FAO TRADE POLICY TECHNICAL NOTES

on issues related to the WTO negotiations on agriculture

No. 6. Sugar: the impact of reforms to sugar sector policies a guide to contemporary analyses

CONTENTS

1 Introduction

This technical note[1] is intended as a guide to assist in the interpretation of a range of existing analytical studies of the impact of current sugar sector policies on world market conditions and on developing country producers, and of the insights that these studies can provide (and those that they cannot) in determining the potential impacts of future reform initiatives. This is especially important in the case of the sugar sector, since recent announcements of major reforms are yet to be fully incorporated into contemporary analytical studies.

The note first highlights the main features of global production and trade (section 2). It then briefly discusses the key distortionary sugar sector policies and explains the sources of pressures for reform of these policies (sections 3 and 4). Section 5 discusses the insights that contemporary analytical studies can provide in informing policy makers as to the potential impacts of reforms to sugar sector policy, highlighting areas where the results of such studies are contradictory and where evidence is lacking. Section 6 lists key areas for further research.

2 Global sugar production and trade

Global sugar production, in raw sugar equivalent[2], is of the order of 135 million tonnes annually, with about three quarters derived from sugar cane and one quarter from sugar beet. India and Brazil together account for 50 percent of sugar cane production, and the European Union (EU) for 53 percent of sugar beet production. The production of beet is regionally more concentrated, and more heavily supported. (See Figures 1 and 2.)

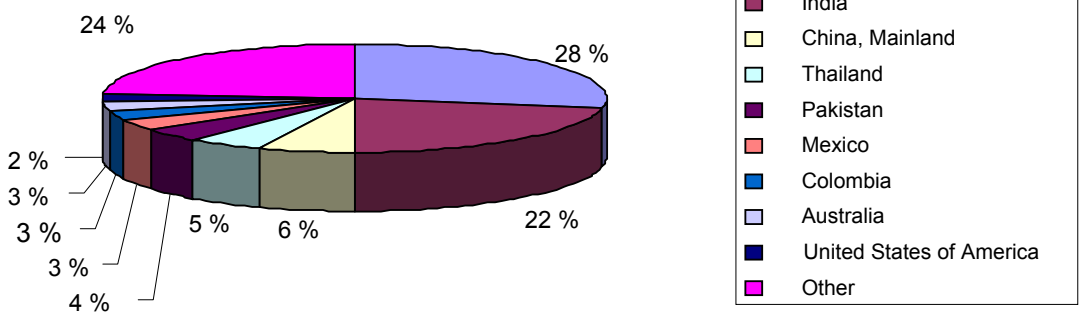
Trade, in terms of raw sugar equivalent, is heavily influenced by the export and import activity of the EU, which although a net exporter on balance, is also the main importer of sugar. The main net importers are Russia, Korea, Japan and the United States of America. The main net exporters are Brazil, Thailand, Australia and the EU. (See Table 1.)

The world sugar price has fluctuated in a band between about 5 and 15 US cents/lb (10–30 US cents/kg) since the early 1980s. The EU intervention price by contrast was fixed at €631.90/tonne in 1995/96 or almost 32 US cents/lb (70 US cents/kg), and has remained at this level since. Similarly, the United States (US) intervention price has remained relatively stable at 20–22 US cents/lb (45–50 US cents/kg). (See Figure 3.)

[1] This note is based on discussions at an informal consultation of experts involved in the analysis of sugar policy reform, held at FAO, Rome on 5-6 August 2004.

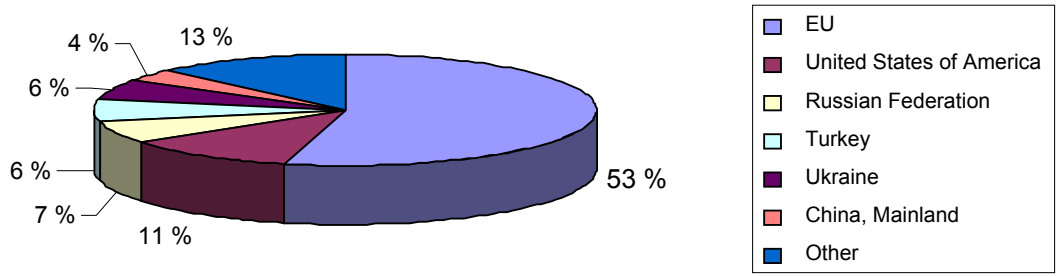
[2] 1 tonne of white sugar is equivalent to 1.087 tonnes of raw sugar.

Figure 1 - Sugar cane production 2000 - 2004



Source: FAOSTAT (2004)

Figure 2 - Sugar beet production 2000-2004



Source: FAOSTAT (2004)

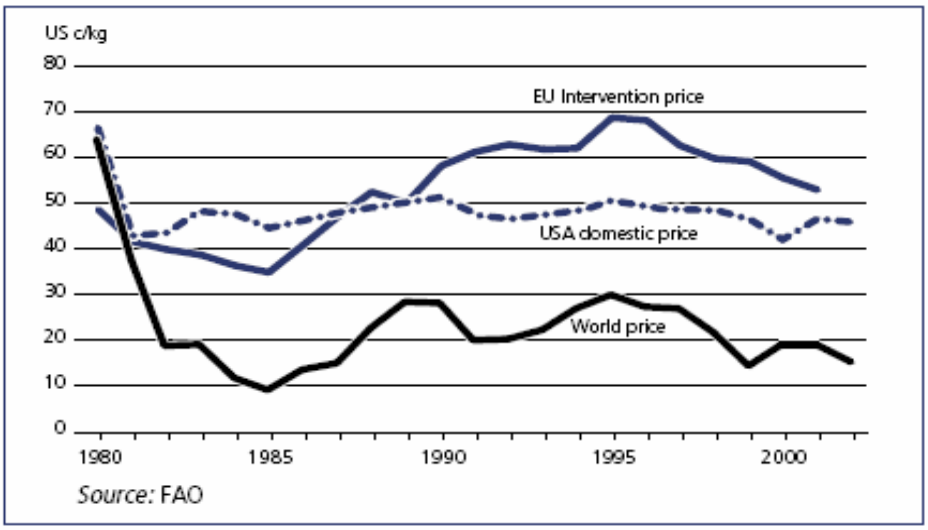
Table 1: Trade in sugar (raw sugar equivalents, average 2000–2003)

	Imports (tonnes)		Exports (tonnes)
EU	5 023 145	Brazil	11 346 046
Russian Federation	4 825 854	EU	8 628 566
Korea, Republic	1 516 569	Thailand	4 282 693
Japan	1 514 213	Australia	3 390 565
United States of America	1 426 188	Cuba	2 809 326
Indonesia	1 399 808	South Africa	1 295 260
Other	22 795 922	India	1 238 718
World	38 501 699	Mauritius	521 615
		Other	9 082 229
		World	42 595 016

Source: FAOSTAT (2004).

Note: Total world exports exceed total world imports due to the time lag between reporting exports and imports, intra EU trade, and conversion factors used between raw and refined sugars.

Figure 3 – Trends in raw sugar prices (US cents/kg)



3 Background to current sugar sector policies

Whilst the international sugar market is recognised to be highly distorted by domestic and trade policies in many countries, the extent and mechanisms of support vary widely. In assessing the impact of reforms, an appreciation of the current mechanisms is critical for both the development of analytical models and in the interpretation of their results. The focus of most analysis is on reforms to policies in the EU (see Box 1) and in the US (see Box 2). Although not impacting to the same extent on the world market as the EU or the US, Japan's sugar policy is more distorted. Raw sugar is imported by Japan at the world market price but imports are restricted to the Ministry of Agriculture, Forestry and Fishery, which then resells at a higher price to local refiners. Beet and cane producers receive high government guaranteed prices (beet prices are five times those in the US and the cane price is ten times that of Australia). Raw sugar target prices were 53 US cents/lb (116 US cents/kg) in 2001 compared to 25 US cents/lb (55 US cents/kg) in the EU and 18 US cents/lb (40 US cents/kg)in the US. Japanese production would almost certainly fall significantly if producers received current world prices.

Box 1: Key aspects of the EU sugar sector policy

The European Union's sugar policy supports producer prices at levels which are well above international prices through a combination of Production Quotas, Import Controls and Export Refunds. There are two types of quota: A and B, with the major difference between the two being the value of the levies applied. The original purpose of the quota system was threefold, namely to limit the total quantity of sugar that could potentially be imported into the EU sugar market; to limit the potential costs of intervention purchases; and to guarantee each member state a certain share of the EU sugar market. The total sugar production quota for the EU-25 is currently 17 440 534 tonnes of White Sugar Equivalent (WSE). Member States are free to produce above quota levels, but to avoid the negative impact that this out-of-quota sugar (C sugar) might have on domestic prices, it must be entirely exported outside the EU market and, further, does not receive any support in terms of export refunds.

Importantly, the EU sugar policy incorporates the EU/ACP Sugar Protocol signed in 1975, which provides ACP (African, Caribbean and Pacific Group of States) countries with a total exemption from import duties on sugar for an indefinite duration. This measure is limited to agreed quantities (1 294 700 tonnes WSE) of sugar imported from ACP country signatories of the sugar protocol. Guaranteed prices for ACP white or raw sugar are applied to specific quantities of sugar at cost insurance and freight paid prices (CIF) delivered to European ports. The price guarantee to ACP countries is fixed each year by an EU Council decision. The EU has been able to prevent competition from imported sugar outside preferential trade agreements, through the use of specific tariffs and by using additional import duties under the WTO Special Safeguard Provisions.

Box 2: Key aspects of the US sugar policy

In the US regulation is through domestic market allocations, and restrictions on imports above the bound minimum import quota. US import quotas on sugar were converted into TRQs following the Uruguay Round (UR) implementation. The TRQ is a two-tiered tariff where the tariff rate depends on the volume of imports. A low-tier tariff of 0.625 US cents/lb (1.375 US cents/kg) is charged on imports below a certain volume, (projected to be 1.21 million short tons raw value (STRV) for FY 2005) and a prohibitive high-tier tariff of 16 US cents/lb (35.2 US cents/kg) is then charged on imports in excess of the quota volume.

To restrict domestic production, a marketing allocation arrangement is implemented which allocates the amount of sugar that millers and processors can sell on the domestic market in a given year. The marketing allocation is triggered if estimates show that the projected supply (domestic production plus imports) is likely to exceed domestic demand.

Virtually all raw cane sugar, refined sugars and sugar syrups, and sugar-containing products are imported under TRQs. TRQs are allocated to some 40 countries based on historical averages for the period 1975-1981. The Dominican Republic, Brazil, and the Philippines have the largest shares (17, 14, and 13 percent, respectively). Recent declines in the overall level of imports have reduced imports of all suppliers except for the ten smallest suppliers whose allocations are limited to 7 258 tonnes. Currently the volume of imports (1.12 STRV) is at its lowest level since 1994. In addition to the TRQ, producers enjoy a support price more than double the world price for sugar. In recent years, because of poor returns to competing crops, sugar beet production has expanded and the TRQ volume has been reduced to offset this increase in production.

Source: United States Department of Agriculture (2003, 2004).

A key driver of change in sugar sector policy during the 1990s was the implementation of the Uruguay Round Agreement on Agriculture (UR AoA), where countries agreed to convert non-tariff trade barriers into tariffs through the tariffication process. Tariffs were then to be bound at maximum levels relative to the base period (1986-1988) and to be reduced over an implementation period. In addition, countries agreed to allow imports up to a minimum of 3 percent (rising to 5 percent of the base) of consumption, or pre-agreement import quantities, whichever was greater. There was concern that the tariff bindings would prohibit imports from reaching their minimum access amounts, because the base period was one of historically high protection. Therefore, tariff-rate quotas (TRQs) were established to deal with this concern. In principle, TRQs specify that imports would be permitted up to the minimum access levels at low tariffs, and larger volumes of imports would face higher tariffs under the provisions of the Uruguay Round (UR) (see Box 6).

Partly as a result of the distorted market conditions that they face, some countries that might otherwise be more competitive than the EU, US or Japan have also instituted domestic support policies. Australia in 2004 provided an AUS$444 million sugar industry assistance package and Brazil has used producer subsidies when world prices have been depressed.

In Brazil, government policy with regard to ethanol production also impacts upon the level of Brazilian exports (see Box 3).

Box 3: Brazilian ethanol policy

Brazil's sugar industry is closely interconnected with its fuel alcohol industry. During the last few years about 50 percent of Brazil's sugarcane output was used to produce fuel alcohol and the remaining 50 percent was used to produce sugar.

The national ethanol programme (PROALCOOL) was introduced in 1975, as an import substitution measure. The implementation of the programme was carried out by two institutions: the Institute of Sugar and Alcohol (IAA) controlled sugar and ethanol production and exports through implementing a production quota and fixed purchasing price of ethanol. Petrobras, a monopolistic state oil company, controlled domestic ethanol sales and distribution. The government set the sugarcane price to independent growers. A wide range of governmental investment support programmes were implemented in the 1980s as the ethanol production capacity expanded to over 16 billion litres of ethanol per year.

Radical programme reforms were introduced between 1997 and 1999. In 1997, the price of hydrated ethanol was liberalized, followed by that of anhydrous ethanol in 1999, and the Petrobras distribution monopoly was abolished. Currently, there are no restrictions on ethanol production. The instrument used by government to regulate the industry is the setting of the anhydrous blend ratio to gasoline. The actual percentage of the blend ratio is determined by the Ministry of Agriculture, as a means of balancing the relationship between supply and demand of sugar and ethanol. A blend ratio of 26 percent is set as the legal maximum blend ratio level.

Source: FAO (2003).

Production expansion at current costs in Australia and Thailand (two other major exporters) is less likely than in Brazil. Any substantial increases in exports from Australia and Thailand would have to be prompted by significant increases in the world sugar price. However, it is expected that both countries will also move towards diversification in order to lessen reliance on weak sugar prices.

It is important to consider the impact of a potential reform of the Single Desk Policy in Australia in relation to the maintenance of the Far East Premium as well as the effects of the AUS$96 million grant for less efficient farmers to assist them in leaving the industry. Under the Single Desk Policy, all raw sugar is acquired by Queensland Sugar Limited (QSL), which in turn is legally required to sell all raw sugar in the domestic market at the prevailing export parity price. However, when it comes to exporting sugar, QSL uses a CIF selling policy, meaning that the derived FOB (free on board) price for Australian exports is higher due to the high levels of the Far East sugar premium.[3]

A fourth significant sugar producing country outside the EU and the US, is India. Current OECD sugar policies have little impact on sugar trade in India, because domestic prices are already high. Imports are controlled by relatively high tariffs (60 percent applied tariff for raw sugar; 150 percent WTO-bound rate for both raw and refined sugar) plus a countervailing duty on imported raw sugar. Through a system of levies and monthly releases, the government controls the supply on the domestic market. Exports are encouraged by payment of a "transport" subsidy and by granting larger domestic "free market" sales quotas to producers who export large quantities. It should be noted that domestic prices are usually higher than world prices, so exports are usually at a loss which is then recovered from sugar mills through higher domestic prices. India's export quota to the US is 8 450 tonnes raw sugar, and to the EU its quota is 10 000 tonnes white sugar and 10 000 tonnes of raw sugar under the Special Preferential Sugar (SPS) arrangement.

4 Pressures for reform

In recent years there has been growing pressure for the reform of EU and US sugar sector policies for a range of reasons. Arguably the most important drivers of policy change are internal budgetary pressures, which have stimulated CAP (Common Agricultural Policy) reform and reductions in the support prices in the US. However, the reforms are also potentially shaped by a number of other factors, which include:

- *The recent WTO Disputes Panel ruling*

On 15th October 2004, a WTO panel ruled on a complaint brought by Brazil, Australia and Thailand against the use of EU sugar export refunds and the cross subsidisation of exports. The panel found that 2.7 million tonnes of exported EU "C" sugar was cross-subsidised by the high guaranteed prices paid for A and B quota sugar. The panel also held that an additional 1.6 million tonnes of refined sugar, which the EU exported to the world market, corresponded to the amount of raw sugar that it imported from India and ACP countries. It is likely that the EU policy will have to be reformed to avoid any potential implicit subsidization of exports in the future.

The ruling in favour of these countries is important as it could stimulate (a) faster reform of the EU sugar policy and (b) more rapid structural change in the global sugar market. Brazil is considered to have become the world's most cost efficient producer of sugar. It is the largest sugar and fuel alcohol producing country in the world, as well as the largest sugar exporter and as explained below, has the potential to expand sugar production and exports significantly. This potential, in addition to improved world market conditions, will however also depend upon the Brazilian policy towards ethanol production as explained in the previous section.

- *The Everything but Arms Initiative*

In March 2001 the EU signed the "Everything but Arms" (EBA) initiative with 48 Least Developed Countries. Under this arrangement, duties on sugar will be gradually reduced until full duty free access is granted in July 2009. In the meantime, duty free tariff quotas will be increased gradually each year by 15 percent from 74 185 tonnes in 2001/2002 to 197 355 tonnes in 2008/2009. The increase in LDC sugar imports through this tariff quota will result in simultaneously decreased imports of SPS from the ACP countries.

- *The Economic Partnership Agreements*

As part of its sugar policy reform, the EU is negotiating with the ACP countries to include sugar under the proposed EPAs. Formal negotiations of EPAs started in September 2002 and the negotiated EPAs will enter into force by 1 January 2008. The unilateral trade preferences will continue to be applied during the interim period of 2000 to 2007. The import quotas (Protocol and SPS) given to the ACP countries amounted to about 10 percent of EU domestic sugar consumption (15 million tonnes in 2004), which is clearly above the 5 percent market access required under the UR AoA.

[3] This premium is the advantage Australian sugar exports have over those of Brazil in the Far East markets, due to the lower transaction costs derived from three crucial elements: i) low freight costs (this is a real advantage Australia has over Brazil in the Far Eastern markets – hence the terminology); ii) quality assurance; and iii) reliability of supplies.

- *The Regional Trade Agreements*

Of particular concern to US policy makers are the obligations under the North American Free Trade Agreement (NAFTA), which specifies a declining high-tariff rate for both raw and refined sugar for Mexico over the transition period to free trade in 2008. In recent years, because of the large discrepancy between the world price and the US price, Mexico has been exporting sugar to the US at the high-tier tariff rate. This has put pressure on the US government to reduce allotments to quota holders of low-tier tariff sugar. This pressure will continue and can be expected to intensify as 2008 approaches. US producers are forecast to increase production and the resulting stocks under the loan programme would then become unsustainable. Other pressures on US sugar producers include the fact that sweetener production is growing by 3.2 percent and consumption by 2.1 percent annually, and that food processors are organized and lobbying for further liberalization with the aim of lowering their import costs.

5 Insights on impacts of liberalization

The pressures for reform discussed above are varied and imply potentially complex negotiation and reform as for example in the EU (see Box 4). The impact on world market conditions will be contingent upon the precise nature of the policy reform, which is itself uncertain. This combines to make modelling the impact of reform problematic.

By definition, models attempt to simplify real world complexity. The impact of current policies, and potential reforms to these policies, have been addressed at several levels. Many contemporary studies focus on the world price impact, and the debate surrounding the results of these studies tends to focus not on the direction of change, where all studies agree it will be positive, but on differences in the magnitude of the estimated increase in the world price following reform. A smaller number of studies have focused on the distribution of the gains from reform across countries, identifying which countries are likely to gain and which will lose following a reform. At a more disaggregate level still, are analyses investigating the impact within individual countries, for example in terms of employment and income effects.

It is extremely difficult to compare the various studies and models that have been developed. The studies were all conducted at different points in time, utilizing different databases and country/region aggregation, and using different modelling approaches.

By way of illustration, Table 2 shows a range of world price projections from different studies for selected trade liberalization scenarios. The table demonstrates two fundamental points (a) different studies perform quite different types of simulation and (b) similar simulations contribute to often widely different estimated world price increases.

Similarly, projected impacts in terms of trade flows differ widely across studies both in terms of their magnitude, and in some cases, in the direction of change. Presenting a cross tabulation of projected trade impacts across all studies and all scenarios would be problematic, not least because many of the studies do not present the impacts on net trade flows for each of the simulations. However, a comparison of the simulation of the implementation of the Uruguay Round Agreement on Agriculture in Devadoss and Kropf with the similar simulation in Wohlgenant,

Box 4: Responses to the pressures for reform – example of the EU

In response to the various pressures, the European Commission made a proposal for the reform of the EU sugar regime in July 2004.[1] The proposal calls for a significant reduction of the institutional support price (20 percent by July 2005 and 33 percent by July 2007). A reference price will be introduced with the intention of establishing a new minimum price for sugar beet producers, with partial compensation for producers in the form of a direct decoupled payment within the CAP budget limits, with the same historical reference period, used in the 2003 CAP reform (2000–2002). This payment will be integrated into the EU single farm payment scheme.

Associated with this price reduction is a proposed simplification of the present quota system by merging the A and B quotas into one quota and the reduction of the resulting total quota level by 2.8 million tonnes in order to achieve a balanced EU sugar market. It is proposed that the C sugar provisions will remain as at present. Subsidized export quantities will be cut by 2 million tonnes. The EU sugar sector will be restructured through transferability of quotas between Member States and a sugar factory conversion scheme will be introduced in order to facilitate the necessary adjustments.

[1] Commission of the European Communities, Communication from the Commission to the Council and the European Parliament: *Accomplishing a sustainable agricultural model for Europe through the reformed CAP – sugar sector reform.* Brussels 14/7/2004.

Table 2: Percent changes in world sugar prices from different types of trade liberalization scenarios (percent change from base)

Study/Trade Liberalization scenario	Developed countries only	US only	EU only	US and EU combined	Multilateral liberalization
Beghin *et al* (2003)		13.2			
Elobeid and Beghin (2004)					47*
Koo (2003)		32.8	21.6	68.2	
Wohlgenant (1999)	10				43.2 (7**)
Devadoss and Kropf (1996)					9**
Sheales *et al*. (1999)		17.0			

*Elobeid and Beghin (2004) uses the same model as in Beghin *et al* (2003).

**Simulation of UR only.

illustrates the difficulty in determining the magnitude and direction of change. Both studies project an increase in US imports (25 percent in Devadoss and Kropf for the year 2001, and 9 percent in Wohlgenant for the year 2000), and both project a decrease in EU exports (0.58 percent and 9.5 percent respectively), but whilst Devadoss and Kropf project increased exports in each of Australia and Brazil, Wohlgenant projects decreases in exports from both countries.

6 Reasons for the differences in results of the studies

The variation in estimates of world price increases or net trade impacts across studies results from a number of factors: what is being modelled; the model structure; the policy specification in the model; the parameter estimates used, and the baseline data among others. In the following sub-sections, these factors are discussed in detail.

- *What type of policy reform is being modelled?*

In comparing results across studies, it is critical to associate the relative magnitudes of the estimated price changes with the type of simulation performed. The simulations compared in Table 2 are listed as being for (a) trade liberalization in developed countries, (b) trade liberalization in the US only, (c) trade liberalization in the EU only, (d) trade liberalization in the US and EU simultaneously, and (e) multi-lateral trade liberalization. However, the degree of liberalisation modelled differs between models and the simulated reforms do not therefore necessarily coincide with contemporary reform proposals. Therefore the magnitudes cited should be treated as being indicative in seeking to inform debates related to sugar sector reform.

Devadoss and Kropf (1996) modelled the impact of trade liberalization under the UR. The simulation was performed by comparing baseline projections to 2001 with the projections of full implementation of the UR AoA, which included reducing aggregate measures of support, tariff equivalents, and export subsidies and increased import access. The world price was estimated to increase by 8.8 percent following full implementation of the UR.

By contrast, a model developed by Benirschka, *et al.* (1996) was used by Koo (2003) to simulate the effects of elimination of import restrictions and the loan rate programme in the US, and elimination of import restrictions in the EU. These simulations were conducted in the same way as the Devadoss and Kropf study by comparing baseline projections with projections simulating the policy changes. Simulations were performed for removal of trade barriers in the US and the EU separately and then jointly. The Caribbean port price (a proxy for the world price) is predicted to increase 32.8 percent in 2004 compared to the base scenario if only US barriers are removed, 21.6 percent if only EU barriers are removed, and 68.2 percent if barriers in both countries are simultaneously removed.

Wohlgenant (1999) simulated a number of possible trade scenarios. Simulated results were obtained for the UR AoA implementation, partial and complete unilateral trade liberalization, partial and complete trade liberalization in developed countries, and partial and complete trade liberalization in major developing countries. The simulations indicate that the world raw sugar price could increase 43.2 percent with complete trade liberalization, 10 percent with complete trade liberalization in developed countries (US, Canada, EU, other Western Europe, Australia, New Zealand, Japan, South Africa, and Israel), and 17 percent with complete trade liberalization in major developing countries (Brazil, China, India, Indonesia, and Republic of Korea).

Elbehri *et al*. (2000) performed three simulations to determine net trade impacts (price effects are not reported): (i) Partial TRQ liberalization (33 percent reduction of out of quota tariff and 33 percent expansion of TRQ) in the US only, (ii) EU sugar liberalization only, and (iii) multilateral sugar trade liberalization. Their analysis shows that EU sugar import liberalization has a much greater impact on world sugar trade balances, including regional welfare effects, than does US sugar liberalization alone.

Beghin *et al.* (2003) model the liberalisation of the TRQ for the US sugar industry. Counter-factual simulations of US sugar trade liberalization

show that even with less than complete pass-through of sugar cost savings, consumers would benefit relative to losses incurred by producers and processors, and total net welfare gains would be large. Moreover, world raw sugar prices would increase by 13.2 percent.

- *What is the model structure and the level of aggregation adopted?*

The model structure, and importantly, the degree of country aggregation plays a key role in determining the results of the studies and their usefulness for informing contemporary debates. The majority of studies are similar in terms of their level of aggregation, focussing on the major producing countries, particularly those in which there is substantial government intervention. However, they seldom disaggregate at the level of the developing countries most likely to be impacted by policy reform in the more protectionist countries. This limits the extent to which the models can be used to determine impact over and above the world market price effect.

Elbehri *et al* (2000) use a general equilibrium model derived from the Global Trade Analysis Project (GTAP) model, consisting of 20 regions and 13 tradeable sectors. Devadoss and Kropf (1996) use a non-spatial equilibrium model consisting of 21 countries/regions. The Benirschka *et al.* model is similar in structure to the Devadoss and Kropf model, but only includes 17 sugar-producing and sugar-consuming countries/regions. Beghin *et al* define 29 countries/regions.

The OECD (2004) sugar model covers 15 countries and 5 regions. Individual countries include Argentina, Brazil, Canada, China, Cuba, India, Indonesia, Japan, Republic of Korea, Mexico, Russia, South Africa, Thailand, and the United States. The region coverage includes an aggregate of ACP countries, the enlarged EU, and the rest of the World. At a less aggregate level, Wohlgenant (1999) developed a multi-region, non-spatial equilibrium model of the world sugar market consisting of 42 countries/regions.

The degree of aggregation depends upon the purpose of the study, and the extent of data availability. One reason for the relatively similar results is that country groupings at an aggregate level are similar across the studies. Comparisons suggest that the aggregate elasticities for the OECD model and the aggregate elasticities derived from the Wohlgenant study are very close. The aggregate elasticities from the CARD sugar module (Beghin *et al.,* 2003) are also likely to be very similar because the forecast effect of multi-lateral trade liberalization on world sugar prices is very close (47 percent) to Wohlgenant's prediction (43 percent).

A problem with such aggregation however, is that within aggregates the gainers tend to cancel out the losers and the overall impacts on country groups can appear small. This also makes the identification of winners and losers difficult.

Elobeid and Beghin (2004) underline the fact that removing all policies would cause a significant production relocation away from protected OECD markets (the European Union, Japan, and, to a lesser extent, Mexico and the US) and toward producers in competitive countries, chiefly Brazil, Cuba, and Australia. However, the nature of reforms can have very different implications for individual developing countries. For example, if existing OECD polices are adjusted to accommodate higher imports from EBA countries and NAFTA, it has been suggested that many low-cost producers, such as Brazil, will lose because they do not currently have large quotas and are not ACP, EBA, or NAFTA countries.

On the other hand, Huan-Niemi and Niemi (2003) argue that the EU reform proposal is likely to devalue the EBA initiative. The reduction of sugar prices will not facilitate investment in most of the LDCs. They also argue that ACP countries will lose export income from sugar exports to the EU of more than one third on the basis of the proposed 37 percent price reduction alone.

Results from the aggregate studies discussed above suggest that while most developing countries would gain access to more markets from trade liberalization, these gains would be offset by quota rent losses from eliminating TRQs in importing countries (particularly from the EU and US). As a group, with complete trade liberalization and complete elimination of transfers from the EU and US, export earnings of developing countries could fall by 18 percent (Wohlgenant 1999). For the Small Island States (SIS) aggregate, a smaller decline of 4 percent in export earnings is projected (Wohlgenant 1999). The analysis reveals that the transfers from the EU and US to ACP and SIS due to quota rents are worth between 27-31 percent of their export earnings.

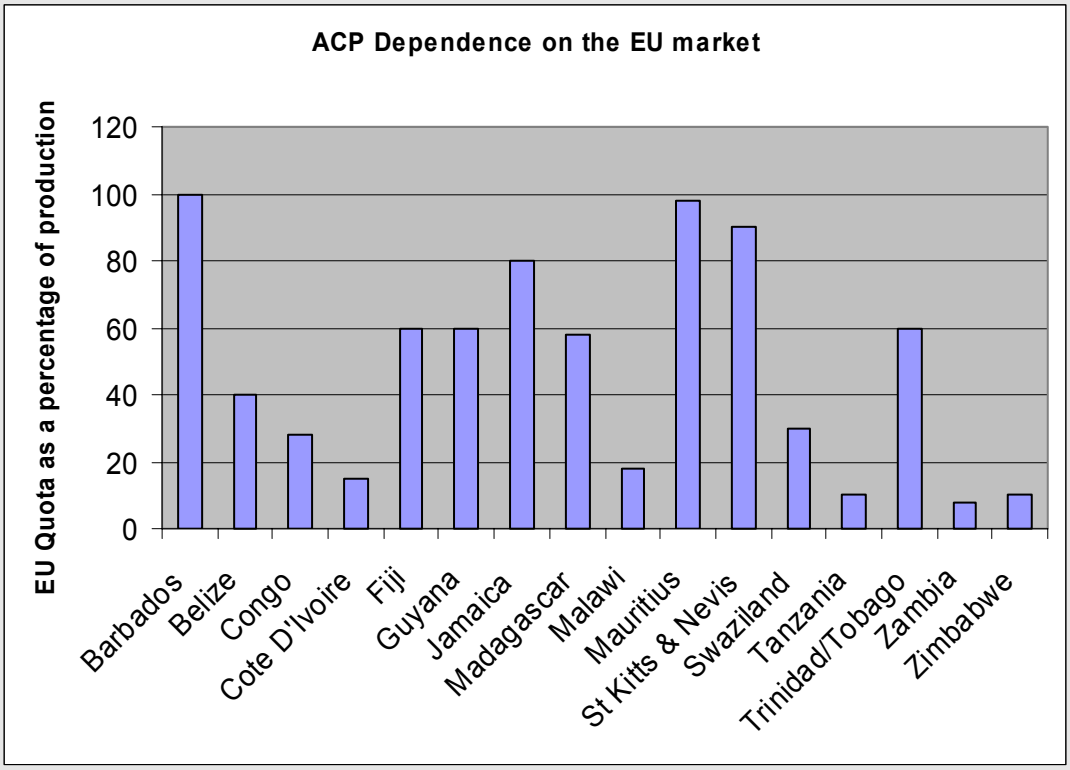
However, analysis at a more disaggregate level suggests that the impact of EU reform on ACPs is ambiguous. Whilst there is the opportunity for some countries to expand exports to the EU after 2008, others, despite the existence of preferences, are currently not profitable even at the high price of 25 US cents/lb (55 US cents/kg) (LMC, 2004). Box 5 discusses the types of insights that the non modelling analyses may provide. A fuller discussion of the relative merits of such approaches is provided in the following text.

Box 5: Disaggregate analysis - Insights from non-modelling studies

Given the limitation of models with respect to developing country detail, analysts have sought alternative mechanisms for attempting to determine the effect of reform on these countries. For example, the implication of the reforms for individual ACPs is argued by LMC to depend on factors including their level of dependence on the EU market, their ability to survive a reduction in profitability and on the level of future access under EPAs (or EBA for ACP LDCs).

Dependence on the EU Market

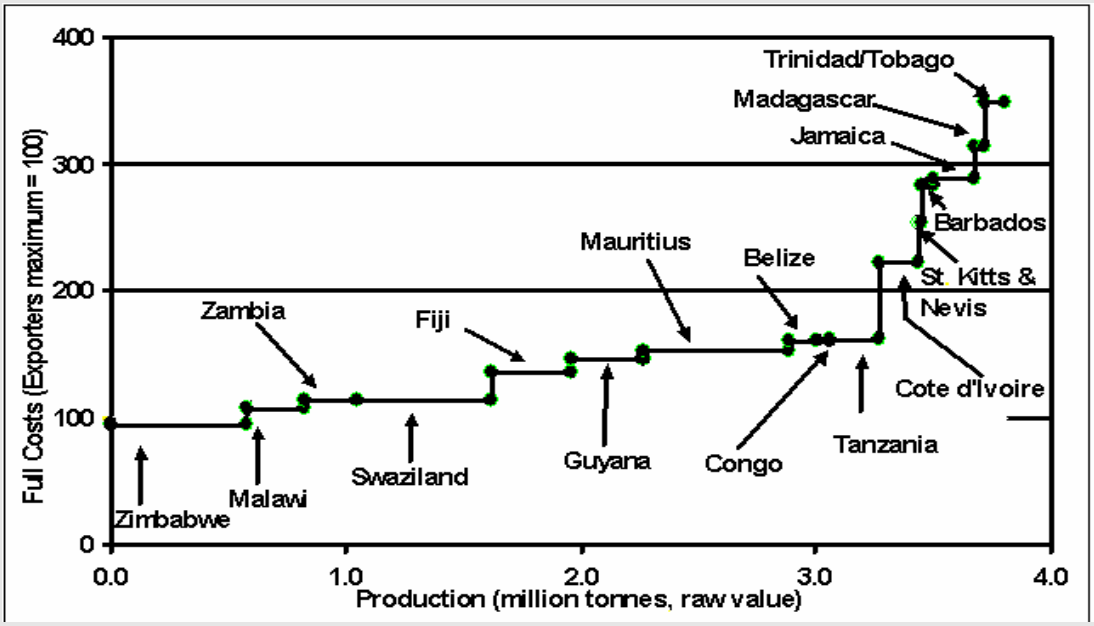
The level of dependence varies significantly across the ACP countries, with the EU quota equal to100 percent of production in Barbados, but less than 20 percent of production in Malawi, Cote d'Ivoire, Zambia and Zimbabwe.



Source: Adapted from LMC (2004).

Production costs

To assess the extent to which ACP countries could withstand competition under liberalised market conditions, LMC estimates the degree to which their current production costs compare with the highest cost prevailing among the world's leading free market exporters. Therefore, if a country can supply sugar on a FOB basis at a cost that is equal to or below this level, then it is likely to have a viable export oriented sugar industry. The graph below indicates relative production costs on the vertical axis representing a three year average for 2000 to 2002. These costs are expressed relative to the highest cost prevailing among the world's leading free market exporters, the *World Exporters' Maximum,* which is set at 100 for the purpose of comparison, and represents the maximum cost level of the leading free market exporters. The table shows that among the ACP countries only Zimbabwe sits on the 100 mark, and generally the lowest cost ACP producing countries are found in southern Africa, whereas the highest cost producers are found in the Caribbean. *Production* volumes are shown on the horizontal axis and represent a three year average from 2000/01 to 2002/03.



Source: Adapted from LMC (2004).

Economic Partnership Agreements (EPAs)

The implications of EPAs will depend critically on the price received by producers. The future price within EPAs will depend on whether the EPA region is a surplus or a deficit region. In deficit regions, the producer price will be determined by the import parity plus tariff. In surplus regions (e.g. Eastern and Southern Africa), if prices move towards the export parity price, then countries will supply the EU rather than the regional market. In addition, the implications of rules of origin are unclear and require more analysis. Additionally, analysis of EPAs is complicated by overlap with existing RTAs.

It is also important to consider whether the agroclimatic opportunities in the first group of countries as well as the state of political stability in these countries would allow production expansion.

On the basis of the analysis, three subgroups of countries are suggested by LMC. *Group 1* includes those countries that are low cost producers, have low exposure to the EU and/or could survive at a lower world price; *Group 2* includes those that could survive with restructuring, but would be highly susceptible to developments in other countries; and Group 3 includes those countries unlikely to survive.

Group 1	Group 2	Group 3
Congo	Fiji	Barbados
Malawi	Guyana	Belize
Swaziland	Mauritius	Côte d'Ivoire
Tanzania		Jamaica
Zambia		St Kitts
Zimbabwe		Trinidad

• *How are sugar sector policies specified in the models?*

A third way in which models differ is in the detail and manner in which individual policies are specified. Many of the earlier models use a fairly generic approach. Devadoss and Kropf is typical, in that the effects of domestic and trade policies on production, consumption, stocks, and trade are modelled at the country/region level. For each country/region, supply, demand, and price linkage relationships were estimated for raw sugar using data from 1970-1992. The supply component consists of separate sugarcane and sugar beet area planted equations and total sugar production. Demand is influenced by both consumption and ending stocks. The effect of trade and domestic policy is captured through a price wedge (see below) between domestic or internal prices and the world price of raw sugar. Examples of the tariff equivalents estimated by Devadoss *et al.* are 149 percent and 46 percent for the US and Brazil respectively. The model also allows for less than complete price transmission, with more regulated sectors having lower transmission coefficients than less regulated, for example the US at 0.46 as opposed to Thailand and Indonesia at 0.90.

In Benirschka *et al*., area and yield equations are specified and estimated for both sugarcane and sugar beets. The area equations are dynamic equations, where sugar area harvested is expressed as a function of lagged acreage, lagged raw sugar price, lagged alternative crop price, and a domestic policy variable defined for example for the EU as the lagged sugar quota quantity. Per capita sugar consumption is specified as a function of raw sugar price, per capita disposable income, and trend to represent changes in consumer tastes and preferences. End of the year stocks are expressed as a function of beginning of the year stocks, quantity of sugar produced, and raw sugar price. Where estimated functions did not perform well, expert judgement was used to inform assumptions regarding the model parameters.

In Wohlgenant's model, which uses a combined beet and cane supply response equation, only baseline quantities and prices and elasticities of supply and demand are needed to implement the model. Most of the elasticities were estimated with country data over the period 1970--1995, with indices of weighted averages of prices used for country aggregates. Where estimated elasticities were counter to *a priori* expectations, elasticities were specified on the basis of previous studies. Particular attention in this study focused on the influence of high fructose corn syrup (HFCS) on sugar demand in the US. Domestic prices were related to the world raw sugar price by modelling the wedge as the *ad valorem* tariff (based on bound tariffs agreed to in the UR). These were estimated at 175 percent for the US, 70 percent for the EU and 337 percent for Japan.

Elbehri *et al.* (2000) provide the most explicit model to date regarding treatment of TRQs. The impact of TRQs on economic rents to exporters is modelled at the country level and compared to benefits to exporters from trade liberalization. In-quota ad valorem equivalents were estimated at zero percent for the EU and 2.44 percent for the US, whilst out of quota tariffs were estimated at 147 percent and 129 percent for the EU and US respectively. Models incorporating TRQs have attempted to specify the selection of the price wedge based upon the level of import, i.e. a low level of import within quota would be paired with the in-quota tariff, and volumes exceeding the quota would be paired with the higher out of quota tariff. However, as indicated in Box 6, modelling the responsiveness of imports to changes in prices when a TRQ system is in place is problematic.

Box 6: The importance of incorporating TRQs

The treatment of the TRQ in the models is critical. Developing countries have been concerned that how TRQs are implemented impacts on market access. The fact that quota underfill has been prevalent since the UR underscores this concern and the focus of the WTO on addressing complicated administrative methods believed to act as a non-tariff barrier to market access (Abbott 2002).

If over-quota tariffs are prohibitive, the quota will be binding. The rents created by quotas, complicate analyses of the overall impact of reform since countries receiving rents will lose in addition to domestic producers. Besides this complication of accounting for quota rents, prohibitive over-quota tariffs pose further problems in predicting the effects of reform because the effects on trade volumes seem to depend upon the particular method by which quota is allocated. This presents problems for economists attempting to quantify the effects of trade liberalization because market supply and demand responses under the TRQ regime are less clear.

Beghin *et al.* (2003) specify detailed supply and demand relationships for the US sweetener sector. Particular attention is given to the interaction between the domestic sugar programme and the TRQ. In addition, the issue of imperfect competition in the sugar processing sector is addressed by allowing for less than full pass-through of cost savings from trade liberalization on US consumers.

The OECD (2004) model is the most detailed with respect to domestic and trade policy. The model contains 431 equations with prices determined by the model including (i) world refined sugar, (ii) world raw sugar, (iii) refined sugar in the EU-15 (2003) and EU-25 (2004), (iv) raw sugar in Mexico until full integration with US sugar market, (v) refined sugar in the US, (vi) sugar in China, and (vii) ethanol in Brazil.

Consumer demand is modelled as a function of own price, income, and other sweeteners price. Stock demand is a function of stock capacity and speculative motives. Trade falls out residually in most components and is distributed between refined and raw on the basis of price margin and past share – i.e. trade flows, as in most models, are not the key focus. A weakness of the model is the fact that the ACP is modelled as an aggregated block.

A key area of contrast between the studies is the specification used to depict relationships between domestic and world sugar prices. It has become customary to estimate the price equations with econometric methods (e.g., Devadoss and Kropf, 1996). The problem with this approach is that the price wedges estimated include the trade and domestic policy distorting effects, so when simulating the effects of removal of these distortions the price relationships themselves will change. In contrast to this approach, one could either use tariff equivalent rates as price wedges (e.g. Wohlgenant, 1999), specify the price wedges using actual data on transaction costs, tariffs, etc. (OECD, 2004), or a combination of the two (Beghin *et al*., 2003). One problem in using the tariff equivalent approach is that TRQs are not well reflected by tariff rate equivalents. Moreover, tariffication reflects the maximum rates that may not have been applied by many countries (Abbott 2002). The estimates used in Wohlgenant and in Elbehri *et al,.* and in Devadoss and Kropf as recorded above, are for example, significantly different.

- *How is the responsiveness of supply modelled?*

Assumptions made regarding the responsiveness of sugar sectors to changes in price levels are critical in influencing both the estimated world price impact, and in determining the extent to which different countries/regions gain or lose from a given policy change.

A comparison of price elasticities across the analytical studies (where they are specified) indicates that for key countries, elasticities are similar in the OECD, Wohlgenant, and Devadoss and Kropf studies (Table 3). The table also demonstrates that assumptions of elasticity values are often derived from previous studies. For example, Wohlgenant uses elasticities for Brazil and Mexico from Devadoss and Kropf. The use of estimates from previous studies brings with it the danger of carrying over errors in estimation from one study to another.[4]

The Beghin *et al*. study is different from the others in that cost function specifications are used to describe sugar and HFCS refining, and a demand model is used to calibrate parameter estimates making use of elasticity estimates from previous studies. The purpose in this modelling strategy is to make the resulting model consistent with individual consumer demand and production theory so that there is no ambiguity in the results when using the model for welfare estimation. It is notable that many of the supply elasticities reported are very small, even in comparison with those of other studies

Similarity in estimates is also notable at the aggregate world level. The OECD model estimates an intermediate aggregate supply elasticity of 0.23 and aggregate demand elasticity of -0.14 and the Wohlgenant model produces intermediate supply and demand elasticities of 0.21 and -0.24, respectively.

Table 3: Comparison of sugar price elasticities for selected countries

Study/ Elasticity	Supply Elasticity	Demand Elasticity
OECD		
US	0.6*	-0.82
EU	0.21*	-0.10
Brazil	0.41*	-0.04
Cuba	0.38*	-0.45
Mexico	0.72*	-0.12
ACP Countries	0.08*	-0.34
Wohlgenant		
US	0.29*	-0.44
EU	0.22*	-0.12
Brazil	0.09*	-0.01
Cuba	0.1*	-0.23
Mexico	0.89*	-0.02
ACP Countries	0.17*	-0.13
Devadoss & Kropf		
US	0.22**	-0.04
EU	0.23***	
Brazil	0.09	-0.01
Mexico	0.89	-0.02
Beghin *et al.*		
Brazil	0.07	
Cuba	0.01	
Mexico	0.002	
Thailand	0.014	

*Intermediate run (five year) adjustment period.
**For sugar beet production only.
***For Quota A sugar only.

As noted above, assumptions related to the responsiveness of supply are critical in determining estimates of impacts in terms of price effects and in the identification of winners and losers.

The supply response of Brazil for example, has been identified as a key determinant of future global sugar market conditions. As noted above, Brazil has not expanded exports significantly in the face of previous price increases and previous estimates of supply elasticities have therefore been low (at or about 0.1). The assumption that a similar magnitude of response will occur in the future has however been questioned by experts

[4] A fuller discussion of the estimation of supply elasticities is provided in the FAO Technical Note on Domestic Support.

who believe that Brazil now has significant capacity to respond to relatively small increases in export prices. A problem for analysts is that on the basis of historical data, under different policy conditions and where responsiveness was low, it is not possible to estimate an elasticity that conforms with contemporary observations.

A question that arises is why Brazil now has the capacity to expand production and export levels. One reason is that Brazilian infrastructure has developed to a sufficient level. The historical pattern of agricultural expansion in Brazil has been that cattle production is the first to expand into new land as it needs limited infrastructure investment. As infrastructure improves, soybeans take over the land. Sugar comes next needing greater investment in infrastructure. In many parts of Brazil, the level of infrastructural development is now sufficient to allow a transition to sugar production. Past sectoral and macro policies in Brazil also explain limited past expansion of sugar production. In the mid 1990s the exchange rate overvaluation made the sector uncompetitive. This has been corrected since 1999 and Brazil's share of the world market has since increased.

- *What do the estimated price increases actually mean?*

The assumptions regarding supply response have obvious implications for the model results and their interpretation. A number of the studies reviewed above estimate significant price increases (greater than 40 percent for full multilateral trade liberalization). However, most sugar experts argue that Brazil's potential supply response would prevent increases in price of this magnitude. A 10 percent world price increase could increase Brazilian production significantly. Therefore if a model is predicting a 40 percent increase in the world price, the argument is that it is not accurately accounting for Brazilian supply response potential. It should be noted that models using the GTAP framework assume a continuation of historical export patterns. Therefore when the EU for example, liberalizes and prices increase, an increased Brazilian response is not expected because it has faced significant barriers to trade in the past as explained above.

An alternative approach is to determine the relative production costs that would allow countries to enter the market as competitive players at different world prices, as used by LMC (see Box 5). The price at which Brazil will be willing to increase supply will depend on the cost of production in Brazil and the profitability of other crops. A profit equalizing price (i.e. a price at which the production of sugar becomes more favourable than that of other crops) is estimated at about 8-9 US cents/lb (17.6-20 US cents/kg). Analysts estimate that production costs in Brazil may be as low as 6.9 US cents/lb (15.2 US cents/kg), with a higher range estimate of 7.48 US cents/lb (16.5 US cents/kg). Even the higher rate is competitive when compared to the average world price of 10.27 US cents/lb (22.6 US cents/kg) during the 1990s.

However, there are a number of problems in using production cost estimates to determine future supply response. In particular, analysts need to:

- consider the profitability of a country's production net of transport costs. The freight rate will have significant effect on the capacity to export to new markets. Fobbing (domestic transport and handling) costs from the mill to port are often in excess of US$50/tonne. Assuming an import price to the EU of US$329/tonne, and subtracting US$40/tonne for freight and US$100/tonne for fobbing, leaves a return of US$180/tonne ex factory, which is not an attractive price for most suppliers.
- consider the investment climate. There must be appropriate conditions (for example competitive interest rates) to provide the incentive for expansion of production, not just cost advantages given the existing capacity.
- note that opportunity cost is not the same as the production cost. The LMC approach uses an engineering cost approach, providing only one point on the average cost curve, which in itself provides little information on the supply response since it is the marginal cost and not the average cost that guides economic production decisions.
- note that the lowest cost producer will not necessarily respond fastest or most significantly to a price increase. For example, likely constraints to LDC export supply include: fast growing and high priced domestic markets (many LDCs are net importers); high transport costs to the EU; enhanced access to regional markets under EPAs; and high investment costs due to the reliance on imported capital.

Another important aspect that is not captured in the production cost approach is the specification of the length of time for adjustment to a price change. Trade liberalization by its nature is not considered to be transitory but permanent and therefore it would make sense to use longer run elasticities in policy analysis. Unfortunately, it is not always possible to determine from past studies what length of run the elasticities were estimated for. In fact, more attention has centred on developing short-run estimates, which are not as appropriate for policy analysis. A case in point is estimation of stock demand elasticities. There is no question that stock-holding is significant and important for sugar, especially given the volatile world prices. However, speculative stock-holding

is not an important determinant of demand in the intermediate and long run. Therefore, for policy analysis related to trade and domestic reform, it would seem prudent to focus more on estimating long-run determinants of demand and supply within each country.

- *How do baseline projections differ?*

When evaluating the estimated price increase of a model, users need to be aware of the baseline price from which the projection is made, because of the wide variation in world sugar prices from year to year. For example, a 40 percent increase against a 12 US cents/lb (26 US cents/kg) base is more significant than the same percentage increase against a 9 US cents/lb (20 US cents/kg) base price. Unfortunately, baselines are not recorded in all of the studies reviewed. In Wohlgenant's study, a base of 1993-1995 with an average world price of 11.9 US cents/lb (26.2 US cents/kg) is used. Devadoss *et al* project a base over the period 1993-2001, recording a price of 12.78 US cents/lb (28.15 US cents/kg) in 1995. The model in Beghin *et al* is calibrated to 1996 and to 1998. In 1996, the actual world price was 12.24 US cents/lb (26.6 US cents/kg), but in 1998 had fallen to 9.68 US cents/lb (21.3 US cents/kg). It should be noted that the estimated price increases are interpreted as being indicative of an increase over a long term trend. Experts believe that 9 US cents/lb (20 US cents/kg) is a more realistic long term projection than the 12 US cents/lb (26 US cents/kg) that is implied as the baseline in some studies.

- *How is the demand side modelled?*

On the demand side, what is relevant for raw sugar as well as refined sugar is derived demand, but it is not clear from the studies reviewed whether this is always the demand response parameter being estimated. Derived demand estimates used in the model should reflect both processor and consumer response in all affected markets, not just consumer response or processor response.

An important determinant of demand for raw sugar is the substitute product HFCS. Haley (1998), in a comprehensive analysis of sweetener demand, estimates a derived demand elasticity for raw sugar of -0.8 in the US. Referring to table 3, both the OECD and Wohlgenant studies concur with this level of demand response, much higher than that used in other studies. However, if research suggesting HFCS is linked to obesity is substantiated, there could be a substantial substitution towards sugar.

7 Areas of consensus and further research

That the world sugar market is highly distorted is not disputed. Similarly, there is consensus that the pressure for reform of sugar policy regimes in many regions is intensifying. However, it is in estimating the impact of potential reform scenarios where this consensus quickly breaks down.

While the results of modelling exercises that are focused on sugar sector reforms predict significant increases in the world sugar price, albeit to varying degrees, depending in part on the scenario under investigation, qualitative studies and expert opinion suggest that such results may be misleading. Prices are unlikely to increase to the extent predicted because the ability to increase exports to supply the market is likely to be greater than assumed in the models.

This does not mean that there will be only minimal impact on sugar producing countries following reforms. Whilst the world sugar price may not increase significantly, trade flows and regional production patterns will almost certainly change as markets become more accessible to competitive producers and as higher cost producers become more exposed to competition.

However, current modelling approaches tell us little about which countries will gain and which will lose. Although most studies specify the "larger" players, smaller developing countries in particular are treated at a high level of aggregation, meaning for example that the impact on individual countries within the ACP grouping as a result of preference erosion is not adequately captured.

With reference to such limitations, key issues warranting further investigation have been identified to include:

- A better understanding of the ability of different countries to respond to changing price incentives and access to market opportunities, for example, taking into consideration new information on variables such as the current relative costs of production in Brazil.
- The development of less aggregated models which focus on trade flows and production patterns rather than price and welfare indicators and which are able to provide insights as to how smaller developing countries are affected.
- Models that more fully address the multiplier effects associated with sugar production, elaborating on issues that address employment and income generation, food security and poverty alleviation.
- Qualitative studies focused on the issue of sugar demand, defining the role of sweeteners and the extent of competition between these and sugar within the framework of new reforms especially in the US.

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