar model but this time driven by demands of small farmers instead of the firm. Minot and Ngigi (2005) tell the story of a horticultural farmers' group in Kenya that were formed in part by a desire to eliminate brokers and to deal directly with exporters. The group employed itself a field supervisor charged with the responsibility of supervising and monitoring production practices to ensure that the farmer members follow the prescribed methods. The supervisor was trained by the exporter.

Table 10: Control and supervision by the firm

	Unit	No. of obs.	Mean
Proportion of farmers…			
… where firm makes the choice of the crop	share	199	0.23
… where the firm makes the choice of the area under contract	share	199	0.36
… where the firm makes the choice of plot	share	199	0.06
… where the firm makes the choice on the technique to be used	share	199	0.99
… where the firm controls if right technologies are used	share	196	0.98
… where the firm puts the pesticides on the product	share	199	0.34
… where firm knows number of plants under contract			
All	%	121	60
About	%	64	32
Not quite	%	10	5
No	%	4	2
… where firm knows exact location of plots	share	199	0.99
Number of visits of an extension agent per week	number	199	1.33
… that is visited less than once a week	share	199	0.30
… that is visited once a week	share	199	0.30
… that is visited more than once a week	share	199	0.41

For some crucial aspects of the vegetable production process, representatives of the company will even intervene in the production management to ensure it is rightly done. The latter is particularly important for pesticide use. For example, to export into Europe, the produce has to fulfill the norms on MRL (Maximum Residue Levels) of the country that it is exported to. Given that these requirements are not harmonized for all products across European countries, the firm adheres to the most severe one.[113] The MRL norms have become stricter over time - leading to a reduction in the active ingredients in pesticides - and the firm is continuously adjusting the packages that are distributed at the farmer level. Given the implication for potential rejection as well as for its reputation, the pesticide application has to be monitored very closely. Only the recommended doses can be applied and the timing of pesticide application matters since it cannot be done in the period just before the harvest. In the survey, 34% of the farmers report that representatives of the firm will themselves put the pesticides on the crops to ensure that it is rightly done.

The firm will only pay for the products that fulfill the quality norms on size and length set by the firm. This control is done by the *assistants de culture* in the field as well as in the plant itself. The produce that is not bought by the firm is sold on the local market, used for own consumption or given as feed to animals. The prices that the firm offers are most often higher than those in local markets. 61% of the farmers believe that the contract price is on average lower on the local market. 21% and 13% of the farmers thinks that it is higher or the same respectively. When comparing the actual price offered by the firm and the price fetched on the market for the rejected produce at the time of the survey, the market price was found to be significantly lower. However, even if contract prices would be lower than market prices, most farmers would stick to the contract within a reasonable large range (Minten et al., 2005a).

Supplier assistance packages and contract enforcement

As in other modern supply chains where the processor or trader provides inputs to farms which are constrained in their access to these essential inputs, the firm distributes seeds, fertilizer and pesticides as part of the contract. The value of these pre-financed inputs has to be paid back in kind. The average input value per contract is estimated at about 10,000 Ariary or 5 US dollar (Table 9). This compares to an average value of produce sold under one contract of 20 US dollar. The first harvests that come in are used for re-imbursements of these inputs. The firm only starts to pay the peasants mostly from the 4th week of harvest on.

[113] The European Union pesticide legislation is under review. The setting of MRL is based on the work done by Codex Alimentarius, an international standards-setting group based in Rome.

The firm has high pay-back rates and during the year of the survey, about 98% of the farmers expected to pay the full credit back to the firm (Table 9). When asked what would happen if they would be unable to pay back the credit, all of the farmers believe that there will be no judicial implications. However, there will be pressure from the *chef de zone* to pay. Social pressure is less used and 38% of the farmers believe that, even if they would not be able to pay back, they would still be able to do contracts with the firm afterwards.

While there is a written agreement, these contracts are seldom legally enforceable in practice, as often the case in other developing and transition countries (Kirsten and Sartorius, 2002; Gow et al., 2000). The poorly developed legal institutions, the small amount involved, and potential souring relationships between agri-business and farming communities makes that the only threat at the disposal of the firm is to discontinue the contract with the farmers. To be able to follow up on farmers on their performance and pay habits, the firm keeps a meticulous database of all the farmers that it works and has worked with.

IMPACT ON FARMERS

Technology adoption and land use

One of the benefits of contracting with the firm is that it teaches farmers how to make compost. The compost consists of a mixture of manure and vegetable matter. Its main benefit on the fields is in maintaining the soil structure, to provide nitrogen and other minerals that promote healthy crop growth and in providing the ability of the soil to retain moisture (Jacoby and Mancuri, 2004). The use of compost is long-lasting and can have an effect on the fertility of the soil for some years and might therefore be the cause of spillover effects. Farmers were asked to what extent the requirements on the making of compost and the use of chemical fertilizer has changed the way they are farming and would be farming in the future (Table 11). The majority of the farmers state that they are using compost on their plots and that they did not do so before the contract with the firm started. They also report that they are currently using compost on other plots than those plots that are under contract.[114] In the case that the firm would stop the contract, they report they would continue to produce compost and apply it to their fields.[115]

[114] We tested this statement for the one riceplot which was not under contract and on which we asked detailed information. Compost was used on a high 60% of the plots where off-season crops were grown.

[115] While the teaching of the use of compost might seem as a small contribution, this is a clear illustration of technology improvement in rural areas in a country where the state never succeeded in providing decent agricultural extension services and where most of the agriculture is still done as it was centuries ago.

Table 11: Impact contract on technology adoption

	Farmers that agree	
	%	Number
Use of compost		
Are you obliged to produce compost and use it on your plots?	93	186
Before you first contract with the firm, did you use already compost?	12	23
Are you now using compost on other plots than those under contract?	87	168
If the contract would be terminated for one reason or another, would you continue using compost?	95	184
Suppose that there would be no contract with the firm, would you use more compost than before?	66	132
Change in agricultural practices		
Did you change the way you do other off-season crops cultivation because of the contract?	93	186
a. use of inputs (fertilizer, pesticides, manure)	91	172
b. use of compost	96	181
c. more maintenance (weeding, watering)	72	135
Did you change the way you do other rice cultivation because of the contract?	6	13
a. use of inputs (fertilizer, pesticides, manure)	33	4
b. use of compost	50	6
c. more maintenance (weeding, watering)	50	6

It was then further asked to what extent the contract with the processing firm has changed their agricultural practices (Table 11). 93% of the farmers report that they have changed the way they cultivate their other off-season crops. More than 90% of the farmers report to use compost and inputs on these plots. About 70% of the farmers state that they do also more weeding. It thus seems that the contracts with the firm have led to significant changes in the way farmers do off-season crops and it seems to have a lasting impact. However, when asked about changes in the cultivation of rice, only 6% of the farmers report to have changed the way they cultivate rice since the start of the contract. This is not surprising given the stark differences in the cultivation of rice and off-season crops.

Unconditional land productivity differences for rice between the two types of plots, one without a contract in the off-season and one with a contract, were calculated. The results indicate that rice productivity is 64% higher on the plots with a contract compared to those plots without a contract and off-season crops: yields increase from 3,6 to 6,0 ton per hectare.[116] There are thus significant spillovers from contract farming on the production of rice, Madagascar's major staple, probably due to the organic and chemical fertilizer use in the off-season.

Income and welfare

Although the areas that are cultivated are relatively small, the income that contract farmers get out of the contract is relatively important. For the average household, the contract income represents almost 50% of their monetary income (Table 12). As expected, French beans are the most important, representing 66% of the total contract income. The total average contract income that the contractors earned during the season 2003-2004 amounted to about 87,000 Ariary (or 45 US dollars).[117]

[116] A t-test shows that these differences are largely significant. Regressions were then further run as to explain to what extent differences in rice productivity were driven by changes in labor or capital allocations to the contracted field. However, no statistically significant differences were found and most of the productivity differences are thus explained by spillover effects on rice productivity of the use of off-season crops on the ricefields (for more details, see Minten et al., 2005b).

[117] While this might be low at first sight, one must remember that average agricultural household income (including auto-consumption) in Madagascar was estimated in 2001 at 315US dollars (Randrianarison, 2003). Given that the largest part of agricultural production is auto-consumed, this thus makes up an important part of *monetary* income, as stated by these farmers.

Table 12: Income and perceived benefits of contract farming

	Unit	No. of obs.	Mean	St.dev.
Income				
Income from the contracts	Ariary	199	87270	72179
Income beans under contract	Ariary	199	57812	57667
Income gherkins under contract	Ariary	199	26716	35715
Income leek under contract	Ariary	199	1630	10490
Income peas under contract	Ariary	199	266	1622
Income another crop under contract	Ariary	199	36	383
Estimated income of contracts compared to total monetary income of household	%	200	47	32
	Mean	Median	Min	Max
Welfare				
Current length of the lean period (months)	1.68	2	0	6
Length of lean period before contract (months)	3.69	4	0	8
Length of lean period for similar household without contract (months)	4.32	4	0	9
		Importance		
	Not	A bit	Quite	Very
Reasons why households signed a contract (%)				
Stable income during the year	0%	2%	32%	66%
A higher income	10%	42%	31%	17%
Price stability	10%	22%	49%	19%
Access to inputs on credit	0%	7%	33%	60%
Learning of new technologies	0%	8%	37%	55%
No other alternatives for income	8%	61%	19%	12%
Access to a source of income during the lean period	1%	2%	25%	72%

Contract farmers perceive the contracts to be good for welfare, especially for seasonality smoothing. High seasonality in production and consumption is a major characteristic in rural areas in Madagascar (Minten and Zeller, 2000). As a significant number of households are constrained to reduce consumption during the lean period, it is characterized by higher incidences of disease and mortality (Waltisberger et al., 1998). The length of this lean period varies between regions and by household but is estimated in the province of Antananarivo, where the contract farmers are situated, to be around 4,4 months (Minten et al., 2003). The estimated length of the lean period of the contract farmers is 1,7 months. The farmers were also asked about the length of the lean period before they started contracts with the firm and to compare the lean period to households similar to theirs but who have no contract. In both cases, the household believes it is better off as lean periods are estimated to be respectively 3, 7 and 4, 3 months.

The importance of the reduction in risk and variability is also reflected in the reasons given by the farmers themselves on why they signed a contact with the firm (Table 12). Farmers were presented with different reasons why they could do so and had to rank them from 1 to 4, reflecting a gradual change from ‘not important’ to ‘very important’. About three quarters stated that access to a source of income during the lean period was for them a major reason for the signing of the contract. 66% of the farmers found it very important that they got a stable income during the year. Other major reasons that were mentioned were access to inputs on credit and the learning of new technologies. A higher income was mentioned by a relatively low number of contractors.

CONCLUSIONS AND POLICY IMPLICATIONS

By comparing the results of surveys with domestic traders and global retail chains, we find an increasing sophistication in marketing arrangements from small to large firms. Larger traders rely more on relationships and social capital than smaller traders as to overcome the problems of imperfect markets. However, this type of marketing arrangement is insufficient to fulfill the strong requirements on standards by rich consumers/countries as information about unobservable attributes cannot be credibly transmitted. As a result, information about these attributes does not circulate through this type

of value chain and growers receive no incentive for taking positive action regarding unobservable crop attributes (Fafchamps et al., 2006).

To solve this problem, suppliers for global retail chains rely on formal micro-contracts, fixing the price in advance and supplying seeds, fertilizers and chemicals on credit, as to fulfill the strong norms. In this global supply chain, small farmers' micro-contracts are combined with extensive farm assistance and supervision programs to fulfill complex quality requirements and phyto-sanitary standards of supermarkets. Small farmers that participate in these contracts have higher welfare, more income stability and shorter lean periods. We also find significant effects on improved technology adoption, better resource management and spillovers on the productivity of the staple crop rice.

These findings raise several issues for further analysis and have important implications. An important issue is whether the benefits of this model can be extended to allow a larger share of poor farmers in Madagascar to benefit in these emerging value chains. Major constraints in Madagascar are the high transport and transaction costs. A first constraint for expansion for this type of activity in Madagascar is the bad road infrastructure. The firm thus only has contracts with farmers in a 120 km radius around the capital Antananarivo where its processing plant and export units are situated but the recent rural road improvement – the priority of the government in its PRSP[118] - has allowed the firm to expand the number of contracting farmers by almost 1,000 in just one year. However, as to allow the trucks to pass, the firm itself is obliged to continuously organize road maintenance.

The second constraint is low human capital, causing high training costs and long duration required for training of the *assistants de culture* which organize and supervise the contracting farmers in the field. It is estimated that it takes on average two to three years until the firm will be able to give him/her full responsibility in the field. This slows down growth and expansion.

Third, transactions costs are large because of individual contracts. If farmers would be able to constitute farmers groups, internalize the verification system and provide as such economies of scale, more firms might be attracted to invest in Madagascar. This type of group has shown to be successful in other countries (Winters et al., 2005; Kirsten and Sartorius, 2002). However, while there are significant interventions of donors and the government as to get such groups going, they have overall a weak track record in Madagascar, especially related to export agriculture, given the difficulty to overcome moral hazard and asymmetric information problems.

The study also suggests that effects on farmers from investments by global retailers in supermarkets in Madagascar have not materialized yet. Local supermarkets seem to purchase mostly from local, informal, suppliers rather than from companies selling high standard produce. Local supermarkets do not value quality and standards sufficiently and are hesitant to engage in contracts which are needed for producing such standards. These results seem to contrast with other studies which argue that the emerging modern supermarket sector has difficulties finding local supplies which fulfill their high standards as we find that the high standards suppliers find the modern retail chains in Madagascar not (yet?) interested in their products.

[118] Poverty Reduction Strategy Paper

REFERENCES

Badiane, O., Goletti, F., Lapenu, C., Mendoza, M., Minten, B., Ralison, E., Randrianisoa, C., Rich, K. & Zeller M. 1998. Main Results and Policy Implications of the IFPRI-FOFIFA research project on Structure and Conduct of Major Agricultural Input and Output Markets and Response to Reforms by Rural Households in Madagascar. Washington DC, IFPRI.

Bigsten, A., Collier, P., Dercon, S., Fafchamps, M., Gauthier, B., Gunning, J., Isaksson, A., Oduro, A., Oostendorp, R., Patillo, C., Soderbom, M., Teal, F. & Zeufack, A. 2000. Contract Flexibility and Dispute Resolution in African Manufacturing. Journal of Development Studies, 36(4): 1-37.

Delgado, C. 1999. Sources of Growth in Smallholder Agriculture in sub-Saharan Africa: The Role of Vertical Integration of Smallholders with Processors and Marketers of High Value-added Items. Agrekon, 38: 165-189

D'Haese, M. & Van Huylenbroeck, G. 2005. The Rise of Supermarkets and Changing Expenditure Patterns of Poor Rural Households: Case study in the Transkei area, South Africa. Food Policy, 30: 97-113.

Dolan, C. & Humphrey J. 2000. Governance and Trade in Fresh Vegetables: The Impact of UK Supermarkets on the African Horticulture Industry. Journal of Development Studies, 37(2): 147-176.

Fafchamps, M. 1996. The Enforcement of Commercial Contracts in Ghana. World Development, 24(3): 427-448.

Fafchamps, M. 1998. Market Emergence, Trust and Reputation. Stanford, Stanford University. (mimeo)

Fafchamps, M. & Minten B. 1999. Relationships and Traders in Madagascar. Journal of Development Studies, 35 (6): 1-35.

Fafchamps, M. & Minten B. 2001. Property Rights in a Flea Market Economy. Economic Development and Cultural Change, 49(2): 229-268.

Fafchamps, M. & Minten B. 2002. Returns to Social Network Capital among Traders. Oxford Economic Papers, 54: 173-206.

Fafchamps, M., Vargas-Hill R. & Minten, B. 2006. The Marketing of Non-Staple Foods in India. World Bank. (mimeo)

Gibbon, P. 2003. Value-Chain Governance, Public Regulation and Entry Barriers in the Global Fresh Fruit and Vegetable Chain in the EU. Development Policy Review, 21 (5-6): 615-625.

Gow, H., Streeter, D. & Swinnen J. 2000. How Private Contract Enforcement Mechanisms Can Succeed Where Public Institutions Fail: The Case of Juhosucor A.S. Agricultural Economics, 23(3): 253-265.

Gow, H. & Swinnen J. 2001. Private Enforcement Capital and Contract Enforcement in Transition Countries. American Journal of Agricultural Economics, 83(3): 686-690.

Greif, A. 1993. Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition. American Economic Review, 83(3): 525-548

Greif, A. 1994. Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies. Journal of Political Economy, 102(5): 912-950.

Humphrey, J., McCulloch, N. & Ota, M. 2004. The Impact of European Market Changes on Employment in the Kenyan Horticulture Sector. Journal of International Development, 16(1): 63-80.

Instat 2005. Enquête Démographique et de Santé: 2003-2004. Antananarivo.

Jacoby, H.G. & Mancuri G. 2004. The (in)Efficiency of Share Tenancy Revisited: Evidence from Pakistan. World Bank. (mimeo)

Jaffee, S.M. & Henson S. 2004. Standards and Agro-Food Exports from Developing Countries: Rebalancing the Debate. World Bank Policy Research Working Paper 3348.

Kandori, M. 1992. Social Norms and Community Enforcement. Review of Economic Studies, 59: 63-80.

Key, N. & Runsten D. 1999. Contract Farming, Smallholders, and Rural Development in Latin America: the Organization of Agroprocessing Firms and the Scale of Outgrower Production. World Development, 27(2): 381-401.

Kirsten, J. & Sartorius K. 2002. Linking Agribusiness and Small-scale Farmers in Developing Countries: Is there a new Role for Contract Farming? Development Southern Africa, 19(4): 503-529.

Mendoza, M.S. & Randrianarisoa C. 1998. Structure and Behavior of Traders and Market Performance. IFPRI. (mimeo)

Minot, N. & Ngigi M. 2004. Are Horticultural Exports a Replicable Success Story? Evidence from Kenya and Côte d'Ivoire. EPTD/MTID discussion paper, International Food Policy Research Institute.

Minten, B. & Zeller M. 2000. Beyond Market Liberalization: Welfare, Income Generation and Environmental Sustainability in Rural Madagascar. Vermont, Ashgate.

Minten, B., Randrianarison, L. & Randrianarisoa, C. 2003. Agriculture, Pauvreté Rurale et Politiques Economiques à Madagascar. Antananarivo: Cornell University / FOFIFA/INSTAT.

Minten, B., Randrianarison, L. & Swinnen J. 2005a. Spillovers from Globalization on Land use: Evidence from Madagascar. (mimeo)

Minten, B., Randrianarison, L. & Swinnen J. 2005b. Global Retail Chains and Poor Farmers: Evidence from Madagascar. (mimeo)

Moser, C., Barrett, C.B. & Minten, B. 2005. Missing Markets or Missed Opportunities: Spatio-temporal Arbitrage of Rice in Madagascar. (mimeo)

Randrianarison, L. 2003. Les revenus extra-agricoles, in Minten, B., Randrianarisoa, C. & Randrianarison, L., Agriculture, Pauvreté Rurale et Politiques Economiques à Madagascar, Cornell University/FOFIFA/INSTAT, Antananarivo.

Razafindravonona, J., Stifel, D. & Paternostro, S. 2001. Changes in Poverty in Madagascar: 1993-1999. World Bank Africa Region Working Paper Series, No. 19. Washington, DC.

Reardon, T. & Barrett, C.B. 2000. Agroindustrialisation, Globalization and International Development: An Overview of Issues, Patterns and Determinants. Agricultural Economics, 23: 195-205.

Reardon, T. & Berdegué, J. 2002. The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development. Development Policy Review, 20(4): 371-88.

Reardon, T., Timmer, C.P., Barrett, C.B. & Berdegué, J. 2003. The Rise of Supermarkets in Africa, Asia, and Latin America. American Journal Agricultural Economics, 85(5): 1140-1146.

Reardon, T. & Swinnen, J. 2004. Agrifood Sector Liberalization and the Rise of Supermarkets in Former State-Controlled Economies: Comparison with Other Developing Countries. Development Policy Review, 22(5): 515-524.

Waltisberger, D., Cantrelle, P. & Ralijaona, O. 1998. La Mortalité à Antananarivo de 1984 à 1995. Paris, Document et Manuel du CEPED No. 7.

Weatherspoon, D., Cacho, J. & Christy, R. 2001. Linking Globalization, Economic Growth and Poverty: Impacts of Agribusiness Strategies on sub-Saharan Africa. American Journal of Agricultural Economics, 83(3): 722-729

Winters, P., Simmons, P. & Patrick, I. 2005. Evaluation of a Hybrid Seed Contract between Smallholders and a Multinational Company in East Java, Indonesia. Journal of Development Studies, 41(1): 62-89.

Value Chain Analysis and Market Power in Commodity Processing with Application to the Cocoa and Coffee Sectors

Christopher L. Gilbert[119]

ABSTRACT

Value chain analysis extends traditional supply chain analysis by locating values to each stage of the chain. This can result in a "cake division" fallacy in which value at one stage is seen as being at the expense of value at another. Over the past three decades, the coffee and cocoa industries have witnessed dramatic falls in the producer (i.e. farmer) share of the retail price. Both industries are highly concentrated at the processing stage. Nevertheless, developments in the producer and retail markets are largely unconnected and there is no evidence the falls in the producer shares are the result of exercise of monopoly-monopsony power. The explanation of declining producer shares is more straightforward – processing, marketing and distribution costs, incurred in consuming countries, have tended to increase over time while production costs at origin have declined.

INTRODUCTION

This paper has both a methodological and a substantive agenda. At the methodological level, I examine the potential contribution of Global Value Chain (GVC) analysis in the commodity sector. Substantively, I aim to resolve the apparent paradox that retail coffee and chocolate prices have declined at most modestly over the past three decades while producer prices for coffee and cocoa have fallen more dramatically. This has resulted in substantial falls in the producer shares of retail prices. Some commentators see these declines in producer share as the result of exercise of monopoly and monopsony power in processing industries which showed high levels of concentration.

The term "global value chains" appears to be originally due to Hopkins and Wallerstein (1977, 1986, 1994) who proposed to analyze a sequence of processes culminating in the production of the final product. This endeavour was in part motivated by the realization that many industrial goods are processed in multiple countries prior to final retail sale, and that trade in intermediate products has become a major component of all international trade. Industrial products typically combine a number of different raw material and other inputs – GVC analysis looks at the value contribution of each of these to the final product.

Production processes for many traditional tropical agricultural products are often much less complicated. In some cases, the retail product may appear to be little more than a repackaging of the raw material input. Roast coffee appears to conform to this paradigm. In cases such as these, GVC analysis simply extends traditional supply chain analysis by locating values to each stage of the chain.

GVC analysis is a framework, not a hypothesis. It therefore lacks substantive implications. According to its proponents, it is well-adapted for posing particular classes of question, arguably neglected in traditional economic analysis, rather than others, more favoured by traditional analysis. In particular, GVC analysis has been used to analyze the geographical, often international, distribution of activities and value creation in the production of a final good – see, for example, Korzeniewicz and Martin (1994). In this respect, GVC analysis links to the contemporary discussion in international economics of the extent of and effects of outsourcing – see Feenstra and Hanson (1996, 1999). Its major shortcoming is that it invites interpretation of changes in value shares as measuring the incidence of

[119] Dipartimento di Economia - Università degli Studi di Trento - Via Inama 5, 38100 Trento, Italy
cgilbert@economia.unitn.it

changes in market power, an interpretation which is only valid in particular circumstances. In particular, GVC discussions can be prone to a "cake division" fallacy in which value at one stage is seen as being at the expense of value at another. To be useful, the GVC framework needs to be complemented by more traditional industrial organization models in which questions of market power can be more satisfactorily addressed.

It is perhaps fair to say that many applications of GVC analysis to tropical agricultural commodity markets have been polemical rather than scholarly. Agricultural commodity prices have tended to be low over the two decades in which GVC analysis has been under development, and the primary purpose of many GVC contributions in this sector has been to lament the low share of the value of final products received by developing country farmers (Oxfam 2002a, 2002b; Daviron and Ponte, 2005). These low producer shares are presented as posing an ethical problem, but the absence of causal structure makes it difficult to discuss the origin of the changes in value share and therefore to consider policies which might alleviate the position in which the farmers find themselves.

I illustrate these issues by reference to the world coffee and cocoa industries. Coffee and cocoa are both tropical tree crop commodities produced largely (cocoa) or substantially (coffee) by smallholder farmers. A number of countries (most importantly Brazil, Côte d'Ivoire and Indonesia) are important producers of both crops. Marketing arrangements are similar. Coffee has the merit that the value chain is relatively simple while, at the same time, there is considerable concentration at the processing stage giving rise to the potential for the exercise of monopoly and monopsony power. Coffee prices were very low during the so-called Coffee Crisis years of 1999-2003. The cocoa industry is more complicated because the final product, chocolate, exhibits greater variety than roast and soluble coffee, and because chocolate incorporates other raw material inputs. Price fluctuations over recent decades have been less extreme than in coffee. However, cocoa processing ("conversion") is as or more concentrated than coffee roasting.

In both industries, it has been suggested that market concentration has allowed value to be appropriated by multinational processing companies at the expense of developing country farmers and that this was one of the factors underlying the Coffee Crisis. I argue that there is no merit in this argument. In particular, there is no evidence that the margins in either cocoa or coffee processing have risen over time. This is not to imply an absence of monopoly or monopsony power, but only that one cannot explain a loss of producer share through an increase in market power. Instead, the decline in the producer share of the retail coffee price is the fact that only around one half of the costs underlying retail coffee prices are attributable to the fob price of coffee. The proportion of chocolate production costs attributable to cocoa is even lower. The remaining costs are incurred in consuming countries. Productivity gains have reduced coffee production costs but coffee processing and distribution costs have risen, at least until the start of this decade. The result is that retail coffee and chocolate prices have only fallen modestly implying a decline in the producer shares of the retail price.

The structure of the paper is as follows. Sections 2 and 3 respectively describe the coffee and cocoa supply chains. Section 4 sets out an accounting framework for GVC analysis and section 5 builds on this framework to develop a simply GVC model. The model does not have predictive power but amounts instead to an analytical device for understanding changes in value shares. Sections 6 and 7 set out the facts in relation to the evolution of producer value shares in the coffee and cocoa industries respectively over the past three decades. Sections 8 (the statistical framework), 9 (the producer coffee and cocoa markets) and 10 (the retail coffee and chocolate markets) apply the analytical framework developed in section 5 to explain these observations. Section 11 concludes.

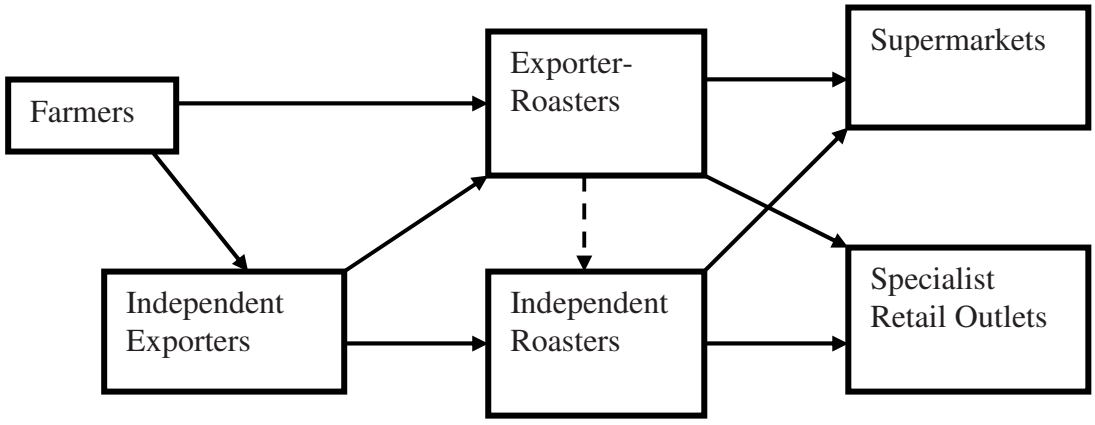
THE COFFEE SUPPLY CHAIN

Coffee is a tropical tree crop commodity. There are two principal tree varieties – arabica and robusta – the beans from which give coffees with very different characteristics. Robusta coffees, which are grown at low altitudes, have less flavour but greater strength than arabicas, which are grown at higher altitudes and often on volcanic soils. To further complicate matters, arabica beans can either be wet or dry-processed. Wet processing, used throughout the Spanish speaking Americas and in most of East Africa, results in mild Arabica coffee which is ideally suited to filter coffees. Dry processing, which is the standard practice in Brazil and Ethiopia, gives a more bitter coffee which is particularly-suited to the preparation of espresso. Arabica is more difficult to grow and prepare than robusta, and quality variations are much more considerable. Some high quality arabicas fetch large market premia, in particular from the speciality coffee retailers. By contrast, most major roasters blend coffees from different origins in order to obtain a quality which is consistent over time. The blends typically use arabica for flavour with robusta as a filler, the relative proportions of the two determining the overall cost of the blend.

Coffee is produced both by smallholders and on large farms and estates. Estates are particularly important in Latin America but also in Kenya. Most of the remainder of African production is from smallholders.

Coffee processing firms are called roasters. Roasters sell directly to retailers (supermarkets and bars or restaurants). The retail product may either be in the form of roasted coffee (beans or as ground coffee) or as soluble (instant) coffee. There are two technologies for the production of soluble coffee – spray drying, which is low cost but results in considerable loss of flavour, and freeze drying, which conserves flavour but is more costly and requires access to proprietal technology. Figure 1 illustrates the simplest case in which farmers sell (often via cooperatives or local buyers) either to independent exporters or to exporters owned or controlled by multinational exporters.

Figure 1: The Basic Coffee Supply Chain



The two principal variants of the structure illustrated in Figure 1 arise in certain Latin American countries, most notably Colombia, where a parastatal (or state supported) roaster competes with the multinational exporter roasters, even to the point of selling directly to supermarkets and through specialized outlets; and the East African structure in which all, or almost all, sales for export pass through a national coffee auction (Kenya and Tanzania).

Coffee roasting is a concentrated activity. In 1998, the two largest roasters accounted for 29% of total world coffee roasting, and the top six roasters[120] for 60% (van Dijk *et al*., 1998). This concentration is principally the result of branding. Heterogeneity among coffee varieties and across origins allows roasters to produce differentiated products geared to tastes in specific markets and specific market sectors. Brands are often heavily promoted and this gives rise to a barrier to market entry. Economies of scale are important only in the production of soluble coffees.

The coffee market has been controlled for much of the post Second World War period, most notably by the sequence of International Coffee Agreements (ICAs). The first ICA was negotiated in 1962. It and the succeeding three agreements limited exports to keep prices at levels deemed fair to both producers and consumers. Intervention ended in July 1989. Gilbert (1996, 2004), who follows Law (1975) in describing the ICAs as "internationally sanctioned cartels", concluded that the agreements both raised coffee prices but had little effect on variability. Subsequent to the breakdown of coffee controls, the coffee market has seen two extended periods of low prices. The first, from 1989-93, resulted from the release onto the market of producer inventories, previously held back by ICA export restrictions, while the second, from 1999-2002, was the consequence of large production increases in Brazil and Viet Nam against a backdrop of slow consumption growth – see Gilbert (2005).

THE COCOA SUPPLY CHAIN

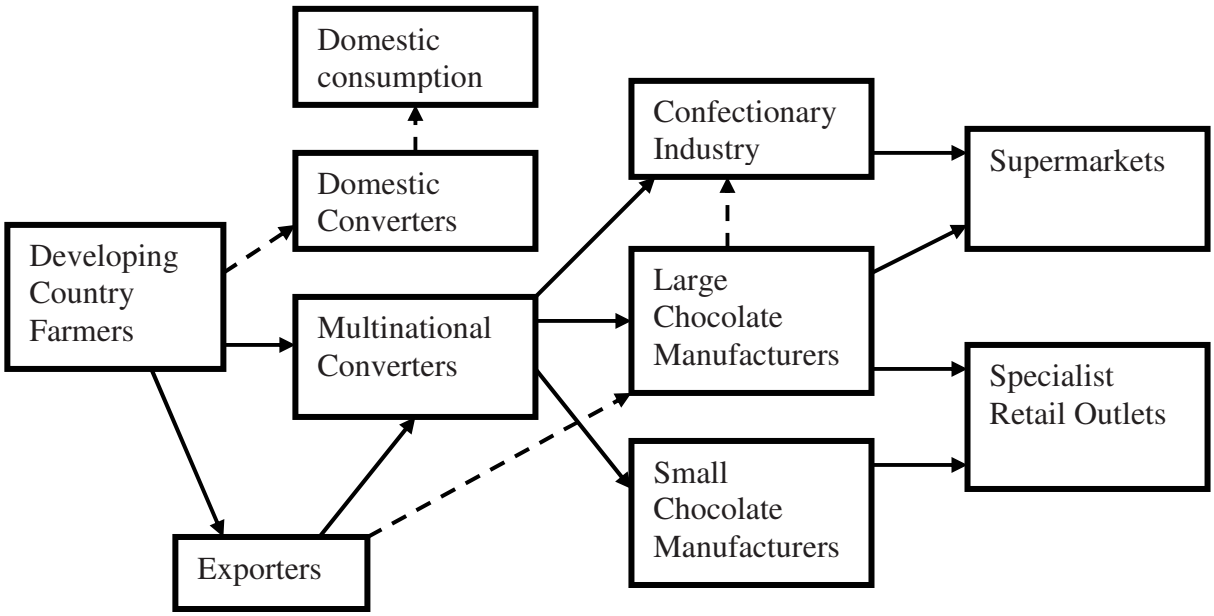
Cocoa is a tropical tree crop produced almost entirely by smallholder farmers under competitive conditions. Cocoa processing consists in the production of two intermediate products, cocoa butter and cocoa powder. This operation is known as converting (or grinding) and the firms which do this are the converters (or grinders). Cocoa butter and powder are recombined, in varying proportions, to make chocolate which also incorporates other inputs –most importantly milk and sugar. Cocoa powder is also used without the butter in confectionary products. Butter and powder are produced in fixed proportions, given the fat content of the beans, and powder is normally seen as a by-product. Cocoa butter is highly homogeneous and, once processing has taken place, origin is at most a minor consideration.

A simplified version of the cocoa supply chain is illustrated in Figure 2. Developing country farmers sell their cocoa beans (perhaps indirectly via a cooperative and/or a local buyer or *traitant*) to en exporter. In many producing countries, some or all of the largest exporters will be either the multinational converters themselves or local companies controlled by the converters. Once shipped to Europe or North America, the beans will be converted to cocoa butter (destined for chocolate) and cocoa powder (used in the confectionary industry). The large converters are not involved in chocolate manufacture, but some large chocolate manufacturers may have conversion capacity and so be able to buy directly from exporters. (Figure 2 shows less important links as broken arrows). Otherwise, exporters will find themselves selling to the major converters, often prior to shipping. Chocolate is sold both through supermarkets and through smaller specialist outlets. A small amount of (generally low quality) cocoa may be processed locally but it is costly to export the butter which is therefore sold locally.[121]

[120] Now reduced to five through mergers: Altria, Nestlé, Proctor and Gamble, Sara Lee and Tchibo.

[121] In Ghana, the second largest cocoa producer and exporter, the Cocoa Marketing Board (Cocobod) is a monopsony buyer. Cocobod exports either directly or through major exporters. Figure 2 omits the cocoa terminal markets which are used primarily for paper transactions.

Figure 2: The Cocoa Supply Chain



We turn now to industrial structure. With a few important exceptions, the cocoa markets in the producing countries are free and competitive either because they have always been this way or because or recent moves to liberalize tropical agricultural markets. By contrast, converting exhibits massive economies of scale both in the conversion process itself and in transportation. Figure 2 underlines the pivotal position of the converters in the cocoa value chain. The conversion industry is highly concentrated. Four large oligopolists dominate the industry – ADM, Barry Callebaut, Cargill and Hosta. These big converters do not manufacture chocolate, and the two most important – ADM and Cargill – see themselves primarily as trading companies. The chocolate industry is much less concentrated. Chocolate producers have the choice between buying butter and powder from an independent converter or buying beans and undertaking the conversion themselves. Traditionally, they have opted for the latter route but increasingly they are moving towards purchase of butter and powder from the major converters.

THE ACCOUNTING FRAMEWORK

To move from a supply chain to a value chain we need to attach values to each stage in the supply chain. A prerequisite for doing this is an accounting framework. Simple value share discussions often appear to be based on the identity:

retail price of processed coffee = producer price of coffee + gross margin

or $$p = \pi + m \qquad (1)$$

Within this structure, the producers' value share is just $\omega = \frac{\pi}{p}$.

It is obvious but not always made explicit that the producer price π of a commodity is at most an upper bound on the return obtained by the producer. The production of many commodities requires inputs and these can account for a large proportion of the price the farmer receives. Production may also involved hired labour inputs. Finally, there the opportunity cost to the labour that the farmer and his family provide. The farmer's net return is likely to vary across commodities and producing countries depending on the importance of these various factors. It is not clear a priori that one should expect a very strong relationship between the gross producer shares implied by identity (1) and the net returns obtained by the producers, which is presumably our ultimate concern.

Suppose that we are nevertheless happy to interpret the producers' value share ω as implied by identity (1) as a measure of producer welfare. Does it follow that a decline in this share is due to the exercise of monopoly or monopsony power? The accounting identity (1) aggregates the processors' profit margin with processing and intermediation costs in the same way that it includes input and labour costs in the producers' gross receipts. For other commodities, such as cocoa, other raw material inputs (milk, sugar) may be as or more important than the cocoa input.

Figure 3: Indicative Cost Breakdown, U.K. Milk Chocolate, 2004

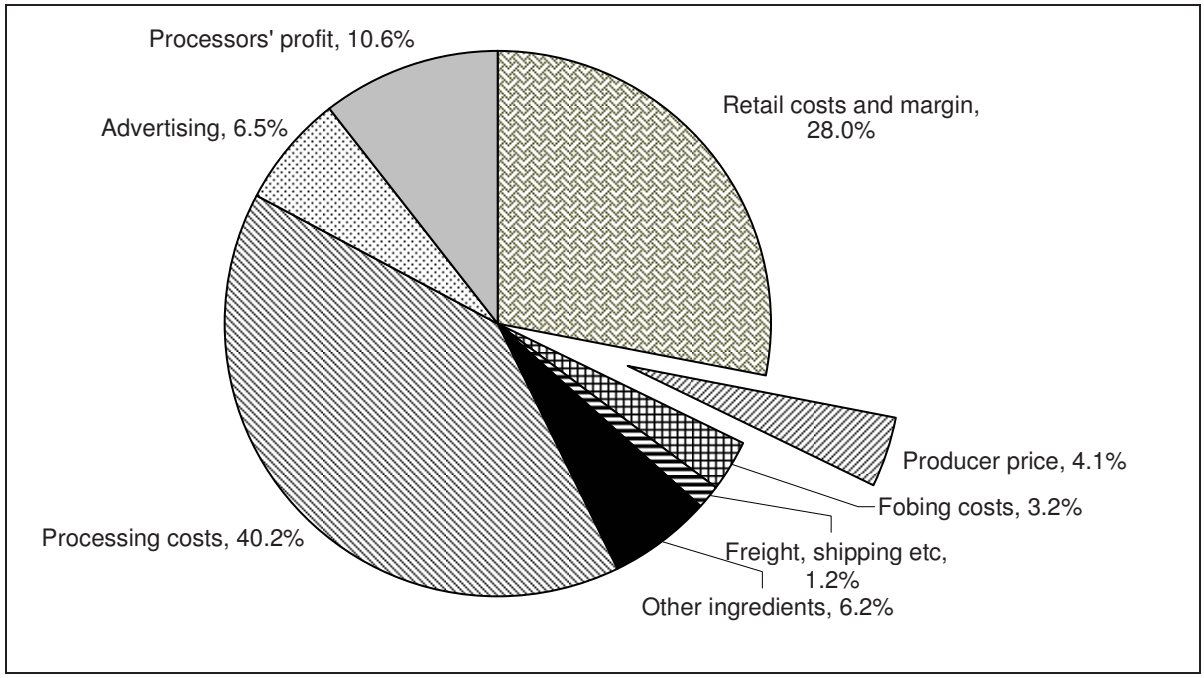


Figure 3 shows an indicative cost breakdown for U.K. milk chocolate in 2004.[122] Milk chocolate is made from milk and sugar in addition to cocoa. The cocoa producer is seen as obtaining only 4% of the final retail price. Total raw material costs (including transport etc.) are estimated as 14.7% of the retail price. Processing and retail costs are responsible for the largest share of the total (40.2% and 28.0% respectively). A more complete framework which can accommodate this degree of complexity is the following:

retail price of processed product = [commodity producer price (2)
+ internal transportation and other fobbing costs]/exchange rate
+ cif-fob margin and other export costs
+ costs of other raw material inputs
+ processing cost
+ processing margin
+ advertising cost
+ retail costs and margin
+sales or value added tax

GVC analysis tends to ascribe much of the variation of the producer value share ω to changes in the processing margin which reflect, in part, changes in processors' monopoly power. Identity (2) emphasizes that many other factors can contribute to changes in producer value shares. Trade

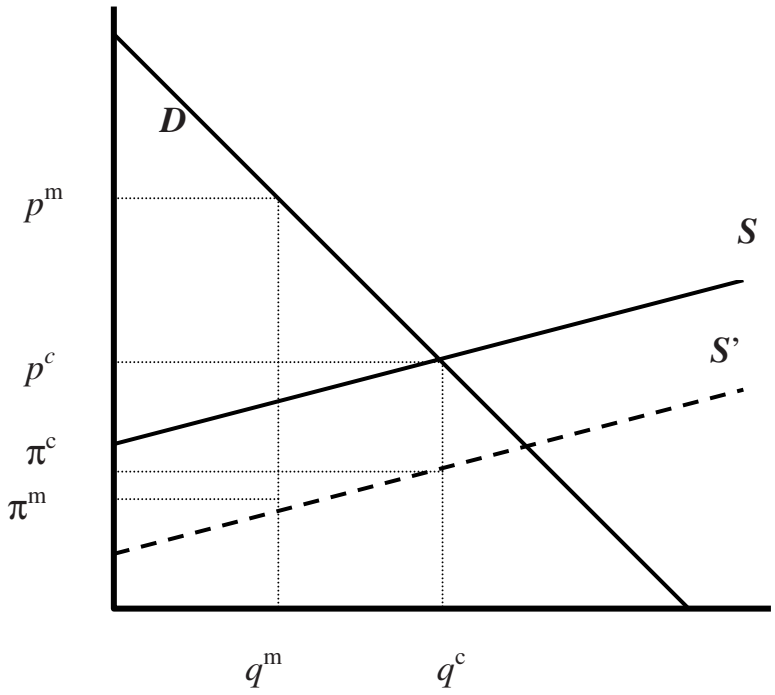
[122] Source: confidential (private communication).

liberalization can affect the cif-fob margin.123 In particular, market liberalization should lower processing and fobbing costs – see Akiyama (2001) and Varangis and Schreiber (2001) for the effects of coffee and cocoa market liberalization respectively.

AN ECONOMIC FRAMEWORK FOR GVC ANALYSIS

In order to discuss the economic determinants of changes in value shares, we need to embed the GVC concept in a simple economic framework. I use the most simple possible linear supply and demand framework.

Figure 4: The GVC Decomposition in a Simple Supply-Demand Model



In Figure 4, demand for the processed product, price p, is given by the demand function D. S' is the supply function of the commodity raw material, price π. There is a constant processing cost c which is common to all firms (and which includes the processing margin and retail costs and margin). There is no quantity loss in processing and, in this simple example, no other raw materials are used. This implies a competitive supply function S for the processed product which satisfies the equation $p = \pi + c$. Under competition, production is qc with commodity price πc and processed good price pc. As we have seen, however, commodity processing tends to be concentrated and processing firms have monopoly power. This will imply a lower level of production qm with commodity price πm and processed good price pm. Conditional upon this reduction, the product price rises from pc to pm while the commodity price falls from πc to πm. The extent to which the product price is high is governed by the slope of the demand curve D, while the extent to which the commodity price is depressed depends on the slop of the supply curve *S*'.

[123] Exchange rates pose a further issue. The first two terms on the right-hand side costs in identity (2) while the remaining terms and the left hand side are in the currency of the consuming country. If exchange rate changes are not fully and immediately reflected in both producer and retail prices, the producers' value share will exhibit some exchange rate dependency.

In what follows, I consider two value share measures: the producer's value share of the final retail price $\omega = \frac{\pi}{p}$ and $\sigma = \frac{\pi}{f}$, the producer's share of the fob price *f*. The two measures are related through the identity

$$\omega = \frac{\pi / f}{p / f}. = \frac{\sigma}{1+\mu} \qquad (3)$$

where μ is the processor's gross margin over the fob price.

The appendix sets out a formal model for the determination of these three ratios in both a competitive and a oligopoly-oligopsony market structure. Here, I illustrate the model by considering a simple example. I suppose the demand function

$$Q = 125 - \tfrac{1}{4} p \quad (4)$$

and the supply function

$$Q = 2\pi \qquad (5)$$

I take both pre- and post-fob costs to be 25 (i.e. $c = k = 25$) and, in the oligopolistic case, suppose that the number *n* of firms is 4. The processor's net margin $\nu = \mu - \frac{k}{f}$. Consumer surplus, the standard measure of consumer benefit from consumption of a good, is measured by the area under the demand curve:

$$CS = \frac{1}{2}\left(\frac{\alpha}{\beta} - p\right)Q \qquad (6)$$

Table 1 gives the outcomes. In this example, the supply elasticity is unity while the demand elasticity rises from 0.25 in the competitive case to 0.56 in the oligopolistic case. Since demand is less elastic than supply, the effects of the oligopolistic restriction of output is greater on the retail price than on the producer price, as illustrated in Figure 4. Oligopoly halves the producer share of the retail price from 50% to 22.2%, but most of this impact comes from the higher retail price – the producer share of the fob price declines marginally from 66.7% to 66.1%. The actual decline in the producer price, presumably what matters to the farmers, is 20%, from 50 to 40. The massive fall in the producer share of the retail price confuses the issue by exaggerating the possible price for which farmers might look, while their share of the fob price "flushes out the baby with the bath-water" since both numerator and denominator of the ratio are affected in the same way. In the end, it is always better to consider prices than shares.

Table 1 Results – Base Case

		Competition	Oligopoly
Quantity	Q	100	80
Retail price	p	100	180
Fob price	f	75	65
Producer price	π	50	40
Producer share of retail price	ω	50.0%	22.2%
Producer share of fob price	σ	66.7%	61.5%
Processor gross margin	μ	33.3%	176.9%
Processor net margin (profit)	ν	0.0%	138.5%
Consumer surplus	CS	20,000	12,800

We may use this framework to consider a number of scenarios. I consider the following:

- market liberalization, resulting in a fall in pre-fob costs c from 25 to 20;
- technological advance in processing, resulting in a fall in post-fob costs k from 25 to 20;
- an increase in labour costs in the consuming country unmatched by productivity advance, resulting in a rise in post-fob costs k from 25 to 30;
- an increase in concentration at the processing stage, modelled as a fall in the number n of firms from 4 to 3;
- increased advertising, modelled as a fall in the slope β of the demand curve from 0.25 to 0.20, together with a fall in the intercept α from 125 to 120.[124]

Table 2 Results – Variations

	Base Case	(a)	(b)	(c)	(d)	(e)
		Market Liberal-	Techno-logical	Increased Wages	Increased Concent-	Increased Advertising
Quantity Q	80.0	80.9	80.9	79.1	75.0	80.0
Retail price p	180.0	176.4	176.4	183.6	200.0	200.0
Fob price f	65.0	60.4	65.4	64.6	62.5	65.0
Producer price π	40.0	40.4	40.4	39.6	37.5	40.0
Producer retail share ω	22.2%	22.9%	22.9%	21.5%	18.8%	20.0%
Producer fob share σ	61.5%	66.9%	61.8%	61.3%	60.0%	61.5%
Processor gross margin μ	176.9%	191.9%	169.6%	184.3%	220.0%	207.7%
Processor net margin ν	138.5%	150.6%	139.0%	137.9%	180.0%	169.2%
Consumer surplus CS	12,800	13,086	13,086	12,517	11,250	16,000

[124] The fall in α ensures that prices and quantity in the competitive equilibrium is unaffected by the change in the slope β.

Results, taking the second column of Table 1 as the base case, are summarized in Table 2.

- Producers gain little from market liberalization. The 25% reduction in pre-fob costs from 25 to 20 only raises the producer price by 1%, from 40.0 to 40.4. The long term incidence of cost reductions in the commodity industries is on consumers (consumer surplus rises by 2.2%) and processors rather than producers – see Gilbert and Varangis (2004).[125]
- A reduction in processing costs has the same impact on prices and quantities as the same reduction in pre-fob costs. The only difference is in the fob price itself. Again, the incidence is primarily on consumers. The small rise in the producer share of the retail price is the same in both cases, but in the case of technological advance farmers see a sharp fall in his share of the fob price despite the fact that they are unambiguously better off as the result of the advance.
- An increased in labour costs in the consuming countries has the opposite impact of productivity advance in processing and distribution. The producer share of the retail price falls but there is little impact on the producer share of the fob price.
- Increased market concentration pushes up the retail price, in this instance by 11.1%, and also depresses the producer price, here by 6.7%. The producer share of the retail price falls by 3.4% but, because the cost wedge between the fob and producer prices remains fixed, the producer share of fob falls by 6.1%.[126]
- In the example chosen, the increase in advertising leaves output unchanged from the base case but allows the producer to charge a higher retail price. The unchanged output implies unchanged levels for the fob and producer prices. The producer share of the retail price therefore falls while its share of the fob price remains constant. There is a substantial rise in consumer surplus, essentially because advertising results in consumers putting a higher evaluation on intra-marginal units of consumption. Perhaps paradoxically, advertising is seen as benefiting consumers far more than it does producers.
- Overall, the value share measures tend to confuse rather than illuminate the changes in the situation of the producers. In particular, comparison of the producer price with the retail price can result in a fall in the value share despite an unchanged producer price (the case of increased advertising).

Sections 6 and 7 present evidence that the producer share of the retail price has fallen for both coffee and cocoa producers over the past three decades. In sections 8-10, I demonstrate that this is due almost entirely to a rise in the margin of retail coffee and chocolate prices over fob coffee and cocoa prices and that producer shares of fob prices have tended to rise rather than fall in both industries. I suggest that these findings may be explained by two factors:

- The principal explanation of the rise in the margin of retail prices over fob prices is the rise in labour costs in consuming countries unmatched by productivity increases – case (c) in Table 2.
- By itself, this latter factor would tend to decrease the producer share in the fob price – see Table 2. In many producing countries, that reduction has been offset by the effects of market liberalization and reduced export taxation.

The overall effect is to generate a rising producer share in fob prices coincident with a decline in the producer share of retail prices.

---

[125] Oxfam (2002, p.21) appears to assert that market liberalization may actually worsen the position of farmers: "However, the impact of ill-imposed liberalization on international prices often negates any short-term positive benefit to farmers." This statement is only correct if "negates" is translated as "partially offsets".

[126] Discussing the cocoa market, Oxfam (2002, p.5) states, "The fact that processing is controlled by powerful multinationals … means that corporations can use monopolistic buying practices to artificially inflate prices. This in turn reduces demand for cocoa … and exerts a downward pressure on producer prices."

THE PRODUCERS' VALUE SHARE IN COFFEE

There have been a number of applications of GVC analysis to the coffee market – see in particular Talbot (1997) and Daviron and Ponte (2005). Some of these analyses have been provoked by a feeling of crisis in the industry resulting from low market prices, first in the early nineteen nineties in the immediate aftermath of the ending of coffee controls, and more latterly over the period 1999-2002 when prices again became very low. With specific reference to this later period, Oxfam (2002b) asserted that coffee farmers were averaging 5% of the value of retail coffee. By contrast, Talbot estimates producers' share of final value to have been around 20% over the period in which the ICAs remained economically active.

The decline in the producer share in value added over the post-ICA period is taken as implying that the market process has been unfair. Daviron and Ponte (2005, p.123), for example, state that "the proportions of generated income were relatively fairly distributed between consuming and producing countries" under the ICA regime, but that, starting from the 1990s, farmers have been "squeezed" (*ibid*, p. 209) with the result that value has been "transferred from farmers to consuming-country operators" (*ibid*, p. 246). It is undeniable that the majority of smallholder coffee farmers have not obtained satisfactory returns over much of the past fifteen years, while the roasters have enjoyed much greater prosperity. The danger with discussions which adopt the cake division analogy can give a misleading impression that the prosperity of the processors is a cause of the difficulties experienced by the farmer. We saw in section 5 I that exercise of monopoly or monopsony power is only one of a number of factors which can result in changes in the producers' value share.

In what follows, I look at the producers' value shares for five major arabica producing countries (Brazil, Colombia, Guatemala, Kenya and Tanzania) and five major robusta producers (Brazil, Côte d'Ivoire. Indonesia, Uganda and Viet Nam). In each case, I compare the producer price in the producing country to the retail price of coffee in the United States. All prices are measured in U.S. dollars.[127] Table 3 gives the value shares for the Arabica producers and Table 4 for the robusta producers.

Table 3 Value Shares for Arabica Coffee Producers, 1980-2005

	Brazil	Colombia	Guatemala	Kenya	Tanzania	Average
1980-88	27.3%	27.4%	37.4%	43.6%	35.9%	34.3%
1989-2005	22.6%	23.4%	21.1%	27.0%*	16.5%	22.1%
1989-93	28.1%	22.6%	18.9%	18.4%	16.8%	20.9%
1994-98	21.6%	27.2%	24.3%	40.9%	22.3%	27.2%
1999-2003	17.6%	20.0%	18.4%	22.3%	12.7%	18.2%
2004-05	23.7%	24.3%	25.9%	24.9%**	10.6%	21.7%

The table gives the producer price for coffee beans as a share of the U.S. retail price of coffee. All prices are measured in U.S. dollars. The final column gives a simple average of the five country shares. Years are calendar years. Source: ICO
* Kenya: 1989-2004, ** Kenya: 2004

In each case, I compare the producers' value shares in the final decade of ICO controls (row 1) with the post-ICA period (row 2), but I also break down the post-ICA period into four sub-periods:

1989-93 This was the initial low price period during which the market was obliged to absorb stocks previously held back in producing countries as the result of ICA quota restrictions on exports.

[127] Source: International Coffee Organization.

1994-98	1994 saw prices surge as the result of frosts in Brazil. Prices remained above normal levels through the following three years.
1999-2003	These were the Coffee Crisis years. Low prices resulted from the emergence of Viet Nam as a major robusta exporter and from the substantial expansion of mechanized production in Brazil.
2004-05	These two years show recovery to normal prices in the context of a more general commodity price boom.

A number of features are apparent from Tables 3 and 4.

- In all periods, and for almost all countries, the producers' value share was higher for arabicas than for robustas. It seems likely that this reflects the higher costs incurred by arabica farmers and hence does not imply that they obtained a superior return.
- There is considerable variation across producers within each group. In arabicas, producers in Kenya and Tanzania have seen much greater share variability than have their counterparts in Latin America, particularly Brazil and Colombia. There is greater consistency in the pattern exhibited by the robusta producers. In common with the East African Arabica producers, Uganda has experienced the greatest share variability, but Côte d'Ivoire, Indonesia and Viet Nam have seen the greatest erosion of share.
- Although it is true on average that most arabica and robusta producers have lost value share in the post-control period, this is not uniformly true. In particular, Brazilian robusta producers are seen as having experienced a small value share gain[128] and the loss of share in Uganda is very small.
- Value shares did fall to very low levels for robusta producers over the Coffee Crisis years. There has subsequently been some recovery for a number of these producers, but the recovery has not been uniform.

Table 4 Value Shares for Robusta Coffee Producers, 1980-2005

	Brazil	Côte d'Ivoire	Indonesia	Uganda	Viet Nam	Average
1980-88	14.4%	17.5%	19.2%	16.5%	43.6%	23.8%
1989-2005	14.7%	10.3%*	11.9%	15.1%**	13.6%	13.2%
1989-93	12.3%	12.5%	10.4%	8.1%	14.5%	11.6%
1994-98	21.8%	12.1%	19.5%	24.5%	19.1%	19.4%
1999-2003	10.5%	7.2%*	7.0%	12.2%**	8.6%	9.1%
2004-05**	13.2%	6.5%	8.7%	-	10.1%	12.1%

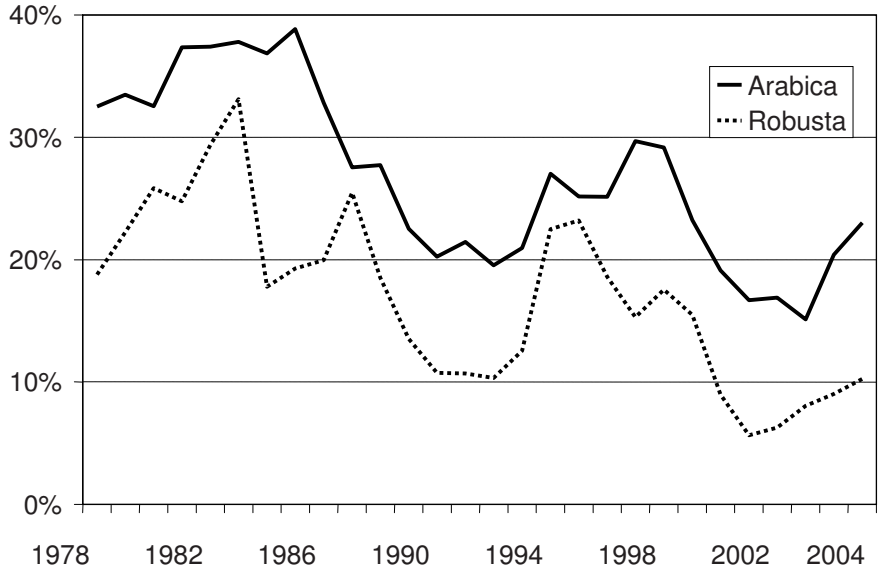
The table gives the producer price for coffee beans as a share of the U.S. retail price of coffee. All prices are measured in U.S. dollars. The final column gives a simple average of the five country shares. Years are calendar years. Source: ICO
* No figure is available for 2001 in Côte d'Ivoire.
** I have disregarded the figures reported by the ICO for Ugandan producer prices in 2003-05 as being implausibly high.

These diverse patterns underlines the argument advanced in section 4 that the accounting framework which underlies much GVC analysis over-simplifies the allocation of overall value. One should be cautious about drawing strong conclusions from changes in the value share of a single producer or even from an average. The most one can conclude simply from inspection of the information in Tables 2 and 3 is that there has been some general loss in producer value share in the post control period, that these value shares were indeed very low for robusta producers over the Coffee Crisis years, but that

[128] The bulk of Brazilian robusta is consumed domestically so a value share relative to U.S. retail prices is not very interesting.

there has been a general but non-uniform recovery over the most recent years. This is illustrated in Figure 5 which shows the average value shares across the five Arabica and robusta producers considered in Tables 2 and 3 respectively.[129]

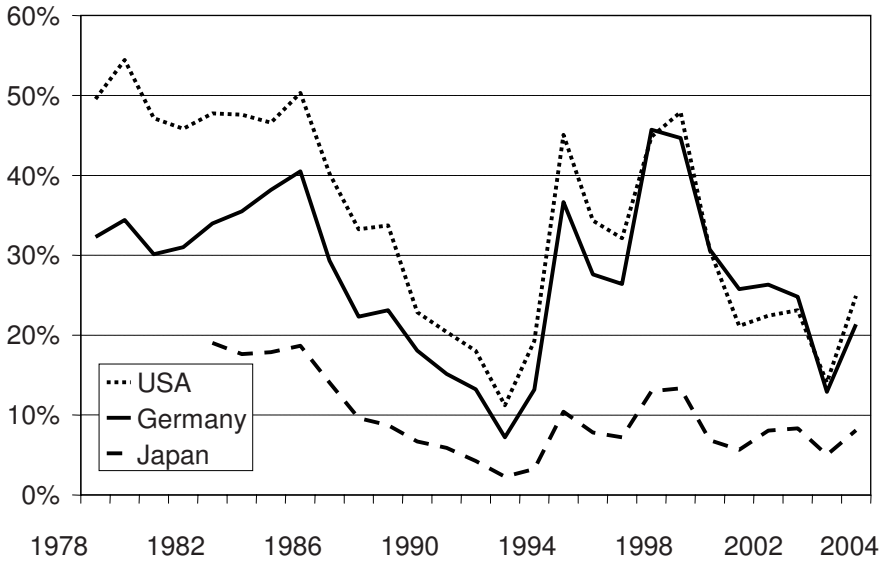
Figure 5: Average Arabica and Robusta Producer Value Shares, 1978-2005



The shares reported in Tables 3 and 4 and graphed in Figure 5 all compare the producer price received by the farmer with the U.S. retail price of coffee. Much of the coffee from central and south America is sold in the United States so that is a natural comparison. However, Kenyan coffee is primarily exported to northern Europe and Japan has become a major importer of Tanzanian coffee. Figure 6 charts the Kenyan producer share of retail prices in the United States, Germany and Japan. Through the nineteen eighties, Kenyan producers attained a consistently higher share of the US retail price than they did of the German price, but these shares have now converged and move closely together. By contrast, Japanese retail coffee prices are much higher and the producer share is therefore correspondingly lower. While it is possible that coffee processors have greater market power in Japan than in Europe or North America, but it is equally likely that these share differences reflect differences in the way coffee is retailed in Japan.

[129] The figures are simple averages.

Figure 6: Producer Value Share, Kenya, 1978-2004



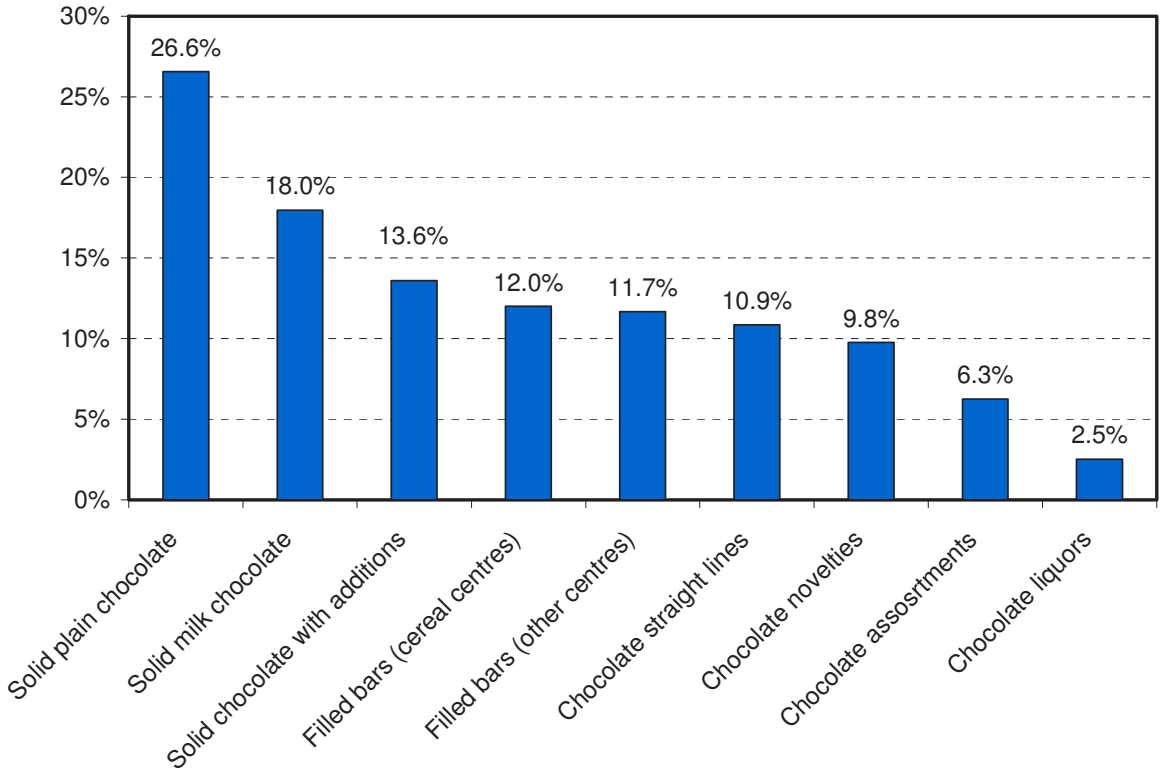
THE PRODUCERS' VALUE SHARE IN COCOA

A clear albeit brief recent discussion of the cocoa and chocolate value chain may be found in Oxfam (2002a). According to that report, "farmers receive at best about 5% of the retail value of chocolate" (*ibid*, p.23). The report also remarks that retailers have considerable market power in chocolate and that they obtain high margins. The most thorough discussion is that reported by ICCO (1990).[130] This study is highly detailed but it relates exclusively to the United Kingdom and covers the period 1975-88. It is beyond the scope of this paper to update the detail of these results or to extend them to other consuming countries. However, in what follows, I rely heavily on the ICCO calculations.

It is more difficult to calculate the producers value share for cocoa than coffee because chocolate is a more heterogeneous product than roast or soluble coffee. In particular, and unlike roast coffee, chocolate incorporates other raw material inputs, notably milk and sugar. The cocoa content of a particular chocolate item therefore depends on the "recipe", and there is substantial variation in these recipes across chocolate product varieties and consuming countries. We may infer U.K. chocolate recipes over the period 1975-88 from the figures in ICCO (1990).[131] Average cocoa contents over this fourteen year period are charted in Figure 7. Cocoa content varies from 26½% in solid plain chocolate to just 2½% in chocolate liquors. The weighted average across the nine product varieties is 11.3%. On average, cocoa accounted for 39.4% of the raw material input cost into chocolate products.

[130] Authored by Henri Jason.
[131] These figures relate to the chocolate sector and exclude confectionary which also uses some cocoa.

Figure 7: Cocoa Content of Different U.K. Chocolate Products, 1975-88



ICCO (1990) provides an estimate of the average retail price of chocolate products in the U.K. over the period 1975-84 based on detailed cost analyses of the nine product lines illustrated in Figure 7. I have updated these estimates to 2005 on a much more crude basis by using the "sweets and chocolates" component of the U.K. Retail Price Index.[132] The results of these calculations are shown in Figure 8 which charts the price of chocolate in the U.K. (£/lb) deflated by the U.K. producer price index, the ICCO Indicator Price converted into sterling and similarly deflated, and finally producer prices of cocoa in Côte d'Ivoire and Ghana on the same basis.[133] (The time pattern for other cocoa producers is similar). The figure shows the chocolate price rising from a 1984 low of £2.88/lb to a high in 2005 of £3.61/lb. Over the same period, cocoa producer prices have tended to fall in real terms from around 40p/lb in 1984 to around 20p/lb in 2005.

[132] Source: U.K. National Statistics StatBase. This series was no longer calculated after 2005. Note that the coverage of this index is broader than the chocolate index developed in ICCO (1990).

[133] I am grateful to the ICCO for access to their data on cocoa producer prices used in this figure and reported in Table 5. While it would be more natural to deflate the chocolate price by a consumer price index, this would be a less appropriate deflator for the producer prices.

Figure 8: Real Price of Chocolate in the U.K., and Real Sterling Cocoa Prices

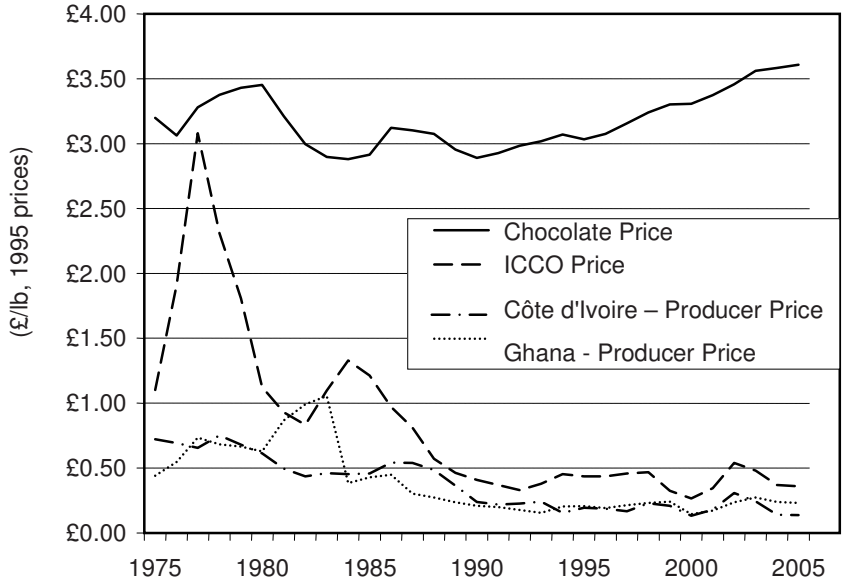


Table 5 gives 10 year averages of the ratio of sterling cocoa producer prices for eight major cocoa producers to the U.K. chocolate price over the period 1976-2005. The table confirms the visual impression of Figure 8 – a sharp drop in the share of cocoa producers in the chocolate price over the 1976-85 decade, followed by a much more modest fall from 1986-95 to 1996-2005. Lacking similar retail price data for other consuming countries over a comparable period, it is not possible to be absolutely confident that the trend illustrated in Figure 8 and Table 5 is general, but calculations for the United States (not reported here) from 1985 tell a similar story.

Table 5 Cocoa Producer Price as a Share of the U.K. Chocolate Price, 10 Year Averages

	1976-85	1986-95	1996-2005
Brazil	34.9%	11.9%	10.8%
Cameroon	17.5%	11.7%	7.1%
Côte d'Ivoire	17.9%	10.6%	5.7%
Dominican Republic	34.9%	9.9%	7.5%
Ecuador	34.7%	13.3%	9.1%
Ghana	22.3%	8.0%	6.4%
Indonesia	23.7%	11.2%	8.1%
Malaysia	28.9%	13.6%	10.3%
Nigeria	31.2%	18.8%	18.7%
Average	*27.3%*	*12.1%*	*9.3%*

Producer prices (source: ICCO) converted into Sterling at annual average £:$ exchange rate (source: IMF, International Financial Statistics) as a proportion of the UK chocolate price (£/ton) – see text for source and explanation.
Cameroon: no producer price for 2004-05.
Dominican Republic: no producer price for 2003 and 2005.
Ecuador: no producer price for 1976-77.
Indonesia: no producer price for 2003-05.
Malaysia: no producer price for 1976-80.

ECONOMETRIC FRAMEWORK

Sections 6 and 7 demonstrated a common negative tendency in the shares of coffee and cocoa farmers in retail coffee and chocolate prices over the past three decades. Arabica farmers have seen their value shares decline from around 35% in the late nineteen seventies to around 20% in the current decade while the decline for robusta farmers has been from around 25% to around 10% over the same period. On the basis of more limited data, the share of cocoa farmers in the chocolate price has declined from around 30% to 10% over the same period. The decline is fairly uniform across the different cocoa producers but there is greater variety in the coffee experience with some producers experiencing only a modest share decline.

The commonality in the decline in producer shares across the coffee and cocoa sectors indicates that a common explanation is required. This suggests that the explanation should probably be sought in the coffee and chocolate consuming countries rather that in the producing countries. To proceed in this direction, we follow the analysis developed in section 3 in considering producer shares of retail prices as having two components – the producer share of the terminal market price and the share of the terminal market price in retail prices.

Equation (3) expressed the producers' share ω in the retail price as the ratio of the producers' share σ in the terminal market price and the ratio of the retail price to the terminal market price: $\omega = \frac{\pi / f}{p / f}$.

This decomposition separates the forces at work in the retail market from those that determine the producer share of the world price. This separation will be valid if market forces act through terminal market price and are transmitted from these prices both upward to retail prices and downward to producer prices. What is ruled out is any direct link between producer prices and retail prices, as, for example, might exist if vertically integrated processing companies set retail prices directly on the basis of the prices they pay farmers and not on the terminal market value of these purchases, which measures their opportunity cost.

If this decomposition is not to be misleading, it is important that the numerator and dominator of the ratio $\omega = \frac{\pi / f}{p / f}$ be in some sense independent. Statistical independence is too strong a condition, and in fact the terms are highly correlated. A weaker requirement, which is nevertheless sufficient for our purposes, is that the two terms are causally independent in the sense that neither Granger-causes the other. Absence of Granger-causality allows us to discuss the evolution of the two ratios independently, as we shall in sections 9 (the producer share of the terminal market price) and 10 (terminal market prices as a ratio of retail prices).

Table 6 Granger Causality Tests

	Arabica Coffee	Robusta Coffee	Cocoa
$\frac{\pi}{f} \rightarrow \frac{p}{f}$	26.82 [0.0%]	0.273 [76.3%]	0.757 [48.0%]
$\frac{p}{f} \rightarrow \frac{\pi}{f}$	3.812 [3.7%]	2.086 [14.7%]	2.308 [12.1%]

Fob prices (*f*): arabica - ICO Other Milds; robusta – ICO Robusta Index; cocoa – ICCO Index.
Tail probabilities in parentheses.
A tail probability of less than 5% is required to reject at the 95% level.
Coffee: 1978-2005. Tests are $F_{2,23}$
Cocoa: 1977-2005. Tests are $F_{2,24}$

We need to reduce the dimensionality of the data to carry out these tests. I therefore construct average producer prices for each of arabica coffee, robusta coffee and cocoa and an average retail price for all processed coffee.[134] Table 6 reports the resulting set of six Granger-causality tests based on a VAR[135] of lag length 2. There is no evidence of any Granger-causal link in either direction for robusta coffee or cocoa, but there is strong evidence a link from arabica producer prices to the ICO Other Milds Index and weaker evidence for the reverse link. I conjecture that these dependencies arise out of the dominant position of Brazil in the arabica market.

These test outcomes suggest that there should be no problem in analyzing the producer and retail markets for robusta coffee and for cocoa separately, but caution that results may not be valid for arabica coffee where there may be a direct dependence of retail prices on producer prices.

PRODUCER SHARES IN TERMINAL MARKET PRICES

We first consider the denominator of the ratio of equation (3) and in particular the relationship between the ten coffee producer prices distinguished in section 6 and the relevant fob prices (i.e. either the ICO Other Milds Index or the ICO Robustas Index). Here, we need to consider the wedge between the two prices. These wedges will reflect a variety of factors:

- transport and other costs in getting the coffee to port and selling to an exporter (*c* in section 5),
- taxation,
- any quality premium or discount relative to the fob price.

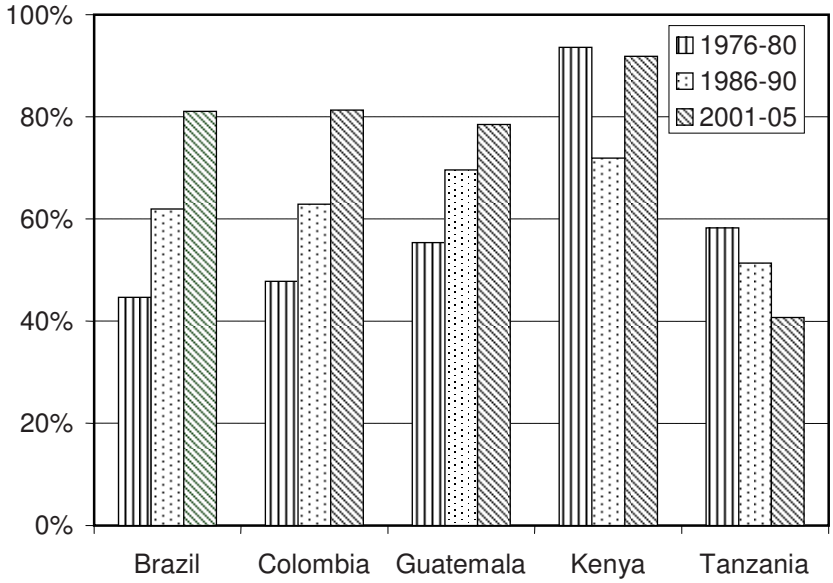
Market liberalization has exerted downward pressure on the first of these components – see Akiyama et al. (2001) for coffee and Varangis and Schreiber (2001) for cocoa. At the same time, the governments of many coffee exporting countries have reduced export taxation in response to low producer prices. However, some governments, which remain heavily dependent on commodity export taxation, have been unable to proceed in this direction. Quality differentials tend to be fairly consistent over time for cocoa and robustas but vary considerably for arabicas depending on the relative availability of different types of beans – see Gilbert and Tollens (2003) on West African cocoa differentials.

[134] Arabica weights: Brazil 56.7%, Colombia 29.6%, Guatemala 8.3%, Kenya 3.6%, Tanzania 1.8%. Robusta weights: Brazil 0.2%, Côte d'Ivoire 25.2%, Indonesia 39.7%, Uganda 15.5%, Vietnam 19.4%. Cocoa: Brazil 19.2%, Cameroon 6.8%, Côte d'Ivoire 32.7%, Ecuador 4.9%, Ghana 16.0%, Indonesia 4.4%, Malaysia 6.6%, Nigeria 9.4%. Weights are based on production shares over 1096-2005. I assume that Brazil and Tanzania 90% arabica and 10% robusta and that Uganda is 90% robusta and 10% arabica. The retail coffee price index is a simple average of the retail prices discussed in section 6. The retail chocolate price is the U.K. chocolate price – see section 7.

[135] Vector AutoRegression. The VAR regresses each ratio on two lags of itself and the other ratio. The Granger non-causality test is the standard Wald test for the exclusion of the latter two lagged variables. See Stock and Watson (2003, p.449) for a discussion of Granger causality tests.

For these reasons, it seems unlikely that there will be much consistency across countries in the behaviour of producer shares of the fob price. Figure 9 shows average producer share of the ICO Other Milds index for the five arabica producers over the most recent five year period (2001-05) by comparison with the five years 1986-90 at the end of the ICO control period and the five years 1976-80 which covered the coffee boom. Figure 10 shows the comparable share of the ICO Robustas index for the five robusta producers.

Figure 9: Arabica Producer Prices as a Share of the ICO Other Milds Index



There is considerable variation in both the levels of these ratios and the change over the 25 year period considered.

- The three Latin American coffee producers exhibit a steady increase in producer share.
- Tanzanian farmers obtain the lowest share of the fob arabica price. Furthermore, this share has tended to decrease over time while arabica producers in other countries have seen increased shares.
- There is no general tendency evident in the producer share for robusta farmers. Brazilian and Ugandan robusta producers have benefited from a high and rising share, while farmers in Côte d'Ivoire and Viet Nam have witnessed a decline in their shares of the world price, albeit from a high level in the case of Viet Nam.

Overall, however, it is clear that there has been no general downward tendency for the producer's share of terminal market prices. Rather, market liberalization, reduced taxation and quality improvements have tended to generate high producer shares. The evidence is insufficient to allow us to conclude that there has been no increase in monopsony or oligopsony power over the pat decades, but any such effects must have been sufficiently small to be offset by these other factors.

Figure 10: Robusta Producer Prices as a Share of the ICO Robustas Index[136]

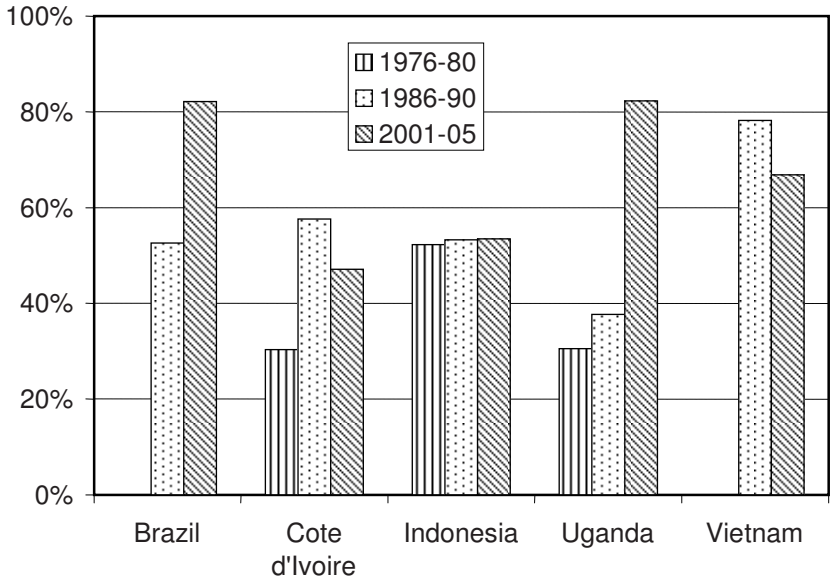


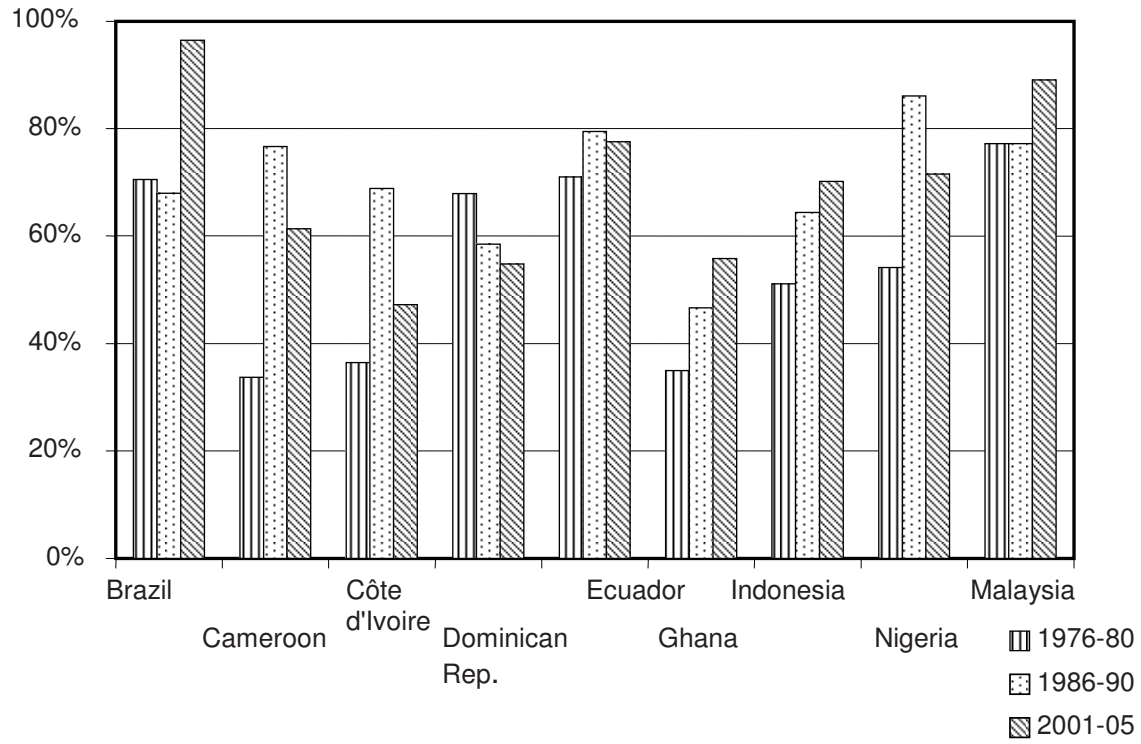
Figure 11 reports the same calculations for cocoa producers. The general tendency was for producer shares to rise over the nineteen eighties, from an average of 55% in 1976-80 to 69% in 1986-90. There was little overall change over the more recent decade with increased shares in Brazil, Ghana, Indonesia and Malaysia offset by falls elsewhere.

Notable in Figure 11 is the convergence of producer shares in the West African countries with those elsewhere in the world. West Africa is responsible for approximately 70% of world cocoa production. Côte d'Ivoire is the largest producer with 40% of world production followed by Ghana at 20%. Cameroon and Nigeria are also significant producers. Historically, West African cocoa was marketed through monopoly-monopsony market boards (Ghana and Nigeria) or sold through caisses de stabilisation (Cameroon and Côte d'Ivoire). These arrangements were absent in other cocoa exporting countries, of which the most important is Indonesia, responsible for approximately 10% of world production. The West African marketing systems have been comprehensively liberalized starting with the 1986 abolition of agricultural marketing boards in Nigeria.[137] As a consequence, the region operates under broadly the same structure as the remainder of the sector, although a slimmed-down marketing board continues to function in Ghana.

[136] Brazil 1987-90, Uganda 2001-02 and Vietnam 1988-90.

[137] The cocoa liberalization experience is discussed in Gilbert (1997), Varangis and Schreiber (2001) and Gilbert and Varangis (2004).

Figure 11: Cocoa Producer Prices as a Share of the U.K. Chocolate Price [138]



As in the case of coffee, there has been no tendency for the producer's share of terminal market prices to fall. Indeed, on the limited evidence available cocoa producer shares have rose consistently across almost all producing countries over the nineteen eighties, in part because of market liberalization. We can draw two conclusions:

- The decline in the producer share of retail coffee and chocolate prices, documented in sections 6 and 7, must therefore be despite and not because of lower producer shares in terminal market prices. Explanation for the declining share of retail prices must be sought in the retail market.
- By itself, the evidence marshalled in this sub-section is insufficient to demonstrate that roasters have not exercised monopsony or oligopsony power, but it does show that any increase in monopsony power, which would have reduced producer shares of terminal market prices, has been offset by other factors.

THE MARGIN OF RETAIL OVER TERMINAL MARKET PRICES

In analyzing the margin of retail prices over terminal market prices, I revert to the model set out in section 5. First consider retain coffee prices. The retail coffee price in each consuming country is modelled in terms of the terminal market prices for arabica and robust coffee and, as a measure of processing and distribution costs, the wage rate in the country in question. Unfortunately, information on advertising costs and country-specific measures of market concentration is lacking.

[138] Source: as Table 5. Certain averages are curtailed over a reduced number of observations – see Table 5 for details.

I adopt the simplest possible specification:

$$\ln p_{it} = \alpha_i + \beta_i \left[\delta_i \ln f_t^a + (1-\delta_i) \ln f_t^r \right] + (1-\beta_i) \ln w_{it} + \gamma_i trend_t + u_{it} \qquad (6)$$

where p_{it} is the year t retail price of coffee in country i, converted into U.S. dollars, w_{it} is the year t wage rate or average earnings index for country i, converted into U.S. dollars,[139] f_t^a and f_t^r are respectively the ICO indices of arabica ("Other Milds") and robusta prices for year t, $trend_t$ is a time trend incrementing at one per year and u_{it} is an error term. The equation expresses retail coffee prices in each country as a (geometric) weighted average of the world prices of arabica and robusta beans and the local wage rate. The coefficient β_i $(0 \le \beta_i \le 1)$ measures the share of coffee in total production costs in country i while δ_i $(0 \le \delta_i \le 1)$ measures the share of arabica in country i's total coffee costs.[140] Finally, the coefficient γ_i measures the annual rate at which the retail margin in country i is either increasing or decreasing. Increased monopoly or oligopoly power on the part of the roasters will imply a positive value for γ_i while productivity advances in retailing and distribution will yield a negative value.

The first eight rows of Table 7 report the coefficient estimates.[141] The estimated share of coffee in total retail coffee costs is around 45% in much of continental Europe but only around 30% in Germany, the U.K. and the U.S.A. These coefficients are fairly precisely determined, except in the case of Italy where the fit is poor. Arabica predominates over robusta with the arabica share around 70%. The estimates, which are only imprecisely determined, are lower for Germany and the U.K., and higher for France, Italy and the U.S.A. The estimated time trends are uniformly negative, although these coefficients are small and statistically insignificant for the U.K. and the U.S.A. The Netherlands is close to being the representative coffee-consuming country with all coefficients except γ corresponding to the sample median.

Overall, the estimates give little support to the view that increased monopoly power has pushed up retail coffee prices. Instead, retail margins appear to have fallen over time, particularly in France and Germany, suggesting productivity advances have outweighed any tendency towards increased monopoly power.

The estimates in Table 7 imply that, in the base year of 2000, coffee itself accounted for only around 40% of the retail price of coffee, the remaining costs being associated with processing and distribution.[142] These costs have tended to rise over time even in real terms with the result that real retail coffee prices have only fallen modestly despite steep the fall in fob coffee prices. The result is that processors' gross margins, which include consuming country costs, have risen, while the producers' share of the retail price has fallen.

---

[139] Source: IMF, International Financial Statistics.

[140] It is preferable to use the ICO Other Milds and Robusta prices rather than the ICO Indicator Price because this allows separation of the arabica and robusta weights. The Indicator Price averages these two prices with the ICO price indices for Brazilian naturals and Colombian milds. While the Other Milds and Robusta prices derive from terminal market prices, the Brazilian naturals and Colombian milds derive from trade quotations which may be less representative of world conditions.

[141] Estimation is by Nonlinear Least Squares (NLS). It is possible to reparameterize the equation in such a way as to allow estimation by Ordinary Least Squares. The advantage of direct NLS estimation is that the standard errors and equation statistics relate directly to the equation as formulated in (6). The estimates of δ for France and Italy are constrained at unity. The sample is 1976-2005 except for the U.K. and U.S.A. where the fit was poor over the observations for 1976-1984 which were omitted from the sample. The U.K. equation also includes a dummy variable for 1993-94 which may account for an exchange rate-related effect. The equation residuals exhibit some serial correlation which may have the effect that the reported standard errors being too low. In section 8, I noted that, in the case of arabica coffee, it is not necessarily possible to analyze the producer and retail markets separately – see Table 6. I suggested specifically that retail coffee prices might depend on arabica producer prices directly and not via the ICO Other Milds price. The final column of Table 7 reports Lagrange Multiplier t tests for omission of the average producer price variable discussed in section 8. The null hypothesis of no misspecification is rejected for Italy and the U.S.A. with a marginal failure to reject for France. The results for the four remaining countries appear secure.

[142] Coffee prices were low in 2000. Use of a different year as base would give a higher coffee share.

Table 7 Retail Coffee and Chocolate Price Equations

	Coffee Weight β	Arabica Share δ	Trend (p.a.) γ	R^2	Specification *t*
France	45.9% (9.7%)	100% (restricted)	- 3.2% (0.9%)	86.4%	2.03 [5.3%]
Germany	30.5% (8.4%)	57.8% (58.7%)	- 2.9% (0.9%)	85.5%	0.88 [38.8%]
Italy	46.0% (11.6%)	100% (restricted)	- 0.6% (1.2%)	53.3%	3.73 [0.1%]
Netherlands	38.1% (7.2%)	71.6% (40.2%)	- 0.3% (0.6%)	79.8%	0.59 [56.3%]
Sweden	46.2% (6.7%)	69.4% (32.7%)	- 1.8% (0.7%)	80.9%	0.73 [47.1%]
U.K.	27.2% (3.3%)	45.9% (30.3%)	- 0.3% (0.3%)	75.0%	1.37 [11.2%]
U.S.A.	34.2% (5.6%)	96.7% (34.7%)	- 0.5% (0.5%)	73.7%	2.46 [2.5%]
Average	38.3%	77.3%	-1.4%	76.4%	
Median	38.1%	71.6%	-0.6%	79.8%	
	Cocoa Weight β	**Exponent λ**	**Trend (p.a.) γ**	**R^2**	
U.K. Chocolate	23.1% (2.0%)	- 3.6% (0.8%)	- 0.5% (0.2%)	87.2%	0.17 [86.7%]

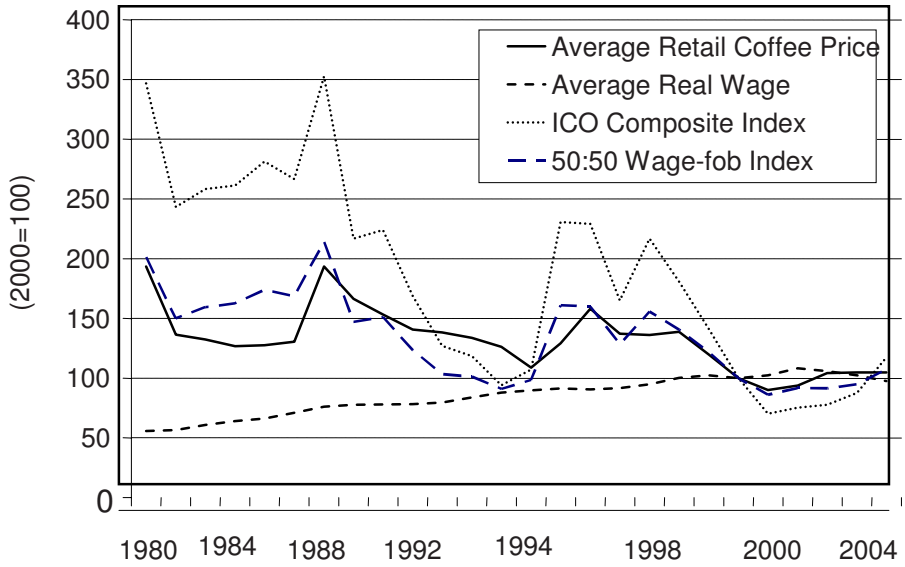
Coffee: equation (6). Cocoa: equation (7). Estimation by Nonlinear Least Squares, standard errors in "()" parentheses. Sample: 1976-2005 except U.K. coffee and U.S.A. (1985-2005).

The final column reports the Lagrange Multiplier omitted variable test, distributed as a Student t, for omission of the average producer price variables discussed in section 8. The tail probability in "[]" parentheses must be less than 5% for rejection of the null of no misspecification at the 95% level.

Equations also include an intercept. The U.K. coffee equation includes a dummy variable which takes the value unity in 1993 and 1994.

This is illustrated in Figure 12 which shows the deflated retail coffee price averaged across the seven countries we have analyzed, the real wage averaged across the same seven countries and the deflated ICO Indicator Price. (All indices are set to 100 in 2000). The figure also shows a price index formed by averaging the ICO Indicator Price and the real wage index. This tracks the average retail coffee price remarkably well.[143]

Figure 12: Average Consuming Country Retail Coffee Prices and Wages



The results from estimating a similar relationship to equation (6) for the U.K. chocolate price are less clear-cut. As discussed in sections, cocoa is only one of the ingredients used in the manufacture of chocolate. Milk and sugar are also important, and may contribute more to overall chocolate costs. Despite this, no clear statistical relationship between U.K. chocolate prices and the prices of milk and sugar is evident. I therefore elected to relate the chocolate price simply to the cocoa price and the U.K. wages index. However, to obtain a reasonable fit, it was necessary to modify the equation in two further respects:

- The terminal market cocoa price enters with a one year lag reflecting the practice in some major U.K. chocolate firms of hedging their cocoa purchase a year ahead.[144]
- There is clear evidence that the weight of the cocoa price in determining chocolate prices has declined over time. We modify equation (6) to reflect this.

The modified equation thus becomes

$$\ln p_t = \alpha + \beta e^{\lambda.trend_t} \ln f_t + \left(1 - \beta e^{\lambda.trend_t}\right) \ln w_t + \gamma.trend_t + u_t \qquad (7)$$

Estimated coefficients are given in the final row of Table 7. Cocoa is seen as accounting for only 23% of chocolate costs at the start of the sample (1976), but this weight is seen as declining at 3½% per annum with the result that the estimated weight of cocoa in overall U.K. chocolate prices is now only 7%. Equation fit is comparable to that for the coffee equations.

Cocoa is seen as accounting for only a small and declining proportion of retail chocolate prices. The largest component of chocolate production costs are incurred in the consuming countries themselves

[143] $r^2 = 0.63$. Note that this is not the outcome of any statistical fitting exercise.

[144] We use the ICCO Indicator price. Ideally, we should use the lagged one year futures price in place of the lagged ICCO index, but the two will be highly correlated. The equation also includes a dummy variable for 1978, the year following the 1977 high cocoa prices when futures were below spot prices.

and appear to be related to labour costs. The decline in terminal market cocoa prices is therefore only reflected to a limited extent in retail chocolate prices. In the U.K., the continued growth in real wages (measured relative to the PPI) has resulted in stability of the real chocolate price despite lower cocoa prices. The consequence is a rise in the margin of chocolate prices over terminal market prices and a decline in the producer share of the chocolate price even though producers have obtained an enhanced share of cocoa terminal market prices.

CONCLUSIONS

Because value chain analysis is only a framework for analysis, it does not, by itself, have substantive implications. The issue is whether it is useful, not whether it is correct. Gereffi *et al.* (1994) assert that GVC analysis "… allows us to pose questions about contemporary development issues that are not easily handled by previous paradigms …" (*ibid*, p.2). The value chain is seen as a geographically distributed network and the GVC "approach explains the distribution of wealth within a chain as an outcome of the relative intensity of competition within different modes" (ibid, p.4). I have argued that if GVC analysis is to be employed for this purpose, it must be augmented by the standard tools of industrial organization which are routinely used in the analysis of competition.

Proponents of GVC analysis tend to imply that their approach substitutes conventional microeconomic models. This cannot be the case since GVC analysis does not have substantive content. Instead, GVC analysis can complement conventional tools by providing a potentially richer context in which these tools can be employed.

Applications in the primary commodity industries have tended to use value chain analysis to suggest that processors have exerted monopoly-monopsony power with the result that producers' shares of the retail price have been squeezed. This impression is given credence by the high levels of processor concentration in some of these industries. The analysis of the coffee and cocoa industries in this paper has failed to provide any evidence supportive of this view. Rather, the decline in producer value shares is seen to reflect an evolution of the cost structures in the processing industries. The conjunction of lower raw material (coffee and cocoa bean) prices with a continuing rise in the real labour and other costs incurred in the consuming countries has resulted in real retail prices declining only modestly (coffee) or remaining broadly stable (chocolate). Despite the high levels of concentration in both cocoa conversion and coffee roasting, there is no evidence that this shift in cost structures has anything to do with relative intensities of competition. This is a conclusion which is absolutely compatible with the GVC framework – a question has been posed any answered negatively – but it does contradict the expectations of the GVC proponents.

The explanation for the decline in the producer share of the retail coffee price is simpler – only around one half of the cost of roast coffee is attributable to the coffee beans themselves. The other half is the result of processing, transportation and marketing costs incurred in the consuming countries and these costs have tended to increase or remain broadly constant. The fall in the world price of coffee had no effect on these consumer country costs. Retail coffee prices reflect all production costs, not just those incurred in producing countries.

Cocoa accounts for an even smaller proportion of retail chocolate prices since chocolate products incorporate other raw materials. Evidence for the U.K. suggests a cocoa value share which has declined from around one quarter to less than 10% over the past three decades. The effect of declining cocoa prices have been offset by real increases in some of these other costs keeping real chocolate prices broadly stable. Even though many cocoa farmers have benefited from an increased share of fob prices, the decline in cocoa costs as a proportion of retail chocolate prices has implied a decline in the producer share of retail chocolate prices.

Some commentators suggest that market liberalization in the cocoa and coffee producing countries, often seen as imposed and/or poorly executed, has contributed to the decline in producer shares of retail prices. This is not the case. The general tendency has been for producers to obtain an increased share of the fob price has offset the tendency for fob prices to decline as a proportion of retail prices.

Absent market liberalization, producers (particularly West African cocoa producers) would have seen an even larger decline in their share of retail prices.

Do declining value shares matter? Farmers are interested in prices, not value shares. If producer prices had risen in real terms, it would be irrelevant to them if retail prices had risen faster. The coincidence of falling real producer prices and stable or near stable product prices generates an impression of inequity even if, as is broadly the case in the coffee and cocoa industries, changes in the producer share of fob and the retail margin over fob are independent.

The likely long term course of cocoa and coffee prices depends on labour market conditions and productivity in the producing countries. Sadly, many of the countries in which tropical commodities are produced have seen only slow growth over recent decades with the result that few alternative occupations are available to farmers. If these countries can generate more rapid development in the future, it will be necessary either to offer higher producer prices or for farmers to increase productivity levels. Farmers will benefit either by earning more for the same levels of production or by producing more for the same price. In that circumstance, it will be irrelevant to them whether retail coffee and chocolate prices have risen by more or by less than their earnings.

APPENDIX: A VALUE CHAIN MODEL

This section sets out the model used in section 5 of the paper. Consider the market for a homogenous final product, price *p*, produced from a homogeneous raw material input price π. Aggregate demand *Q* for the final product is

$$Q = \alpha - \beta p \qquad \text{(A1)}$$

Assuming 100 percent conversion ratio, aggregate supply of the raw material is

$$Q = \gamma + \varphi\pi \qquad \text{(A2)}$$

I assume uniform processing costs of *c* to the fob price and *k* from the fob price to the price of the processed good. Under competition, the price p^c of the final product is

$$p^c = \frac{\alpha - \gamma}{\beta + \varphi} + \frac{\varphi}{\beta + \varphi}(c + k) \qquad \text{(A3)}$$

Similarly, the commodity price π^c under competition is

$$\pi^c = \frac{\alpha - \gamma}{\beta + \varphi} - \frac{\beta}{\beta + \varphi}(c + k) \qquad \text{(A4)}$$

Aggregate output is

$$Q^c = \frac{\alpha\varphi + \beta\gamma - \beta\varphi(c + k)}{\beta + \varphi} \qquad \text{(A5)}$$

The producers' value share ω^c of the final price π of the processed good is

$$\omega^c = \frac{\alpha - \gamma - \beta(c + k)}{\alpha - \gamma + \varphi(c + k)} \qquad \text{(A6)}$$

The fob price *f* is given by

$$f^c = \pi^c + c = \frac{\alpha - \gamma + \varphi c - \beta k}{\beta + \varphi} \qquad \text{(A7)}$$

and hence the producer's share σ of the fob price is

$$\sigma^c = \frac{\alpha - \gamma - \beta(c + k)}{\alpha - \gamma + \varphi c - \beta k} \qquad \text{(A8)}$$

Similarly, the gross producer margin μ over the fob price is

$$\mu^c = \frac{p^c - f^c}{f^c} = \frac{k}{f^c} = \frac{(\beta + \varphi)k}{\alpha - \gamma + \varphi c - \beta k} \qquad \text{(A9)}$$

Turning to the case on monopsony-monopoly, I suppose *n* identical incumbent firms, where *n* is a small fixed number. Entry is prohibitively expensive. Consider the profit Π_1 of firm 1 which chooses output level q_1:

$$\Pi_1 = (p - \pi - c - k)q_1 = \left(\frac{\alpha - Q}{\beta} - \frac{Q - \gamma}{\varphi} - (c + k)\right)q_1$$

Write $Q = q_1 + \sum_{j=2}^{n} Q_j = q_1 + Q_{-1}$. Then

$$\Pi_1 = \left[\left(\frac{\alpha}{\beta} + \frac{\gamma}{\varphi} - (c+k) \right) - \left(\frac{1}{\beta} + \frac{1}{\varphi} \right) (q_1 + Q_{-1}) \right] q_1$$

If the firms engage in Cournot competition, the first order condition for profit maximization gives

$$q_1 = \frac{\frac{\alpha}{\beta} + \frac{\gamma}{\varphi} - (c+k)}{2\left(\frac{1}{\beta} + \frac{1}{\varphi} \right)} - \frac{1}{2} Q_{-1} \quad \text{(A10)}$$

Since the firms are identical, the equilibrium must be symmetric with $Q_{-1} = (n-1) q_1$. Hence

$$q_1 = \frac{\frac{\alpha}{\beta} + \frac{\gamma}{\varphi} - (c+k)}{(n+1)\left(\frac{1}{\beta} + \frac{1}{\varphi} \right)}$$

$$\text{and} \qquad Q^m = \frac{\lambda \left[\alpha\varphi + \beta\gamma - \beta\varphi(c+k) \right]}{\beta + \varphi} = \lambda Q^c \quad \text{(A11)}$$

where $\lambda = \frac{n}{n+1}$. The price of the final product is

$$p^m = \frac{\alpha - Q^m}{\beta} = \frac{\alpha(\beta+\varphi) - \lambda \left[\alpha\varphi + \beta\gamma - \beta\varphi(c+k) \right]}{\beta(\beta+\varphi)} \quad \text{(A12)}$$

while the raw material price is

$$\pi^m = \frac{Q^m - \gamma}{\varphi} = \frac{\lambda \left[\alpha\varphi + \beta\gamma - \beta\varphi(c+k) \right] - \gamma(\beta+\varphi)}{\varphi(\beta+\varphi)}. \quad \text{(A13)}$$

The ratio of the raw material price π^m given by equation (A13) to the product price p^m given by equation (A12) corresponds to identity (1) and yields the producer share ω^m of total value. One obtains

$$\omega^m = \frac{\pi^m}{p^m} = \frac{(\lambda\alpha - \gamma) - (1-\lambda)\frac{\beta\gamma}{\varphi} - \lambda\beta(c+k)}{(\alpha - \lambda\gamma) + (1-\lambda)\frac{\alpha\varphi}{\beta} + \lambda\varphi(c+k)} \quad \text{(A14)}$$

The fob price f may be derived in the same way as in the competitive case:

$$f^c = \pi^c + c = \frac{\lambda \left[\alpha\varphi + \beta\gamma - \beta\varphi k \right] + \varphi \left[\varphi + (1-\lambda)\beta \right] c - \gamma(\beta+\varphi)}{\varphi(\beta+\varphi)} \quad \text{(A15)}$$

The producer's share σ of the fob price f follows as

$$\sigma^m = \frac{\lambda\left[\alpha\varphi+\beta\gamma-\beta\varphi\left(c+k\right)\right]-\gamma\left(\beta+\varphi\right)}{\lambda\left[\alpha\varphi+\beta\gamma-\beta\varphi k\right]+\varphi\left[\varphi+\left(1-\lambda\right)\beta\right]c-\gamma\left(\beta+\varphi\right)} \qquad \text{(A16)}$$

while the monopolistic margin is given by

$$1+\mu^m = \frac{\alpha\left(\beta+\varphi\right)-\lambda\left[\alpha\varphi+\beta\gamma-\beta\varphi\left(c+k\right)\right]}{\lambda\beta\left[\alpha\varphi+\beta\gamma-\beta\varphi k\right]+\left[\varphi+\left(1-\lambda\right)\beta\right]c-\gamma\beta\left(\beta+\varphi\right)} \qquad \text{(A17)}$$

REFERENCES

Akiyama, T. 2001, Coffee market liberalization since 1990. *In* Akiyama, T., Baffes, J., Larson, D. and Varangis, P. eds., *Commodity Market Reforms: Lessons of Two Decades*, Washington D.C., World Bank.

Daviron, B. & Ponte, S. 2005, *The Coffee Paradox. London*, Zed Books.

Feenstra, R.C. & Hanson, G.H. 1996, Globalization, outsourcing and wage inequality. *In American Economic Review*, Papers and Proceedings, 86, 240-51.

Feenstra, R.C. & Hanson, G.H. 1999, The impact of outsourcing and high-technology capital on wages: estimates for the United States, 1979-1990. *In Quarterly Journal of Economics*, 114, 907-40.

Gereffi, G., Korzeniewicz, M. & Korzeniewicz, R.P. 1994, Introduction: global commodity chains. *In* Gereffi, G. and Korzeniewicz**,** M. eds., *Commodity Chains and Global Capitalism*. Westport, Greenwood Press.

Gilbert, C.L. 1996, International commodity agreements: an obituary notice. *In. World Development*, 24, 1-19.

Gilbert, C.L. 1998, *Cocoa market liberalization: Its effects on quality, futures trading and prices*. Cocoa Association of London.

Gilbert, C.L. 2004, International commodity agreements as internationally sanctioned cartels. *In* Grossman, P.Z. ed., *How Cartels Endure and How They Fail*. Cheltenham, Edward Elgar.

Gilbert, C.L. 2005, The long run impact of the ending of coffee control. Paper prepared for the Second World Coffee Conference, Salvador (Bahia), Brazil, 23 – 25 September 2005.(Also available at http://dev.ico.org/event_pdfs/wcc2/presentations/gilbert%20text.pdf)

Gilbert, C.L. & **Tollens, E.** 2003, Does market liberalisation jeopardise export quality? Cameroonian cocoa, 1988–2000, *In. Journal of African Economies*, 12, 303-42

Gilbert, C.L. & Varangis, P. 2004, Globalization and international commodity trade with specific reference to the West African cocoa producers, ch. 4 of Baldwin, R.E. and. Winters, L.A eds., *Challenges to Globalization*. Chicago, University of Chicago Press (for the National Bureau of Economic Research).

Hopkins, T.K. & Wallerstein, I. 1977, Patterns of development of the modern world-system, *In Review*, 1, 11-145.

Hopkins, T.K. & Wallerstein, I. 1986, Commodity chains in the world economy prior to 1800. *In Review*, 10, 157-79.

Hopkins, T.K. & Wallerstein, I. 1994, Commodity chains: construct and research. *In* Gereffi, G. & Korzeniewicz, M. eds., *Commodity Chains and Global Capitalism*, Westport, Greenwood Press.

International Cocoa Organization (ICCO). 1990, Recent evolution of the share of the cocoa cost component in the retail price of chocolate in the United Kingdom, Note by the ICCO Secretariat for the Seventh Meeting of the Advisory Group on the World Cocoa Economy, Accra, Ghana, 18-22 June 1990.

Korzeniewicz, M. & Martin, W. 1994, The global distribution of commodity chains. *In* Gereffi, G. and Korzeniewicz, M. eds., *Commodity Chains and Global Capitalism*, Westport, Greenwood Press.

Oxfam. 2002a, The Cocoa Market – A Background Study. (Also available at http://www.maketradefair.com/en/assets/english/CocoaStudy.pdf)

Oxfam. 2002b, Mugged – Poverty in Your Cup, Oxford, Oxfam. (also available at http://www.maketradefair.com/assets/english/mugged.pdf)

Stock, J.H. & Watson, M.W. 2003, *Introduction to Econometrics.* Boston, Addison-Wesley.

Talbot, J.M. 1997, Where does your coffee dollar go? The division of income and surplus along the coffee value chain. Studies in Comparative International Development, 32, 56-91.

van Dijk, J.B., van Doesberg, D.HG.M., Heijbroek, A.M.A., Wazir, M.R.I.A. & de Wolff, G.S.M. 1998. *The World Coffee Market*. Utrecht, Rabo Bank International.

Varangis, P., & Schreiber, G. 2001, Cocoa market reforms in West Africa. *In* Akiyama, T., Baffes, J., Larson, D. and Varangis, P. eds., *Commodity Market Reforms: Lessons of Two Decades*, Washington D.C., World Bank.

Governance, coordination and distribution along commodity value chains

Rome, 4–5 April 2006

The changing patterns of value chains in agriculture affect equity between producers and buyers and equity among producers themselves, alter the allocation of resources in agriculture and have implications for domestic as well as international policy. This set of workshop proceedings is published to assist in the understanding and analysis of the implications of these developments, particularly the development of market power among the participants in these markets.

ISBN 978-92-5-105748-3 ISSN 1816-5303

9 789251 057483

TC/M/A1171E/1/6.07/850