A General Equilibrium Analysis of Ownership, Property Rights and Control in a Transition Economy

by

Pasquale Lucio Scandizzo

A GENERAL EQUILIBRIUM ANALYSIS OF OWNERSHIP, PROPERTY RIGHTS AND CONTROL IN A TRANSITION ECONOMY

INDEX

A GENERAL EQUILIBRIUM ANALYSIS OF OWNERSHIP, PROPERTY RIGHTS AND CONTROL IN A TRANSITION ECONOMY

by

Pasquale Lucio Scandizzo*

1. Introduction

1.1 Modelling transition

A transition economy is characterised by the fact that neither the contracts nor the property rights are perfectly defined. In general, operators are less informed than their counterparts in market economies, but, at the same time, the institutions available to reduce transaction costs are fewer and less efficient. Households and firms are forced to devote a greater share of their resources to find information in non transparent markets and to avoid opportunistic behaviour by contractual partners.

The degree of efficiency in resource use, and the absolute level of employment, however, are subject to a gradual increase, if transition is successful, reducing operational uncertainty, by a more complete specification of individual property rights, through a process of *appropriation.* Such a process consists in widening the range of possible resource uses, both in terms of technological potential and the number of economic agents. We can consider appropriation as a process that specifies more finely individual property rights under a wider range of options, and producing, in so doing, relevant external economies that have pervasive influence on the general disposition of transactions in the entire economic system. Transition can be thus largely seen as a critical phase of the appropriation process, one in which internalising the externalities within the operators activities shifts the attention to the variation of the agents' cost functions, taking into consideration both costs and benefits of the reference system of laws.

General equilibrium analysis of transition should thus concern not only the change in technology, input use or in the patterns of taxation and transfers, but also the re-definition of property rights and the re-distribution of wealth. This process, in turn, is linked to the establishment of a new system of laws and of constitutional arrangements in the various stages before the achievement of a real market economy. In this paper I develop an analysis along these lines by building a series of general (dis-)equilibrium models, where both property rights and the rules of the game may be changed to reflect transition progress. These rules include: (i) rationing (Scandizzo, 1998, Dréeze, 1985), (ii) Stackelberg equilibria with sector or institutional leadership, (iii) Nash equilibria under non co-operative conditions. Appropriation, ownership and default are treated as part of a standard social-accounting matrix, by endogenizing the shares of factor incomes

* *University of Rome "Tor Vergata".* *Thanks are due to David Sedik and Kostas Stamoulis for helpful comments on an earlier draft.*

appropriated by the different institutions (households of various types, firms, government) and/or by endogenizing some transfers.

The models can be used to address some of the questions on agricultural transition which have proven more difficult to analyse within the traditional CGE framework. For example, the removal of implicit food subsidies and the ensuing squeeze on consumers and on small producers (Brooks et al. 1991) may be partly counterbalanced by the gradual removal of rationing. Because privatisation of former state farms often requires several stages of appropriation and capital build up, in fact, the markets of many agricultural goods may undergo a prolonged period of disequilibrium.

More generally, an explicit treatment of asset appropriation provides a way to handle characteristics such as the re-distribution of incentives, economic power and control. These characteristics are automatically embodied in decentralised form through demand and supply functions (or through utility and profit functions) in the CGE models, but this treatment is grossly inadequate for transition economies. The main problem in these economies, in fact, is precisely the way in which decision-making is becoming decentralised through the appropriation of the different assets, the re-definition of values and market power associated to the assets (including labour and human capital) previously held, and the determination of prices according to disequilibrium or non-conventional equilibrium rules.

The process of appropriation is also associated with a re-distribution of benefits and costs that entails winners and losers as well as compensations to stabilise the environment and avoid an excess of conflicts and external costs. Price determination thus concerns not only goods and services produced within the production period, but also assets accumulated in the past whose value is not fully captured by the prices of the services produced. The models may simulate this additional process of value determination, by exploring game-theory pay-off concepts such as compensatory payments, fair prices, default values and risk premia. The ensuing decision-making structure and simulation mechanisms may be used also for the case of developing countries who experience institutional changes regarding property rights (e.g. privatisation), market regimes (e.g. liberalisation), or the system of rights and regulations associated with contracts (e.g. de-regulation , governance reforms etc.)

As an empirical application, I extend the general equilibrium model built for Slovakia (Scandizzo 1998), to include appropriation processes, with special attention to agriculture and to the process of privatisation of former state farms. This requires the development of a contractual form of general equilibrium analysis, where a solution is sought that does not only compute sector and factor levels, but also “entitlements” levels for operators and institutions. This type of a model is well established in the theoretical literature (see, for example, Commons (1968), Schlager and Ostrom (1992), Williamson (1994)), but it has never been incorporated in a computable, general equilibrium structure.

The research moves from the estimates already obtained for the SAMs constructed for Slovakia. These SAMs include a “perspective” matrix which tries to quantify some of the expected trends in input-output coefficients and factor and institutions’ shares after transition. The SAMs are further imbedded in a general equilibrium model, which computes allocation and distribution levels under different degrees of rationing. The shift from the command to the market economy is assumed to occur mainly through an increasing weight to the private sector, a corresponding, declining role of the public sector, an overall evolution of technological coefficients, and an increasing efficiency of factor markets. Within this approach, transition is further modelled by linking income distribution and market performance. This is accomplished by two means: (i) by attributing different objective functions to the institutions involved (households, firms, government, foreign sector) and, (2) by computing Nash equilibria and other non-cooperative solutions. One class of solutions is given by Stackelberg games, whereby one institution acts as a leader and the other as followers. In

this case the endogeneity of appropriation shares is accomplished by computing appropriate reaction functions.

Given this modelling structure, I have attempted several simulations to analyse some of the most neglected aspects of transition, such as the role of privatisation in determining incentives and response patterns, the importance of residual rights, the emergence of new stakeholders and the related efficiency and equity issues. For example, it is possible to simulate the effects of accelerated privatisation versus a more gradual transfer of property rights, through systems of concessions, government franchising and regulations. Alternative mechanisms of empowerment of different social groups can be examined by simulating an evolving environment where price formation and demand and supply levels depend, *inter alia*, of the relative concentration of wealth and associated market power. The importance of transaction costs can also be investigated by simulating their impact on the internalisation of externalities, imperfect contracts and prices.

1.2 The main results

The main results of the modelling exercise conducted may be summarised under the three headings of *static, dynamic* and *institutional* distortions. For the *static* distortions, violations of marginal cost rules appears to generate prices uniformly higher than the "free market" solution, as they reflect the squeeze on consumers that producers are allowed to exercise, directly and indirectly, through monopoly power, rent extraction or monopolistic competition. User costs for capital are also higher, while labour becomes largely under-employed. Capital formation increases sharply, at the expense of consumption, real incomes and welfare (measured as consumer surplus).

On the other hand, the effects of consumption and production constraints are diverse. The consumption bounded equilibria all show lower nominal incomes. Setting lower bounds for food consumption and combining food consumption and agricultural production lower bounds, on the other hand, which may be interpreted as the upholding of social standards on the demand and the supply side (Scandizzo and Knudsen, 1996), results in a marked reduction on prices. When these lower bounds are combined with upper bounds for the consumption of other goods, however, the price index increases considerably (more than 20% with respect to the base solution and more than 40% with respect to the solution where only food consumption and agriculture are constrained.). It thus appears, as the welfare indexes seem to demonstrate, that food demand and supply objectives may be pursued with some beneficial effects on the economy. On the contrary, the constraints on other sectors appear only to be able to void some of the beneficial effects of food and agricultural policies, and worsen the general conditions of the economy to a non sustainable point. A transition economy, such as the case we are examining, however, may find difficult to separate some of these constraints because they are deeply embedded in the characteristics of the markets and in the high degree of vertical integration of the manufacturing sectors.

The results of the experiments where inefficiencies are allowed (in the food as well as in other sectors) underline the key role played by food production and consumption in the economy. As a consequence of low price elasticities and strong backward and forward linkages, in fact, food prices rise in all experiments involving violations of the marginal cost rule, more than any other price. When consumption and production lower bounds are imposed, on the contrary, food prices fall absolutely, but their relative level remains unchallenged in the experiments involving only food and agricultural constraints. When the consumption of other sectors is constrained from above, however, as with rationing and vertical integration constraints, relative food and agricultural prices fall sharply.

Under *dynamic* distortions, income distribution, prices, consumption, production, value added and welfare do not appear to vary smoothly with factor increases, but change abruptly, sometimes with quite wide swings. In fact, for certain variables, such as factor income and production, the appearance of the simulated time pattern is one of a cycle due to exogenous shocks, in spite of the underlying deterministic structure of the model.

Why does then a deterministic model display these pseudo-stochastic fluctuations? The answer appears to lie in the wide adjustments that even a small variation in factor endowment may entail to reach efficiency. Even though the increase in capital and labour from one year to the next may be small, in fact, the range of relative factor intensity among sectors is sufficiently wide that factor employment and remuneration may vary significantly to exploit the opportunities made possible by the change. The discontinuity of the production possibility set in this case plays a critical role, as for small changes in factor endowment, the base solution may switch and imply discrete and wide changes in the choice of production and consumption levels. For example, the increase in labour endowment may not be exploited immediately, since it is more convenient to expand the capital- intensive sectors.

The role played by the different sectors and by agriculture also appears to be diverse. First of all, taking food as a numeraire, relative prices remain broadly stable, as it has to be expected from proportional growth. Fluctuations from one "year" to the other appear to be small for crops (given the choice of the numeraire), but relatively large for livestock , forestry and both marketable and non marketable services. For several years the simulations show , in fact, that the failure to employ all labour results in a generalised fall in prices with the exception of food and agriculture. These two sectors thus appear to play a "fundamental" role to help stabilising or smoothing the adjustment pattern over time.

When exogenous growth acts upon an economic structure characterised by all the "transition" constraints identified, a rather steady pattern of production growth appears to emerge with a few small fluctuations, and with uninterrupted full employment of labour and unemployment of capital. At the same time, however, there appears to be hardly any growth. The increase in the availability of labour and capital, in fact, seems to be entirely absorbed by a decrease in the value of aggregate rents measured by the objective function. In terms of real consumption, in particular, growth appears to be negative, for most of the simulation period.. Household consumption, in particular, remains stagnant throughout all the experiments considered and the level of welfare increases very little over the whole set of experiments.

These "dynamic" results suggest that the transition constraints considered may be equivalent to a straight-jacket, in the sense that they stabilise the economy, at the cost of depriving it of some critical elements of flexibility. The costs of transition, in other words, may reside in the need to eliminate the constraints that allow part of the economy to extract rents and to stifle growth. Positive shocks such as exogenous increases in factor endowment (for example from foreign investment) may only result in increases in aggregate rents and will not spur growth unless flexibility in factor allocation is restored.

Finally, the *institutional distortions* (the limited property rights experiments) appear to indicate that one of the reasons why transition may not be successfully spurred by liberalisation or privatisation policies may be due to the "stickiness" of the pattern of resource ownership that was characteristic of the centrally planned regimes. If factors of production remain *de facto* owned by the public sector, either because they are materially held in its possession, or because they are controlled by it, the result may be an over-extension of government that may be particularly unfavourable for all the private parts of the economy. Furthermore, this particular variety of "government failure" may be specially difficult to fight with the usual instruments of economic

policy. These are directed, in fact, to remove market distortions and improve overall efficiency of the markets, while the non desirable characteristics of government over-extension, may be only distributive in nature, and may have very indirect, albeit far reaching bearing on Pareto efficiency.

2. The Stackelberg structure of a computable general equilibrium model

2.1 A Mathematical Programming Formulation

As Norton and Scandizzo (1981) showed, a computable general equilibrium (CGE) can be naturally stated as a multi-level programming model, with an intrinsic Stackelberg structure. More specifically, if we focus on a private ownership economy (Debreu, 1959), and assume for simplicity that production set is of the input-output type, we can write the following CGE formulation:

$$(1.1) \quad \text{Max } W = \sum_{h,s} \theta_{hs} \left[P'(I - A) Q_s - r' b_s \right]$$

subject to:

$$(1.2) \quad \sum_h X_h - \sum_s (I - A) Q_s \leq 0 \qquad \text{Commodity balance}$$

$$(1.3) \quad X_h - f_h(P, y_h) \geq 0 \qquad \text{Demand functions}$$

$$(1.4) \quad D \sum_s Q_s - \sum_s b_s \leq 0 \qquad \text{Resource constraint}$$

$$(1.5) \quad y_h - r \omega_h \sum_s b_s - \sum_s \theta_{hs} \left[P'(I - A) Q_s - r' b_s \right] \leq 0 \qquad \text{Income distribution}$$

$$(1.6) \quad (I - A')P - D'r \leq 0 \qquad \text{Efficiency condition (no rent)}$$

where:

Q_s = J x 1 vector of production levels for the s-th producer.

(s = 1, 2…S)

X_h = J x 1 vector of demand levels for the h-th consumer.

(h = 1, 2….H)

ω_h = K x 1 vector of factor shares owned by the h-th consumer, $\sum_h \omega_h = 1$.

θ_{hs} = share of the s-th producer owned by the h-th consumer, $\sum_h \theta_{hs} = 1$ for s = 1, 2…S.

P = J x 1 vector of price levels for the J goods.

r = K x 1 vector of price levels for the K factors.

A = J x J matrix of input - output coefficients for intermediate goods.

D = K x J matrix of input - output coefficients for factors.

$f_h(P, y_h) = J\,x\,1$ vector of demand functions for the h-th.

b_s = consumer vector of resource availability for the s-th producer.

In Appendix A we'll show that the formulation in (1.1) – (1.6) yields a CGE solution.

2.2 A Stackelberg formulation

The model presented in (1) has an intrinsic Stackelberg structure with the "invisible hand" maximising aggregate profits W, under the economy-wide constraint given by the "reaction functions" of consumers and producers, as a result of their own constrained maximisation.

More specifically, the model can be written as follows:

$$(2.1) \qquad \text{Max } W = \sum_h w_h$$

subject to:

$$(2.2) \qquad w_h - \sum_h \theta_{hs} \left[P'(I - A) \sum_s Q_s - r' \sum_s b_s \right] = 0$$

$$(2.3) \qquad X_h = \text{argmax} \left[U^{(h)}(X_h);\ P'X_h \le w_h + r'\omega_h \sum_s b_s \right]$$

$$(2.4) \qquad Q_s = \text{argmax} \left[P'(I - A)Q_s;\ \ DQ_s \le \sum_s b_s \right]$$

According to this formulation, general equilibrium can be seen as a process, whereby an authority representing market forces seek to determine commodity and factor price levels, in order to maximise aggregate profit, under the two constraints formed by the solution to the consumer and producer maximisation problems, respectively captured in the "reaction" functions on the demand side in (2.3) and in the supply side in (2.4).

More specifically the Stackelberg game in (2.1)- (2.4) would consist of two separate moves: first, the market authority would choose both good and factor prices, anticipating the reaction of consumers (2.3) and producers (2.4). Second, consumers and producers would choose, respectively, consumption and production levels, given the prices fixed by the authority. These last two decisions are independent of one–another, since we assume that consumers are unable to anticipate the

reaction function of the producers and are thus unable to anticipate the value of their own incomes, for the part that depend on realised profits. The two reaction functions (2.3) and (2.4) thus produce a subgame with a Nash-Cournot equilibrium for each choice of P and R by the market authority.

The game is illustrated with reference to the usual combination of transformation and social indifference curves in Figure 1.

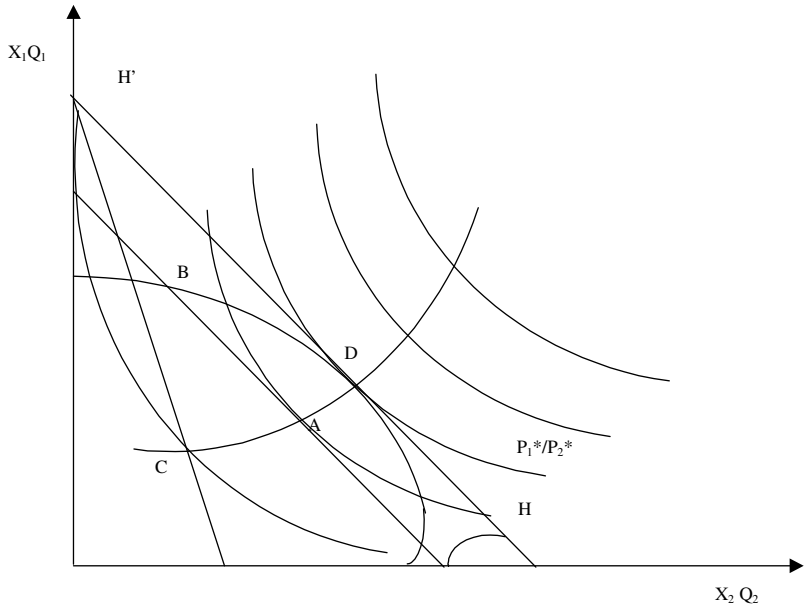


Figure 1

For each choice of the price line, consumers would be able to choose a single combination of the two good X_1 and X_2, such as, for example, point A. The level of the budget line, however, would depend on producers' choice regarding production levels Q_1 and Q_2, such as, for example, point B even though this information is only available to consumers ex post (i.e. after the market authority and producers have made their decision). The consumers reaction function is thus the curve uniting the different choices that would be made under alternative price (the slope of the budget line) and income levels (the intercept of the same line).

Similarly, producers can choose a point on the transformation curve only after they know what prices are. Point D, which is the market equilibrium, is chosen only after the market authority has chosen the price ratio P_2^*/P_1^*. Once this choice is made, producers choose the production point D and consumers discover that their budget line is HH' and that the point D coincides with their own optimum.

The same process can be seen more clearly in the partial equilibrium setting of Figure 2.

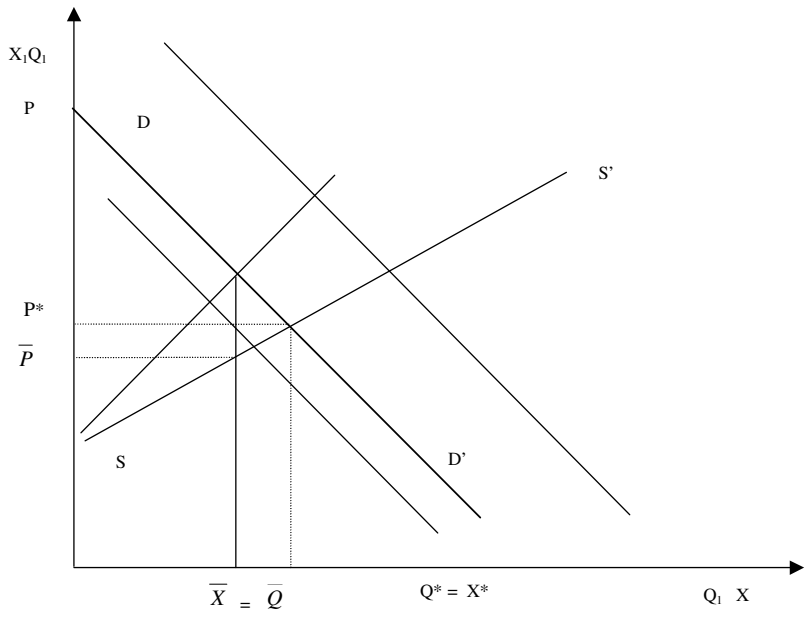


Figure 2

Here, we can imagine that the market fixed the price, taking into account the demand (the line DD') and supply (SS') functions.

The level of the demand function, however, depends on consumer income and this, in turn, depends both on the price and quantity choices respectively by the market authority and by the producers. If consumers don't know the supply function, they will wait to see what is the price fixed by the authority[1] and the quantity chosen by the producers.

Once these choices are made, they learn that their demand function is DD' and choose the equilibrium consumption X*. Even if consumers could move before the producers and were able to anticipate their reaction, however, they could not implement a monopsonistic strategy, because by assumption the authority has the power to fix the price level P* and, at that price, X* is still the optimum consumption level. If the consumers were the leaders however, they would choose the quantity, $\overline{X}$, the authority would be forced to choose the price level $\overline{P}$ and the producers the quantity $\overline{Q}$.

The model in (2.1) – (2.4) can thus be changed into a series of Stackelberg games with various degree of monopsony or monopoly according to the assumptions made on the sequence of moves and on the information available to each player.

[1] Since we are in a partial equilibrium setting, the objective function of the market authority would be the same of producers' and consumers' surplus.

2.3. Ownership and property rights

The model presented brings forth ownership and property rights under several aspects. First, as a private ownership economy, both the objective function and the consumers' budget constraints incorporate the assumption that a major component of property rights is constituted by the distribution of "residual" rights to the firms economic results. This means that if producers' profits were non-zero, they would be distributed according to pre-assigned shares. As we know, in a competitive equilibrium solution, a la Debreu, profits turn out to be zero. Moreover, even though owing shares may give controlling rights to the shareholders, share are assumed to be fixed and non - transferable.

Second, the consumers' budget constraints contain a second element of property rights, depending on the ownership of the means of production: labour and capital in their various specific and non specific forms. Because consumers include also the government, a key characteristic of transition economies is the extent to which government still controls, directly or indirectly the factors of production, even in the presence of what can be considered a market economy.

Third, the formulation of the model objective function in (2.1) implies that prices are chosen to maximise net social surplus, i.e. the difference between value added and factor income. This would in effect occur if shareholders had full controlling rights, under the hypothesis of no externalities and no government interference. Both these hypothesis, however, can be removed by assuming that the social pay-off depends on prices different of market prices, i.e. that consumers and producers are expected to respond to appropriately specified functions of the prices selected by the market authority, rather than to the prices themselves. The shares in the objective function can also be modified to reflect the fact that controlling rights do not necessarily coincide with property rights. They may thus differ from the shares acknowledged in the budget constraint, which reflect more directly the payment of dividends related to property rather than control.

Fourth, producers may not maximise profits, as a consequence of the fact that shareholders do not control the firms and/or may not be able to discipline the managers to convince them to cure their interests. If the government is prepared to pay subsidies or bankruptcy laws are imperfect or hard to enforce, this will imply that price may be less than unit costs and / or that some productive capacity is left unused.

Finally, both consumers and producers may be prevented from rationally pursuing their objectives by rationing. This may be the consequence of government interference, as well of imperfect property rights.

How do property rights affect transition? Most of the features identified above characterise the passage from centrally planned economies, where property rights are vested onto the government, and market economies, where property rights are distributed across a broad spectrum of consumers, including the government.

As the discussion on the various aspects of the model has shown, however, property rights are not limited to factors of production. They concern the right to control the economy though various means, including active ownership of the enterprises, and unencumbered exercise of management of the firm and of consumers affairs, respectively by the firm managers and by the consumers themselves.

At the root of property rights thus lies the question of control. Whether the means of production appear or not to be in the hands of the households, in fact, the real question concerns the power of deciding factor allocation vested out their hands. Even in market economies, the distribution of this power is unequal and does not follow the clear path outlined in the model,

where, regardless of the share owned by each group of institutions, the "invisible hand" always ends up maximising total net social surplus.

The key assumption that allows this to happen appears to be the distributional property of the shares: $\sum_h \theta_{hs} = 1$. This property insures that, whatever the distribution of power within a firm, ultimately all interests are taken into account. In other words, the control of the firm is humanimously exercised by the shareholders, who always decide "what is best" for the firm as a whole.

In reality, we know that this is not the case: shareholders control the firm by using majority rule and, when the capital of the firm is widely distributed, even a minority of shares may allow the exercise of effective control. A simple way to reflect this condition in the model is to assume that $\sum_h \theta_{hs} \neq 1$ in the objective function for same s. In other words, only a fraction of the shares owned by households and institutions exercise *de facto* controlling rights. These shares do not necessarily correspond to property rights that are formally owned, as in the case of common stock. Rather, they are the consequence of the fact that controlling rights do not coincide with formal property rights, either because of voting rules, or because of the exercise of outside power by the government, other institutions or pressure groups.

If $\sum_h \theta_{hs} \neq 1$ in the objective function, social surplus (i.e. the objective function) may not be zero at the optimum. As a consequence, consumers income will not be limited to factor income, but it will be increased (or decreased) of the amount of social surplus distributed. This consequence, however, poser a further problem. The amount distributed, in fact, may follow the lines of property rights, and thus accrue to consumers according to their *ex ante* shares of production. Alternatively, it may be appropriated in a greater proportion by those consumers who exercise a larger share of control, though the shares of appropriation need not to be the same as the shares of control entering the objective function. Finally, appropriation shares and control shares may be completely different. For example, the government may control everything, including the distributional shares. These, however, will reflect only indirectly government control and will be non zero for all consumers.

Can the control of distributional shares be endogenous? If control reflects voting rights and consumers are partitioned into groups with different "ideologies" or political positions, the model may be used to reflect majority rule or other types of voting rules. In this case, the objective function will include the shares of the groups forming the majority and their attempt to set a price system reflecting their interests. The solution, however, will not be a competitive equilibrium. The objective function, in fact, will be non zero at the optimum and its value will reflect a surplus, which will be appropriated by the leading groups. For the same reason, the no–rents condition in (1.6) will no longer hold.

More specifically, the Stackelberg game would consist of the following two separate moves: first, the leading coalition would set commodity and factor prices according to equation (3.1), and once these prices are known, consumers and producers would set quantities according with (3.2) and (3.3):

$$(3.1)\quad Q_{s'}P, r = \operatorname{argmax}\left[\sum_{\ell'} w_{\ell} r;\ w_{\ell} r = \sum_{s'} \theta_{ls'}\left(P'(I-A)Q_{s'} - r' b_{s'}\right) DQ_{s'} \le b_{s'},\ D\sum_s Q_s \le \sum_s b_s\right];$$

$$l = 1, 2 \ldots L \le H \qquad\qquad s' = 1, 2 \ldots T \le S$$

$$(3.2)\quad X_h = \operatorname{argmax}\left[U^{(h)}(X_h);\quad P'X_h \le w_h + r'\omega_h \sum_s b_s,\ w_h = \sum_{h,s} \theta_{hs}\left(P'(I-A)Q - r' b_s\right)\right]$$

$$(3.3)\quad Q_{s\neq s'}, b_{s\neq s'} = \text{argmax}\left[P'(I - A)Q_s - r'b_s \,;\, DQ_s - b_s \leq 0\right]$$

According to (3.1), certain owners (l = 1, 2…L) for certain businesses (s'= 1,2….T) are allowed to behave as Stackelberg leaders. By virtue of their control rights, in fact, they may set prices and quantities taking into account the responses of consumers (3.2) and other producers (3.3).

An alternative way of proceeding is to examine the market distortions that may arise as a consequence of the non coincidence of control rights with property rights (Appendix A).

In general, even though we may rationalise the distortions from a competitive equilibrium in different ways according to their genesis, the market forces, differences between property and control, government interference and other concurring factors, the main forms that the distortions take are a few. In fact, one can say that there are only two basic distortions: (i) artificial constraints on consumption and production and, (ii) differences between prices and marginal costs. These two forms correspond to the constraints that it is possible to impose on the model variables and, because of the self-dual nature of the problem, constitute a sort of internal isomorphism of the model. More precisely, we can prove the following ***theorem****:*

Proposition 1 *. If the sum of the weights in the objective function of the problem in (2.1) – (2.4) is not unity, i.e. if the objective function accounts for the surplus shares of a subset of consumers, at the ensuing equilibrium value added is not all distributed in form of factor income. As a consequence, the following conditions hold: (i) expenditure falls short of the values of resources available, (ii) some resources are unemployed, (iii) prices are greater than marginal costs* (the proof is in Appendix A).

Proposition 2. *Any discrepancy between control and property rights corresponds to a coordinated set of positive wedges between: (i) income and expenditure, (ii) resource availability and resource use, and (iii) prices and marginal costs* (the proof is in Appendix A).

Proposition 3. *Limited control rights will always cause the net social surplus to be positive. As a consequence, (i) all consumers will gain a non-negative share of undistributed profits, (ii) all consumers will share the costs caused by the ensuing fall in efficiency, but (iii), only for the controlling coalition will the benefits be greater than the costs* (the proof is in Appendix A).

3. A Computable General Equilibrium Model for the Slovak Economy

3.1.The Slovak Social Accounting Matrix

The 1991 and 1993 Slovak social accounts, estimated by a group of researchers of INFOSTAT (Bozik, 1997), are reported in tables B.1 and B.2 of Appendix B. The flows estimated in the social accounting matrix (SAM) show the interdependence among 12 sectors and 8 institutions. The sectoral disaggregation emphasises the situation of agriculture, which is subdivided into three subsectors: agriculture, livestock and forests. Food, beverage and tobacco, the fourth sector of the i-o table embedded in the SAM, is also related to agriculture, while the other sectors are: manufacturing and services.

The SAM coefficient variations between the two years (Table 1) document the fact that the Slovak economy is crossing the transition stage and rapidly advancing toward the standards of a full market economy. In agriculture, the main changes concern the weight of fuel and chemical products, whose i-o coefficient jumps from 14 per cent to more than 27 per cent of total value of production, and other manufacturing products (an index of vertical integration), whose weight falls from 19 per cent to 6.5 per cent. As a component of value added, the share claimed by operating surplus also increases drastically, from 3.8 to 15 per cent, while the labour share decreases from 19 to 14 per cent. The burden of government intervention also disappears, while the weight of imports increases as documented by the jump in the Rest of the World coefficient from 7 to more than 9 per cent.

According to these data, agriculture is becoming more capital intensive, less vertically integrated, freer of government interference and more open to imported inputs. A similar story, although with less impressive features, can be told for livestock and forestry. For livestock, however, a sharper decrease in the degree of vertical integration is documented by the fall of the coefficients for agriculture and livestock, and the rise in those for food products, fuel and chemicals, machinery and imports. For forestry, the main change appears in the fall of the weight of "other manufacturing products" (from 11 to 2.5 per cent) and of "other market services" (from 7.4 to 4.1 per cent).

Food and beverages present a different story, because, like all other manufactures except machinery and construction, value added increases, as both domestic and imported intermediates fall as percentages of total value of production. In all cases, however, there is a considerable increase in the value added share of capital. Construction work and services, on the other hand, appear to follow an opposite trend, characterised by a fall in value added and in the capital share, except for non market services, for which it is the labour share to suffer in the change.

The institutional accounts, on their part, display changes more directly associated with the re-shuffling of property rights and the agent interdependencies. The government account shows a decrease in the budget deficit, and a sharp fall in transfers to enterprises. Farm household accounts deteriorate, with an increase in negative savings and an increase in consumption, while non farm households appear to improve their performance, both in terms of savings and key consumption goods (housing, transport and market services). Capital formation shows few changes except for a major increase in the weight of machinery and equipment, which has apparently undergone a considerable process of substitution. Slightly changed for the worse appears the situation of the Rest of the World account, but a few significant increases in net export weights can be noted (market services, transport and construction works).

In conclusion, the SAM estimates suggest that the Slovak economy is becoming more industrialised, more value added intensive, more open to the rest of the world. The government weight, however, is increasing, even though it is now following the more familiar pattern of the increase in public administration and income transfers, while the nexus to the enterprise sector is progressively falling.

But what about the future? In order to assess the possible changes beyond the transition period, I combined coefficient forecasts for the agricultural sector provided by Bozik (1997) with the 1993 Slovak SAM and the I/O data of the Italian 1988 matrix. Italian coefficients can be considered "best practice" targets for industry and services, and, as the regressions in Scandizzo (1998) show, the 1984 coefficients explain, with some adjustment due to difference in accounts, about 70% of the 1993 Slovak SAM.

As shown also by the differences in Table 2, in comparison with the 1993 estimates, the "perspective" matrix displays a dramatic decrease in the weight of intermediates (with a corresponding increase in domestic value added) for electricity, gas and water and significant fall for agriculture (crops) and market services. For all other sectors, the shares of intermediates stationary or increases, and these increases are particularly pronounced in the two sectors of fuel & chemical products and machinery equipment.

The capital (operating surplus) share is mostly stationary, but it does go up 14 points for agriculture - crops, while it is reduced from 0.10 to 0.03 for livestock. These changes may reflect the fact that for crops agriculture will increasingly rely on capital intensive cultures and farm types, while livestock may be progressively taken over by small enterprises. As conjectured in section 2, furthermore, this move may be accompanied by an increase in the intensity of use in crop agriculture and labour combined with mechanisation.

For electric energy, gas and water, where the domestic value added would experience a very large increase, both the capital and the labour share would rise, roughly doubling their 1993 shares.

In the social transaction part of the matrix, the largest differences concern the increases in taxation for labour and the (moderate) decrease for enterprises. Household consumption shares rise significantly for the sector of food products, electrical energy, gas and water and other manufactured products. Furthermore, patterns of consumption of farm and non farm households appear to converge.

In sum, the perspective matrix shows a rather mature economy, with a substantial industrial sector, which has not developed, however a great degree of integration between industry and services. Reliance on intermediates is high and so are, correspondingly, backward and forward linkages. The degree of import dependence, at the same time (and the correspondingly linkages) is significantly reduced.

3.2 The CGE model

In order to design an appropriate CGE model from the SAM information presented above, I now follow the three step procedure outlined by Norton, Scandizzo and Zimmerman (1986): (i) choosing the elements of the SAM that are to be regarded as endogenous; (ii) specifying equations or constraints for these elements; and (iii) specifying model closure.

For decision (i), all the cells in the different SAMs used are supposed to be endogenous, even when they correspond to an institution (such as, for example, the government) which acts as a

source of exogenous injections in the policy experiments. This apparent discrepancy corresponds to the assumption that for these agents there is both an endogenous and an exogenous component to account for. For decision (iii), I close the model with specific hypotheses on its Stackelberg structure (i.e. the role of leader and followers attributed to institutions in the Stackelberg game associated to the model) and to the various types of distortions that may affect or be the indirect result of imperfect property rights. (see para. 2.2 and 2.3 above).

For decision (ii), in order to specify the equations, note that the variables chosen are outputs, factor use, factor incomes, farm and non farm household, corporate and government incomes, government expenditures, savings by institution and quantities consumed, investment, foreign trade activities, and prices of outputs, of final goods, and factors. The model is thus articulated into the following eight different modules, each of which corresponds to a block of equation and/or constraints:

Module I: Market equilibrium equations

Commodity balance equality is imposed for all activities, and provides for market clearing requirement for all goods and factors. Because in all policy experiments domestic prices are endogenous, while some prices (e.g. international prices, tariffs and rationing prices) are assumed to be exogenously given and invariant, market clearing is achieved by finding the appropriate price levels that ensure equilibrium. For those sectors that include exogenous prices, market clearing is enforced by either rationing or by exporting (or importing) the correspondent surplus (or deficit). Thus, total domestic production for each activity must equal the total of the different sources of demand: intermediate input-output use, household, government and corporate consumption, uses as capital goods, net exports. Also, upper and lower bounds are imposed on consumption and production to reflect, in various experiments, different property rights, government interference and/or the prevalence of institutional social standards of behaviour. Each equilibrium equation is expressed in real terms (constant prices), but holds in current prices as well. Factor demand (labour and capital) also equals factor supply, factor prices being the endogenous element enforcing the equality.

Module II: Production, Factor use, and Factor Incomes

Because I adopt the assumption of input-output technology, factor substitution in production is allowed only by varying the composition of output, but i-o coefficients are fixed in real terms for each activity. The combination of labour and capital capable of producing a given amount of output, however, varies over time, as we shall see by comparing the three different versions of the model.

As for factor use, and incomes, they are both the joint consequence of factor demand, as specified in the i-o submatrix, of factor supply equations, and market equilibrium conditions. Factors have all been posited to have large (≥ 10) supply elasticities with respect to own prices, to reflect the fact that resources are unemployed or under-utilised. This implies that factor price percentage increases will not exceed $1/10^{th}$ of the percentage increase in factor use, which appeared as the most reasonable upper bound in our calibration experiments with all the version of the model.

Factor incomes are defined as factor prices multiplied by factor utilisation, so that value added at current prices varies both because of employment and of factor price variations. Since these variations are in the same direction and because product prices are supposed to be equal to

production costs, demand stimuli in the model are unequivocally inflationary, while other types of shocks (on prices, budget shares etc.) may have both inflationary or deflationary effects.

For both commodities and factors, the base year physical levels were established by setting the corresponding prices equal to unity. This implies that all prices in the various solutions can be interpreted as percentage changes with respect to the base year.

Module III: Income Distribution.

Factor and other incomes are distributed across institutions using the shares computed from the corresponding SAM's. These shares are assumed to reflect patterns of resource ownership and to be stable over different solutions. They correspond to the expenditure shares of factor and institutions computed along the columns and, while they are given for each SAM, their variation across the three different SAMs considered is one of the key element of structural change. In order to study the impact of change in the pattern of asset ownership, furthermore, some of the experiments include, for a given SAM, a variation of income distribution shares.

Module IV: Consumption and Savings.

The SAM all provide average propensities to save and consumption budget shares. For example, in 1991 processed food and beverages provided for 63 per cent of total expenditure of farm Households and 61 per cent for non farm households. To introduce marginal propensities to consume and price demand elasticities, however, it has been necessary to use estimates based on international standards, adapted to the Slovakia case using a want-separability assumption (Frisch, 1959). The composition of total expenditure for each institution other than non farm households is assumed to remain constant, both in terms of goods and income transfers. This implies that marginal propensities to save, except for non farm households, are also constant and equal to average propensities.

Module V: Investment and Capital Stock.

The SAM capital formation row represent the savings of each commodity and institutional account, while the corresponding column accounts for investment (in the sense of production available for capital accumulation).

In spite of the fact that capital formation is treated as any institution, the interpretation of the model coefficients is peculiar since the expenditure shares represent along the column, the contribution of activities and, along the row, of each institution, capital accumulation. For the activities, this is simply the amount of production that survives un-consumed the production period. For institution it corresponds to their contribution to national savings. Equality between savings and investment is ensured by Walras Law, which in turn derives from the simultaneous equality of demand and supply on commodity markets (physical balances) and on factor markets, and of prices and costs of production.

Module VI: The Foreign Sector.

The SAMs used in the model specifies net exports without distinguishing between gross exports and gross imports. The Rest of The World (ROW) column and row are respectively used to specify demand for net exports and fixed expenditure shares for each institution. This implies that net exports for each sector are treated as demand levels of a foreign agent (the ROW account) who can purchase them at fixed prices (the world prices) and with a limited expenditure capacity. This in turn cannot exceed the demand for non-competitive imports resulting from the i-o coefficients or from the demand for imports of each institutional account. Balance of payment equilibrium is thus assured, but its components (in particular, trade and capital) may be in disequilibrium.

Module VII: The Government Accounts.

The SAM expenditure coefficients in the Government row account are used as coefficients of revenue collection and are assumed to be fixed. The shares in the Government column account, instead, are assumed to be endogenous and depend on total revenue collected.

Module VIII: Prices.

Relative factor and activity prices are determined from the model solution, by enforcing demand supply equalities in all markets in some experiments, or alternatively assuming that some markets are open to foreign trade so that prices are exogenous. In these cases domestic supply prices may either exceed (in the case of exports) or fall short (for imports) of production costs in equilibrium. The exchange rate is assumed to be fixed, and equilibrium values will reflect the shortage (or the surplus) of foreign exchange, so that an implicit shadow exchange rate can be calculated as an indicator of disequilibrium in the foreign sector.

Table 3 presents a synthesis of the model estimates for the “perspective” year in matrix form. The matrix presented can be considered the Jacobian of an underlying general equilibrium sets of values. For each activity, factor and institution account, the matrix elements quantify the effect that a unit shock of final demand of the sector (or the income of the institution) of the row of element considered would produce on the transaction level corresponding to the same cell.

3.3 Transition properties of the model

In capturing the features of a transition economy in a computable general equilibrium model, it is first necessary to look in a somewhat special way at the social accounting matrix (SAM). As is well known, the SAM scheme itself can be interpreted as a systematic way of looking at general equilibrium from the perspective of the stakeholders of the economy (see, for example, Pyatt and Round (1977), Norton et al. (1986)). The original identification of the stakeholders was based on their nature of “institutions”, but in view of the recent literature on contractual rights and stakeholding, it seems more appropriate to re-label the main entries of the SAM as stakeholders. The SAM columns and rows can thus be considered accounts of payments respectively from and to the main stakeholders of an economy.

But just who are the stakeholders? For a market economy, the classical division is: sectors of production, firms, households, capital formation, and rest of the world, with the possibility of conveniently disaggregating any of these accounts. Moreover, for each of these sectors, a CGE model considers two sets of variables: prices and quantities, so that the CGE model is characterised by an expanded SAM that includes both rules of income distribution and price formation.

More specifically, on the basis of the SAM's available for 1991, 1993 and the "perspective" SAM, and using the formulation described in more detail in (1) - (3) and in (A2)-(A8) of Appendix A), the CGE model for the Slovak economy can be summarised by the following compact formulation:

(4) $$\text{Max } W = \Omega'(P_x'(I - S_{xx})Q - P_z'Z)$$

subject to:

(5)
$$\begin{bmatrix} Q \\ X \\ Z \\ V \\ P_x \\ P_z \\ P_v \end{bmatrix} \leq \begin{bmatrix} S_{qq} & I & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & C_v & C_{P_x} & 0 & C_{P_v} \\ S_{zq} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & S_{vz}P_z' & S_{vv} & 0 & S'_{vz}Z' & 0 \\ 0 & 0 & 0 & 0 & S'_{qq} & S'_{zq} & 0 \\ 0 & 0 & 0 & 0 & 0 & G_p^{-1}S'_{zq} & 0 \\ 0 & 0 & 0 & 0 & 0 & S'_{vz} & S_{vv} \end{bmatrix} \begin{bmatrix} Q \\ X \\ Z \\ V \\ P_x \\ P_z \\ P_v \end{bmatrix} + \begin{bmatrix} Y_q \\ Y_x \\ Y_z \\ Y_v \\ Y_{p_x} \\ Y_{p_z} \\ Y_{p_v} \end{bmatrix} + \Theta' w$$

$$\zeta \leq S \zeta + Y$$

where: $$w = P_x'(I - S_{qq})Q - P_z'Z$$

The variables and parameters in (4) and (5) can then readily be interpreted as follows:

Q	=	a vector of quantities produced
X	=	" " " " consumed
Z	=	" " " " of factor uses
V	=	" " " incomes of stakeholders
P_x	=	" " " prices of goods and services
P_z	=	" " " factor prices
P_v	=	" " " price indexes of stakeholders
Y	=	" " " " of constants and/or exogenous shocks
S_{qq}	=	a matrix of input-output coefficients

C_v = a matrix of marginal propensities to spend

C_p = a matrix of partial derivatives (consumption w.r.t. prices)

S_{vz} = a matrix of factor shares indicating the claims of stakeholders over factors

S_{vv} = a matrix of institutional shares, indicating the claims of stakeholders over other stakeholders

Z_p = a matrix of derivatives of factor supplies with respect to factor prices.

Ω = a vector of control weights $(\Omega' \iota \leq 1)$

Θ = a vector of property weights $(\Theta' \iota = 1)$

As I have shown before (see para. 2.1. –2.3. above), the programming problem in (4)-(5) can be viewed as a Stackelberg game having as protagonists the stakeholders, who compete for incomes and property rights in the economy under consideration. In particular, expression (4) identifies the objective function of the leader when control powers broadly coincide with property rights and no single or collective stakeholder may simultaneously set prices and quantities under the knowledge of the other agents (or stakeholders) reaction functions. Expression (5), on the other hand, represents the maximising conditions for three basic aggregations of stakeholders: consumers, factor owners and producers. These conditions may also vary along the path of transition from centrally planned to market economies according to the ability of the stakeholders to behave in accordance with their interests in a less than friendly institutional and economic environment.

In a transition economy, three main characteristics have to be identified to utilise the structure in (4)-(5): (i) the stakeholders typology, (ii) the structure of claims among stakeholders and between each stakeholder and each factor, (iii) the distribution of property and control rights over resources and enterprises, (iv) the order and the limitations under which the nest of maximisation problems can be solved.

Who are the stakeholders of a transition economy and in what way do they differ from the stakeholders of a "normal" market economy? In order to fully answer this question we have no choice but to analyse each specific transition economy. However, certain general characteristics may serve to identify at least the main classes of transition stakeholders.

First, transition is characterised by the overlapping of some elements of the old and the new regime. Among the firms, the public sector remains strong, even when extensive privatisation has been carried out. The banking sector is not fully developed. Commercial protection is still strong. The relationship between the treasury, the central bank and capital formation is murky.

Second, the benevolent market forces that are synthesised in the objective function in (4) are not necessarily at work, because market institutions are insufficiently developed, property rights may not be adequately protected, and there may be a wide gap between ownership and control.

Third, the nature of the relationship between factor income and the income of the stakeholders cannot be simply captured by a matrix of shares. Privatisation has often been accomplished by vesting property rights onto workers and managers. In many cases, a substantial portion of the stock is in foreign hands through direct holding or joint ventures.

Fourth, because of budget limitations, the difficulties of state enterprises, lack of planning, and the insufficient development of market institutions, rationing is widespread. This implies that persistent gaps between demand and supply, high variance in prices and low demand multipliers go

hand in hand with resource unemployment. In other words, we have all the disadvantages of supply side economics without the benefits.

Fifth, some of the linkages of the input-output structure are missing because of gaps in the backward or forward marketing chains. Reducing the degree of vertical integration of existing companies has been one popular activity of privatised firms. But suitable substitutes for needed intermediaries are often difficult to find, as the parallel efforts to build up supply lines through joint ventures or other types of recourse to market are costly and slow.

Sixth, key stakeholders, such as many households and firms, may be too weak to stand on their own in the fierce competition that characterises the newly open markets. Thus, in some of the phases of transition, protecting property rights may not be enough to ensure that the right market forces are unleashed and competition may proceed undistorted. Protecting the weak may indeed require vigorous antitrust actions. On the other hand, political influence and pressure groups may not only hamper these efforts, but even distort the economic environment to protect those who are already strong.

We show some of the implications of these six points on the formal features of the model in Appendix A.

3.5 Simulation results

3.5.1. Static effects of transition constraints

Table 4 presents the summary results of a first set of model runs under some of the features that can be considered "typical" of transition[2]. These features have to be taken only as exemplary of an intermediate situation in which a market economy has been established, but the environment is still pervaded by some of the constraints characterising a centrally planned system (see, for example, the discussion in Shleifer, 1994 and in Basu et al., 1996). The constraints deriving from transition according to these "exemplary" characteristics have been selected from a calibration process among a range of possible distortions. They include upper and lower consumption and production bounds for basic commodities and violations of the price-marginal cost rules in various combinations.

Consumption and production bounds, are thus stipulated on the basis of different values of the elements of the vector of control parameters Ω in the model objective function in (4), and correspond to various degrees of market power on the part of the sectors considered. More specifically, consumption lower bounds may be interpreted as the consequence of sectoral control shares larger than property shares[3]. Upper bounds, on their part, are de facto rationing constraints that penalise or benefit firms according to whether they produce goods with "high" or "low" price elasticities. Production lower bounds, on the other hand, may be the consequence of rigidities in the supply lines and vertical integration, as in (A14) and (A15) of Appendix A, that require some enterprises to supply a minimum amount of the intermediate goods needed to support their own production. These bounds, it has to be emphasised, are not necessarily welfare reducing, since the balance of payment constraint is enforced by assuming that net exports of final goods for each sector are a function of total income of the ROW account from imports of intermediates. This is

[2] The model is solved via GAMS using the multilevel maximisation routines written by Norton and Scandizzo (1981) and available on the GAMs website.

[3] Alternatively, they may correspond to government interference variously motivated (see II.3.B).

equivalent to assume that exports are a function of domestic prices and thus puts the economy in a second best condition.

The first column of the tables, on the other hand, reports the "base" solution. This corresponds to a general equilibrium of the conventional type, in the sense that it is obtained by applying the computational algorithm without assuming that any specific distortion affects the outcome of the market process.

As Table 4 and 5 and Figure 3 show, in terms of the main aggregates, expressed both in current prices and at base year constant prices, comparing the solutions with the distortions with the base "free market" model, we can distinguish two main sets of "transition" effects. In the experiments involving the violation of the marginal cost rule, prices are uniformly higher than the "free market" solution, as they reflect the squeeze on consumers that producers are allowed to exercise, directly and indirectly, through monopoly power, rent extraction or monopolistic competition. User costs for capital are also higher, while labour becomes largely under-employed. Capital formation increases sharply, at the expense of consumption, real incomes and welfare (measured as consumer surplus).

On the other hand, the effects of consumption and production constraints are diverse. The consumption bounded equilibria all show lower nominal incomes. Setting lower bounds for food consumption and combining food consumption and agricultural production lower bounds, on the other hand, which may be interpreted as the upholding of social standards on the demand and the supply side (Scandizzo and Knudsen, 1996), results in a marked reduction on prices (see experiment n.6). When these lower bounds are combined with upper bounds for the consumption of other goods (experiment n. 9), however, the price index increases considerably (more than 20% with respect to the base solution and more than 40% with respect to the solution where only food consumption and agriculture are constrained.). It thus appears, as the welfare indexes seem to demonstrate, that food demand and supply objectives may be pursued with some beneficial effects on the economy. On the contrary, the constraints on other sectors may only do harm, void some of the beneficial effects of food and agricultural policies, and worsen the general conditions of the economy to a non sustainable point. A transition economy, such as the case we are examining, however, may find difficult to separate some of these constraints because they are deeply embedded in the characteristics of the markets and in the high degree of vertical integration of the manufacturing sectors.

Tables 6 and 7 show in more detail the impact of the various hypotheses on absolute (Table 6) and relative (Table 7) price levels. The results of the experiments where inefficiencies are allowed (in the food as well as in other sectors) underline the key role played by food production and consumption in the economy. As a consequence of low price elasticities and strong backward and forward linkages, in fact, food prices rise in all experiments involving violations of the marginal cost rule, more than any other price. When consumption and production lower bounds are imposed, on the contrary, food prices fall absolutely, but their relative level remains unchallenged in the experiments involving only food and agricultural constraints. When the consumption of other sectors is constrained from above, however, as with rationing and vertical integration constraints, relative food and agricultural prices fall sharply.

3.5.2. Dynamic effects of transition constraints

In order to study more closely the effects of the distortions on the economy, we can also examine the impact of exogenous growth on sectors and institutions under alternative regimes. Table 8 presents the results of a set of experiments designed to explore the effects of growth under

the assumption of no constraints and coincidence between property rights and control rights. In the first eight experiments (from time 1 to 8), starting from the base solution (labelled 0), capital and labour are assumed to grow 3% per year, while in the last two experiments the endowment of the two factors increases 21% per each year.

Before comparing the results to the case where transition constraints are introduced, displayed in Table 9 (other results are described in Appendix B), it is interesting to analyse some of the features of these sequential equilibria. As all tables show, income distribution, prices, consumption, production, value added and welfare do not vary smoothly with factor increases, but change abruptly, sometimes with quite wide swings. In fact, for certain variables, such as factor income and production, the appearance of the simulated time pattern is one of a cycle due to exogenous shocks, in spite of the underlying deterministic structure of the model.

Why does then a deterministic model display these pseudo-stochastic fluctuations? The answer can be seen by looking at the wide adjustments that even a small variation in factor endowment may entail to reach efficiency. Even though the increase in capital and labour from one year to the next is small, in fact, the range of relative factor intensity among sectors is sufficiently wide that factor employment and remuneration may vary significantly to exploit the opportunities made possible by the change. The discontinuity of the production possibility set in this case plays a critical role, as for small changes in factor endowment, the base solution may switch and imply discrete and wide changes in the choice of production and consumption levels. For example, the increase in labour endowment in four cases is not exploited immediately, since it is more convenient to expand the capital- intensive sectors. In these instances it thus takes more than one year to employ all the increase in labour, and such a strategy, which is necessary to achieve efficiency, can be exploited to the fullest because of the complete flexibility of the free market solution, which has no constraints besides those requiring that each agent be rational. The role played by the different sectors and by agriculture in particular appears to be diverse. First of all, taking food as a numeraire, relative prices remain broadly stable, as it has to be expected from proportional growth. Fluctuations from one "year" to the other appear to be small for crops (given the choice of the numeraire), but relatively large for livestock , forestry and both marketable and non marketable services. For the 3, 4, 6, 9 year, in fact, the failure to employ all labour results in a generalised fall in prices with the exception of food and agriculture. These two sectors thus appear to play a "fundamental" role to help stabilising or smoothing the adjustment pattern over time.

Consider now the case where exogenous growth acts upon an economic structure characterised by all the "transition" constraints defined above. Tables 9 reports the results for 10 sequential experiment that run "parallel" to those discussed before for the "free market" case. In contrast with those results, Table 9 shows a rather steady pattern of production growth with a few small fluctuations limited, and with uninterrupted full employment of labour and unemployment of capital. At the same time, however, there appears to be hardly any growth. The increase in the availability of labour and capital, in fact, seems to be entirely absorbed by a decrease in the value of aggregate rents measured by the objective function. In terms of real consumption, in particular, growth appears to be negative, until the eight year. Household consumption, in particular, remains stagnant throughout all the experiments considered and the level of welfare increases of only 12% over the whole set of experiments (see also Tables B23-B33 in Appendix B).

Rather than by immediately forcing lower values of income and consumption, these "dynamic" results thus seem to suggest that the transition constraints considered may be equivalent to a straight-jacket, which stabilises the economy, at the cost of depriving it of some critical elements of flexibility. The costs of transition, in other words, may reside in the need to eliminate the constraints that allow part of the economy to extract rents and to stifle growth. Positive shocks

such as exogenous increases in factor endowment (for example from foreign investment) will not be effective in spurring growth unless rents are eliminated and factor flexibility restored.

The price pattern for each sequential experiment show a very clear trend of a moderate deflation (Tables B24 and B25 in Appendix B show the details). In order to interpret this surprising outcome, return to Table 9, where the increase in factor endowment shows that the wage-rate is remarkably stable over the whole range and slightly declining only for the last two cases. Thus, contrary to the free market case, the growth path suggested by the sequence of solutions is exclusively constrained by labour availability.

In sum, as the diagram in Figures 4 and 5 show, the constraint ridden solutions that we have taken as representative of transition, suggest that the main handicap arising from imperfect property rights concerns the capacity to react profitably to growth opportunities. This lack of capacity is partly linked to the rigidity induced by rent taking and partly by the constraints imposed by monopolistic power and government interference. Contrary to what is generally believed, therefore, it is not the immediate efficiency effect of market distortions that may be damning for the transition economies, but rather the medium and long term lack of capacity for growth that they might be inducing.

3.5.3. Exploring Property and Control rights

Tables 10 and 11 report the results of a more ambitious set of experiments aimed at exploring the impact of different structures of property and control rights on the market variables. The first of these experiments assumes that, while property is distributed according to the observed shares, control is only exercised by the government. In other words, instead of assuming that prices are set "as if" all agents were involved, we assumed that the government alone is in charge of the objective function. As a consequence, as we have demonstrated before, the objective function will not be zero at the optimum, and the surplus generated will be distributed according with the property shares. Experiments 2-5 derive from a more radical hypothesis, in which we assume that the government owns completely or almost completely (80%) some sectors of production and that it can manipulate the price system to favour these sectors.

Consider first experiment n. 1. Here, the departure from full control rights for all property owners does not appear to have major consequences on aggregate performance. Some inflation arises, with the price index growing marginally from 0.9 to 0.97, household and enterprise consumption increases at the expense of exports and government expenditure. Both nominal and real incomes decrease., the main cause being a drop in capital employment not sufficiently counterbalanced by the raise in wages. The value of the objective function, which can be interpreted as an index of aggregate efficiency, remains zero.

This experiment can be interpreted as one of a moderate departure from a market economy, as it may occur, for example, in the last stage of successful transition The results suggest that, at least in aggregate terms, the effects on the economy are mainly to discourage accumulation, through a policy of high salaries and under-utilisation of capital.

Experiments 2-4 represent an accentuation of experiment 1, with the additional twist due to the fact that the government is assumed to control and own only some of the production activities in the economy. Experiments 5 -7, furthermore, present the same scenario under the additional assumption that the government tries to enforce minimum and maximum levels of consumption for selected goods. Looking again only at the aggregates, we see that the characteristics of the simulated performance are much worse, except for employment in experiments 4 and 5. All other indicators,

however, appear to be worse than the "free market" or the “successful transition” cases. Inflation is very high, the value of the objective function is positive and high indicating that large rents are being generated, consumption, government expenditure and real incomes are either lower or much lower. In a phenomenon common to past socialist economies, real factor incomes are inflated by the large salaries paid to labour, but this apparent “real” increases are not substantiated by a parallel increase in domestic or foreign supply of goods and services. The collapse of capital formation, government expenditure and exports, furthermore, gives further impetus to the loss of real income on the part of households and enterprises. The negative effect of interposing a wedge between control rights and property rights and of an over-extended public sector appear to be reduced, if only with very limited success, by the enforcement of upper and lower bound on consumption.

Tables 11 shows the results of a final set of experiments, where the consequences of the government ownership of the means of production - a more straightforward Marxist tenet – are explored by assuming that the government owns, respectively, 100, 80 and 50 per cent of all resources. In terms of the model parameters these three experiments simply entail that a corresponding percentage of the proceeds from capital, labour, and taxes of various form (including export taxes and import duties) are given in the first instance to the government. Because the model specifies a set of given propensities of the government to redistribute its revenue in the form of government expenditure and taxes, income of the other sectors and institutions is not necessarily reduced. Moreover, because the price-marginal cost rules are not affected, the solution is a general equilibrium of the first best variety and should be more or less desirable than an alternative allocation only from a distributive point of view. As the Table show, however, compared to the more balanced pattern of ownership of the base solution (where all labour is owned by households and less than 30 per cent of capital is owned by the government), the results of the simulation indicate a generalised fall in indicators of aggregate performance for all agents. Consumption of all accounts, except the government, plummets, and so do production, the foreign account, nominal incomes, sector prices and the price of capital. On the other hand, government expenditure soars, and so do both labour prices and real factor incomes. While “real incomes” appear to rise, the increase in purchasing power of the various agents is not translated into an increase of consumption or savings. We show other results in Appendix B.

In sum, this last set of experiments suggests that one of the reasons why transition may not be successfully spurred by liberalisation or privatisation policies may be due to the “stickiness” of the pattern of resource ownership that was characteristic of the centrally planned regimes. If factors of production remain *de facto* owned by the public sector, either because they are materially held in its possession, or because they are controlled by it, the result may be an over-extension of government that may be particularly unfavourable for all the private parts of the economy. Furthermore, this particular variety of “government failure” may be specially difficult to fight with the usual instruments of economic policy. These are directed, in fact, to remove market distortions and improve overall efficiency of the markets. The non desirable characteristics of government over-extension, such as heavy taxing and price interference, for consumption, production and income patterns, may be only distributive in nature, and may have only indirect, albeit far reaching bearing on Pareto efficiency.

4. Conclusions and Policy Implications

This paper has examined the transition economies from the point of view of a computable general equilibrium model, whose structure allows to explore the impact of different forms of

property and control rights, combined with a variety of market distortions. The model is based on the idea that the mechanism of co-ordination underlying the achievement of a general equilibrium may be simulated by a Stackelberg game. Here a market agent, who entertains rational expectations on the demand and supply functions of the other agents on the market, sets goods and factor prices as a first mover, followed by consumers and producer organised in form of households, enterprises and other institutional agents.

The above structure allows first to introduce widespread rationing and price controls, as in most transition economies, and secondly a wedge between control rights and property rights. By exemplifying the model structure and the theoretical nature of its solutions, it is possible to demonstrate that the non coincidence between property and control rights can also take the form, and be induced from the market distortions characteristics of transition. These may include rationing, price controls, lower and upper bounds for production, as well as a trade structure de facto equivalent to a system of quotas. In the process of calibrating the model, it is also possible to search for the system of market distortions more consistent with a specific set of wedges between property an control.

The numerical experiments run all show the heavy consequences due to the departure from competitive equilibria deriving from the use of market interventions and in general from government interference in the economy. The difference between property and control combined with government activism, however, seems to be by far the potentially most dangerous type of distortion, in the sense that it is capable of completely upsetting the structure of the economy, defying comparative advantage and generating unemployment and inflation.

As far as agriculture is concerned, at least for the case of the example examined (i.e. the "perspective" SAM for the Slovak republic), its sensitivity to the institutional set up, as well as to the specific market distortions does not seem to be particularly high. Rather high appears to be instead the sensitivity of the food sector, which is strictly tied to agriculture by upward linkages. Contrary to what could be expected, this sensitivity is high both on production and consumption, in spite of the possibility of trading the surplus at fixed prices. The need to achieve balance of payment equilibrium, which can be interpreted as a plausible long run constraint, makes in fact relatively rigid the pattern of trade. This depends, inter alia, on the assumption that the bulk of import needs derive from intermediate goods.

The main policy indications of these results may be summarised in the following five points. First, market inefficiencies due to meddling with costs and implicit taxes and subsidies on producers result in suboptimal equilibria characterised by high factor rents, unemployment and consumer losses. Removing price controls and letting uneconomic firms to exit the market should thus be a clear priority during transition. Second, controlling consumer prices and upholding minimum standards for food consumption, even though resulting in some aggregate welfare costs, appears to have also beneficial effects, specially through the strong linkages existing with the agricultural and the food sector. Thus, rationing and consumer subsidies should not be the main target for removal, as they appear to yield benefits in terms of employment and income distribution. Third, the top priority for transition policies should be the removal of rents and monopolistic behaviour, both from the government and selected private concerns. Liberalising the economy, in fact, appears to hold the major promise for a dynamic increase in incomes and employment, which both seem to be held down by rent taking, monopolistic behaviour, and the inflexibility induced by government intervention. Fourth, privatisation also seems necessary, as an independent policy, even if we assume that the government is as efficient as the private sector in running the individual enterprises. The distributive consequences of government over-extension, in fact, result themselves in high transaction costs and widespread inefficiencies, which hamper the capacity of the economy to function and to respond to economic incentives.

In conclusion, the model developed generates a set of disequilibria that strongly differ from the usual general equilibria simulated by computing algorithms, and provide a rich set of second and third best suggestions on the possible sources of inefficiencies for transition economies. For the Slovak republic, in particular, the results appear to support the possible contention that institutional reforms may be more important for progress than the technological achievements incorporated in the “perspective matrix”.

Tables 1-11

Figures 3, 4, 5

References

Basu S., Estrin S., Svejnar J. (1996), "A review of some studies about links between unemployment topics and economic and institutional variables can be found", in Svejnar J., Enterprises and workers in the transition: econometric evidence, *American Economic Review*, 2.

Benassy J.P. (1986), Macroeconomics: an introduction to the non-Walrasian approach, Academic Press, New York.

Bozik M. (1997), "The role of the Agricultural sector in Transition", RIAFE Bratislava, Slovak Republic.

Brooks K., Guasch J.L., Braverman A., Csaki C. (1991), "Agriculture and Transition to the Market", *Journal of Economic Perspectives,* .5 (4).

Commons J.R. (1968), "Legal Foundations of Capitalism", Madison, University of Wisconsin Press.

Debreu G. (1959), Theory of Value, John Wiley & Sons, New York.

Dréeze J. H. (1985), Second Best Analysis with Markets in Disequilibrium: Public Sector Pricing in a Keynesian Regime, *European Economic Review*, 29.

Frisch R. (1959), A Complete Scheme for Computing All Direct and Cross Demand Elasticities in a Model with Many Sectors, *Econometrica*, 27, pp. 177-196.

Grossman G.M., Helpman E. (1994), Endogenous Innovation in the Theory of Growth, *Journal of Economic Perspectives*, 8 (1), pp. 23-44.

Knudsen O.K., Scandizzo P.L. (1996), "Social Supply and the Evaluation of Food Policies", *American Journal of Agricultural Economics*,78 (1), pp. 137-145, February.

Knudsen O.K., Scandizzo P.L. (1980), "The Evaluation of the Benefits of Basic Need Policies", *American Journal of Agricultural Economics*, 62 (1), pp. 46-57, February.

Knudsen O.K., Scandizzo P.L. (1986), "The Demand for Calories in Developing Countries: Reply*", The American Journal of Agricultural Economics,* 68 (1), February.

Norton R., Scandizzo P.L. (1981), "General Equilibrium Computations in Activity Analysis Models", *Operations Research*, 29 (2), pp. 243-262.

Norton R., Scandizzo P.L., Zimmerman, L.W. (1986), "Portugal's Entry into the EEC: Aggregate and Distributional Effects Determined by Means of a General Equilibrium Model", *Journal of Policy Modeling*, 8 (2), pp. 149-180.

Pyatt G., Round J.I. (1977), "Social Accounting matrices for Development Planning", *The Review of Income and Wealth*, 23 (4), pp. 339-364, December.

Scandizzo P.L. (1998), "A Computable general Equilibrium Model for a transition economy", FAO.

Schlager E., Ostrom E. (1992), "Property rights Regimes and Natural Resources: a Conceptual Analysis", *Land Economics,* 68 (3), pp. 249-262, August.

Shleifer A. (1994), “Competition Policy in Russia during and after Privatization: Comment”, *Brooking Papers on Economic Activity,* 0(0), Microeconomics, pp. 375-376

Williamson O.E. (1994), “Transaction Cost Economics and Organization Theory”, Smelzer N.J., Swedberg R, eds. *The handbook of economic sociology.* Princeton, Princeton University Press, New York: Russell Sage Foundation.

APPENDIX A: A MATHEMATICAL APPROACH

1. The problem in (1.1) - (1.6) (§2.1) is a General Equilibrium

In order to prove that the solution to the problem in (1.1) - (1.6) is a general equilibrium, consider the Lagrangean:

(A1)

$$L = \sum_{h,s}\theta_{hs}\left[P'(I-A)Q_s - r'b_s\right] + \rho'\left[\sum_h X_h - \sum_s (I-A)Q_s\right] + \sum_h \Pi_h'\left[X_h - f_h(P, y_h)\right] +$$
$$+\gamma'\left(D\sum_s Q_s - \sum_s b_s\right) + \sum_h \gamma_h\left\{y_h - r'\omega_h\sum_s b_s - \sum_s \theta_{hs}\left[P'(I-A)Q_s - r'\sum_s b_s\right]\right\} + \xi'\left[(I-A)'P - D'r\right]$$

where $\rho, \Pi_h, \nu, \mu_h, \gamma_h$ and ξ are all vectors of Lagrange multipliers.

The Kuhn Tucker conditions deriving from (A1) are:

$$(A2.1)\quad \text{either } P_j = 0 \quad \text{or } (I-A)_j \quad \sum_s Q_s - \sum_h \frac{\partial f_{hj}}{\partial P}\Pi_h - \sum_{h,s}\gamma_h\theta_{h,s}(I-A)_j\sum_s Q_s + (I-A)_j\,\xi = 0$$

$$j = 1,2\ldots J$$

$$(A2.2)\quad \text{either} \quad r_k = 0 \quad \text{or} - \sum_s b_{sk} - \sum_{hs}\gamma_h\omega_{hk}b_{sk} + \sum_{hs}\gamma_h\theta_{hs}b_{sk} - D_k\xi = 0$$

$$k = 1,2,\ldots K$$

$$(A2.3)\quad \text{either} \quad Q_{js} = 0 \quad \text{or} \quad (I-A)_j P + (I-A)_j\,\rho + D_j\nu + \sum_h \gamma_h\theta_{hs}(I-A)_j P = 0$$

$$j = 1,2\ldots J \qquad s = 1,2\ldots S$$

$$(A2.4)\quad \text{either} \quad X_{jh} = 0 \quad \text{or} \quad \rho_j + \Pi_{jh} = 0$$

$$j = 1,2\ldots J$$

$$(A2.5)\quad \text{either} \quad y_h = 0 \quad \text{or} \quad -\ \Pi'_h\frac{\partial f_h}{\partial y_h} + \gamma_h = 0$$

$$h = 1,2\ldots H$$

$$(A2.6)\quad \text{either} \quad \rho_j = 0 \quad \text{or} \quad \sum_h X_{hj} - \sum_s (I-A)_j Q_s = 0$$

$$(A2.7)\quad \text{either} \quad \Pi_{hj} = 0 \quad \text{or} \quad X_{hj} - f_{hj}(P, y_h)_j = 0$$

$(A2.8)$ either $\nu_k = 0$ or $D_k \sum_k Q_s - \sum_s b_{sk} = 0$

$(A2.9)$ either $\gamma_h = 0$ or $y_h - r'\omega_h \sum_s b_s - \sum_s \theta_{hs}\left[P'(I-A)Q_s - r'b_s\right] = 0$

$(A2.10)$ either $\xi_j = 0$ or $(I-A')_j P - D'_j r = 0$

where the subscripts j and k denote the corresponding element of the vector or the corresponding row of the matrix with the same symbol.

At the optimum $\rho_j = -\Pi_{jh} \forall h$. In fact, if ρ_j and Π_{jh} are both different of zero, then conditions (A2.5) and (A2.6) hold. But this implies that $\rho_j = -\Pi_{jh}$, since ρ_j and Π_{jh} both shadow -price the quantity X_{hj} with a reverse inequality sign. More precisely, at the optimum ρ_j is the *loss* (gain) in value of the objective function in (1.2) of §2.1 for a unit *decrease* (increase) of net production $\sum_h (I-A)_j Q_s$. On the other hand, Π_{jh} is the *loss* (gain) in value of the same objective function for a unit *increase* (decrease) in the quantity demanded of the j-th good the h-th consumer. But $\sum_h (I-A)_j Q_s = f_h(P, y_h)$ by virtue of (1.2) and (1.3) (§2.1).

The Lagrange multiplier ν_k is non zero if the corresponding resource constraint is binding. This implies, however that $\nu_k = r_k$, at the optimum, if the corresponding constraint is binding, ν_k shadow prices the availability of the k-th resource. But this implies that ν_k equals the gain (loss) in value of the objective function for a unit *increase* (decrease) of resource availability $\sum_s b_{sk}$. Since $\sum_s b_{sk}$ enters directly the objective function with the price r_k, the value of the unit gain or loss cannot be different of r_k.

Given that $\nu_k = r_k$ for all $\nu_k \neq 0$, k = 1,2….K, it follows that equation (A2.3) can be write

$(A3)$ $(I-A)_j P - (I-A)_j \Pi + D_j r + \sum_h \gamma_h \theta_{hs} (I-A)_j P = 0$

From equation (A2.9), for all $\gamma_h \neq 0$, the budget constraint is binding and its shadow price for all the h-th consumer γ_h must equal at the optimum –1. This is because the constraint in the second part of the expression (the definition of consumer income) is nothing but the negative of the component of the objective function. In turn this implies that (A3) can be written as:

$(A4)$ $(I-A)_j P - (I-A)_j \Pi + D_j r - (I-A)_j P = 0$

which simplifies as:

$$(A5) \qquad (I-A)_j \Pi - D_j r = 0$$

Hence : $\Pi = P$ by (A3.10) for all $\xi_j \neq 0$.

By a similar argument, since ξ_j at the optimum shadow prices the constraint $D_j r$, it must be equal $\sum_s Q_{js}$, since $r' D_j \sum_s Q_{js} = r' \sum_s b_s$ enters directly the objective function. Thus, substituting $\xi_j = \sum_s Q_{js}$, $\gamma_h = 1$, $\Pi = P$ in (A2.1), and simplifying, we obtain:

$$(A6) \qquad \sum_h \frac{\partial f_{hj}}{\partial P} P + (I-A)_j \sum_s Q_{js} = 0$$

which, by virtue of (1.2) coincides with the so called Cournot aggregation condition, obtained by differentiating the budget constraint with respect to P.

Similarly, substituting P for Π'_h in (A2.5) and setting $\gamma_h = 1$ yields the Engel aggregation condition:

$$(A7) \qquad P' \frac{\partial f_h}{\partial y_h} = 1$$

Equations (A6) and (A7) assert the budget constraint in differential form, in the sense that if and only if the budget constraint is satisfied at the optimum will the two equalities in (A6) and (A7) hold.

We have thus shown that the formulation in (1.1) – (1.6) (§ 2.1) yields a CGE solution. Moreover, this solution is self-dual in the sense that the primal variables and the dual variables coincide at the optimum. This also implies that the objective function cannot be but zero, as it can be easily checked by substituting (A2.2) or (A2.9) into (1.1) (§ 2.1).

2. Basic distortions from an efficient market equilibrium

We can distinguish the following basic distortions from an efficient market equilibrium.

1. Rationing

$$(A8.1) \quad P, r = \operatorname{argmax} \left[\sum_h w_h \; ; \quad w_h = \sum_s \theta_{hs} \left(P'(I-A) Q_s - r' b_s \right), \sum_h X_h - (I-A) \sum_s Q_s \geq 0 \right]$$

$$(A8.2) \quad X_h = \operatorname{argmax} \left[U^{(h)}; \; P' X_h \leq \sum_s \omega_{hs} b_s + w_h; \quad X_{hm} \leq X_h \leq X_{hM} \right]$$

$$(A8.3)\quad Q_s = \text{argmax}\ \left[P'(I - A)Q_s - r'b_s\ ;\ D\,Q_s - b_s \le 0\right]$$

2. Imperfect property rights

(A8.1), (A8.2) with no rationing and, for $l \neq h$:

$$(A8.2.A)\quad X_1 = \text{argmax}\ \left[U^{(l)};\ P'X_1 \le \sum_s \omega_{ls} b_s + \theta_{ls}\left(MP'(I - A)Q_s - Tr'b_s\right)\right]$$

$$(A8.3.A)\quad Q_s = \text{argmax}\ \left[MP'(I - A)Q_s - Tr'b_s;\quad DQ_s - b_s \le 0\right]$$

where M and T are two appropriate diagonal matrices. Alternatively:

(A8.1.A)

$$P, r = \arg\max\left[\sum_h w_h ; w_h = \sum_s\ \Omega_{hs}(P'(I - A)Q_s - r'b_s), \sum_h X_h - \sum_s (I - A)Q_s \ge 0, \sum_h \Omega_{hs} < 1\right]$$

(A8.2.) and (A8.3).

3. Government interference (setting of minimum/maximum production levels).

(A8.1), (A8.2) with no rationing and :

$$(A8.3B)\quad Q_s = \text{argmax}\left[P'(I - A)Q_s - r'b_s;\ DQ_s - b_s \le 0\right]$$

$$s \neq m$$

$$Q_m = \text{argmax}\left[P'(I - A)Q_m - r'b_m;\quad D\,Q_m - b_m \le 0,\quad Q_m \gtrless \overline{Q}_m\right]$$

This distortion, as the one in (A8.3.A), has the effect of altering the price-unit cost inequality. If the constraint is binding, prices may be lower or greater than unit costs, unless a subsidy is paid (a tax is levied on) the firm.

4. Rent seeking

$$(\text{A8.1.A}) \quad P, r = \text{argmax}\left[\sum_h w_h;\ w_h = \sum_s \theta_s \{V_s(P'(I - A)Q_s) - r'\Omega_s b_s\},\ \sum_h X_h - (I - A)\sum_s Q_s \geq 0\right]$$

In this case a different weight is given to value added and factor income.

The above four distortions are only a simple, fundamental reference point. In a transition economy, in fact they are combined in multiple ways. For example, even though rationing may have officially exist, government regulations and discretionary bureaucratic power may de facto impose lower, or, more frequently, upper bounds for consumption of several goods. These might include, in particular, government services.

Rather than through control rights, as in (3.1)-(3.3) of § 2.3, managers and politicians may be allowed to extract rents by operating at prices different of market prices, as in (A8.3 A). This may occur through a variety of means: (i) by letting monopolistic rents to develop or to stand unchallenged (ii) by directly granting collecting rights to population subgroups, (iii) by tolerating corruption and, (iv) by failing to protect property rights.

Direct government interference (in (A8.3 B)), is also bound to occur and can relate in various ways to the still pervasive role of public bureaucracies in the economics of transition. Production maximum or minimum levels may be imposed to favour particular business lines (presently or formerly owned by the state), as a consequence of trade and / or distribution policies. In some cases, they may be simply revealing a tendency to impose discretionary controls for rent-seeking purposes.

Rent seeking, however, (see (A8.1.A) can also more generally be seen as an attempt by particular income groups to pursue the interests of subgroups of producers and / or factor owners. Expression (A8.1. A) thus focuses on the objectives, letting the means to be determined by the model solution.

3. Proofs of Propositions of § 2.3

Proposition 1. *If the sum of the weights in the objective function of the problem in (2.1) – (2.4) is not unity, i.e. if the objective function accounts for the surplus shares of a subset of consumers, at the ensuing equilibrium value added is not all distributed in form of factor income. As a consequence, the following conditions hold: (i) expenditure falls short of the values of resources available, (ii) some resources are unemployed, (iii) prices are greater than marginal costs.*

Proof. Consider for simplicity, and without loss of generality, two consumer groups with property claims on the surplus (i.e. the value of the difference between value added and factor remuneration), respectively equal to θ_1 and $(1-\theta_1)$, and assume that the first share (θ_1) corresponds to both property and control, while the second one is only a property claim. Assume also the production sector can be divided into two groups of firms, the first, respectively producing output Q_1 and Q_2, and that the first group of firms is controlled by the first group of consumers. The maximisation problem in (2) can be re-stated as follows:

$$(\text{A9.1}) \qquad \text{Max } W = \theta_1[P'(I - A_1)Q_1 - r'b_1]$$

P, r

subject to:

$$(\text{A9.2}) \qquad \mathrm{X_h} = \operatorname{argmax}\left[\, \mathrm{U^{(h)}(X_h)};\ \mathrm{P'X_h} \le \theta_h(\mathrm{P'(I-A)}\textstyle\sum_s \mathrm{Q_s} - \mathrm{r'}\sum_s \mathrm{b_s}) + \mathrm{r'}\omega_h \sum_s \mathrm{b_s}\right]$$

$$h = 1,2, \quad \theta_1 + \theta_2 = 1, \ s=1,2$$

$$(\text{A9.3}) \qquad \mathrm{Q_s} = \operatorname{argmax}\left[\mathrm{P'(I-A)Q_s};\ \ \mathrm{DQ_s} \le \textstyle\sum_s \mathrm{b_s}\right] \qquad s=1,2$$

Forming the Lagrangean and deriving the Kuhn-Tucker conditions, we obtain, *inter alia,* the following conditions:

$$(\text{A10}) \qquad \theta_1(I - \hat{A}_1)Q_1 = \hat{P}'\left(\frac{\partial f_1}{\partial P} + \frac{\partial f_2}{\partial P}\right)$$

$$(\text{A11}) \qquad D\hat{Q} - \theta_1 b_1 = 0$$

$$(\text{A12}) \qquad \theta_1(I - \hat{A}_1')P = \hat{D}'r$$

where $Q = \sum_s Q_s$, $b = \sum_s b_s$ and the hats denote the variables that are non zero at the optimum or submatrices and sub-vectors corresponding to these non-zero variables.

Conditions (A10) - (A12) all state the basic rules of a Stackelberg equilibrium, namely, that the marginal utility of the Stackelberg leader be equalised to the marginal value of the reaction function of the followers. This implies that the first derivative of the objective function of the leader is equalised to the second derivative, i.e. the derivative of the first order condition necessary to maximise the objective function of the follower. In particular, equation (A10) states that, in order to maximise its welfare, the ruling coalition sets prices to equate direct marginal benefit, equal to the share of the surplus captured by the group for any given set of quantities produces, to the marginal costs. These are given by the fall in output following the negative effect of a price increase on the demand levels of all consumers. Substituting $\sum_h f_h(P, y_h)$ for $(I - A)Q$ and integrating both sides of (A10), we obtain:

$$(\text{A13}) \qquad \hat{P}'\sum_h \hat{f}_h = y - (1-\theta_1)\sum_h \hat{f}_h$$

where y denotes the value of total income available for expenditure.

Equation (A11) also depends on the equilibrium that the controlling coalition will seek between the coalition costs $\theta_1 b_1$, from raising resource remuneration of one unit, and the benefits DQ from increasing factor income for all. For example, by raising of one unit the wage rate, total

surplus is reduced by $\theta_1 b_{l_1}$, where b_{l_1} is labour availability in industry 1. At the same time, however, the wage raise will cause total income to increase of $D_l Q$, i.e. of the amount of total labour employed: thus, consumers will see their income increase and will raise their expenditure of the same amount.

Equation (A12), finally, corresponds to the equalisation of the benefit of the controlling group from increasing total output to the cost arising from employing additional amounts of resources at the current prices.

Proposition 2. *Any discrepancy between control and property rights corresponds to a coordinated set of positive wedges between: (i) income and expenditure, (ii) resource availability and resource use, and (iii) prices and marginal costs.*

Proof: The proof follows directly from (A10)-(A13) above.

Proposition 3. *Limited control rights will always cause the net social surplus to be positive. As a consequence, (i) all consumers will gain a non-negative share of undistributed profits, (ii) all consumers will share the costs caused by the ensuing fall in efficiency, but (iii), only for the controlling coalition will the benefits be greater than the costs.*

Proof: As shown above, the Stackelberg leader sets prices in such a way that marginal coalition benefits are equated to the costs arising from the other coalition (and the producers) reaction. In contrast, the other consumers and the producers can only adjust their quantities once they face the prices set by the leader. As a consequence, the dead-weight loss from departing from the first best solution is entirely borne out by the followers.

4. Some implications on the formal features of the CGE model

In order to trace out some of the implications of these six points on the formal features of the model, consider in turn each set of equations of the system in (5) (§3.3). The first of these equation sets would be, for a market economy, the demand-supply equality:

(A14) $$Q = S_{qq} Q + X + Y_q$$

Assuming that supply limitations may arise, however, we would have to re-specify (A14) as follows:

(A15) $$Q = \min(\max(Q), S_{qq} Q + X + Y_x)$$

where max (Q) indicates the vector of the upper bounds (where they exist) of output for each production process. These upper bounds may either be the effect of outright rationing or the reflection of the fact that the matrix S_{qq} may not be sufficient to describe the production process, because of gaps in the supply lines.

Because of rationing, consumption by stakeholders (households, government etc.) only segments of demand will be dependent on prices. This implies that in the second set of equations:

(A16) $$X = C_p P_x + C_v V + Y_x$$

the matrix C_p will be sparse, i.e. it will be zero for a number of goods. In turn, this will mean that the Edgeworth aggregation conditions will not hold for all goods, i.e.:

(A17) $$\exists C_i; \sum_{j=1}^{n} p_i \frac{\partial X_j}{\partial p_i} - X_i \neq 0 \quad i = 1,2...I$$

but the Engel aggregation conditions will continue to hold:

(A18) $$(I - S_{vv})^{-1} P' C_v = 1$$

where S_{vv} = matrix of transfer payments among the institutions such that:

(A19) $$V = V_A + S_{vv} V + \Theta'(P_x'(I - S_{qq}) - P_z' Z)$$

and V_A = vector of value added (factor income)

The third set of equations in (18) concerns factor demand and can be modified as follows:

(A20) $$Z \geq S_{zq} X$$

For an input-output technology, factor demand (and value added) is directly determined by the requirements in the matrix S_{zq}. Under a transition regime, however, factor demand may be larger than what is required by technology for a variety of reasons: the need to account for waste, the lack of secure provision of inputs, shirking and labour conflicts, the bad state of infrastructure.

Income distribution, expressed in (A19), defines the way income shares are determined both for value added and for transfer payments. In a transition economy transfer payments are limited, but a plurality of stakeholders lay claims directly on factor incomes. Stakeholders include households, private firms, public companies, the government and a class of renters.

Consider now the price equations. The first, given the rationing equilibria, should read:

(A21) $$P_x \geq (I - S_{qq}')^{-1} S_{zq}' dP_z$$

In other words, production cost is a lower bound on prices, but rationing or other distortions depending on control rights may make higher prices necessary to equate demand and supply.

Factor prices, on the other hand, are determined by demand-supply conditions:

(A22) $Z_p P_z \geq S_{qq} Q \rightarrow P_z \geq Z_p^{-1} S_{zp} Q$

Because of unemployment, reservation prices for factors may exceed what firms are willing to pay.

By substituting into (A19), we obtain finally:

(A23) $P_x \geq (I - S_{qq}^{'})^{-1} S_{zq}^{'} Z_p^{-1} S_{zq} Q$

Figure A1, panel 1 and 2 sketches the outline of the two causal chains respectively under general equilibrium in a market economy, and under rationing in a transition economy.

Notice that the construction of the model as in (4)-(5) of § 3.3 leaves unprejudiced the question of macro-economic closure. The model, in fact, determines only relative prices, as in (A22)-(A23) and an explicit numerary is not chosen. Rather, prices levels are measured with respect to the prices of a theoretical base solution (the SAM utilised) which are all taken to be equal to one.

In order to examine the question of inflation, for example, we may close the model by simply using the quantitative equation:

(A24) $M=kPZ^{*}$

where k is a constant, M is a money supply, P a price index defined as an appropriate weighted average of commodity prices in P_x, and Z^{*} value added (GNP). In this case, we obtain:

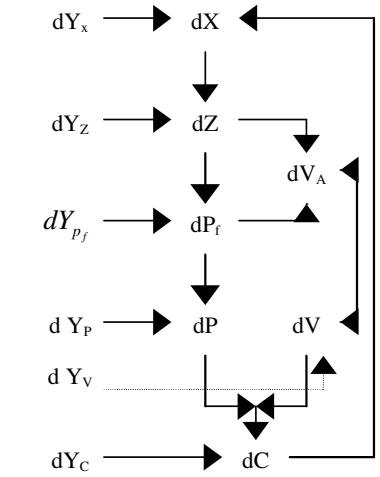
(A25) $dM=w'dP_x+ i'dZ$

and, substituting (25), (27) and (28):

(A26) $dM \leq \left[w\left(I - S'_{xx}\right)^{-1} S'_{zx} Z_p^{-1} S_{zx} + i' S_{zx} \right] dX$

under "pure" monetary closure, therefore, non inflationary money supply is limited from above by the sum of the increases in prices and value added (at constant prices) generated by the exogenous shock. Notice that the model can record an endogenous increase in the general prices index entirely due to the reshuffling of relative prices in higher response to supply limitations. Because of this "crowding out" effect, money supply may have to rise less than GNP in order that to cause inflation.

Panel 1
Causal chain under general equilibrium in a market economy



Panel 2
Causal chain under market equilibrium with rationing in transition economy

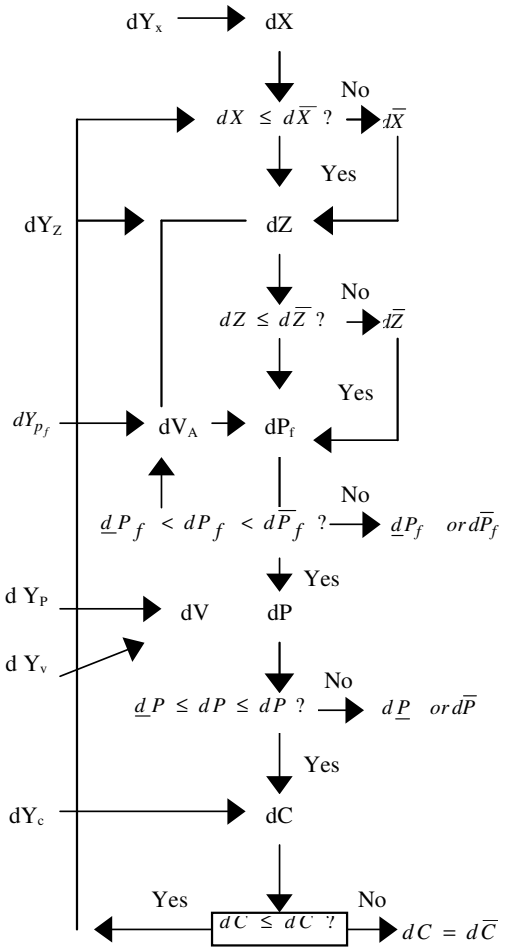


Figure A1

APPENDIX B: SOME RESULTS OF THE EXPERIMENTS

1. Static effects of transition constraints

Table B4 shows the consumption levels of households and enterprises in the various runs. These levels are measured at constant "free market" prices. The experiments concerned with violation of production efficiency appear to display a large negative effect on food supply, while the other sectors, even though directly involved in the inefficiencies, do not show significant declines. In fact, it is remarkable that the food sector seems to absorb almost all the impact of the distortions implying a break down of the efficiency rule and, as a consequence, higher prices and positive profits.

The table also shows that the main tradeoffs in the experiments on consumption lower bounds (experiments 5-9) concern food (the main sector interested), but not agriculture, the chemical sector, and, most of all, non marketable services. These are greatly expanded when marginal cost rules are violated, while they are reduced in the other experiments , presumably because of the need of transfer policies associated with the minimum consumption requirements. The introduction of upper bounds on consumption (experiments 7-9) displays a complete overturn of consumption patterns. Experiment 8, in particular, where lower bounds on food are not taken into account, and only upper bounds on construction and services are enforced, shows a collapse of consumption in all sectors. The complementarity across sectors through linkages and cross price elasticities thus appears to be such that even a moderate constraint on consumption levels in only two sectors tends to depress dramatically consumption everywhere.

The results for capital formation (Table B5) show how investment is distributed across the production sectors, as a consequence of the accumulation of products that are not consumed in the time period considered. As a general tendency, production rents (experiments 1-4) appear to induce larger rates of investment in all sectors, but especially in those, like construction, machinery, chemicals and livestock where the capital component is more important. As a consequence, one can speculate that one of the results of allowing inefficiencies to prosper is a higher degree of capital intensity, or, in some cases, simply of waste. While the experiment with minimum food consumption maintains a somewhat balanced profile, the other cases for which upper and lower bounds on production and consumption are combined (experiments 6-9) show the opposite tendency to reduce investment, specially in the capital intensive sectors.

Table B6, on the other hand, shows that the effect of production rents on government expenditure are negative, while physical constraints tend to increase the consumption by the government (and, indirectly by everybody else, of non market services. Table B7 suggests the minimum food consumption constraint as the only significant factor of change in the foreign trade balance.

Table B8, reporting the results for gross production, generally gives an idea of a more robust set of "canonical" levels than for the other variables. Production inefficiencies, however, seem to reverberate negatively only on food, while all others sectors involved show large increases as a consequence of non competitive pricing. This is somewhat surprising since one would expect a fall in production in those sectors where keeping prices above costs is equivalent to extracting monopolistic rents. As in other cases where general equilibrium solutions do not confirm partial equilibrium expectations, this result is to be interpreted as a consequence of sector linkages both on the demand and the supply side. Agriculture and food, however, are strongly penalised in experiment n. 8, where upper bounds are imposed on consumption for services and construction. This experiment differs from experiment 5, 6 and 9, where no such a negative effect emerges, only because the latter include minimum consumption and production constraints for food and agriculture. Thus, one might argue that a sort of complementarity exists between agriculture and food production on one hand, and services and construction on the other.

In other words, if agro-industrial production and consumption is supported, directly or indirectly, agri-food production expands, regardless of limitations to other sectors. If these limitations are imposed without supporting food and agriculture, instead, the result is a major contraction.

Tables B1-B11

2. Dynamic effects of transition constraints

From the consumption point of view (Table B15), household and enterprise consumption of products from the crop and the food sectors increases smoothly in response to the increases in factor endowment, with an exception only for the first unemployment spell affecting labour in the fourth year. Consumption of livestock and forestry products, however, is not so smooth. Nevertheless, the largest fluctuations occur in the case of electricity, machinery and specially services.

Capital formation (Table B16), on its part, shows a pattern of consistent growth only for machinery and construction. Government expenditure (Table B17) shows also quite wide swings. The sudden decreases are limited to the years where prices are lowest, specially for the non market services, as a consequence of labour unemployment.

On the production side (Table B19), while aggregate production and the industrial sectors grow mostly smoothly through the sequence of factor increases, agriculture shows some ups and downs, but it is mainly the non-market services that bear the brunt of the adjustment-instability. This structure of response is well reflected in the income pattern (Table B20), which shows that, aside from a minor role played by the households, it is government income that has to compensate for the bulk of the fluctuations caused by the failure to adjust continuously to the variation in factor endowments.

Tables B12-B22

Table B26 shows that the pattern of consumption for households and enterprises shows some variations over the years, but overall growth is nil. To wit: in comparison to an in increase in total consumption (at constant prices) of 131 per cent in the case of unhampered, free market growth, transition constrained growth for consumption is zero.

Capital formation (Table B27) appears to be stable and essentially unchanging for most of the sequence. A different behaviour can be observed for government expenditure (Table B28), which strongly increases, however, through the first eight experiments declines in the ninth and grows again in the tenth. But gross production (Table B30) appears to be increasing through all experiments in the aggregate, with occasional falls in sectors such as agriculture and chemicals. Finally, the income pattern of growth (Table B31) also displays an overall positive trend, even though some ups and down do appear from some intermediate experiments.

Table B23-B33

3. Exploring Property and Control rights

Tables B35-B44 present the details of an ambitious set of experiments aimed at exploring the impact of different structures of property and control rights on the market variables. In general, we can observe that contrary to what could be expected, total ownership and near- total ownership and control on the part of the government do present large differences in the range of "achievable" disequilibria. The solutions suggest that food and agriculture may be particularly vulnerable to even small differences in the pattern of ownership and control. For example, in the third experiment, where government owns 80% of agriculture, food, energy and chemicals, food production falls from 150627 mil SKK to 42946 mil SKK, and food consumption from 91463 to 4162 mil SKK.

Table B37 shows how these results affect in an extreme way households and enterprises, whose consumption would fall to zero in several sectors, unless it is supported by appropriate lower bounds on demand and upper bounds on prices, as shown in the last two columns.

While these numerical results have to be interpreted within the realm of extreme suggestions of a rather sketchy model, they do give the idea of the profound inefficiencies that may be associated to a system, whose structure is identical to a free market, general equilibrium configuration, except for the essential detail of property and control. The fact that the government, owns in the first instance the proceeds of all or a large part of the economy, in particular, and that it can, at the same time fix output and factor prices, seems to imply that consumption will be concentrated only in a few sectors, where the formation of appropriable surplus may be more profitable. This is specially evident in Table B27, that reports the gross production levels for each experiment. Here the strategy resulting from price fixing can be seen to be both extreme and unstable: in experiments 3, for example, it privileges electricity and transport, while in experiment 4 it is heavily based on agriculture, chemicals and market services. In experiment 5, the government strategy appears to rely on machinery, other manufactures and market services.

Tables B34-B44

In the final set of experiments we assume that the government owns a percentage of all resources.

Because the government account is merely a transfer fund and does not give any direct contribution to other agents, in the whole, the impact of government ownership on the economy appears to be strongly negative. For all experiments, as we can see from the Tables B45-B55, however, a positive effect does materialise on "real incomes", i.e. on the theoretical purchasing power of the various agents at the new, lower prices. Because this effect is not translated into an increase in consumption or savings, however, it appears largely an artefact of the fall in the price of capital and, consequently, of consumer prices. As Table B55 shows, if we use consumer surplus as an indicator of real income, it unambiguously falls, since consumption under extended government ownership is lower than the base solution for every sector, with the only exception of electricity in the third experiment. Only in this experiment welfare shows a slight aggregate increase.

Tables B46-B54 show the sector allocations behind these aggregate results. Food prices fall in terms of almost all prices, while prices for non market services soar. For households and enterprises, consumption and production of both these goods appear to decrease more than proportionally with the government share of the resources. Household consumption and production of crops and livestock, as well of several other sectors, also decline dramatically in the first (100% ownership) and second (80%) experiment, but they jump back almost to base solution levels in the third experiment (50% ownership). Capital formation offers a varied allocation pattern, maintaining the investment in the basic sectors (agriculture, livestock, forestry, and food) almost unchanged, while marking sharp declines in construction and, for the last experiment (50%) a very large increase in chemicals. Government expenditure, in the end proves to be the key to understand some of the reason for the changes, because of the large increase in non market services, a predictable result which accounts for most of the displacement of the pattern of the base solution.

Tables B45-B55