

Modelling the EU Sugar Policy

A preliminary study of policy reform scenarios

by

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Abstract

In this paper we present and model in an applied global general equilibrium framework (GTAP) the EU sugar policy, and undertake a few illustrative policy reform scenarios. Particular attention is given to the modelling of the quite complex quota regime and the calibration of the model, including the determination of the marginal cost of producing sugar beets, in the EU member countries.

Three scenarios are analysed using the developed model and database. The chosen scenarios are all motivated by the recent reform proposal by the EU Commission. They include 1) a 25 per cent reduction in intervention prices with no direct compensatory payments, 2) a 25 per cent price reduction with compensatory payments to land, and finally 3) a 8 per cent reduction in the sugar quota.

This paper reports work in progress, and all the results presented are therefore to be considered as preliminary. It is concluded that the results depend critically on the chosen calibration of the model and, in particular, the identification of the individual member countries as either high, medium or low cost sugar beet producers. Nevertheless, given such a categorisation of the member countries, the model results – being quite rich in terms of interesting qualitative and quantitative results - clearly illustrate the very different regional impacts of a given reform scenario. The impacts of price cuts versus quota reductions will also be very different across the EU member states.

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1. Background and objective of study

The EU is under pressure to reform its sugar regime. Following the Uruguay Round Agreement on Agriculture, the EU is bound to reduce border protection and to limit the quantity of supported exports of sugar. In addition, the prospective for enlargement of the EU is increasingly causing concern in regard of the budgetary consequences of high support for agriculture. The inclusion of Central and Eastern European Countries in the present EU market regime would greatly increase the potentials for surplus production of sugar, and enhance the financial burden of the market regime in the EU.

In an attempt to tackle these problems, the European Commission is heading for a major revision of the sugar regime, involving three options (European Commission, 2000a):

- a price reduction following the Agenda 2000 model combined with a compensation to the producers for the loss of income,
- a progressive reduction in prices over a number of years,
- a continuation of the present price level and minor adjustments of the quota level.

In the first option, the Commission envisages a 25% price cut and a 50% compensation to farmers for loss of income. According to the report, this could have important budgetary consequences for the EU, and necessitate reopening the discussion of the financial framework of the Agenda 2000 reform. The second option is expected to require significant price reductions to have any real effect on production, competitiveness, and on the market. Even if distributed over several years it would – according to the report – entail substantial cumulative effects on producers' income, raising a demand for compensation from producers. The third option builds on an extension of the present regime, involving minor revisions including a reduction in sugar quotas of 115,000 tons in order to fulfil the WTO obligations on restrictions of supported exports.

As the sugar regime is scheduled for revision by 1 July 2001, the EU Agricultural ministers met in May 2001 to discuss the reform paper presented by the EU Commission. The outcome of that meeting was an interim continuation of the present regime for 5 years, maintaining the present price level, and reducing the quota as mentioned (Agra Europe, 2001). The EU ministers also agreed to discuss the EU sugar regime again in 2003.

This paper presents and model in an applied global general equilibrium model the EU sugar regime at the member level. We investigate the impact of a reduction in the EU guaranteed prices for sugar of 25% with and without compensating farmers for loss of income by way of direct payments. In order to demonstrate the effects of different market regimes, a quota reduction scenario is also investigated.

2. The EU sugar scheme

The EU market regime for sugar features high border protection, guaranteed prices for limited quantities of production, and public support for re-export of sugar imported on preferential terms (Box 1).

The total production of sugar in the EU amounts to about 17 million tons. Total exports have in recent years accounted for about 6 million tons, of which 2-3 million tons is C-sugar exported

without support from the EU. The remaining export is either B-sugar (financed by levies on internal production) or re-exports of imported sugar (financed by the EU). Imports of sugar have amounted to 2.3 million tons annually for the period 1996/97-98/99, most of which is imports on preferential terms from ACP-countries. The rate of self-sufficiency in sugar is in the range of 130 - 140 per cent.

Box 1
The EU Sugar Scheme

The market regime for sugar

The EU-scheme for sugar is based on a multiple pricing system, providing sugar refineries with a guaranteed price for A- and B-quotas of sugar, imports of sugar being restricted through high import tariffs. The intervention price for white sugar is negotiated annually between the EU Commission and producer organisations (minimum prices have been frozen in nominal terms since 1984/85). Each member country is allocated a fixed quota of sugar that is non-transferable between countries.

The scheme is self-financing in the sense that production in excess of A- and B-quota of sugar is exported at the world market price, whereas the cost of exports of A- and B-sugar in excess of internal demand is covered by taxes on primary production. Costs associated with other exports of sugar, including re-export of imported sugar at preferential terms, is covered by the EU.

Regulation of primary production

Producers of sugar beets are allocated A- and B-quotas for deliveries of sugar beet to refineries. The basis for the individual quotas is the national quota as described above. Producers of sugar beet receive a base price for A- and B-quotas, net of the tax. The base price is linked to the price of white sugar through a formula allowing for standard costs of refinement, transportation etc.

The sugar quota is distributed to member states in fixed proportions, reflecting the levels of production at the time the sugar scheme was established or - for new members - at the time of entry into the EU. As indicated by Table 1 in the Appendix, the quota fill rate varies considerably from country to country. Mediterranean countries as Greece and Portugal have not been able to fill the A-quota, and Italy and Finland have difficulties exhausting the B-quota. On the other hand, countries like the UK, France, Austria and Germany have a considerable production of C-sugar, indicating that at least some countries in the EU might be capable of producing sugar at the world market price.

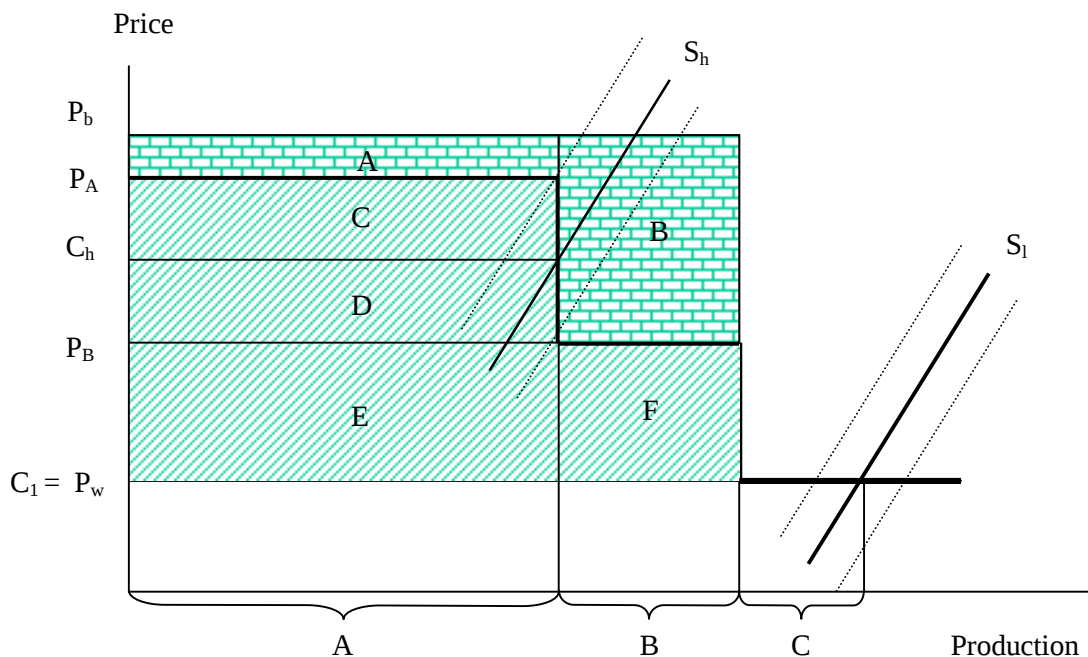
The lack of quota fill is the result of various factors. Portugal had hardly any production of sugar at the time of accession to the EU, and the EU sugar scheme does not appear to be sufficient to establish production in a larger scale. In the case of Finland, sugar production was heavily supported before Finland entered the EU, and the producers have therefore been facing lower prices after the entry, resulting in falling production. Swedish producers, on the other hand, receive higher prices after entering the EU, and are about to fill the quota. The central regions of the EU are by nature the most favourable areas for producing sugar beets. In the Northernmost areas of the EU, production tends to be hampered by cold weather and a short growing season, whereas in the Mediterranean area, the weather is often too hot and dry for that kind of production. This also

explains why Spain, having a long tradition for irrigation of field crops, is capable of producing C-sugar.

Under the EU sugar regime, for each member country, sugar refineries' intermediate demand for domestically produced sugar beet is subject to different taxes according to the assigned national quotas by the EU, cf. Figure 1. The price of A-production of sugar beet (P_A) is determined as the base price (P_b) minus a levy of 2% (marked as the shaded area A in the figure). Similarly, the price of B-production (P_B) is equal to P_b minus a B-levy of maximum 37.5% tax (shaded area B in the figure).¹ Depending on the marginal cost, the producers will therefore have different quota rents.

A high cost producer (represented by the supply curve S_h) will receive the price P_A for all his production. With a marginal cost equal to C_h , there is a quota rent corresponding to the shaded area C (the quota rent depends on the difference between the price P_A and the marginal cost C_h). A low cost producer (represented in the figure by the supply curve S_l) having marginal cost equal to the world market price, will get the high price (P_A) for A-production, a lower price (P_B) for B-production, and the world market price for production in excess of quota deliveries (C-production). The quota rent will in this case be equal to the shaded area CDEF.

FIGURE 1. Taxes and quota rent – producers of sugar beet



Note: Dotted supply curves indicate variation in yields of production (see later)

Because of different marginal costs, member countries of the EU are expected to react differently to price changes. In Figure 1, the high cost producer is expected to maintain the level of production as long as the quota rent (C) is positive, whereas the production of the low cost producer will not be

¹ If necessary, a supplementary levy (in addition to the A- and B-levies) can be applied to cover losses in a marketing year caused by the disposal of Community production in excess of internal consumption.

affected, since the production at the margin is determined by the world market price.² It is therefore crucial to know the position of Member countries with regard to marginal cost of production.

3. Modelling the EU sugar regime

Modelling the EU sugar policy regime in an applied general equilibrium model is a difficult task and it involves both a correct specification of the institutional mechanism and getting the data right at the EU country level.

The EU sugar regime is modelled in the GTAP model (Hertel (1997)), with the following key components:

- **A base price for sugar beet (P_b) and the A- and B-quota system.** This is modelled as a “tax-quota system”, where different input taxes are levied on sugar refineries’ intermediate demand for domestically grown sugar beet, cf. Figure 1.
- **An input tax levied on the input of beet in sugar refineries.** This tax - being endogenously determined - finances the EU costs of exporting B-sugar (export subsidies). Thereby the A- and B-sugar beet prices adjust endogenously in line with changes in the tax. In the case of ceasing B sugar export, this imply that sugar beet growers will get the same price for both A- and B-sugar beet.
- **A quota rent** being generated from the gap between the base price (adjusted for the tax) and the actual cost of production.
- **A border protection (import tariffs and export subsidies) for sugar.** The border protection supports the high EU price for sugar and it is determined endogenously by the world market price and the border protection. For the ACP countries - having preferential access to the EU market (TRQs) - the imports are exogenously fixed (no changes) assuming the quota rent (endogenously determined) adjusts and accrue to the EU³.
- **A contract agreement between the growers and the refinery.** It is assumed – given the rather complicated institutional fixed relationship between the price of white sugar and the one for sugar beet, cf. Box 1 – that the base price of beet follows the changes in the market price for sugar. The allocation of the total quota rent is therefore endogenously determined. The total quota rent is divided between a pure economic rent accruing to the sugar refineries (modelled as an output subsidy) and a quota rent accruing to the land used for producing sugar beet (modelled as a subsidy to land)⁴.

² The production may augment if the world market price increases as a result of the reduction in internal prices.

³ It is assumed the ACP countries do not gain further access to the EU market in the scenarios analysed. We plan to refine this representation later (as an explicit tariff rate quota system).

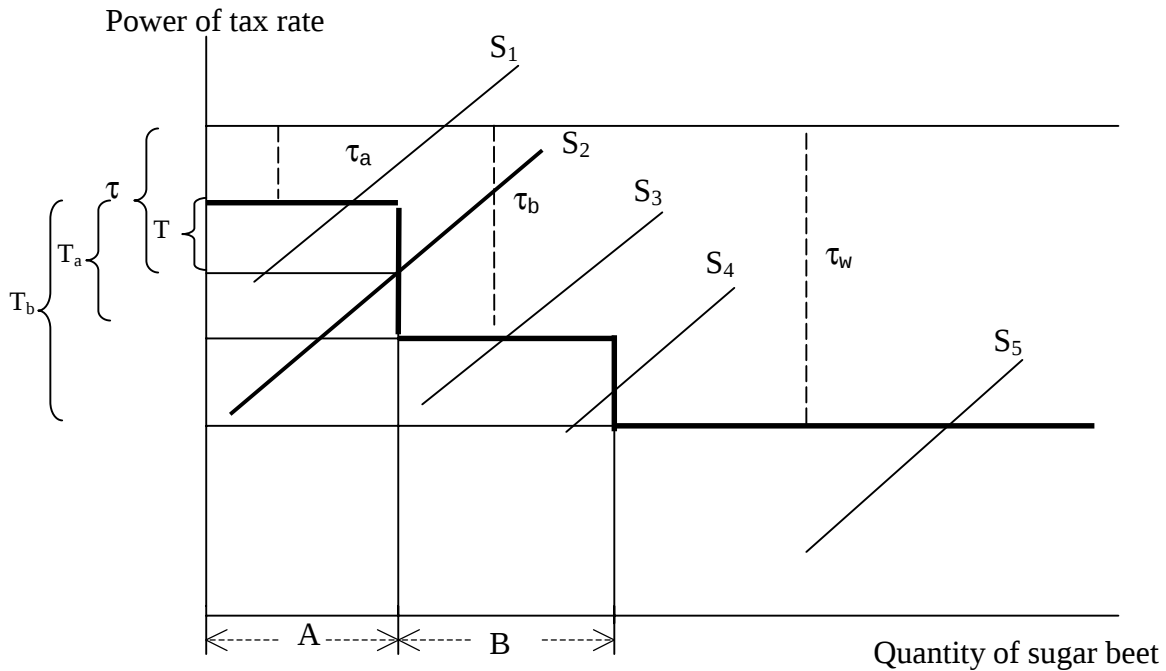
⁴ We are aware that in reality the split of the total quota rent between growers and refineries are much more difficult to determine. By splitting the total quota rent between the two agents we assume that the sugar refineries do have a willingness to pay (accepting a part of the adjustment) to avoid that the production of sugar beet decline “too much” (excess capacity). The chosen strategy implies e.g. that a 20 % cut in the sugar price will be translated into a 20 % fall in the refinery’s purchase price of sugar beet. Further, given the lack of data, we assume in this study that growers and refineries are equally sharing the initial quota rent on a 50-50 % basis at the point of calibration.

The first component, the tax-quota system, is not only the important but also the most difficult part as it is complicated conceptually and difficult computationally. Thus, the following presentation focuses mainly on this part.

The EU sugar regime is much like the Tariff Rate Quota system (TRQ), which includes one low tariff rate for in-quota import and one high tariff rate for out-of-quota import. The multi-quota system of EU sugar regime is more complicated than the TRQ due to the presence of an additional regime switch when production exceeds the total quota (thus C sugar). However, the TRQ modelling approach by Elbehri and Pearson (2000) can be extended to describe the behaviour of the sugar regime, to delineate the positions of EU member countries under the regime, and to determine changes in these positions after possible policy shocks.

To fully describe the sugar regime, the following variables are needed: the power of input tax⁵ for in-quota-A sugar beet (denoted as τ_a), the power of input tax for out-of-A-quota (within B quota) sugar beet (denoted as τ_b), and the power of input tax for out-of-total-quota sugar beet (denoted as τ_w). Figure 2 shows these three tax wedges and the two quotas of the sugar regime. Five possible types of producers are also shown in the figure (S_1 - S_5).

FIGURE 2. An illustration of modelling the EU sugar regime



However, to decide one country's exact position in this structure, the actual power of input tax (denoted as τ), the ratio of actual sugar beets produced over the A quota (denoted as γ_a), and the ratio of the total quota over the A-quota (denoted as γ_b) are also needed. With these five variables we can uniquely identify for a given country's the exact position of sugar beet production with

⁵ The power of tax is the ratio of the post-tax value over pre-tax value, or one plus the tax rate. This concept is used extensively in the GTAP model. See Chapter 2 of Hertel (1997).

respect to its assigned quotas and the EU base price for sugar beet. For example, with supply curve S_2 , the actual power of input tax, τ , is between τ_a and τ_b , and the ratio of actual production to quota A, γ_a , is 1.

Elbehri and Pearson (2000) used the actual extra power in addition to the power of in-quota tax to measure the actual power of import tariff, which has simplified their model. They also showed that to determine one's position in the TRQ regime, it is needed to know the actual extra power of the tax and the actual import relative to the quotas. Following their approach, denote T as the actual extra power of tax in addition to in-quota-A tax (τ_a), T_a as the extra power of in-quota-B tax, in addition to τ_a , and T_b as the extra power of out-of-total-quota tax, in addition to τ_a . These are defined as:

$$\begin{aligned} T &= \tau/\tau_a \\ T_a &= \tau_b/\tau_a \\ T_b &= \tau_w/\tau_a \end{aligned}$$

With this terminology, we can describe each of the 15 country positions in the sugar regime. In Figure 2, with supply curve S_1 , the actual total power, τ , is the same as τ_a , thus the actual extra power of the input tax, T , is just 1. With supply curve S_2 , T is between 1 and T_a , and the ratio of actual production to quota A, γ_a , is 1 since quota A is binding⁶. With supply curve S_3 , T is equal to T_a , and γ_a is greater than 1 and less than γ_b . With supply curve S_4 , quota B is binding. Thus, γ_a is equal to γ_b , and T is between T_a and T_b . With supply curve S_5 , T is equal to T_b , and γ_a is greater than γ_b . This behaviour of the regime is summarised in the following table.

TABLE 1. Summary of behaviour of Tax-Quota system

Supply curve	τ	T	γ_a
1	τ_a	1	<1
2	(τ_a, τ_b)	$(1, T_a)$	$=1$
3	τ_b	T_a	>1 and $< \gamma_b$
4	(τ_b, τ_w)	(T_a, T_b)	$= \gamma_b$
5	τ_w	T_b	$> \gamma_b$

The conditional inequalities entailed in Table 1 pose challenges in the modelling in GTAP and also the computation using GEMPACK. We follow the approach similar to Elbehri and Pearson (2000) in dealing with these implementation and computational issues.

This modelling structure on the tax-quota structure and the other components of the model, are summarized in Table 2.

⁶ Note in Figure 2, the actual extra power of input tax is drawn as if the true supply curve of sugar beet growers is S_2 .

TABLE 2. Summary of the modelling of the EU sugar regime

Sugar policy instrument	Exogenous variable	Endogenous variable	Remarks
Border protection, sugar, exclusive ACP countries	Tariffs and export subsidies	Imports and exports	
Tariff rate quota system for sugar, ACP countries	Imports from ACP are fixed	Shadow price of the quota adjusts	The TRQ quota rent adjusts
Intervention price, sugar		Market price for sugar	Determined by border protection
Base price, beet, for medium and low cost beet producers		Price for beet delivery to refinery. Pure profit in refinery and quota rent in beet production adjust	Equation added: base price for beet follows market price for sugar
Base price, beet for high cost beet producers	Pure profit unchanged and equal to zero	Land price in beet production adjust	No equation added
Self-financing of B-export at EU-level (tax on beet production)		Total EU Tax to finance export subsidy of B-export	Equation added: Tax determined by sugar price, world market price and B-export.
Price on A- and B-quota		Price of A- and B-quota at national level	Equation added: taxes are subtracted from base price
Quantity of A- and B-quota	Quantity of A- and B-quota at national level	Input subsidy to land used in beet production	Equation added: linking size of quota rent and market price of land in beet

4. Estimation and calibration of the supply response and quota rents

The base price, world market price, the three tax wedges, as well as each member country's two designated quotas and marginal cost of production are needed to decide its position in the sugar regime. These data, together with the core GTAP database, will form the basis for simulating the effects of alternative policy scenarios. This section contributes to the estimation and calibration of the supply response and quota rent for each member country.

Bureau et al. (1997) have found that there is a considerable variation in quota values among member countries in the EU, and that sugar production would move from Southern Europe and BENELUX to France, Germany and Denmark if restrictions on quota transfers were lifted. Unfortunately, the study does not include all 15 Member countries, making it insufficient as basis for estimation of quota rents in the present study. Member countries are therefore ranked according to their production of C-sugar and the rate of quota fill, from which information on quota rent might be inferred.

The method builds on the observation that the pattern of supply seems to be quite stable over time, i.e. some Member countries produce C-sugar in quite large quantities year after year, whereas others never manage to fill their quota. To explain these differences, the countries must have different marginal cost functions as indicated earlier by Figure 1. It should, however, also be taken into account that farmers are contractually bound to deliver a fixed portion of sugar beet to refineries each year regardless of variations in yield. Producers failing to fulfil the contract may

forfeit their quota rights. The observed production of C-sugar may therefore reflect that farmers deliberately overshoot their quota in order to fulfil the contract in years of low yields.

In the present analysis, it is assumed that the producers plan to fill their quota in all years (illustrated by the left-hand variation interval of the supply curves in Figure 1). In other words, the high cost producer (S_h) is assumed to be aiming at filling the A-quota, but not to produce B-sugar beet, whereas the low cost producer (S_l) is planning for a certain production of C-sugar beet. In the calculation of the country positions, it is assumed that the farmers in their planning consequently overshoot their quota by an amount corresponding to two times the standard deviation of variation in total production for the country. The result of the analysis is presented in Table 3 that documents the data used to calibrate the model and in particular positions the individual EU member countries with respect to marginal costs.

TABLE 3. Calibrated/estimated sugar beet prices, power of input tax and supply curves

Country	Price					Marginal cost	Power of tax				Supply curve type
	Calibrated Base	A beet	B beet	C beet	Average		τ_a	τ_b	τ_w	τ	
Belgium	47.67	46.72	32.42	19.89	39.76	32.42	1.02	1.47	2.40	1.47	3
Denmark	47.67	46.72	32.42	19.89	38.97	32.42	1.02	1.47	2.40	1.47	3
Germany	47.67	46.72	32.42	19.89	39.79	19.89	1.02	1.47	2.40	2.40	5
Greece	47.67	46.72	32.42	19.89	45.42	46.72	1.02	1.47	2.40	1.02	1
Spain	49.92	48.92	34.62	19.89	44.79	34.62	1.02	1.44	2.51	1.44	3
France	47.67	46.72	32.42	19.89	36.86	19.89	1.02	1.47	2.40	2.40	5
Ireland	49.61	48.62	34.32	19.89	46.28	47.33	1.02	1.45	2.49	1.05	1
Italy	50.78	49.76	35.46	19.89	47.50	49.76	1.02	1.43	2.55	1.02	1
Netherlands	47.67	46.72	32.42	19.89	40.27	43.74	1.02	1.47	2.40	1.09	2
Austria	47.67	46.72	32.42	19.89	39.46	19.89	1.02	1.47	2.40	2.40	5
Portugal	49.61	48.62	34.32	19.89	47.61	48.62	1.02	1.45	2.49	1.02	1
Finland	49.61	48.62	34.32	19.89	44.33	48.62	1.02	1.45	2.49	1.02	1
Sweden	47.67	46.72	32.42	19.89	44.29	39.57	1.02	1.47	2.40	1.20	2
UK	49.61	48.62	34.32	19.89	40.19	19.89	1.02	1.45	2.49	2.49	5

Note: Supply curve types refer to the types in Figure 2.

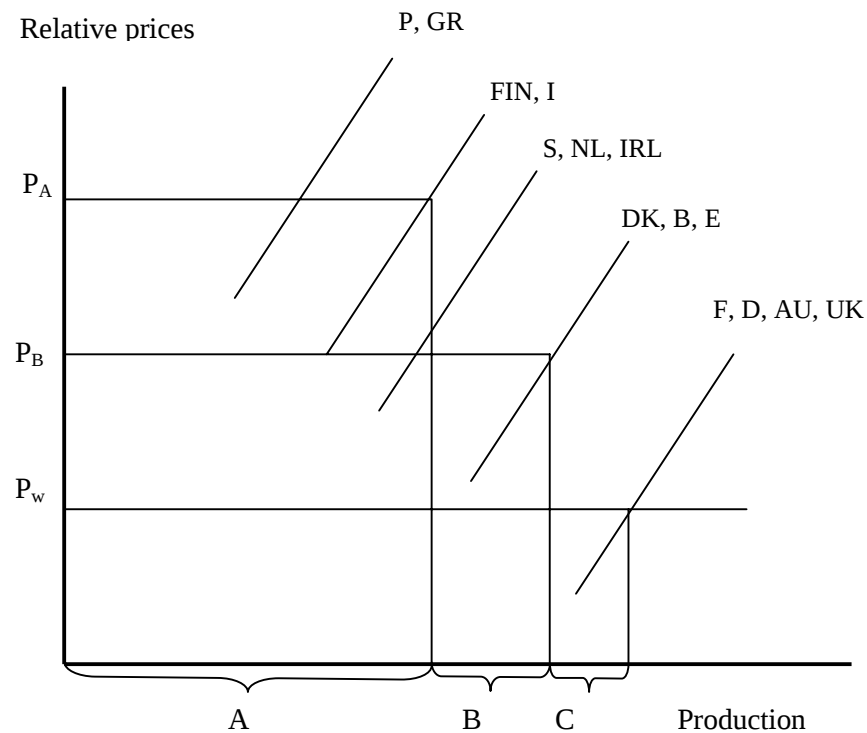
The ranking of Member countries is illustrated schematically in Figure 3. We assume that France, Germany, Austria, and UK are able to produce sugar for the world market; that Denmark, Belgium, and Spain can fill the national quotas; that cost of production in Sweden, The Netherlands, and Ireland may prevent these countries from utilising the B-quota; and that Italy and Finland and notably Portugal and Greece will have difficulties in filling the A-quota.

A few examples may help elucidate the principle of analysis. In France, the year-to-year variation in production of white sugar is fairly low with a standard deviation corresponding to 4.9% of total production (column 7, Appendix Table 1). Yet, the production of C-sugar amounted to 21.5% of total production (column 8, Appendix Table 1), indicating that the production of C-sugar can hardly be explained by precautionary circumstances. In other words, France seems to be able to produce sugar at the world market price.

Denmark is also producing C-sugar in a fairly large scale, but the ratio of production of C-sugar to the standard deviation is considerably lower (less than 2:1), indicating that the production of C-sugar may be a precautionary act by farmers. For Ireland and The Netherlands the position is influenced by the use of pooled A- and B-prices (not modelled), which tend to expand production

beyond the optimal level in a quota system. In the case of Sweden, the analysis indicates that the producers are capable of producing A-sugar only, however to take account of an increasing trend in production after the accession to the EU, marginal cost is reduced relative to the applied principle of analysis.

FIGURE 3. Country position with regard to supply of sugar in the EU



Note: AU: Austria; B: Belgium; DK: Denmark; D: Germany; E: Spain; GR: Greece; F: France; IRL: Ireland; I: Italy; NL: Netherlands; P: Portugal; FIN: Finland; S: Sweden; UK: United Kingdom.

To verify the method, the costs of producing sugar beet in Denmark are investigated from farm account data. Using the total cost of large-scale producers as indicator for the level of marginal cost for the sector⁷, the ratio of marginal cost to the value of production in Denmark was about 0.80 in 1997, cf. Appendix Table 2. In comparison, the ratio of marginal cost to the average price of sugar beet for Denmark in Table 3 is equal to $32.42/38.97 = 0.83$, indicating that, at least for Denmark, the method seems to provide a decent answer. A similar information is not available for other EU countries.

The initial quota rents allocated to land and sugar refineries, and the initial difference between the marginal cost (MC) of sugar beet production and the base price paid by the sugar refineries, are not present in the standard GTAP database⁸. Therefore the so-called altertax program is used to introduce these wedges in the standard database. The power of the input tax (τ) between the marginal cost and the base price for sugar beet is taken from Table 3. The value of the quota rents

⁷ Being the most competitive producers, large-scale producers will on the margin set the level of production costs.

⁸ The analysis is based on GTAP database, version 5, pre-release 3, and the model is solved using GEMPACK (Harrison & Pearson, 1996).

allocated to land is calculated as $((A \text{ price} - MC) \text{ multiplied by the quantity of A sugar beet produced plus } (B \text{ price} - MC) \text{ multiplied by the quantity of B sugar beet produced})$ divided by the MC of total production. The calculated relation between the MC and initial quota value is used to calibrate the initial value of the quota rents allocated to land. The quota rents/profits allocated to the sugar refineries are calculated on the assumption that the refineries have the same relative MC of production as the sugar beet producers. Therefore in regions with high cost producers of sugar beets, the refineries are also classed as high cost refineries with no quota rents/profits to either sugar beet producers or refineries.

5. Scenarios

Three scenarios are analysed to illustrate the effects of the above mentioned reforms: 25% price reduction without compensation, 25% price reduction with compensation, and reduction of quotas without compensation (Box 2). The European Commissions proposal for a 50% compensation is interpreted as half the acreage payment for wheat in the EU, understanding that the full acreage payments would be paid to sugar beets if the border protection for sugar was reduced to the level of wheat.

6. Results

Scenario 1: Price reduction of 25 per cent

A 25% reduction in border protection for sugar in the EU will reduce total production of sugar in the EU by 19.3% (Table 4), eliminating exports of B-sugar. The impact on production varies, however, between the Member states. In Greece, Ireland, Italy, Finland and the Netherlands, production of sugar will be reduced by between 85% and nearly 100%, whereas the production in other EU-countries is little affected.⁹ The impact on the other primary agricultural sectors and industries in the European economy is minimal as sugar production and sugar refineries are of relative minor importance in general. As expected, the major adjustments are in terms of lower return to land used in the production of sugar beet, and declining quota rents.

The differences across the individual EU countries in the production adjustment are explained partly by the mentioned country positions with regard to cost of production (Figure 3), partly by different changes in the price to producers of sugar beet. As the exports of B-sugar ceases in this scenario, producers of sugar beet will receive only one price after the reduction of border protection (the reduced base price), which then becomes the marginal price for producers in countries not producing C-sugar.

For Greece, Italy, and Finland, the price of sugar beet is falling between 7% and 10% only. Since producers are assumed to plan for A-production only, there is no quota rent to exhaust (reflected in a zero change in quota rent in Table 4). The reduction in the price of sugar beet will therefore be reflected in a stiff fall in production, causing land rent in sugar beet production to fall by up to

⁹ In most countries, the change in the production of refined sugar typically follows closely the production of sugar beet, but in a few countries this is not the case. Italy is one example, the difference being explained by only 30 per cent of the production of sugar beet being delivered to the sugar industry in the GTAP database. According to our knowledge this might not be correct (inconsistency of data). A similar inconsistency, but less pronounced, is found for Spain, France, Austria and the UK.

TABLE 4. Scenario 1: 25% reduction in border protection (no compensation)

	EU total	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy	Netherlands	Austria	Finland	Sweden	United Kingdom
<i>Production</i>	Percent change													
Sugar beet	-19.3	-0.1	0.0	-1.5	-81.9	0.0	-0.7	-87.5	-31.6	-77.6	-0.6	-60.5	-23.8	-1.4
Sugar	-19.3	0.0	0.0	-1.6	-88.5	0.0	-2.2	-96.4	-97.2	-85.1	-1.5	-86.6	-24.2	-5.8
Cereals	0.1	0.2	0.4	0.2	0.0	0.1	0.1	0.3	-0.1	0.5	0.2	-1.3	0.3	0.5
Other crops	0.1	0.4	0.1	0.1	0.1	0.0	0.1	0.2	0.0	0.3	0.1	0.0	0.2	0.2
<i>Export value</i>	Million US\$													
Total	-1081	-131	-22	-117	-17	-58	-224	-70	-125	-189	1	-22	-60	-47
- Intra EU	154	3	16	97	0	1	102	-35	-40	-57	17	-3	-36	88
- Extra EU	-1235	-133	-38	-213	-17	-60	-327	-35	-86	-132	-16	-19	-24	-135
<i>Import value</i>	Million US\$													
Total	1560	-111	-35	-26	18	-54	-20	26	853	219	-1	620	32	38
- Intra EU	154	-123	-45	-51	-10	-75	-62	-2	565	39	-18	5	9	-76
- Extra EU	1406	12	11	25	28	21	41	29	288	180	16	615	23	114
<i>Prices</i>	Percent change													
Sugar beet ¹	-	-24	-24	-23	-10	-24	-24	-8	-7	-13	-22	-8	-18	-24
Sugar ²	-	-24	-24	-23	-21	-24	-24	-23	-23	-22	-22	-21	-18	-24
Quota rent ³	-	-65	-64	-28	0	-75	-29	-100	0	-100	-28	0	-100	-30
Land rent ⁴	-	-47	-40	-23	-100	-39	-20	-100	-69	-100	-20	-98	-85	-24
<i>Macroeconomic indicators</i>	Percent change													
GDP	-	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Utility	-	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.7	0.0	0.0
Price of land	-	-10.3	0.4	-0.9	-0.2	-0.4	-0.4	-0.7	-1.1	-4.2	-0.5	-5.7	-3.0	0.6

Note: Portugal omitted due to negligible production.

¹ Base price of sugar beet.

² Average market price.

³ Change in total quota rent divided by production.

⁴ Change in land rent (per hectare) for sugar beet.

100%. For Germany, France, Austria and United Kingdom, the price of sugar beet decline by 22%-24%, but - since the production at the margin is based on the world market price - production is only marginally affected. However, the quota rent is falling by 28%-30%, the land rent in sugar production being reduced somewhat less.

Box 2

Scenarios and country representation

The basis for assessment is the actual situation in 1997 (comparative static analysis).

Scenario 1: Price reduction without compensation

The border protection for white sugar in the EU is reduced by 25%, resulting in approximately the same reduction in the average market for sugar. Because of the 'self-financing' system, the (endogenously determined) base prices to producers of sugar beet may fall less, as the levies on A- and B-production will be reduced when the production and exports decline.

Scenario 2: Price reduction with compensation

The same as scenario 1, but producers of sugar beet are compensated by an area payments corresponding to *half* the compensation to wheat for the EU as a whole. The payments are allocated as flat rate compensation per hectare to the total area of sugar beet in 1997 (including areas used for production of C-sugar).

Scenario 3: Reduction of the EU sugar quota without compensation

The total quota of white sugar in the EU is reduced by 1150 thousand tons (for demonstration purposes the quota is reduced by 10 times the quota reduction suggested by the European Commission in the 3rd option for reform). The quota reduction is distributed on member countries relative to the stipulated coefficients for quota reduction in Regulation (EC) No 2038/1993 (both A- and B-quotas are reduced, but at different rates in different countries).

Countries represented in the analysis

EU-countries: Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Netherlands, Austria, Finland, Sweden, and United Kingdom. Luxembourg has no production of sugar and Portugal is omitted due to negligible production.

Non-EU countries: Australia, USA, Mexico, Central America and Caribbean, Brazil, India, China, Thailand, Rest of South Asia, Malawi*, Tanzania*, Zambia*, Zimbabwe*, Uganda*, Other South African Countries, and Rest of World.

* ACP-countries.

Macroeconomic closure

The macroeconomic closure used is a neo-classical closure where investments are endogenous and adjust to accommodate any changes in savings. This approach is adopted at the global level and investments are then allocated across regions to equalise the marginal rate of return in all regions. The numéraire used is the global primary factor price index.

The output reaction is more complicated for the remaining countries. In the case of Denmark, the price of sugar beet is reduced by 24%. However, since the B-price was more than 30% lower than

the A-price before the price reduction, and since the production of B-sugar is eliminated, the actual change in the marginal price to producers is small. The reduction of prices will therefore not affect production, but the quota rent will decline by 64%, and the land rent in sugar beet production will be reduced by 40%. The similar picture is observed for Belgium and Spain. For Sweden, the Netherlands and Ireland, the cost of production is somewhat higher (marginal cost is somewhere between the initial A- and B-price), which implies that quota rent is fully exhausted, production is reduced subsequently, and the land rent in sugar beet production declines accordingly.

As reported in Table 4, total EU exports to third countries are reduced by US\$1.2 billion (80% relative to initial exports) and imports increase by US\$1.4 billion (about 100% relative to initial imports), thereby reducing net-export to third countries by US\$ 2.6 billion in total. In all EU countries both exports to/imports from third countries, including the developing countries, are reduced/increased. Also, the significant geographical reallocation of the EU production of sugar beet and refined sugar results in a higher EU-intra trade, the fall in production in e.g. Italy being substituted by imports notably from France, Germany and UK.

Scenario 2: Price reduction of 25 per cent with compensation

Scenario 2 deviates from the former scenario only by providing compensatory payments to producers of sugar beet. In general, payments linked to the use of land for a particular purpose (a coupled payment), such as sugar beet, will increase the return to land in that particular crop, and thereby influence the allocation of land. Assuming only a minor impact on the yield per hectare, the production of sugar beet will increase accordingly. However, the effect depends critically on the size of the payment and the conditions under which it is given. A high compensatory payment could for example make it attractive for those countries, that more or less stops producing sugar beet in scenario 1, to continue the production.

The analysis shows that the total production of sugar in the EU will decline by 17.7% in scenario 2, cf. Table 5, as compared with 19.3% in scenario 1, indicating that the suggested compensatory payment will not influence the cost of production sufficiently to maintain the level of production prior to the 25 per cent price cut. The fall in quota rent is approximately the same in the two scenarios, but land rent is declining somewhat less in scenario 2 due to the compensatory payments.

In the case of low cost producing countries (Germany, France, Austria, and United Kingdom, having a significant production of C-sugar), the production is determined by the world market price. Because of rigidity of land use in the model, the introduction of a compensatory payment will have only minor impacts on the production.¹⁰

¹⁰ Introducing a compensatory payment to land used for producing sugar beet in these countries will affect their average cost of production and thereby the competitiveness of sugar beet production in the applied general equilibrium model. In order to reduce this effect, and the impact on the reallocation of land, we assume in all scenarios an elasticity of transformation of land to equal -0.1. At the time of writing we are considering to change the representation a bit allowing the elasticity of transformation to vary across the individual EU countries, depending on the location of the supply curve. It is also under consideration to separate the production of C sugar completely from the production of A- and B-sugar as these two types of sugar clearly are under different institutional regimes (producers responds to very different relative prices). In this case, compensation payments would not be allocated to the production of C-sugar.

TABLE 5. Scenario 2: 25% reduction in border protection (with compensation)

	EU total	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy	Netherlands	Austria	Finland	Sweden	United Kingdom
<i>Production</i>	Percent change													
Sugar beet	-18.5	-0.1	0.0	-1.1	-75.1	0.0	0.6	-87.3	-31.6	-75.1	0.4	-60.4	-23.1	-0.2
Sugar	-17.7	0.0	0.0	-1.1	-81.1	0.0	1.7	-96.3	-97.1	-82.3	1.3	-86.5	-23.5	-2.7
Cereals	0.1	0.2	0.4	0.2	0.0	0.1	0.1	0.3	-0.1	0.4	0.2	-1.3	0.3	0.5
Other crops	0.1	0.4	0.1	0.1	0.1	0.0	0.1	0.2	-0.1	0.2	0.1	0.0	0.2	0.1
<i>Export value</i>	Million US\$													
Total	-839	-118	-22	-95	-17	-54	-66	-70	-125	-189	8	-22	-60	-9
- Intra EU	258	1	14	103	0	1	187	-35	-40	-57	23	-3	-36	98
- Extra EU	-1097	-119	-37	-198	-17	-55	-254	-35	-86	-132	-15	-19	-24	-107
<i>Import value</i>	Million US\$													
Total	1590	-95	-34	-23	16	-45	-28	28	888	212	-3	619	31	22
- Intra EU	258	-105	-45	-44	-9	-63	-62	1	620	43	-18	6	9	-73
- Extra EU	1331	10	10	21	25	18	34	28	268	170	14	614	22	95
<i>Prices</i>	Percent change													
Sugar beet ¹	-	-24	-24	-23	-14	-24	-24	-9	-8	-16	-23	-9	-19	-24
Sugar ²	-	-24	-24	-23	-21	-24	-24	-23	-23	-22	-23	-21	-18	-24
Quota rent ³	-	-66	-65	-28	0	-75	-32	-100	0	-100	-31	0	-100	-33
Land rent ⁴	-	-38	-31	-19	-48	-22	-8	-6	6	-54	-10	-5	-64	-14
<i>Macroeconomic indicators</i>	Percent change													
GDP	-	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Utility	-	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.7	0.0	0.0
Price of land	-	-8.4	0.7	-0.5	-0.1	-0.1	0.1	0.4	-0.3	-2.1	0.0	-4.7	-2.1	1.1

Note: Portugal omitted due to negligible production.

¹ Base price of sugar beet.

² Average market price.

³ Change in total quota rent divided by production.

⁴ Change in land rent (per hectare) for sugar beet.

Scenario 3: Reduction in the quota

A reduction in the total EU sugar quota of 1 150 000 tons of white sugar or 8 per cent will result in only 1.8 per cent fall in the overall EU production (Table 6), reducing exports of B-sugar by 72%. In the case of Belgium and Denmark, where the quota is binding, the production is reduced by about the same amount as the reduction in the quota, whereas in the other countries outputs are less affected. For France, Germany, Austria and United Kingdom this is explained by production being determined by the price of C-sugar, not by the quota. For the remaining countries, quotas are less binding. Due to the self-financing system, the price of B-production will increase when production (and exports of B-sugar) is reduced, resulting in higher quota values. This is affecting Belgium and Denmark in particular, where the quota rent augments by 24% and 31%, respectively. The change in land rent mirrors the changes in sugar beet production and thereby the demand for land to produce this crop.

The applied reduction in quotas has only a minor impact on the EU trade in sugar. Total exports decline, and imports increase slightly, however the trade balance is affected far less than in scenarios 1 and 2, as the production is reduced only by a fraction of the reduction in these scenarios. The analysis demonstrates clearly that the distribution effects of a reduction in prices are quite different from a reduction in quotas when the cost of production varies, as much as they do between countries.

The impact on third countries

The effects on EU trade with third countries are shown in Table 7. Among the countries presented in the table, Malawi, Tanzania, Zambia, Zimbabwe and Uganda are ACP-countries having preferential access to the EU market. However, due to the way that import quotas are administrated, and that we in this study for simplicity assume that the ACP export to the EU market will not be affected (tariff rate quotas), the ACP countries do not gain any further market access to the EU market.¹¹ The main producing sugar countries (Brazil, Thailand, Rest of South Asia and Rest of World), not having any preferential access to the EU market, are therefore the main beneficiaries of the larger EU import demand. Due to a change in the general trade pattern and the world market price, the production of sugar changes in all third countries, although only marginally in a number of countries, in scenario 1 and 2. Production expands, however, significantly in Central America and Caribbean, Rest of South Asia, Zimbabwe and Rest of World. In scenario 3, the production in countries outside Europe is hardly affected by the policy change.

Macroeconomic indicators

The scenarios have only marginal impacts on the rest of the European economies, cf. Table 4, 5 and 6.

¹¹ Imports on preferential terms are administrated through the issuing of import licences, i.e. the holder of import licences is the beneficiary of the system. It is assumed that the import of sugar is controlled by EU-importers, not by exporters in the exporting countries, meaning that the quota rent remains in the EU. Hence, ACP-countries receive only the world market price on exports to the EU, and are therefore not affected by the fall in the internal price of sugar in the EU.

TABLE 6. Scenario 3: Reduction of quotas (no compensation), change in production, trade and prices

	EU total	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy	Netherlands	Austria	Finland	Sweden	United Kingdom
Production	Percent change													
Sugar beet	-1.6	-7.8	-8.5	0.1	3.3	-1.3	0.2	-4.4	-2.3	-3.0	0.2	-3.4	4.6	0.2
Sugar	-1.8	-7.8	-9.5	0.2	3.5	-3.2	0.7	-4.9	-7.2	-3.3	0.6	-4.9	4.7	0.6
Cereals	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0
Other crops	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Export value</i>	Million US\$													
Total	-162	-104	-36	6	1	-21	32	-6	-41	-21	1	-17	20	14
- Intra EU	43	-17	-8	17	0	0	43	-3	-11	-5	2	-2	12	9
- Extra EU	-204	-87	-28	-11	1	-21	-12	-3	-30	-16	-1	-14	8	5
<i>Import value</i>	Million US\$													
Total	87	17	10	-3	-3	12	-6	0	47	0	-3	21	-4	-5
- Intra EU	43	16	10	-4	-4	10	-9	0	41	-4	-4	1	-4	-7
- Extra EU	44	1	0	1	1	1	3	0	6	4	1	21	0	2
Prices	Percent change													
Sugar beet ¹	-	1	1	0	0	0	0	0	1	0	0	3	-1	0
Sugar ²	-	0	0	0	0	0	0	0	1	0	0	2	0	0
Quota rent ³	-	24	31	2	-	10	1	66	-	42	1	-	10	0
Land rent ⁴	-	-23	-24	0	11	-4	1	-13	-7	-9	1	-11	16	1
<i>Macroeconomic indicators</i>	Percent change													
GDP	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Utility	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Price of land	-	-4.9	-0.7	0.0	0.0	-0.1	0.0	-0.2	-0.1	-0.5	0.0	-0.8	0.7	0.0

Note: Portugal omitted due to negligible production.

¹ Base price of sugar beet.

² Average market price.

³ Change in total quota rent divided by production.

⁴ Change in land rent (per hectare) for sugar beet.

TABLE 7. Non-EU countries: Change in trade and production of sugar and macroeconomic indicators

	Total	Australia	USA	Mexico	C. America & Caribbean	Brazil	India	China (Mainland)	Thailand	Rest of South Asia	Malawi	Tanzania	Zambia	Zimbabwe	Uganda	Other South African countries	Rest of world
Trade	Million US\$																
<i>Scenario 1</i>																	
EU Exports	-1235	-1	-17	0	-8	-23	-8	0	-6	-1	0	0	0	0	-9	-1	-1160
EU Imports	1406	11	11	10	0	141	68	11	144	194	0	0	0	0	0	0	817
<i>Scenario 2</i>																	
EU Exports	-1097	-1	-14	0	-7	-22	-7	0	-5	0	0	0	0	0	-8	-1	-1032
EU Imports	1331	10	10	10	0	130	66	10	130	187	0	0	0	0	0	0	777
<i>Scenario 3</i>																	
EU Exports	-204	0	0	0	-1	-3	-2	0	0	0	0	0	0	0	-1	0	-196
EU Imports	44	0	0	0	0	3	2	0	5	6	0	0	0	0	0	0	27
Production	Percent change																
Scenario 1	-	2.6	1.4	0.9	8.0	4.5	0.5	1.7	1.2	8.2	2.5	2.3	0.3	3.9	0.6	0.8	3.6
Scenario 2	-	2.4	1.3	0.8	7.3	4.2	0.5	1.6	1.1	7.6	2.3	2.1	0.3	3.5	0.6	0.7	3.3
Scenario 3	-	0.3	0.1	0.1	0.7	0.4	0.0	0.1	0.1	0.3	0.2	0.2	0.0	0.4	0.2	0.1	0.3
GDP	Percent change																
Scenario 1	-	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scenario 2	-	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scenario 3	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: Scenario 1: 25% reduction in border protection for sugar in the EU. No compensation paid to producers.

Scenario 2: 25% reduction in border protection for sugar in the EU. With compensation paid to producers.

Scenario 3: Reduction in quotas. No compensation paid to producers.

7. Concluding remarks

This paper addresses the issue of modelling the EU sugar policy at the detailed member country level – a task that is difficult given the complexity of the policy and the very different conditions for producing sugar beet in the member countries. As indicated in the paper, our approach has presented a possible way forward while, at the same time, identifying areas for further research and alternative avenues for representing the sugar policy and its impacts at the individual country level.

Clearly, the results depend critically on the chosen calibration of the model and, in particular, the identification of the individual member countries as either high, medium or low cost sugar beet producers. Nevertheless, given such a categorisation of the member countries, the model results – being quite rich in terms of interesting qualitative and quantitative results - clearly illustrate the very different regional impacts of a given reform scenario. The impacts of price cuts versus quota reductions will also be very different across the EU member states.

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APPENDIX TABLE 1. **Production of white sugar in the EU, average 1996/97-98/99**

Member country ¹	Quota		Production				Standard deviation total production ³	Share of C-sugar in total production (8)
	A-quota (1)	B-quota (2)	A-sugar (3)	B-sugar (4)	C-sugar (5)	Total ² (6)		
----- Thousand tons -----							%	%
Belgium	680	146	680	146	101	921	9.2	10.9
Denmark	328	97	328	97	85	524	10.2	16.7
Germany	2637	812	2637	810	616	4083	5.5	15.2
Greece	290	29	266	10	0	276	17.7	0.0
Spain	960	40	960	40	175	1175	10.7	14.9
France	2996	806	2812	759	980	4651	4.9	21.5
Ireland	182	18	182	18	16	217	7.3	7.6
Italy	1320	248	1320	223	1	1591	9.8	0.1
Netherlands	690	182	690	166	104	960	11.4	10.8
Austria	316	74	317	74	86	489	9.4	18.1
Portugal	73	6	44	2	0	46	161.9	0.0
Finland	134	13	133	9	6	148	14.8	4.0
Sweden	336	34	336	34	15	398	7.5	4.0
UK	1040	104	1040	104	336	1500	10.1	22.7
EU-15	11982	2609	11746	2493	2521	16979	5.2	15.0

¹ No quotas are assigned to Luxembourg.

² Due to different sources of information, production of A-, B- and C-sugar may not add to total production.

³ In percent of total production. Based on data for 1990/91-98/99. For Austria, Finland and Sweden 1994/95-98/99.

Source: European Commission (2000b) and own calculations.

APPENDIX TABLE 2. **Cost of producing sugar beet in Denmark, 1997**

	Acreage of sugar beets per farm, hectare						
	2-5	5-10	10-15	15-25	25-35	35-50	50 -
	ECU per hectare ¹						
Value of production	2 148	2 227	2 353	2 548	2 597	2 545	2 618
Cost I ²	785	745	712	645	610	578	525
Cost II ³	1 059	1 013	971	992	859	925	1 004
Cost III ⁴	258	275	263	314	301	295	327
Opportunity cost of land ⁵	97	89	116	155	266	302	261
Total cost	2 199	2 122	2 062	2 106	2 036	2 100	2 117
Total cost/value of production	1.02	0.95	0.88	0.83	0.78	0.83	0.81

¹ "Green" exchange rate DKr 7.49997 per ECU.

² Seeds, fertilisers, chemicals, water, energy, rental of machinery.

³ Labour, maintenance and depreciation of machinery.

⁴ Land tax, energy tax, insurance, cost of automobile, maintenance and depreciation of farm buildings.

⁵ Return to land in wheat production on farms producing sugar beets.

Source: SJFI(1999).