Sugar and Spice and all things nice? Assessing the Impact of the 2006 EU sugar regime reforms

Alan Renwick[1]*, Cesar Revoredo-Giha[1], George Philippidis[2], Michael Bourne[2], Mark Reader[3] and Ben Lang [3]

[1]Scottish Agricultural College
[2]Government of Aragon
[3]University of Cambridge

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*Corresponding author: Alan Renwick, SAC, West Mains Road, Edinburgh, EH93JG. Phone: +44 (0) 131 5354046, email: alan.renwick@sac.ac.uk

Abstract

This paper investigates the economic impacts of the reforms both on the EU sugar sector but also more globally and examines the intended and unintended consequences of the reforms. This provides insights into the likely impacts of the further reforms proposed for 2015 – namely the removal of sugar beet quotas within the EU. We find, in line with other studies that whilst the reforms have improved the economic efficiency of the EU sugar sector the nature of the reform process has meant that these gains have not been maximised. This is due to the fact that production was cut in some of the more efficient regions of Europe as well as the least efficient. Our modelling highlights that the reforms have led to alternative trade patterns emerging both internally within the EU as well as externally. Internally, cessation of production in a number of countries provides opportunities for those remaining in production. Externally the significant decline in EU sugar on the world market has provided opportunities for other countries. It would appear that Brazil and Thailand have been amongst the main beneficiaries of the disappearance of EU sugar from the world market.

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Introduction

The EU sugar regime has been part of the Common Agricultural Policy (CAP) since 1968, and prior to 2006, had never been fundamentally reformed. Prior to 2006 the regime was based on minimum support prices, production quotas, export refunds and tariff protection, whilst preferential arrangements allowed raw cane sugar to be imported, mainly into the UK, from traditional (ACP) suppliers. Quotas had at times been cut in order to meet WTO ceilings on subsidised exports. A system of producer levies contributed to the financing of the export refunds.

Unlike other sectors of the CAP, sugar was left untouched by the reforms of 1992, 2000 and 2003, and therefore the sugar regime came under increasing pressure to promote greater competitiveness and stronger market orientation in line with the reformed CAP. In addition further pressures were being placed on the managed EU sugar market by the Everything But Arms (EBA) and Balkans initiatives which allowed unlimited duty-free preferential imports and the WTO case on EU exports, led by Brazil, Australia and Thailand.

The reform process effectively began in September 2003, when the European Commission proposed three broad possible ways forward. They were:

- Extend the present regime beyond 2006, cutting quotas as necessary;
- Reduce the EU internal price, with a view to eliminating quotas;
- Completely liberalise the current regime, including tariffs.

As usual the process of agreeing a reform package involved extensive negotiation between the member states and the initial proposals were extensively modified before the final package was agreed.

According to the European Court of Auditors the reforms had three main objectives:

- to ensure the competitiveness of the EU sugar industry;
- to stabilise the markets and to guarantee the availability of sugar supplies;
- to contribute to providing a fair standard of living for the agricultural community via instruments put in place to mitigate the significant direct and indirect social and economic impact on the agricultural community in the regions affected.

Though it is clear that a number of sub-objectives were required from the reforms, not least making the regime WTO compliant by reducing the pressure to export EU sugar on to the world market.

The 2006 reforms marked a major change in the EU sugar regime. Details of the reforms can be found in council regulation (EU, 2005) but the key measures introduced can be summarised as:

- Merging "A" and "B" quota into single production quota.
- Additional quota made available for purchase at EU level (up to 82,847 tonnes available for the UK) to maintain production in "C" producing countries.
- Production charge of 12 €/tonne introduced from 2007/8 on processors based on their sugar quota.
- Restructuring levy on processors to be paid in 2006/7 to 2008/9 to fund the restructuring measures of the reform.
- Sugar for biofuel, chemical and pharmaceutical industries to be excluded from quota.
- 36% price cut for raw sugar from 497 €/tonne to 335 €/tonne in 2009/10.
- 40% reduction in the minimum beet price to producers by 2009/10
- Abolition of intervention by 2010. Thereafter private storage aid to be introduced as a safety net.
- Direct income support for beet growers based upon 64.2% of the notional price cut.
- Introduction of voluntary restructuring scheme to encourage factory closures and surrender of quota. Scheme to be funded by a levy on quota holding sugar factories.

The reforms aimed to reduce EU sugar production by 6 million tonnes over 4 years (to around 13/14m tonnes, raw value). This level of change was expected to lead to a reduction in exports of between 4 and 4.5m tonnes (down to 1.4m tonnes) and a doubling of sugar imports to around 4.5m tonnes (Gudoshnikov, 2010).

This paper investigates the economic impacts of the reforms both on the EU sugar sector but also more globally and examines the intended and unintended consequences of the reforms. The impacts on prices, profitability, structures, trade and welfare

The next section outlines the methodology adopted for this study. The results are then presented examining the impact on prices, profitability, structures, competitiveness, production, trade and welfare. The final section considers the overall impact of the reforms and discusses the unresolved issues and looks forward to the future reforms.

Approach

A five fold approach was adopted for the study

1. Literature review of both published and grey literature
2. Detailed examination of farm business data to assess impact on farm profitability
3. Modelling of reforms using a modified GTAP model
4. Interviews with representatives of a range of stakeholder organisations
5. Stakeholder workshop

Literature Review

A detailed analysis of available literature was undertaken from a wide variety of academic and industry sources. Ahead of the reform process Defra published an extensive Regulatory Impact Assessment (RIA) (Defra, 2005), this provided a useful background document against which the actual impacts could be compared with the predicted impacts. In November 2010, the European Court of Auditors published their analysis of the regime which also provides useful information for consideration in this study. In the realisation that not all information on the sugar sector is likely to

be in the wider public domain, stakeholder contacts were also asked to provide any information that they thought would be helpful to the study.

Analysis of Farm Business data

To assess the farm level impacts of the reform process on farms in England, analysis of Farm Business Survey (FBS) data was undertaken. The Farm Business Survey is an annual survey undertaken by Defra of over 1800 farms in England. Analysis involves examination of the changes to crop area (within the business unit), yield, price, input costs, gross and net margins to enable measurement of changes in the farm production system. The published data is weighted using consistent FBS methodology that can be compared to all outputs from the FBS since 2005[1]. Similar detailed production data is available for the 2002 harvest year as result of an earlier study for Defra[2] and therefore longer term comparisons can be made. Although caution needs to be exercised where comparing the 2002 and 2009 datasets as methodological differences exist. The 2002 data was unweighted and some (enterprise level) costs were imputed based on data available for the North West and Eastern Counties. With this caveat some time series data presented within this study draws from both sources.

In terms of numbers of sugar beet farms, in 2009 the FBS included 139 sugar beet producing farms in England for which full margin data was available on 133 farms. Among the 2009 farms, 45 participated in the 2002 study and a further 34 remained in the FBS having ceased sugar beet production. Many of the farms surveyed in 2002 had left the FBS due to a requirement that farms remain in the survey for a maximum of 15 years, although some simply opted to leave the FBS which is a voluntary survey. It should be noted that FBS data is published only if the sample size comprises of at least 15 farms

Use is also made of agri-benchmark data from a number of European countries for the 2009 harvest year (agri-benchmark, 2010). Although the data does not allow a comparison of the situation pre and post the reforms it does provide useful insight into the profitability of sugar beet production after the reforms had been fully implemented

Stakeholder interviews and Workshop

At the outset of the study it was realised that whilst much information may be gleaned from available literature, the relative recent nature of the reforms and also the nature of the sugar industry itself means that some information may not be in the public domain. Therefore it was decided that a key part of the study would involve semi-structured telephone interviews with key stakeholder organisations and businesses. Interviews were held with a range of stakeholder organisations, representing farmers, processors, refiners, isoglucose/starch producers, ACP countries and sugar users.

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[1] Farm Business Survey Definitions, Defra
http://archive.defra.gov.uk/evidence/statistics/foodfarm/farmmanage/fbs/documents/fbs-definitions.pdf
[2] University of Cambridge and RAC (2004) Economic, Social and Environmental Implications of EU Sugar Regime Reform. Final Report to Defra

Towards the end of the study the same stakeholders were invited to a workshop at Hughes Hall Cambridge where preliminary results were presented and discussion held. Feedback generated at this workshop was used to inform the final analysis.

GTAP model and data

The main quantitative component of this research employs the Global Trade Analysis Project (GTAP) computable general equilibrium (CGE) model and accompanying database In its current incarnation, version 7.1 of the database (Narayanan and Walmsley, 2008) is benchmarked to 2004. Version 7.1 represents a significant advance on the previous version in terms of (inter alia) broader regional coverage (112 regions), improved trade and demand elasticity estimates and significant refinements to the support and protection data. The 'standard' neoclassical comparative static GTAP model employs neo-classical optimising behaviour to derive Hicksian consumer and intermediate demands. Regional utility is aggregated over private demands (non-homothetic), public demands and savings (investment demand). Production, which is 'demand driven' through a series of accounting conventions and market clearing balances, is characterised employing a perfectly competitive, constant-returns-to-scale technology, and bilateral imports are differentiated by region of origin using the Armington (1969) specification. The model incorporates five factors of production, where skilled/unskilled labour and capital are perfectly mobile, whilst land and natural resources are both sector specific with the former moving 'sluggishly' between productive sectors. In all factor markets, full employment is assumed (long run). Finally, investment behaviour functions through the creation of a fictitious 'global bank'. This entity collects investment funds (savings) from each region and disburses them across regions according to a rate of return or a fixed investment share mechanism.

To capture as far as possible the intricacies of the sugar policy, three specific modelling extensions were added to the standard GTAP model: the 'old' A, B and C sugar quota mechanism; tariff rate quotas and imperfect competition to characterise the concentrated nature of EU processed sugar production. Examining the issue of EU sugar quotas, the most detailed modelling endeavour to date is that of Frandsen et al. (2003). Although published prior to the enactment of the 2006 sugar reforms, it successfully captures all of the salient modelling mechanisms inherent within the 'old' EU sugar system in our benchmark year. Employing a series of step functions ('complementarities'), the authors characterise 'A', 'B' and 'C' quotas, institutional prices for each quota; a treatment of quota rents; a detailed implementation of the self financing mechanism and a mechanism for calibrating the relative cost competitiveness of the EU member states.

Employing GEMPACK (reference) model code, the current study adopts the approach of Frandsen et al. (2003). To calibrate each EU member's position on the sugar supply curve (i.e., 'A', 'B', or 'C') and calculate quota rents, information on institutional prices and marginal costs (i.e., shadow prices) are necessary, whilst some estimate of each country's level of competitiveness is required (i.e., is the region an 'A', 'B' or 'C' producer?). Initially, we followed the approach adopted in Frandsen et al. (2003) who assumed that farmers overshoot beet production by two times the standard deviation of variation.[3] Thus, employing time series data 'average' sugar production is measured as arithmetic average total production in each year minus 2 times the standard deviation. This statistic for each EU

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[3] Frandsen et al. (2003) note that farmers deliberately overshoot their quotas because they are contractually bound to deliver a specific quantity of sugar beet to the refineries. Failure to fulfil the contract may result in a loss of quota rights.

member is matched with corresponding A and B quota allocations, which indicate whether a region is an A, B, C or non producer (NP) in 2004. Our initial estimates suggested the following classification (Table 1):

Reg	Status	Reg	Status	Reg	Status	Reg	Status	Reg	Status
AUT	C	EST	NP	HUN	C	LUX	NP	SVK	C
BEL	B	FIN	C	IRE	A	MAL	NP	SVN	A
CYP	NP	FRA	C	ITA	A	NLD	C	ESP	B
CZE	C	GER	C	LAT	A	POL	C	SWE	C
DNK	C	GRE	A	LTU	A	PORT	A	GBR	C

Table 1: Classification of EU25 sugar production

Source: Own calculations

However, cross referencing our calculations with actual data from Eurostat on sugar production (at constant prices) from 2004, we discovered that the supply responsiveness of a minority of EU25 regions was not consistent with their sugar status reported in the table above. For example, the Czech republic witnesses a 15% reduction in sugar beet production, despite the fact that we have classified it as a (competitive) C producer. We consequently revised the Czech republic as a B producer. Similarly, with production reductions in excess of 50%, Finland, Spain, Hungary, and Slovakia were reclassified as A producers.

Tariff rate quotas (TRQs) follow the publically available model code provided in Elbehri and Pearson (2005). To support the TRQ model code, additional secondary data (WTO, 2005) is necessary for the quota fill rates, as well as the in-quota and over-quota tariff rates. Following guidance in Elbehri and Pearson (2005), modelling assumptions are employed to reconcile these data with the tariff data inherent within the GTAP database. For the purposes of this study, TRQs are only implemented on EU sugar imports, whilst it is assumed that the tariff quota rate is filled on all EU imports.

Finally, our characterisation of imperfect competition in the sugar processing sector draws on similar CGE studies (Hertel 1994, Harrison et al. 1994) combining strategic (Cournot) conjecture, with freedom of entry/exit of firms.[4] In the model variant employed here, the mark-up (P > MC), presented in equation 1 below, is allowed to adjust endogenously for each representative firm,[5] and vary according to the seller's market (i.e., domestic vs. export):[6]

$$MARK-UP_i = \frac{P-MC_i}{P} = \frac{\Omega_i}{N} \cdot \left| \frac{1}{\varepsilon} \right| \tag{1}$$

where

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[4] Arguably, food processing sectors, typically regarded as oligopolistic, are more aware of quantity changes in perishables across bilateral routes vis-à-vis the alternative of price (Betrand) as a strategic variable.
[5] Owing to a lack of data, it is assumed that all firms in the imperfectly competitive industry are symmetric (i.e. they have the same cost and technology structure and face the same demand curve).
[6] In the appendix, a full derivation of the mark-ups is shown.

$\Omega_i = \dfrac{\partial Z}{\partial Q_i}$ - changes in industry output (Z) with respect to changes in firm output (Q_i).

N - The number of firms in the industry.

$\left|\dfrac{1}{\varepsilon}\right|$ - The *absolute* value of the inverse elasticity of demand for the composite industry tradable.

The freedom of entry/exit coupled with the accounting condition of long run zero profits determines output per 'representative' firm. A full appendix shows the derivation of the mark-ups.

Having described the development of the GTAP model the following section present the key findings from the modelling exercise and other analyses with respect to changes in price, profitability, structures, production and the impacts on trade and welfare

Results

Prices

A key component of the reform process was a cut in prices to beet growers and processors. Available evidence indicates that during the first three years of the reform, the EU sugar market price was stable and around the reference price. In addition, the EU selling price followed the downwards movement of the reference price. However, more recently the sugar market price has been above the reference price. A key cause of this has been changes in world prices which have increased markedly since the end of 2007, actually surpassing the EU average price in early 2010.

The world price has had such an influence on EU prices due to the fact that the EU moved into a deficit position (due to the reduction in quotas) and therefore the internal EU market was more intimately linked with external world market and therefore the rising world price has put upward pressure on EU prices. This more direct link between world markets and EU prices may be seen to be a direct result of the reform process.

Our analysis indicates that it was not the decline in EU production that led to the increase in world price, but a combination of other factors including poor harvests in the main producing regions and an increasing global demand for sugar. In fact, our model results indicate that, if everything else was held equal, then the reforms themselves would only have had a marginal impact on world prices (an estimated 1.8 per cent rise)

Our model results also indicate that, *ceterus paribus,* the reforms would generally have led to the marked reductions in domestic prices as expected (although varying by country according to their cost structures) had it not been for the changing world maket situation. Within the UK the impact of the price cuts has also been mitigated through the weakening of the currency due to the macroeconomic situation within the country.

The thorny issue of price transmission

Whilst it is clear that, initially at least, the price cuts were fully felt by the sugar supply sector there has been considerable controversy as to whether the price cuts have been fully transmitted through

the supply chain to reach consumers. Available data suggests that retail prices did not fall in line with the cut in prices. Whilst sugar users contend that this is attributable to generally rising costs within the supply chain (energy, labour, etc), there is still though an unanswered question as to the extent that sugar users have been able to 'capture' the price cuts and not pass them on to consumers.

Effect of the Sugar Reform on the UK domestic prices

Figure 1 comprises two panels. The upper panel presents the average retail price, the wholesale price, the EU reference price and the world price. The marketing margin for white granulated sugar can be seen as the difference between the retail price and the wholesale price. The lower panel presents the average retail price and the minimum and maximum values of a sample of prices collected by the Office of National Statistics (ONS).

Three facts are worth noting from the figure. First, the wholesale price converged to the reference price as expected after the reform of the sugar sector. Second, in sharp contrast with the wholesale price, the retail price of sugar followed an increasing trend, that seemed closer to the world price than to the wholesale price, leading to an increasing marketing margin. Third, the price dispersion around the average retail price increased as the world price and the UK wholesale price became closer.

Figure 1 - UK White granulated sugar prices - Marketing margin and price dispersion 2006-2011
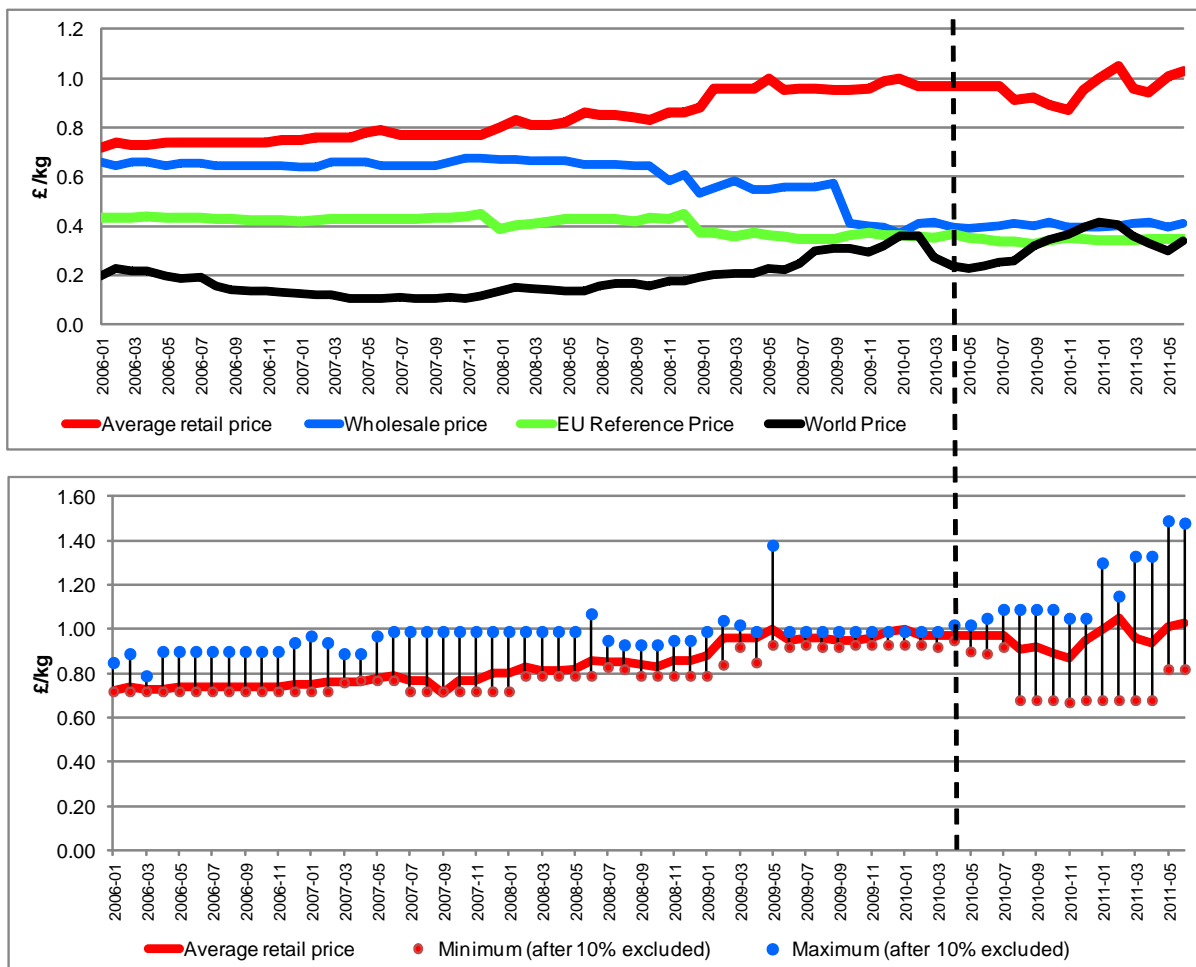
Source: Based on data from the ONS, Defra and the World Bank.[7]

Figure 1 illustrates that for whatever reason, domestic consumers of white granulated sugar did not benefit from the decrease in the wholesale price due to the reform.

Price transmission has long been a controversial issue in agricultural supply chains. It is, of course, not necessarily the case that consumers will benefit one for one from reductions in the producer price. This is due to the fact that the formation of retailers' prices is a complex process, which includes not only the cost of the raw material (i.e., sugar) but also such components as energy and labour costs. In addition, the nature and extent of price transmission from processors to retailers in sugar prices might be affected by the degree of concentration in both the processing sector and the distribution channels (Netherlands Economic Institute, 2000). Concern was expressed by a number of stakeholders about the perceived lack of transmission of the price cuts. As one expressed it 'billions have effectively been taken from the primary producers and processors and consumers have not received the benefits.' Sugar users argue that the price of sugar is only one component and it is the increased cost of other raw materials that has led to the apparent disconnect between changes in producer and retail prices. However, the European Court of Auditors note that the EU are sufficiently concerned at the apparent lack of pass-through of the price cuts to consumers that they are commissioning work to study this (ECA, 2010).

This is a key issue, because as noted above, the Defra RIA identified benefits to consumers as a major source of the welfare benefits of the reform. If we have a situation where the benefit is really just transferred from one sector (sugar processors/refiners and farmers) to another (users of sugar) then it may be argued that the overall welfare gains for society have been diminished.

Concern has been expressed that the price reported by the EU fails to act as a signal that sugar is in short supply and thus triggering possible remedial action by policy makers. This is in part the nature of the statistics collected as they relate to the fact that the majority of sugar is bought yearly ahead (the sugar marketing year) and it is also based on the price for the major part bought. Therefore, it does not reflect the price that a buyer would have to pay on the spot market and is unable to capture for example the price raising effects of shortages. This does raise a question of the role of the prices in signalling potential shortages and the requirement for action to address these shortages

Profitability

At the farm level in the UK, our analysis suggests that whilst in certain years profitability has declined (as a result of yield and price impacts) overall profitability of sugar production has been maintained (Figure 2). In part this can be seen as a result of:

- Improvements in average yields (in part brought about by lower yielding producers leaving the industry)
- Changes in market conditions ameliorating the price cuts

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[7] It is important to note that in order to compute the retail price range, the ONS eliminates the extreme values and the range is based on only 80 per cent of the sample.

- Compensation payments from the EU

Figure 2 Average Gross Margin Performance of Sugar Beet Production 2000 to 2009
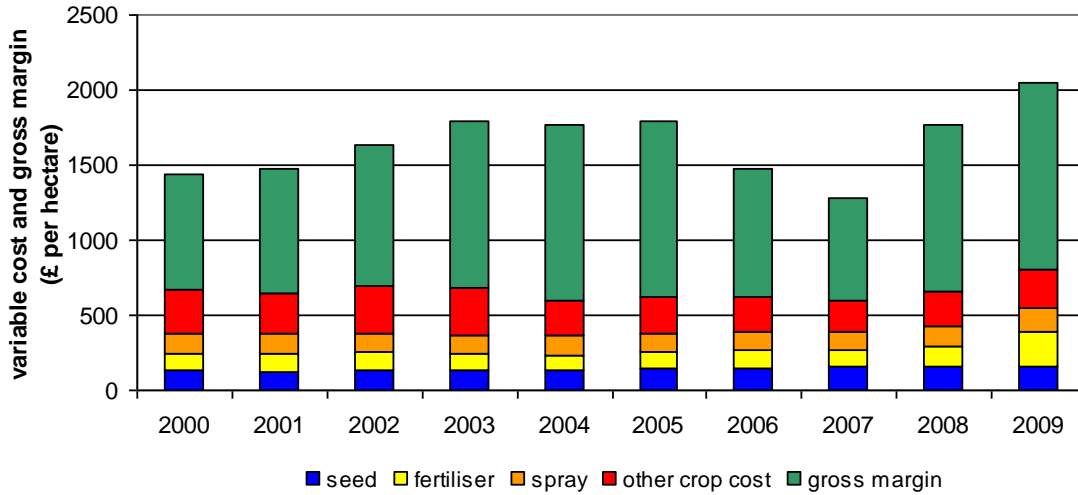

More broadly, analysis of exemplar data from 2009 for a number of countries across Europe, highlights that there remains a wide divergence in profitability of the sugar crop at the farm level after the reforms (Figure 3). Amongst other factors this spread in profitability has been maintained because quotas were not tradeable across countries and therefore efficiency gains have been made within and not across EU states.

Figure 3: Gross margins for selected farms in EU countries in 2009
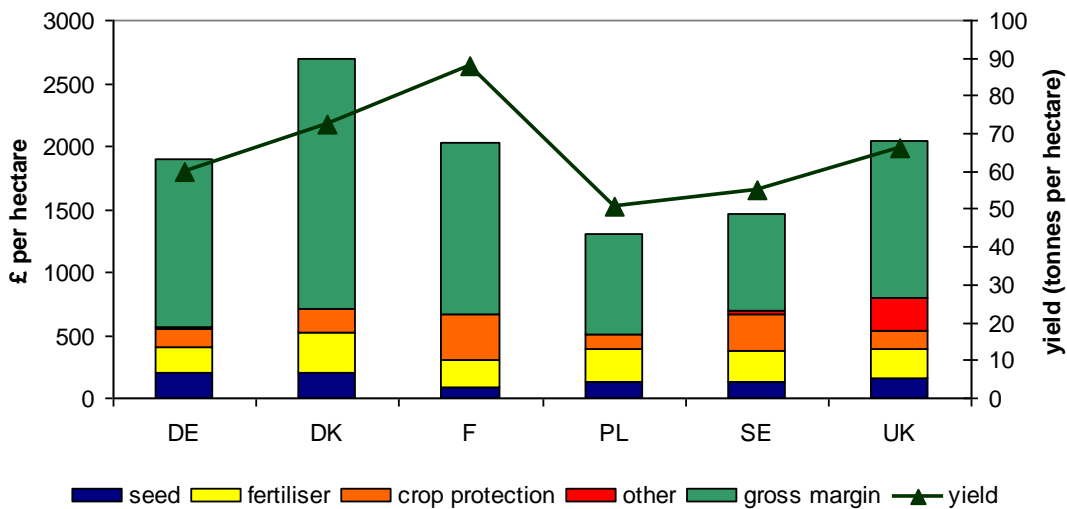
Source: Agri-benchmark/University of Cambridge

At the processing level, the initial failure of reforms to remove capacity, coupled with the inability to export surplus production due to WTO restrictions led to oversupply within the EU and downward pressure on prices. Therefore profitability of processing (and refining) companies was reduced

significantly in the first years of reform. However, the recent shortages and changes in world market prices coupled with major structural changes in processing, have led to improved profitability in this sector.

It is clear that the recent shortages, and the apparent inability of the mechanisms put in place through the reforms to deal with the shortages have dominated discussion and have threatened to overshadow wider issues associated with the reform process.

Structural Change

The European Court of Auditors (2010) noted that before the reform in EU-25 there were 285,000 sugar beet growers cultivating 2.1 million ha of beet for sugar and making use of the services of machinery contractors; over 8,000 cane growers cultivating 43,000 ha of sugar cane, mainly in EU overseas territories. After the reform in EU-27 the number of growers had decreased to 164,000 sugar beet growers cultivating 1.4 million ha of beet for sugar and making use of the services of machinery contractors; and fewer than 8 000 sugar cane growers.

There is no doubt that major structural change has occurred within the sugar processing sector following the reforms of 2006. According to the European Court of Auditors (2010), before the reform there were 189 sugar factories employing 50,000 workers, 16 isoglucose and four inulin syrup producers, producing 820, 000 tonnes and 7 full time refiners importing and processing annually 2 million tonnes of raw sugar derived from sugar cane. After the reform the number of sugar factories has reduced to 114 employing 30,000 workers (including four factories located in the two new EU Member States), 10 isoglucose producers, producing 690 000 tonnes (and no inulin syrup producer).

It may be tempting to apportion all of these changes to the reform process. However, there had been an ongoing process of rationalisation within both beet growing and processing in many EU countries prior to the reforms. For example in the UK, the number of factories had declined from 9 to 6 in the years ahead of the reform. In addition, of the two factories closed in the UK it is likely, given its relative size, that Allscot would have been closed even in the absence of the reforms. These issues aside it is certainly the case that the reforms have sped up the restructuring process in the EU and the UK.

Our analysis estimates that the reforms would have led to a reduction of around 28 per cent of the workforce in beet production as compared to the baseline situation. Within the beet growing sector farms will be able to switch to other crops, such that the impact on overall farm employment will be considerably less than 28 per cent. In the processing sector it is estimated that approximately one-third of the workers would be made redundant, again when compared to the baseline situation.

In addition to the rationalisation of processing facilities major restructuring has been taking place through a process of mergers and takeovers of sugar companies, the creation of new joint ventures and the development of marketing alliances, both within the EU and globally. The restructuring process has seen a further consolidation of ownership across Europe, with over 80 per cent of the EU sugar sector now being in the hands of eight companies, and a growing engagement of EU beet refiners in international trade in cane sugar produced outside the EU. For example, Associated British Foods (owners of British Sugar) now has almost two-thirds of its sugar production outside the

EU, while managers at the French sugar company Tereos (now the second biggest sugar maker in Brazil) expect its business to be 'more and more global' and 'less and less French'. Again, whilst this agglomeration process may have been occurring to some extent ahead of the reforms, they have speeded up the process.

Competitiveness of EU Production

The EU Court of Auditors (2010) were unequivocal in their conclusion that overall the reform process did not fully ensure the future competitiveness of the EU sugar industry via a selective reduction of unprofitable production capacity. For example, whilst the proportion of available sugar production quota renounced was significantly higher in the regions considered to have low/medium productivity, some 2.4 million tonnes was relinquished by producers with factories located in regions considered by the Commission to be most competitive. This said, EU sugar production is now more concentrated in the member states with the highest sugar yields, with these countries accounting for 78 per cent of EU sugar production.

The exit of some of the least competitive producers from the sugar sector has improved the average competitiveness of the EU sugar sector, both at the level of beet production and beet processing. It has also seen beet processors extend their processing of imported raw cane sugar. It is argued that these trends are consistent with the basic objective of the EU Common Agricultural Policy (CAP) reform process: that of shifting sugar production to the areas of the EU most suited to its production.

Within the UK, given the high fixed costs associated with sugar processing, it is inevitable that the closure of two factories, and increasing production in the remaining factories will have lowered the costs of production. In addition through associated schemes, production is now, on average, occurring closer to factories. As beet is a bulky crop, haulage is a significant cost in the production process and therefore by reducing the distance travelled cost savings would have been made. The reforms have accelerated a process of improved productivity within the UK, which has largely been driven by yield improvements.

As for the wider EU situation, the general perception of stakeholders in relation to the impact of competitiveness of the reforms was that the average tonne of beet produced in the EU was now produced at lower cost than before, but the reforms did not maximise competitiveness as it did not ensure the least efficient production was curtailed. Taking the UK as an example, whilst in the UK context the closure of York may have been justified due to its relative competitiveness with other factories in the UK, in EU terms it is likely to have been one of the more competitive factories and certainly more so than a number that remained open after restructuring.

Production

Ahead of the reform process, the EU was a surplus producer of sugar and a significant player on the world market in terms of both exports and, to a lesser extent, imports. By 2010, the reforms had largely achieved their objective of reducing EU production by 6 million tonnes and moving the EU to a deficit situation.

However, it should be noted that the initial reform package appeared to be failing in terms of encouraging countries to relinquish quota. The voluntary nature of the initial reforms meant that inevitably there was a game of 'wait and see' between member states to see whether or not they would have to relinquish quota. There was also a perception from stakeholders that despite agreeing the reforms, some member states had become increasingly concerned about the impact of cessation of sugar production and were using potential loopholes in the initial legislation to discourage processors from relinquishing quota. Thus changes to the reform package were implemented in 2007 to kickstart the process.

Overall the reforms have had a significant impact on beet production in the EU. With the area under beet decreasing by about 700 thousand hectares between 2005 and 2009. Five countries (Bulgaria, Ireland, Latvia, Portugal and Slovenia) stopped producing sugar beet while areas decreased by more than 50% in seven countries (Finland, Greece, Italy, Lithuania, Portugal, Czech Republic and Slovakia). The number of beet growers has sharply declined (but the impact of this has been partly compensated for by higher sugar yields).

During 2009/10 production actually begin to increase again (and is forecast to increase again in 2010/11). This has been driven by out of quota sugar with a significant proportion of this out of quota sugar being used in bioethanol plants (particulary in Germany). In this context, the EU's biofuel policy will clearly play a role in the future of the EU sugar beet sector.

Trade

Our modelling highlights that the reforms have led to alternative trade patterns emerging both internally within the EU as well as externally. Internally, cessation of production in a number of countries provides opportunities for those remaining in production. Externally the significant decline in EU sugar on the world market has provided opportunities for other countries. It would appear that Brazil and Thailand have been amongst the main beneficiaries of the disappearance of EU sugar from the world market.

In terms of traditional suppliers to the EU, our analysis clearly highlights that as a group they suffer a decline in trade and economic welfare. However, the impact is shown to vary considerably across ACP countries, depending upon such factors as their cost structure, size of internal market, access to alternative markets, ability to diversify into other sectors ,etc.

The situation after the implementation of the reforms is complex with several countries in the process of adjustment and others leaving sugar production altogether. In one sense the reforms have had a similar impact in ACP countries as within Europe and that is leading to decline in high cost production. In economic terms it may be seen as a positive rather than a negative if high cost production in these countries is reduced because of the reforms. However, in social terms it is important that the compensation is adequate and that alternative rural employment opportunities can be found.

In this respect, our study found a number of issues relating to the transitional aid given to the ACP countries (effectively compensation for the EU price cuts). These relate to the extent of the transitional aid, how it has been allocated and also the timing of payments.   There was some concern that the level of transitional aid given to the ACP countries did not match that paid to EU

producers in the face of the price cuts. The decision to allocate the task of distributing the transitional aid to DG Development rather than say DG Agri has led to a number of conflicts between those wishing to use the money to invest in improving the efficiency of the sector, against those who wish to use the money for wider development purposes, such as general infrastructure. There have also been delays in paying out the transition compensation.

Whilst it is often cited that the EU shortages have been caused because of production problems in the ACP countries, it is clear that, whilst this is part of the problem, the situation is more complex than this. It is not just about production but also consumption. For example, when EU prices were high there was an incentive for ACP countries to export all their sugar to the EU and then buy supplies from the cheaper world market. Now the EU price has fallen, and the world price has risen, it may be that this incentive has diminished and more sugar is being kept for domestic consumption. In addition, there has been a steady global rise in the demand for sugar increasing the competition with the EU for sugar supplies. It is argued that the EU failed to take account of the impact of these factors when assessing the possible implications of reform.

Welfare

Using a specific measure of welfare derived from the GTAP model (known as equivalent variation (EV), at the EU27 level, the gain from the sugar reforms (vs. the baseline) is approximately half a billion euros (€566 million), which amounts to a little under 0.01% of EU27 GDP. Whilst some member states and groups of states gain more, it is worth noting that in macroeconomic terms, all EU regions realise (at least some) real income gains from the sugar reforms.

In the EU, these EV welfare results are motivated principally by gains that arise because the contraction of sugar activities releases resources into relatively more efficient (i.e., less subsidised) activities (as measure by improvements in allocative efficiency). The largest gains accrue to Italy (€133 million), whilst other notable improvements appear in those areas that were 'less' efficient before the reform process. Whilst Irish and Portuguese sugar sectors collapse, neither sector is particularly large. Thus, allocative efficiency gains are relatively small (€56 million and €20 million, respectively).

Elsewhere, the more important determinant of the welfare (EV) change in the non-EU regions relates to the terms of trade (ToT), particularly where sugar is an important export crop. For example, in the LDC/ACP regions, despite the increase in the world price of sugar, the quantity of sugar exports has dropped due to preference erosion within the EU, which depresses factor prices in these regions, resulting in a net export price index fall. Subsequently, the terms of trade values are negative with respect to the baseline. The exception is South Africa, which increases its output, bidding up factor and export prices. On the other hand, as a net sugar exporter, Brazilian sugar production benefits from the increase in sugar world prices, realising a ToT gain of €142 million.

Compensation

Our analysis also considered the issue of compensation for growers and processors in light of the reforms. Given its sensitive nature, secondary data on actual sugar compensation by region was not publicly obtainable. Consequently, we have employed a series of plausible assumptions and calculations made within the model. Based upon these calculations it does appear that the degree of

compensation to EU producers was in excess of the estimated loss to producers, Italian sugar producers receive the most generous net compensation package (€151 million). Though due to the fact these were based on assumptions, these estimates should be treated with caution.

Discussion

The previous section has assessed the impacts of the reforms on such areas as prices, profitability, structures, and trade. In this section, the various strands of analysis are pulled together to provide a summary of the overall impact and also to highlight some unresolved and emerging issues.

At the outset it is necessary to realise that the reforms arose out of a process of negotiation between countries with different aims and objectives. Therefore within this political process it is inevitable that the economic optimum would not be achieved, and this is certainly the case.

Enhancing competitiveness

In simple economic terms, it is clear that the approach adopted to the reforms was not the most cost-effective way to achieve the aim of enhancing the competitiveness of the EU beet producing sector. This is in no small part due to the fact that the process did not focus on maximising improvements in competitiveness because it did not ensure that the least cost production left the industry. As the ECA (2010) identified, a major flaw was that there were actually no up-to-date or reliable figures as to the actual costs of production of sugar in the different states ahead of the reform.

A notable issue was the removal from the final agreement of the initial proposal to allow quota to be traded across EU countries. Short of the removal of quota itself it is likely that allowing trade would be the most likely way to ensure that production moved to the most efficient areas (where costs of beet growing plus costs of refining were minimised). Of course, a number of (largely political) reasons can be seen why member states would not favour such transfers of quota, but it does mean that the structural process of reform has occurred *within* rather than *between* countries and why ultimately a share of the target reduction had to be bourne by some of the more efficient regions of Europe.

Further, the voluntary nature of the reform process and flexibility offered to countries in instigating the initial 2006 reforms meant that it was perhaps inevitable that the sought after reductions from the least competitive regions were not immediately forthcoming and that changes had to be made to the scheme. Stakeholders pointed out that part of the problem was that there was a game of wait and see being played. Also countries that initially agreed to the nature of the reform package may have become more concerned with the potential implications of cessation of production on rural areas. Therefore it has been speculated that some countries made the most of 'loopholes' in the legislation to delay the reform process. The implicit threat of overall quota cuts ahead of the second stage meant that it led to a significant proportion of more competitive production being relinquished.

In addition, though subject to a number of important caveats, our analysis highlights that there may have been some over compensation for the losses occurred through the implementation of the price cuts. This result from the modelling does seem intuitively plausible as prices have not fallen as far as anticipated and also as restructuring has occurred the overall efficiency has improved reducing the

compensation needs. In a political sense it may have been expected that some degree of initial overcompensation would be needed for voluntary reforms to work especially given that this was the first reform of the regime in over 40 years.

Concentration

As noted, the reforms have led to a very different industry emerging in Europe. The upshot of this is that now processing capacity is concentrated in even fewer hands. This coupled with the fact that, despite the rhetoric, there is still tight control of imports into the EU does lead to the potential for market power to be exercised. This is the fundamental opportunity that still needs to be addressed. In order to be more competitive internationally, the EU firms need to gain maximum economies of scale through these mergers, alliances, takeovers etc. However, because the domestic market is actually heavily protected from overseas competition, it means that the reforms have reduced the number of competitor businesses within the EU. One sugar user indicated that the level of concentration has so far proved beneficial, in that they have to deal with fewer sellers in order to secure supply throughout Europe, and they have yet to see the other side of this in terms of any potentially anti-competitive behaviours. They also have witnessed a narrowing of the gap between prices in different parts of the EU after the reforms when compared to the situation before 2006. This leads to the next section in which issues surrounding the manufacturing industries are discussed

Manufacturing industry(sugar users)

In terms of sugar users there are a number of outcomes of the reform process, relating to prices, supply and exports.

Prices

As one stakeholder put it, sugar users have to understand that the EU has moved from a situation of a generally high (in relation to other regions of the world) but stable price to one which has generally been lower since the reforms, but more volatile. This volatility does present challenges with planning but also does present other challenges. Another stakeholder illustrated the potential issues through the following example. In a situation where everyone faces the same high price then they are competing on a level playing field. Inject volatility into the mix and then potentially it is possible to gain a market advantage. For example if you are supplying own label biscuits into supermarkets (a very competitive area) then if you can secure your sugar for 100 euro less than your competitors you can gain quite a significant advantage.

Shortages

Shortages (or tight supplies) that have been witnessed particularly in the 2010/11 marketing year. An ongoing situation of deficit in domestic production, coupled with the fact that the foreseen increase in imports did not appear, has in the past year led to shortages occurring. This has been one of the main unforeseen consequences of the reform (though a number of commentators stated that they had argued this point during the discussions concerning the reforms). The problem as seen by stakeholders is that because the deficit was unforeseen in the analysis that had been undertaken for assessing the impact of the reforms then no proper measures were in place to deal with it. As witnessed at the end of 2010 and through 2011, a rather *ad hoc* process has been used of allowing out of quota sugar onto the market as well as increasing the level of imports that can enter under

favourable rates. Concerns have been raised that this was too little too late and that the Commission refused to accept that a real shortage existed within the EU. This brings us back to the role of prices and the weaknesses in the official price data as discussed earlier. In addition it has been pointed out that this process, of allowing out of quota sugar onto the domestic market has favoured beet over cane sugar and therefore is going counter to the aim of balancing between the two types of sugar. Having spent at least 6 billion Euros removing sugar from the EU market, it may seem rather counter intuitive to consider increasing production again. Although food and drink manufacturers, to a large extent, will not care where the sugar comes from as long as it comes onto the market.

A number of stakeholders criticised the nature of the EU's *ex-ante* evaluation of the impact of the reforms. In particular they felt that the reforms were not sufficiently tested in terms of how they might perform against various scenarios. They drew attention to how little work was undertaken as to what would happen if world prices rose above EU prices.   Although it may be argued in the EU's defence that given the huge disparity between EU and world prices in the period leading up to the reform this scenario was almost unthinkable.

In fact the most pressure placed on the EU commission at the time of the reform discussions was from those that were worried about a flood of duty free sugar entering the EU market to the detriment of the domestic industries. Therefore, facilities were made to cap the quantity of sugar entering, but nothing done to address the reverse issue of insufficient sugar entering the market.

The shortages and subsequent price rises have placed increasing strain on the relationships through the supply chain. In particular between processors and refiners and customers. There have been claims of contracts being broken and forced renegotiations in this financial year. Although for the refiners at least part of the problem is that given high world prices they have to compete or will not receive the sugar.

Although claims have been made that manufacturers have been relocating or planning to relocate production outside of the EU due to high sugar costs, this did not appear to be a significant issue when stakeholders were interviewed. It seemed that the decision to relocate was based on wide range of economic (and other) factors and that sugar price was only one of these and not the key one. In fact if sugar had been the driving factor, the irony would have been that the EU at the present time is one of the lowest cost sugar regions in the world.

In addition, whilst the current situation does not favour sugar users, it should be noted that in the early years of the reform, when EU production had not declined as far as expected and the EU was constrained on use of export refunds due to the WTO agreements, they had the upper hand in price negotiation.   As identified by Agri-trade this was traumatic time for processors in terms of profitability.

Export refunds

The demise of export subsidies and replacement with increased emphasis on Inward Processing Relief (IPR) has also raised some concerns for manufacturers. In theory the IPR allows firms to buy on the world market an equivalent quantity of sugar as that included in any products that are exported outwith the EU. However, there appears to be a problem in the implementation of the

legislation. The problem arises due to the different interpretation of the rules between EU countries. For example one stakeholder pointed out that it is permitted to triangulate within UK[8], within France it is harder and in the Czech Republic then the manufacturing company needs to physically bring in the sugar itself. Given that the Czech Republic is landlocked the transport costs of doing this are prohibitive.

Isoglucose

As part of the reform quotas for isoglucose production were increased. However, they are still tiny in relation to the sugar quota. As one stakeholder put it if you have peanuts and someone offers you slightly bigger peanuts it is not particularly helpful. Their concern is that the quota does not allow the industry to achieve scale economies in production and therefore make it more efficient. There have always been tensions between sugar production and this sector, which it may be argued only really developed because of the protection offered to sugar producers. However, they do feel they could be competitive with sugar in a truly liberalised market.

Balance is another key aspect between the indigenous beet producing industry and the cane refining sector. A key issue is that currently the refining sector are finding it hard to secure sufficient sugar to maintain production at capacity. Given the very large fixed costs involved in sugar refining then spare capacity can prove very costly. The problem has arisen, as we have seen, because the available production from traditional suppliers has declined markedly due to structural changes. In addition, some suppliers, the most noticeable being Mauritius, have found new markets in the EU, now supplying white rather than raw sugar. The restrictions on imports mean that the refiners are unable to substitute non LDC or ACP sugar to compensate for this. In their view they are facing the worst of both worlds under the current regime – that is they are suffering from the regulated market without enjoying the direct benefits of the protection offered, unlike the beet processors.

This question also emerges in terms of competition between processors and refiners. A beet processing plant can be converted to take raw cane sugar but not vice versa. Therefore, given the large fixed costs associated with refining, it may be the case that the beet processors can either outbid refiners in terms of securing supply or produce at lower costs

Within the reforms there is a need to keep a balance between the various interests. As pointed out in discussion, the refining industry employs around a 1000 workers within Europe and the starch and isoglucose industries utilise a greater area of wheat and potatoes than that grown for sugar beet.

Trade Issues

In one sense the fact that the EU has not been challenged within the WTO since the reforms highlights that at least one of the sub-objectives of the reforms has been met.

An emerging issue is the possible impact of bilateral trade deals. The stalling of the multilateral WTO talks has given greater impetus to bi-lateral deals. The EU can clearly see gains from these talks which may increase access for service industries and other industrial sectors. However, in return there is a demand for greater access for sugar into the EU. We therefore have a situation whereby

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[8] Triangulation refers to the ability of the exporting firm to sell on the right to import the sugar equivalent to a third party.

these agreements can potentially undermine agricultural policy. Of course many of these talks, for example between the EU-Mercusor, are largely in their infancy and it is unlikely that the impact will be felt immediately. However, they do offer potential future sources of sugar for the refining industry in Europe which may increase competition with the beet sector.

Our study clearly highlighted the difficulties that have been faced by many of the traditional sugar trading countries with the EU. It is interesting that for a long time the arrangements with the ACP countries were seen almost as a form of aid. in economic terms it has long been argued that the Sugar Protocol was an inefficient way to support these countries if that was the aim (Sturgess, 1992). This may have been behind the decision to allocate the transitional aid to DG Development rather than DG Agri. However, as highlighted earlier this has led to challenges within the sugar sector of a number of the ACP countries as those wishing to use the money to invest in improving the efficiency of the sector have come up against those who wish to use the money for wider development purposes, such as general infrastructure. As pointed out earlier in terms of economics it may be seen as a positive rather than a negative if high cost production in these countries is reduced because of the reforms. However, in social terms it is important that the compensation is adequate and that alternative rural employment opportunities can be found. The delay in paying out the transition compensation and also the fact that attempts to improve efficiency appear to be thwarted in some countries is concerning.

Market stabilisation and guaranteeing of supplies

The Court of Auditors (2010) found that while relative market stability had been assured up to the time of their analysis, and prices on the EU sugar market had been stable to date around the reference prices, it has been achieved through the use of production quotas which currently set the maximum allowed internal production at a level of production markedly below internal market requirements, at 85 per cent of EU consumption. As a result, EU supplies became increasingly dependent on imports while new uses for sugar placed increasing demands on supplies.

However, the situation identified by the Court, has changed markedly as pointed out by Agritrade-CTA (2010). While the sugar reference price was reduced by 36 per cent, the 'exceptional market conditions' that prevailed in 2009/10 saw the world market price of sugar reach record price levels (up to 30 US cents/lb), which were some 29 per cent above the EU reference price. For the first time since the 1970s, world market sugar prices were not only substantially above the reference price but also 'well above the market price for EU quota sugar'. This has created a situation where, at least on a temporary basis, the EU reference price has become a true 'safety net' price and has no influence on price formation in the EU sugar sector.

Under the exceptional market conditions for the period 2009/10 EU sugar prices have been largely determined by the world market price of sugar. This allowed the EC to table a regulation on 27 January 2010 for 'the export of an additional 500,000 tonnes of out-of-quota sugar in the 2009/10 marketing year' (up to 31 July 2010), without in its view violating its WTO obligations (since, the EC argues, at current world market prices EU companies can profitably export without any need for cross-subsidisation). It was argued by the EC and the EU beet industry that this measure 'can contribute to easing the tight demand situation on the world market', to the benefit of consumers in poor countries. As raised earlier in the report, the degree of industrial concentration in the sugar sector does lead to questions as to the extent that consumers benefit from changes in sugar prices.

The EC also recognises that 'the present market situation for sugar is very unlikely to occur again in the future'.

As a consequence, the EC is committed to keeping the situation under constant review. While high world market prices have facilitated the EU reform process, it is recognised that the situation is likely to change as global production responds to high global sugar prices. Against this background, the EC remains committed to a managed sugar trade regime, with the success of market management measures being an important determinant of whether preventive withdrawals of production quotas are necessary, and indeed whether further reductions in the sugar reference price will be required as part of the 2013 round of CAP reforms.

Looking forward

Recent draft proposals from the EU suggest that the EU sugar quota regime is set to be abolished at the end of September 2015. The Commission appears to be seeking to steer the sugar sector towards greater market orientation, encourage a higher level of competitiveness and put an end to restricted EU exports. Removal of the quota regime is seen to pave the way for the lifting of export restrictions, as the non WTO-compliant issue of 'cross-subsidisation' will be addressed. It is likely that a further fall in EU prices and actual increased production in the EU is likely to have knock on effects on developing countries.

Unsurprisingly, given the views expressed to us during the review of the 2006 reforms, the ACP Group has spoken out in opposition to the proposed move to abolish the sugar quota system. They argue that the current regime "has shown its capacity to properly manage extreme world market disruptions, by ensuring a safe & reasonably-priced supply of sugar to European consumers". They also are concerned over the lack of policy coherence between the floated proposals and EU Development Policy and trade commitments.

A related issue is the relationship between refiners and ACP countries as well as with domestic beet production. It was clear from the evaluation of the 2006 reforms that they want to ensure a level playing field with beet processors. They feel they do not have this and they expressed concerns that simple quota liberalisation without liberalising the restrictive import constraints would be detrimental. For example, in the UK quota liberalisation could allow beet production to increase and introduce greater competition pressure on the refiners (given the generally inelastic nature of demand). If cane refiners were able to access world markets more generally for sugar then they would be more able to respond accordingly and maintain market share. However, if they are constrained, as they currently are, to a limited number of suppliers (who are not necessarily the lowest cost suppliers) this will hamper their ability to compete. However, liberalising imports would erode the preferential access of ACP and LDC suppliers. This could hamper the sugar industry in ACP and LDC countries and engender serious economic and social consequences, particularly in countries that are heavily dependent on sugar and have limited options for diversification. Therefore the extent of wider liberalisation will form a key part of developing scenarios.

In a wider context, (although some extent based on generalisations, it is possible to classify the following stances towards further reforms amongst key stakeholder groups:

- Sugar beet processors and producers - argue for retention of basic measures on the ground of stability, certainty of supply, European food security etc.
- End-Users are mainly concerned with ensuring that the sugar supply market is competitive
- Isoglucose/starch sector are pushing for complete liberalisation
- Cane refiners are seeking what may be termed equivalence of treatment (particularly in terms of access to supplies) to allow them to compete on an equal footing with the domestic beet industry
- ACP countries - want stability, and a remunerative market with controlled access

An emerging issue that was identified through the study is the possible impact of bilateral trade deals on the EU sugar regime. The stalling of the multilateral WTO talks has given greater impetus to bi-lateral deals. The EU can clearly see gains from these talks which may increase access to new markets for their service industries (and other industrial sectors). However, in return there is a demand for greater access for sugar into the EU. As this increased access is granted, there is potential for a situation whereby these agreements can potentially undermine EU agricultural policy which may be more restrictive of imports. However, this increased access will also provide additional sources of raw sugar for the refining industry in Europe, which will increase competition with the beet sector.

In terms of trade liberalisation it is clear that through the process of mergers and takeovers the distinction between the EU sugar industry and the rest of the world is much less clear. Situations are therefore likely to arise in the coming years where the interests of the larger sugar companies progressively become more global. This is already starting to happen for example with ABF, Sudzucker and Tereos. This could introduce differences of approach between their EU and global operations.

Through the findings highlighted in this paper, it is clear that both the approach adopted and the process of implementation had a number of strengths but also weaknesses. In conclusion, Table attempts to summarise the key issues surrounding the reform. Of course, it is necessary to recognise the possible opposing interests of stakeholders, that is what is seen as a positive to one may be perceived as a negative by another. These provide insight into issues that may emerge with the further reforms proposed for 2015.

Table 2 Potential Strengths and Weaknesses of EU Sugar Regime Reform

Positive	Negative
Production EU Industry rationalised Growers restructured Surplus capacity cut with approximately 75 factories closed Subsidised exports cut Subsidised quota exports and export refunds eliminated – no subsequent challenges under the WTO Exports cut from 6 mt to 1 mt EU changed from major global exporter to major importer Increased efficiency and competitiveness of remaining industries Process of merger, acquisition, take-over has strengthened remaining processing firms also diversifying into other non-EU countries	 Growers had little say in restructuring process - presented as fait accompli Restructuring to some extent impeded by politics and therefore some relatively efficient factories (in European context) closed whilst some relatively inefficient factories remain open Exports restricted to 1.4 mt/year – Question as to whether out of quota now subsidised within the EU. If not then should in theory be able to export this EU potentially disadvantaged globally as more efficient producers may be unable to expand in response to improved world market – particular issue for UK industry World market changes have made imports unreliable and therefore shortages have been developing and this has come to a head in 2010/11 Mechanisms adopted did not ensure that the least efficient 6 million tonnes was taken out of production. Significantly reduced number of processors in European market may hamper competition (no evidence yet)
Prices EU prices cut >€720 to €490 Sugar users have faced generally lower prices	Increase linkage between world and EU prices appears to have increased volatility Question as to extent the lower prices have transmitted to end consumers Official price statistics seen as inadequate in reflecting changes in market balances and hence triggering remedial action

Access	
LDCs and ACP given unrestricted access Brazil and other major producers given substantial access	Imports have proved unreliable due to structural changes occurring due to substantial price reductions coninciding with improved opportunities elsewhere Import regulations still rigid
Refining restrictions lifted: Better prices and more choice for developing country cane producers	Due to decline in traditional sources and inability to import from other producers, refiners have been unable to maintain capacity, reducing efficiency
Lower prices within EU market leads to increased efficiency in ACP countries	Demise of high cost producers whilst improving efficiency may have social and cultural impacts Concerns raised over extent, timing and nature of transitional aid for ACP countries
Other	
Out of quota able to be used for alternative uses, including renewable energy – growth area	Competitive industries (isoglucose etc) faced significant reduction in market due to loss of industrial market.
Increase in quota for isoglucose	Quota too small to enable competitive industries to achieve true economies of scale.

Bibliography

Agritrade-CTA (2010a). Executive brief: Update Sugar: trade issues for ACP countries. Jan-March. Available online at:http://agritrade.cta.int/en/Commodities/Sugar-sector/Executive-brief#1

Agritrade-CTA (2010b). Regional perspectives on changing EU-ACP sugar sector relations: The impact of duty-free, quota-free access on ACP exporters, May. Available online at: http://agritrade.cta.int/en/content/view/full/5066

Agritrade-CTA (2010c). Corporate restructuring in the EU sugar sector: Implications for the ACP, May. Available online at: http://agritrade.cta.int/en/content/view/full/5064

Armington, P. (1969). A Theory of Demand for Products Distinguished by Place of Production, IMF staff papers, 16, pp159-178.

Blake, A.T., Rayner, A.J. and Reed, G.V. (1998) A CGE Analysis of Agricultural Liberalisation: The Uruguay Round and CAP Reform, First Annual Conference on Global Economic Analysis, Purdue University, USA.

Buysse, J., Fernagut, B., Harmignie, O., de Frahan, B., Lauwers, L., Polomé, P., Van Huylenbroeck, G., Van Meensel, J. (2007). Farm-based modelling of the EU sugar reform: impact on Belgian sugar beet suppliers, European Review of Agricultural Economics, 34(1): 21-52.

Elbehri, A., Umstaetter, J., and Kelch, D. (2008) The EU Sugar Policy Regime and Implications of Reform, ERR-59. U.S. Dept. of Agr., Econ. Res. Serv. July.

Elbehri, A. and Pearson, K. (2005) Implementing Bilateral Tariff Rate Quotas in GTAP using GEMPACK, GTAP Technical Paper 18, Purdue University, USA.

European Commission (EC) (2004). A description of the common organisation of the market in sugar. Document AGRI/63362/2004. Available online at http://ec.europa.eu/agriculture/markets/sugar/reports/descri_en.pdf

European Commission (EC) (2005). Reforming the European Union's sugar policy, Update of impact assessment [SEC(2003) 1022]. Available online at:www.liz-online.de/gi/ZMO/Arbeitsdokument.pdf

Frandsen, S.E., Jensen, H., Yu, W. And Walter-Jorgensen, A. (2003) Reform of the EU sugar policy: price cuts versus quota reductions, *European Review of Agricultural Economics*, v30(1), pp1-26.

Gohin, A. and Bureau, J. C. (2006). Modelling the EU sugar supply to assess sectoral policy reforms. European Review of Agricultural Economics, 33(2): 223–247.

Gotor, E. and Tsigas, M. (2010). The impact of the EU sugar trade reform on poor households in developing countries: A general equilibrium analysis. Journal of Policy Modeling (Articles in Press)

Narayanan, B. and Walmsley, T. (Eds.) (2008) Global Trade, Assistance and Production, The GTAP 7 Data Base, Centre for Global Trade Analysis, Purdue University.

Netherlands Economic Institute (2000). Evaluation of the common organisation of the markets in the sugar sector - Final report. September. Available online at: http://ec.europa.eu/agriculture/eval/reports/sugar/

US Department of Agriculture – Foreign Agricultural Service (USDA-FAS) (2009). EU-27 Sugar Annual. GAIN Report Number: E49045, 5/5/2009. Available online: www.fas.usda.gov/posthome/useu/sugar.html

Winters, L.A., McCulloch, N. and McKay, A., (2004). Trade liberalization and poverty: The evidence so far, Journal of Economic Literature 42, 71–115.

WTO (2005), 'Tariff Quota Fill', TN/AG/S/20, Geneva: World Trade Organization, 4 July, 2005

Appendix 1:

I. Deriving the Mark-Up
Defining profit in each symmetric firm 'i' (Π_i) as total revenue (industry price (P) multiplied by firm output (Q_i)) minus total costs (TC_i).

$$\Pi_i = P.Q_i - TC_i \tag{A.1}$$

Under Cournot conjecture, maximise profit with respect to firm output. Using the product rule gives:

$$\frac{\partial \Pi_i}{\partial Q_i} = P + Q_i \frac{\partial P}{\partial Z} \frac{\partial Z}{\partial Q_i} - \frac{\partial TC_i}{\partial Q_i} = 0 \tag{A.2}$$

where Z is industry output. Rearranging:

$$P - MC_i = -Q_i \frac{\partial P}{\partial Z} \frac{\partial Z}{\partial Q_i} \tag{A.3}$$

Multiply both sides by (P/P)(Z/Z) and manipulating gives:

$$\frac{P - MC_i}{P} = \frac{\Omega_i}{N} \cdot \left| \frac{1}{\varepsilon} \right| \tag{A.4}$$

where

$$\Omega_i = \frac{\partial Z}{\partial Q_i} \qquad \frac{1}{N} = \frac{Q_i}{Z} \qquad \left| \frac{1}{\varepsilon} \right| = \frac{\partial P}{\partial Z} \frac{Z}{P} \tag{A.5}$$

The derived value for the inverse elasticity demand depends on whether the destination market is domestic or foreign.

II. Deriving the levels inverse demand function for domestic markets
The CES armington demand function for domestic (r=s) good 'i' is represented in levels form as:

$$Q_{i,r,s} = QC_{i,s} \cdot \left[\frac{P_{i,r,s}}{PC_{i,s}} \right]^{-\sigma_i} \tag{A.6}$$

where $Q_{i,r,s}$ is the demand, $QC_{i,s}$ is the composite demand (over domestic and foreign) in destination region 's', and $P_{i,r,s}$ and $PC_{i,s}$ Rearranging (A.6) in terms of $P_{i,r,s}$ gives the inverse demand function:

$$P_{i,r,s} = \left[\frac{Q_{i,r,s}}{QC_{i,s}} \right]^{-\frac{1}{\sigma}} PC_{i,s} \tag{A.7}$$

Take the derivative of (A.7) (product and chain rules) with respect to domestic (r=s) demands:

$$\frac{\partial P_{i,r,s}}{\partial Q_{i,r,s}} = -\frac{1}{\sigma_i} \frac{P_{i,r,s}}{Q_{i,r,s}} + \frac{1}{\sigma_i} \frac{P_{i,r,s}}{QC_{i,s}} \frac{\partial QC_{i,s}}{\partial Q_{i,r,s}} + \frac{P_{i,r,s}}{PC_{i,s}} \frac{\partial PC_{i,s}}{\partial Q_{i,r,s}} \tag{A.8}$$

Multiplying (A.8) by ($Q_{i,r,s}/P_{i,r,s}$) and substituting the derivative expression:

$$\frac{\partial PC_{i,s}}{\partial Q_{i,r,s}} \frac{Q_{i,r,s}}{PC_{i,r,s}} = \frac{\partial PC_{i,s}}{\partial QC_{i,s}} \frac{QC_{i,s}}{PC_{i,s}} \times \frac{\partial QC_{i,s}}{\partial Q_{i,r,s}} \frac{Q_{i,r,s}}{QC_{i,s}} \qquad \text{(A.9)}$$

Yields the inverse elasticity:

$$\frac{\partial P_{i,r,s}}{\partial Q_{i,r,s}} \frac{Q_{i,r,s}}{P_{i,r,s}} = -\frac{1}{\sigma_i} + \frac{\partial QC_{i,s}}{\partial Q_{i,r,s}} \frac{Q_{i,r,s}}{QC_{i,s}} \left[\frac{1}{\sigma_i} + \frac{\partial PC_{i,s}}{\partial QC_{i,s}} \frac{QC_{i,s}}{PC_{i,s}} \right] \qquad \text{(A.10)}$$

In expression (A.10), the derivative ∂QC/∂Q can be calculated by taking the derivative of the underlying CES function:

$$QC_{i,s} = \left[\sum_{r \in reg} \delta_{i,r,s} Q_{i,r,s}^{-\rho_i} \right]^{-\frac{1}{\rho_i}} \qquad \text{(A.11)}$$

and multiplying the result by ($Q_{i,r,s}$ /$QC_{i,s}$) gives :

$$\frac{\partial QC_{i,s}}{\partial Q_{i,r,s}} \frac{Q_{i,r,s}}{QC_{i,s}} = S_{i,r,s} = \frac{P_{i,r,s}.Q_{i,r,s}}{\sum_{r \in reg} P_{i,r,s}.Q_{i,r,s}} \qquad \text{(A.12)}$$

where $S_{i,r,s}$ is the expenditure share of good 'i' from region 'r' over demand for 'i' from all regions 'r' (r=s and r≠s). Substituting (A.12) into (A.10) and take the negative of the inverse elasticity of the derivative to obtain the *absolute* value of the inverse elasticity of demand for domestic (r=s) representative varieties.

$$\left| \frac{1}{\varepsilon} \right|_{i,r,s} = -\frac{\partial P_{i,r,s}}{\partial Q_{i,r,s}} \frac{Q_{i,r,s}}{P_{i,r,s}} = S_{i,r,s} \left[-\frac{\partial PC_{i,s}}{\partial QC_{i,s}} \frac{QC_{i,s}}{PC_{i,s}} - \frac{1}{\sigma_i} \right] + \frac{1}{\sigma_i} \qquad \text{(A.13)}$$

Moreover, following Blake *et al.* (1998), assuming that the absolute value of the inverse elasticity of demand for the composite good ($QC_{i,s}$) is equal to unity:

$$\left| \frac{1}{\varepsilon} \right|_{i,r,s} = S_{i,r,s} \left[1 - \frac{1}{\sigma_i} \right] + \frac{1}{\sigma_i} \qquad \text{(A.14)}$$

III. Deriving the Inverse Elasticity of Demand for Foreign (r≠s) goods
Following Blake *et al.* (1998), the inverse elasticity of demand for exports from 'r' (r≠s) is given as:

$$\left| \frac{1}{\varepsilon} \right|_{i,r,s}^{M} = -\frac{\partial P_{i,r}}{\partial X_{i,r,s}} \frac{X_{i,r,s}}{P_{i,r}} = \left[\frac{\partial P_{i,r}}{\partial PM_{i,r,s}} \frac{PM_{i,r,s}}{P_{i,r}} \right] \times$$

$$- \left[\frac{\partial PM_{i,r,s}}{\partial M_{i,r,s}} \frac{M_{i,r,s}}{PM_{i,r,s}} \right] \times \left[\frac{\partial M_{i,r}}{\partial X_{i,r,s}} \frac{X_{i,r,s}}{M_{i,r}} \right] \qquad \text{(A.15)}$$

where $M_{i,r,s}$ are imports in region destination region 's', $P_{i,r}$ is the price in export region 'r', $PM_{i,r,s}$ is the import price (post tariff) in region 's', and $X_{i,r,s}$ is the export quantity. In the model, the market clearing accounting conventions of the model impose the constraint that the export and import quantities along a given bilateral trade route are equal, such that:

$$\frac{\partial M_{i,r,s}}{\partial X_{i,r,s}} \frac{X_{i,r,s}}{M_{i,r,s}} = 1 \qquad\qquad (A.16)$$

and:

$$\left.\left|\frac{1}{\varepsilon}\right|^{M}_{i,r,s}\right. = -\frac{\partial PM_{i,r,s}}{\partial M_{i,r,s}} \frac{M_{i,r,s}}{PM_{i,r,s}} = S_{i,r,s}\left[1 - \frac{1}{\sigma_i}\right] + \frac{1}{\sigma_i} \qquad r \neq s \qquad (A.17)$$

To calculate $\partial P/\partial PM \times PM/P$ (i.e., the elasticity of changes in export prices in 'r' with respect to changes in import prices in 's') start from the levels expressions in the model for the "free on board" ($PFOB_{i,r,s}$) export price and the "market" ($PM_{i,r,s}$) and "cost insurance freight" ($PCIF_{i,r,s}$) import prices:

$$PFOB_{i,r,s} = \frac{P_{i,r}}{TX_{i,r}.TXS_{i,r,s}} \qquad\qquad (A.18)$$

$$PM_{i,r,s} = PCIF_{i,r,s}.TM_{i,r}TMS_{i,r,s} \qquad\qquad (A.19)$$

$$PCIF_{i,r,s} = PFOB_{i,r,s} + PT \qquad\qquad (A.20)$$

where

$TX_{i,r}/ TXS_{i,r,s}$ – Generic/Bilateral specific export tax/subsidy.

$TM_{i,r}/ TMS_{i,r,s}$ – Generic/Bilateral specific import tax/subsidy.

$P_{i,r}$ – Export market price in region 'r'.

PT – Global shipping sector per unit freight price

Substitute (A.18) into (A.20)

$$PCIF_{i,r,s} = \frac{P_{i,r}}{TX_{i,r}.TXS_{i,r,s}} + PT \qquad\qquad (A.21)$$

Substitute (A.21) into (A.19):

$$PM_{i,r,s} = P_{i,r}.TX_{i,r}^{-1}.TXS_{i,r,s}^{-1}.TM_{i,r}.TMS_{i,r,s} + PT.TM_{i,r}.TMS_{i,r,s} \qquad (A.22)$$

Rearrange in terms of $P_{i,r}$:

$$P_{i,r} = PMS_{i,r,s}TX_{i,r}.TXS_{i,r,s}TM_{i,r}^{-1}.TMS_{i,r,s}^{-1} - PT.TM_{i,r}.TMS_{i,r,s} \qquad (A.23)$$

Taking the derivative gives:

$$\frac{\partial P_{i,r}}{\partial PM_{i,r,s}} = TM_{i,r}^{-1}.TMS_{i,r,s}^{-1}.TX_{i,r}.TXS_{i,r,s} \qquad (A.24)$$

Multiplying by $PM_{i,r,s} / P_{i,r}$, substituting (A.22) and cancelling terms gives:

$$\frac{\partial P_{i,r}}{\partial PM_{i,r,s}} \frac{PM_{i,r,s}}{P_{i,r}} = \frac{PT.TX_{i,r}.TXS_{i,r,s}}{P_{i,r}} + 1 \qquad (E.12)$$

Combining each of these terms into the inverse elasticity of demand for exports of region 'r' (r≠s) (expression A.15) gives:

$$\left|\frac{1}{\varepsilon}\right|_{i,r,s}^{M} = -\frac{\partial P_{i,r}}{\partial X_{i,r,s}} \frac{X_{i,r,s}}{P_{i,r}} = \left[\frac{PT.TX_{i,r}.TXS_{i,r,s}}{P_{i,r}} + 1\right] \times$$

$$\left[S_{i,r,s}\left[1 - \frac{1}{\sigma_i}\right] + \frac{1}{\sigma_i}\right] \times 1 \qquad (E.13)$$

and substituting into the mark-up expression (A.4) gives the mark-up on foreign sales (r≠s)

Appendix 2: Composition of the 29 aggregated GTAP regions

Aggregated region (29)	GTAP Region (112)
United Kingdom	United Kingdom
France	France
Germany	Germany
Ireland	Ireland
Italy	Italy
Portugal	Portugal
Spain	Spain
Poland	Poland
EUA (formerly 'A' producers)	Finland, Greece, Hungary, Latvia, Lithuania, Slovakia, Slovenia
EUB (formerly 'B' producers)	Belgium, Czech Republic
EUC (formerly 'C' producers)	Austria, Denmark, Netherlands, Sweden
OEU25 (non sugar producers)	Cyprus, Estonia, Luxembourg, Malta
AC2	Bulgaria, Romania
Australia	Australia
Brazil	Brazil
Caribbean	Caribbean
China	China
Columbia	Columbia
Guatemala	Guatemala
India	India
Mauritius	Mauritius
Russia	Russian Federation
South Africa	South Africa
Thailand	Thailand
USA	USA
NAfrMEast	Iran, Rest of Western Asia, Egypt, Morocco, Tunisia, Rest of North Africa
WAfr	Nigeria, Senegal, Rest of West Africa
LDCACP	Lao People's Democratic Republic, Rest of Southeast Asia, Bangladesh, Rest of South Asia, Central Africa, South Central Africa, Ethiopia, Madagascar, Malawi, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe, Rest of Eastern Africa, Botswana, Rest of South African Customs Union
ROW	New Zealand, Rest of Oceania, Hong Kong, Japan, Korea, Taiwan, Rest of East Asia, Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, Pakistan, Sri Lanka, Canada, Mexico, Rest of North America, Argentina, Bolivia, Chile, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Rest of South America, Costa Rica, Nicaragua, Panama, Rest of Central America, Switzerland, Norway, Rest of EFTA, Albania, Belarus, Croatia, Ukraine, Rest of Eastern Europe, Rest of Europe, Kazakhstan, Kyrgyzstan, Rest of Former Soviet Union, Armenia, Azerbaijan, Georgia, Turkey