

# Impacts of Elimination of EU Sugar Production Quota on ACP countries

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## ABSTRACT:

Our paper takes into account trade and health implications of elimination of EU sugar quotas on ACP countries and examines following key questions from an international trade and health policy perspective: (a) how will the decline in sugar export price and trade diversion affect sugar industry and total welfare in ACP countries, especially the least developed ones given that sugar industry is one of the biggest sources of foreign currency earning and employment and the direction of the sugar policy weighs heavily on the countries' economic and development efforts; (b) what policy options are viable and feasible for the ACP sugar industry to reverse the welfare loss; (c) What are the likely impacts of such trade policy on the health of EU citizens?

**Keywords:** EU trade policy; Sugar production quotas; ACP countries; CGE modelling

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## **1. Introduction**

Since the 2006 EU Common Agricultural Policy (CAP) reforms, which included a new sugar regime to end EU production quota and reference price for EU beet sugar in 2017 (European Commission 2010), it is likely that the EU will move from being a net importer of sugar to a net sugar exporter. So far, developing and least developed countries from the African, Caribbean and Pacific Group of States (ACP), including Malawi, Zimbabwe, Lesotho and Swaziland have benefited from the export of raw sugar to the EU market. Currently the EU imports approximately 60 per cent of their demand for cane sugar from the ACP countries under the duty-free quota-free access sugar from these countries have to the EU market. Recent work by the European Commission (EC) shows that the reform of the EU sugar regime could lead to a 4.2 per cent increase in EU production of beet sugar, while imports of sugar are estimated to decline by 42.6 per cent, mainly due to the replacement of imports from high-cost third countries, like the ACP countries, by domestic production. In volume terms, this implies that EU sugar imports will decline from 3.5 million tons in 2012 to 1.5 million tons in 2022.

## **2. Literature Review**

Studies by Nolte et al (2010a, 2010b, 2012) analyze sugar quotas abolition report that competition inside the EU will intensify and protection against import from the world market will continue to exist. The studies also suggest that current out-of-quota production will be redirected to the food market. At the same time, efficient producers might increase their production. Both will put internal prices under pressure and drive less competitive EU producers as well as preferential importers out of the market. Despite an increase of internal production, the total revenue of the EU sugar industry will most likely fall. The size of these effects is not clear a priori. Depending on the world market price the EU could stay an importer or become an exporter again. Studies report that while EU consumers, the food industry and the retail sector will be beneficiaries, losers will be beet growers, sugar factories, preferential importers, refiners and users of out-of-quota sugar. In addition to direct economic impact, this policy has implications for sugar consumption in the EU. Recent studies highlight that sugar consumption has health linkages. Within the context of the US, Schroeter et al. (2008) conclude that an 'efficient intervention (to combat obesity in the US) is to apply a tax

on caloric soft drinks. Harnack et al. (2009) find evidence that that consumption of sugar in beverages is a contributor to the ‘epidemic’ of obesity. Bonnet and Requillart employ random-coefficients logit model and find that price changes would lead to an increase in market shares of regular products by 7.5% and to substitutions between brands to the benefit of products with the highest sugar content. On the whole, this would raise consumption of regular soft drinks by more than 1 litre per person per year and consumption of added sugar by 124 g per person per year, this increase being larger in households composed of overweight and obese individuals.

### **3. Analysis of the Impacts of the EU Sugar Quota Elimination on ACP countries**

#### **3.1 Model description**

##### **3.1.1 Production quota elimination**

To examine the likely impacts of the quota elimination in the EU, an accounting exercise from GTAP (Hertel, 1997), a general equilibrium model, is performed. Analysts (ISO, 2015; Matthews, 2013) conclude that removal of EU production quota will lead to an increase between 2 and 10 % of the production of sugar in the EU depending on the estimation techniques. There are two direct ways to model such production increase in the GE framework. One way is to assume that this increase in production comes from land uses, and the other is that it is due to an increase in production technology at farming or processing level. But the use of those two direct ways is less appealing because an increase in sugar land use or in technology in a region like the EU, where agricultural land is already scarce and sugar technology is among the most advanced, seems limited. We therefore adopt a third approach which is to work through the elimination of quota rent, holding land use and technology constant.<sup>1</sup>

The quota rent approach mimics Elberi and Staetter (2005) Lips and Rieder (2001), Bach and Pearson studies which use tax equivalent to represent quotas. Figure 2 shows that quota rent, which is the wedge between producers’ cost and consumer price, times the binding quota amount. Still, this is a huge task as each of the EU members has different levels of quota

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<sup>1</sup> A fourth way would be to assume that the elimination of quota on domestic production is equivalent to an import restriction (a new tariff or a quantitative restriction). The abolition of quota would mean that the out of quota production (already part of the exportation) would be allowed to go into domestic consumption which means that imports from preferential sources are replaced by non-preferential sources.

rents (surely because production costs differ across countries) and data by country are not readily available. The GTAP technique employed in this paper consists of eliminating the quota rent (wedge between the consumer and marginal costs) indirectly and assume that there is a shock between 2 to 10% in the domestic production of sugar in the EU as if there was an ‘endogenous’ subsidy that provokes such an increase in output. This simulation approach is justified since (i) the EU as a region has no uniform level of quota rent and (ii) the impacts on EU import demand would be the same under any other methods for a given percentage increase in EU sugar production.

### **3.1.2. Reciprocal preference between ACP and EU**

Although the main topic is the elimination of EU sugar production quota and its impact, we will also analyze how the reciprocal preference under EPA would affect the ACP countries (not just for sugar but for other commodities) in the last part of the paper. This is done by removing tariffs on agriculture (including sugar), textile, and manufacturing sectors for goods trade between the EU and the ACP groups.

### **3.1.3 Model Aggregation and Closures**

The GE approach uses the GTAP model (Hertel 1997; Hertel and Tsigas 199.), and the data are aggregated to 10 regions and 8 sectors. The regions are ACP low income countries (with per capita GNI equal to or less than 1045 USD per year in 2013); ACP high income countries, the EU (25 countries); North and Central America; Brazil; India; Thailand; Australia and New Zealand (often called Oceania); Rest of Least Developing Countries (i.e. LDC non-ACP); and Rest of the world. The sectors include: Raw Beet and Cane; Refined Sugar; Other Food and agriculture products; Textile and Wearing Apparel; Light Manufacturing; Heavy Manufacturing; Extraction and Mining; and Services. Moreover, the model employs 5 factors which are land, natural resources, unskilled labor, skilled labor, and capital. The Armington model employs same elasticity of substitution among imported sugar from various sources including domestic sources.

The key closures, beside making production increase endogenous, are that there is unemployment of unskilled labour in ACP countries, in the other developing regions that produce sugar (Brazil, India, LDC (non-ACP), and Thailand) and in the Rest of the World). Similarly, Saving minus Investment remains unchanged except in the developed worlds.

## **3.2 Simulation Results: Impacts of the abolition of EU production quota**

### **3.2.1 Welfare impacts**

The GTAP database shows that each year, on average, about one fifth of ACP countries' total revenues of agricultural and food production comes from their sugar cane production and sugar processing. Such a significant contribution to agricultural revenue and implicitly the economy does not yet include the indirect employment and services provided by the sugar industry. For instance, sugar industry is a major supplier of sugar as and an ingredient in many food and beverage industries. In the late 1990's (Vaughan, 2000), ACP countries such as Fiji, Guyana, and Swaziland had their sugar industries contributing 11, 26, and 60 % to GDP respectively. Although the prominence of sugar industries in many ACP countries have somewhat been challenged in the last 15 years, it is still to be expected that the reduction of ACP sugar exports have noticeable effects on total welfare and sectors other than sugar sector. Table 1 (a) reports the welfare impacts of the abolition of the EU production quota. It shows that with the elimination of EU sugar quota leading to a 10% increase in its production, ACP countries' welfare decline by USD 74 million per year. The group with low income ACP countries (branded often as the high cost countries in terms of sugar production) bears more than two thirds of that loss. For the ACP low income group, the welfare loss comes mainly from terms of trade effects (14 millions) and especially endowment effects (32 millions). The negative terms of trade effects come mostly from the declining export price of sugar and increase in the volume of imports of cheaper sugar from the EU. These price movements will be explained in detail in the next section.

<Table 1 here>

The negative endowment effects in the ACP low income countries, on the other hand, indicate that some productive factor inputs (such as labour) move out of the sugar sector and go into to less productive sectors (textile for example). The remaining of the inputs (labor and capital) moving out of the sugar industry but unable to go to go to other sectors in the economy becomes unemployed. Precisely, the two ACP groups' welfare loss due to allocative efficiency effect (about 11 millions) represent the loss of factor (especially labour) income due to the shrinking sugar export and sugar production.

The terms of trade of the ACP countries also take a hit especially as both sugar export price and export volume drops while import of sugar increases. Overall, the 10% increase in EU sugar production due to the elimination of quota leads yields to total welfare loss to the ACP country's economy.

The total welfare impact of the EU elimination of production quota on the EU economy is negative (USD 412 million). Although, the elimination of the production quota improves EU's terms of trade which translates into welfare increase (mostly due to the increase in export volume and reduction in import), it makes the EU bear a large negative allocative efficiency effect. The reason is that input factors in previously productive sectors move to the sugar sectors where beet and white sugar productions are rising. This movement of factors (including capital and labor) to less productive sector reduces allocative efficiency, and costing the EU about half a billion dollars a year's welfare a year. (We note that we assume here that the EU-25 as a region is at full employment for both skilled and unskilled workers).

### **3.2.2 Impacts on sugar sectors in the EU and ACP countries**

The first direct impact of the abolition of EU production quota is that the EU intra-trade grows. We note that that intra-EU trade in sugar has increased by about 14% which justify that the elimination of quota aims to achieve self-sufficiency for the EU. In the welfare decomposition mentioned earlier, we found that the EU total welfare decline substantially by 412 million USD, but such a loss mask the fact that EU consumers are net beneficiary of the quota abolition. Results in Table 2 shows that the EU consumer price for sugar declines by 7% and EU household consumption of sugar increases by 5%.

The second important direct impact of the abolition of EU production quota is that EU import demand shrinks. This shrinking of the sugar imports affects the preferential sources like the ACP countries significantly. Simulation results show that while EU intra-trade in sugar rises by 14%, ACP sugar export to the EU decline by 25% (Table 1 panel b). Because of reduction in export demand in the international market, due to the elimination of EU production quota, the cif price of sugar imported from the low ACP countries drops by about 1%. This decrease in sugar price leads to a shrinking production in both sugar refineries and sugar cane production. At the same time, because of the EU's increase in excess demand (due to the increase in its 10% increase in sugar domestic production), its subsidized refined sugar price

falls on average by 7 to 8 % at the importing countries' borders. As a result, sugar imports from EU increase almost in all regions.

The losses to the ACP sugar exporters and producers are therefore quite significant. If during the period 2008-2010, the estimated yearly average export from all ACP countries to the EU is 1.7 million tons, and if the average fob price of sugar fluctuates between 600 to 700 USD per tons, the 25% decrease in ACP export causes an export revenue loss of 255 to 300 million USD (value fob) per year. Moreover, the conjunction of the decrease in export demand, especially to the EU and the increase in import from the EU leads to a shrinking production and input demand in the ACP countries. The production of raw sugar cane and the production of processed sugar in ACP countries drops by about 2 and 4% respectively (Table 2, panel a). For instance, if the ACP production of raw sugar cane was about xxx and the farm prices of sugar xxxx, the lost revenues for the will amount to. These losses in export revenue and farm revenues in sugar have direct impacts on small farmers' and small workers' income especially in sugar industry.

<Table 2 here>

As mentioned in the welfare decomposition, the decline in sugar production and export affects employment (the endowment effect). For instance, demands for unskilled workers in sugar cane production and sugar refineries declines by 2% and 4% per year in both group of ACP countries. The demand for skilled labour for these sectors declined and by the same amount. The increase in labour demand in the other sectors (manufacturing and textile especially is weak to fully absorb the workers released from the sugar industry.

The third important direct impact of the abolition of EU production quota is that that intra-trade among ACP low income countries and between ACP high and low income countries decline by more than one percent, due to sharp increases in cheaper sugar import from the EU. White sugar exports from the EU to ACP low income and high income rise by 45% and 53% respectively. Likewise, EU exports to the other regions (including non-ACP least developed countries) rise by 45 to 51%. Overall, the EU sugar exporters are the net beneficiary of the production quota elimination.

### **3.2.3 Food Security Implication**

We now examine the food security implications by looking at both the consumption (hence welfare) and income (purchasing power) of the regional household in ACP countries. Table 2 panel (b) and (c) summarize the changes in output price and volumes. As mentioned earlier, the decrease in ACP export due to the production quota elimination in the EU leads to a decline in overall consumer prices in ACP countries. This is due to the combination of increased import of cheap sugar from the EU to these ACP countries and to the decline in export price, hence, farm price (assuming the shock is transferred to farm price) in the ACP countries.

Simulation results show that domestic price of white sugar decline slightly by 0.04% in ACP high income countries and by 0.2% in ACP low income countries. (Prices of food and other goods from other sectors also decline slightly). Domestic consumption of sugar in ACP countries increases slightly. The demand for food and agricultural goods (other than sugar) remain unchanged. Despite the strong effects on ACP sugar imports, the 10% increase in the EU production due to elimination of production quota has limited effects on food consumption in ACP countries.

Contrastingly, we recall the EU consumers benefit largely from the elimination of the production quota with household consumer price falling by 7% and demand rising by about 5%. (This increase in consumption may have to the health issue?).

## **3.3 Sensitivity Analysis**

### **3.3.1 Using different rates of output increases**

The results obtained so far have been based on the assumptions that the increase in EU production is about 10%. We now perform a sensitivity analysis to check how these results change when this output increase varies is 8%, 6% or 2%. Table 3 summarizes these simulations showing that the story remains the same although the impacts on welfare decline with the decline in the levels of outputs.

<Table 3 here>

### 3.3.2 EU sugar output increase based on technological progress

Although we stated earlier that the increase in technology induced by the elimination of quota may be less appealing as the main source of the increase in EU output, the difference in the levels of sugar technology among the 25 countries in the EU (especially between Western and Eastern Europe) implies that there is some room for technological progress for the region as a whole. For this reason, we explore the impact on welfare both in the ACP countries and in the EU when the quota elimination endogenously encourages technological progress within the EU. For the sake of comparison, we focus on the 10% increase in output (swapping  $aoll$  with  $qo$ ) which corresponds to 8.7% increase in technology in sugar processing.

The simulation results are summarized in Table 4. The striking difference (in comparison with the simulation base on endogenous subsidy in Table 1) is that the EU now enjoys a 1.5 billion USD increase in welfare, mainly due to the technical efficiency gain, i.e. due to the endogenous technological progress. The technological progress in the sugar sector attracts productive workers from the other sectors and employment in beet and white sugar production increase by 1 and 1.3% respectively.

<Table 4 here>

## 4. How reciprocal preferential affect these results?

In this section, our aim is to analyze how the reciprocal preferential trade between EU and ACP countries would affect the results obtained so far on the impacts of sugar quota elimination.

Analysis to follow.....

## 5. Conclusion

This paper deals with the impacts of the elimination of EU sugar quota on ACP countries. Our results show that overall EU exporters and consumers are the net beneficiaries of the production quota elimination. Intra-EU trade and EU exports to other regions rise and consumer price falls. For ACP countries, welfare decomposition indicates that ACP's total welfare decline due to flight of capital and increase in unemployment (shown by the relatively large negative endowment effects). As expected, the unemployment and flight of capital occur mostly in the sugar sectors (cane production and sugar processing) and in the food

sector in the low income ACP countries. Although the elimination of EU production quota leads to an increase in cheaper sugar import, such an ease in price remains small to increase consumers' welfare. Income and employment were severely hurt making household worse off. Moreover, the intra-ACP trade in sugar declines considerably as it is replaced by cheaper sugar from the EU. Simulation results hold the same pattern even after we vary the rate of increase in production from 2% to 10%. We also simulate the situation where the abolition of EU production quota results in increase in sugar production, motivated by an increase in EU sugar technology. Results show that the EU's total welfare and its sugar export increase while the sugar production and export from the ACP countries shrink further.

## Reference

- CE Line Bonnet, and Vincent Requillart, (2011) Does the Eu Sugar Policy Reform Increase Added Sugar Consumption? An Empirical Evidence on the Soft Drink Market, *Health Econ.* 20: 1012–1024
- European Commission. (2010) The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2010) 672 final. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0672:FIN:en:PDF> (accessed 12 Jan 2015)
- Harnack L, Stang J, Story M (1999) Soft drink consumption among US children and adolescents: nutritional consequences. *Journal of the American Dietetic Association* 99(4), 436–441.
- Nolte, S. and Grethe, H. (2010a) Developments in the EU and world sugar markets in 2009. *Sugar Industry* (Zuckerindustrie) 135: 29–36.
- Nolte, S., Buysse, J., & Van Huylenbroeck, G. (2011) Modelling the effects of an abolition of the EU sugar quota on internal prices, production and imports, *Eur Rev Agric Econ* (2011)doi: 10.1093/erae/jbr043
- Nolte, S., Buysse, J., & Van Huylenbroeck, G. (2012). Abolition of the EU sugar quotas-what's at stake?. *International sugar journal*, 114(1359).
- Nolte, S., Grethe, H., Buysse, J., Van der Straeten, B., Claeys, D., Lauwers, L. and Van Huylenbroeck, G. (2010b). Modelling preferential sugar imports of the EU: a spatial price equilibrium analysis. *European Review of Agricultural Economics* 37: 165–186.
- Schroeter C, Lusk J, Tyner W. (2008) Determining the impact of food price and income changes on body weight. *Journal of Health Economics* 27: 45–68.
- Burell, (2014). EU Sugar Policy: A Sweet Transition after 2015? Available online: [https://ec.europa.eu/jrc/sites/default/files/jrc\\_tr\\_sugar\\_study\\_pubsy\\_v6.pdf](https://ec.europa.eu/jrc/sites/default/files/jrc_tr_sugar_study_pubsy_v6.pdf)
- International Monetary Fund (2013). Available online: <http://www.imf.org/external/pubs/ft/scr/2013/cr13370.pdf>

El Behri A., Umstaeter J., Kelch D. (2008). The EU Sugar Policy Regime and Implications of Reform. USDA. ERS Report 59. Available online:  
[http://www.ers.usda.gov/media/205576/err59\\_1\\_.pdf](http://www.ers.usda.gov/media/205576/err59_1_.pdf)

Tralac, 2014. The End of EU sugar quota and the implications for African Producers. Available online: <http://www.tralac.org/discussions/article/5684-the-end-of-the-eu-sugar-quota-and-the-implication-for-african-producers.html>

Jensen, G. H., Nielsen C. EU Dairy Policy Analysis: Assessing the Importance of Quota Rents Estimate. Available online:  
<https://www.gtap.agecon.purdue.edu/resources/download/1732.pdf>

Lips, M. Rieder, P. Endogenous Adjustment of Quotas: The Case of Swiss Raw Milk Production. Available online:  
<https://www.gtap.agecon.purdue.edu/resources/download/389.pdf>

Frandsen S., Jensen, H. (2002). Reforming the EU Sugar Policies. Available online:  
<http://ageconsearch.umn.edu/bitstream/24837/1/cp02fr28.pdf>

**Table 1. Impacts of the elimination of EU Sugar production quota (10% output increase**

**a. Welfare distribution (USD million)**

| WELFARE         | 1 alloc_A1 | 2 endw_B1 | 3 tech_C1 | 4 pop_D1 | 5 tot_E1 | 6 IS_F1 | 7 pref_G1 | Total   |
|-----------------|------------|-----------|-----------|----------|----------|---------|-----------|---------|
| ACP Low income  | -9.87      | -31.42    | 0         | 0        | -13.76   | -0.41   | 0         | -55.45  |
| ACP High income | -2.3       | -4.31     | 0         | 0        | -12.05   | -0.29   | 0         | -18.94  |
| LDC (non ACP)   | 0.04       | 0.12      | 0         | 0        | -0.34    | -0.12   | 0         | -0.3    |
| No Cen America  | 0.02       | 0         | 0         | 0        | -38.91   | 0.9     | 0         | -37.99  |
| EU (25)         | -513.33    | 0         | 0         | 0        | 95.74    | 6.05    | 0         | -411.54 |
| Brazil          | -3.69      | -8.49     | 0         | 0        | -23.92   | 2.89    | 0         | -33.21  |
| India           | 0.02       | 0.46      | 0         | 0        | -9.13    | -0.65   | 0         | -9.29   |
| Oceania         | -1.55      | 0         | 0         | 0        | -8.64    | -0.24   | 0         | -10.43  |
| Thailand        | 0.1        | -1.65     | 0         | 0        | -7.44    | 0.3     | 0         | -8.7    |
| RestofWorld     | 54.77      | 54.77     | 0         | 0        | 18.44    | -8.43   | 0         | 119.55  |
| Total           | -475.78    | 9.48      | 0         | 0        | 0        | 0       | 0         | -466.3  |

**b. Export volume (% change from row to column)**

| qxs[SugarRef**] | ACPL  | ACPH  | LDC   | NCAmerica | EU_25  | Brazil | India | AustraNZ | Thailand | RestofWorld |
|-----------------|-------|-------|-------|-----------|--------|--------|-------|----------|----------|-------------|
| ACPL            | -1.12 | 0.03  | 0.01  | -0.21     | -24.68 | -3.4   | 0     | -0.75    | -3.61    | -2.04       |
| ACPH            | -1.35 | -0.2  | -0.2  | -0.45     | -24.86 | -3.65  | -0.27 | -0.96    | -3.86    | -2.27       |
| LDC             | -1.4  | -0.23 | -0.28 | -0.51     | -24.9  | -3.7   | -0.34 | -1       | -3.92    | -2.32       |
| NCAmerica       | -1.45 | -0.3  | -0.33 | -0.56     | -24.94 | -3.76  | -0.37 | -1.05    | -3.97    | -2.38       |
| EU_25           | 45.07 | 52.98 | 50.32 | 49.1      | 14.33  | 49.11  | 50.3  | 50.77    | 49.12    | 44.93       |
| Brazil          | -1.34 | -0.2  | -0.21 | -0.45     | -24.86 | -3.65  | -0.28 | -0.94    | -3.86    | -2.27       |
| India           | -1.39 | -0.24 | -0.27 | -0.49     | -24.9  | -3.7   | -0.3  | -1.01    | -3.91    | -2.32       |
| AustraNZ        | -1.48 | -0.32 | -0.35 | -0.58     | -24.96 | -3.79  | -0.4  | -1.09    | -4       | -2.4        |
| Thailand        | -1.06 | 0.09  | 0.05  | -0.15     | -24.64 | -3.34  | 0.03  | -0.68    | -3.55    | -2          |
| RestofWorld     | -1.28 | -0.13 | -0.16 | -0.38     | -24.81 | -3.59  | -0.2  | -0.89    | -3.81    | -2.21       |

**c. Import price (cif % change, supplied from row to column)**

| pcif[SugarRef**] | ACPL  | ACPH  | LDC   | NCAmerica | EU_25 | Brazil | India | AustraNZ | Thailand | RestofWorld |
|------------------|-------|-------|-------|-----------|-------|--------|-------|----------|----------|-------------|
| ACPL             | -0.08 | -0.08 | -0.08 | -0.08     | -0.08 | -0.09  | -0.09 | -0.07    | -0.09    | -0.08       |
| ACPH             | -0.03 | -0.03 | -0.04 | -0.04     | -0.04 | -0.04  | -0.04 | -0.03    | -0.04    | -0.04       |
| LDC              | -0.03 | -0.03 | -0.02 | -0.03     | -0.03 | -0.03  | -0.02 | -0.03    | -0.03    | -0.03       |

|             |       |       |       |       |       |       |       |       |       |       |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| NCAmerica   | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 |
| EU_25       | -6.92 | -7.64 | -7.34 | -7.24 | -7.51 | -7.8  | -7.35 | -7.52 | -7.84 | -7.07 |
| Brazil      | -0.03 | -0.03 | -0.04 | -0.04 | -0.04 | -0.04 | -0.03 | -0.04 | -0.04 | -0.04 |
| India       | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 |
| AustraNZ    | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 |
| Thailand    | -0.09 | -0.09 | -0.09 | -0.09 | -0.09 | -0.1  | -0.09 | -0.09 | -0.1  | -0.09 |
| RestofWorld | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 |

**d . Demand for input (% changes)**

|              | Food  | Sugarcb | SugarRef | Extraction | TextWapp | LightMnfc | HeavyMnfc | Services | CGDS  |
|--------------|-------|---------|----------|------------|----------|-----------|-----------|----------|-------|
| qfe[**ACPL]  | ACPL  |         |          |            |          |           |           |          |       |
| Land         | 0.03  | -1.58   | -1.65    | 0.03       | 0.06     | 0.06      | 0.06      | 0.05     | 0.02  |
| UnSkLab      | 0     | -2.01   | -3.56    | 0.02       | 0.04     | 0.03      | 0.04      | 0        | -0.04 |
| SkLab        | 0     | -2      | -3.55    | 0.02       | 0.04     | 0.04      | 0.04      | 0        | -0.04 |
| Capital      | 0     | -2      | -3.55    | 0.02       | 0.05     | 0.04      | 0.04      | 0.01     | -0.03 |
| qfe[**ACPH]  | ACPH  |         |          |            |          |           |           |          |       |
| Land         | 0.1   | -1.17   | -1.52    | 0.06       | 0.16     | 0.15      | 0.16      | 0.14     | 0.11  |
| UnSkLab      | 0     | -1.53   | -3.48    | 0.02       | 0.02     | 0.02      | 0.04      | -0.01    | -0.04 |
| SkLab        | 0     | -1.53   | -3.47    | 0.02       | 0.03     | 0.03      | 0.05      | 0        | -0.03 |
| Capital      | 0     | -1.53   | -3.47    | 0.02       | 0.03     | 0.03      | 0.05      | 0        | -0.03 |
| qfe[**EU_25] | EU    |         |          |            |          |           |           |          |       |
| Land         | -0.07 | 5.65    | 4.48     | -0.04      | -0.13    | -0.13     | -0.13     | -0.13    | -0.11 |
| UnSkLab      | 0.02  | 7.2     | 10       | -0.01      | -0.03    | -0.02     | -0.03     | -0.01    | 0     |
| SkLab        | 0.02  | 7.21    | 10.01    | -0.01      | -0.02    | -0.01     | -0.02     | 0        | 0.01  |
| Capital      | 0.02  | 7.2     | 10       | -0.01      | -0.02    | -0.02     | -0.02     | -0.01    | 0.01  |

**Table 2. Impacts of the elimination of EU production quota (10% increase in Sugar Output) on sugar production and consumption**

**a. Production (% change)**

| qo         | ACPL  | ACPH  | LDC   | NCAmerica | EU_25 | Brazil | India | AustraNZ | Thailand | RestofWorld |
|------------|-------|-------|-------|-----------|-------|--------|-------|----------|----------|-------------|
| Food       | 0     | 0.01  | 0     | -0.01     | 0.01  | 0.01   | 0     | -0.01    | 0.01     | 0           |
| Sugarcb    | -1.94 | -1.48 | -0.28 | -0.17     | 6.95  | -0.54  | -0.18 | -0.14    | -1.06    | -0.58       |
| SugarRef   | -3.55 | -3.47 | -0.33 | -0.26     | 10    | -0.76  | -0.24 | -0.8     | -1.06    | -0.76       |
| Extraction | 0.01  | 0.02  | 0     | 0         | -0.01 | 0.01   | 0     | 0.01     | 0        | 0           |
| TextWapp   | 0.04  | 0.03  | 0.02  | 0         | -0.03 | 0.01   | 0.01  | 0.01     | 0.01     | 0.01        |
| LightMnfc  | 0.04  | 0.03  | 0.01  | 0         | -0.02 | 0.02   | 0.01  | 0.01     | 0.01     | 0.01        |
| HeavyMnfc  | 0.04  | 0.05  | 0.01  | 0         | -0.02 | 0.02   | 0     | 0.02     | 0.01     | 0.01        |
| Services   | 0     | 0     | 0     | 0         | -0.01 | 0      | 0     | 0        | 0        | 0           |

**b. Household consumer price (% change)**

| pp         | ACPL  | ACPH  | LDC   | NCAmerica | EU_25 | Brazil | India | AustraNZ | Thailand | RestofWorld |
|------------|-------|-------|-------|-----------|-------|--------|-------|----------|----------|-------------|
| Food       | -0.02 | -0.02 | -0.01 | 0         | -0.02 | -0.02  | -0.01 | -0.01    | -0.01    | -0.01       |
| Sugarcb    | -0.21 | -0.1  | -0.07 | -0.03     | 0.53  | -0.08  | -0.06 | -0.03    | -0.31    | -0.11       |
| SugarRef   | -0.2  | -0.04 | -0.04 | -0.02     | -7.01 | -0.04  | -0.03 | -0.01    | -0.1     | -0.19       |
| Extraction | 0     | 0     | 0     | 0         | 0     | 0      | 0     | 0        | 0        | 0           |
| TextWapp   | -0.01 | -0.01 | 0     | 0         | 0     | -0.01  | 0     | 0        | 0        | 0           |
| LightMnfc  | -0.01 | -0.01 | 0     | 0         | 0.01  | -0.01  | 0     | 0        | 0        | 0           |
| HeavyMnfc  | -0.01 | -0.01 | 0     | 0         | 0     | -0.01  | 0     | 0        | 0        | 0           |
| Services   | -0.02 | -0.02 | 0     | 0         | 0.01  | -0.02  | 0     | -0.01    | 0        | 0           |

**c. Household demand (% change)**

| qp         | ACPL | ACPH  | LDC  | NCAmerica | EU_25 | Brazil | India | AustraNZ | Thailand | RestofWorld |
|------------|------|-------|------|-----------|-------|--------|-------|----------|----------|-------------|
| Food       | 0    | 0     | 0    | 0         | 0.01  | 0      | 0     | 0        | 0        | 0           |
| Sugarcb    | 0.02 | 0.01  | 0.01 | 0         | 0     | 0.01   | 0.01  | 0        | 0.04     | 0.01        |
| SugarRef   | 0.03 | 0.01  | 0.01 | 0.01      | 4.5   | 0.01   | 0     | 0        | 0.02     | 0.05        |
| Extraction | 0    | -0.01 | 0    | 0         | 0     | 0      | 0     | 0        | 0        | 0           |
| TextWapp   | 0    | 0     | 0    | 0         | -0.01 | 0      | 0     | 0        | 0        | 0           |
| LightMnfc  | 0    | 0     | 0    | 0         | -0.01 | 0      | 0     | 0        | 0        | 0           |

|           |   |   |   |   |       |   |   |   |   |   |
|-----------|---|---|---|---|-------|---|---|---|---|---|
| HeavyMnfc | 0 | 0 | 0 | 0 | -0.01 | 0 | 0 | 0 | 0 | 0 |
| Services  | 0 | 0 | 0 | 0 | -0.01 | 0 | 0 | 0 | 0 | 0 |

**Table 3. Elimination of the EU sugar production Impacts: Welfare decomposition with different rates of production increase**

**a. 8% increase in EU sugar production**

| WELFARE        | 1 alloc_A1 | 2 endw_B1 | 3 tech_C1 | 4 pop_D1 | 5 tot_E1 | 6 IS_F1 | 7 pref_G1 | Total   |
|----------------|------------|-----------|-----------|----------|----------|---------|-----------|---------|
| 1 ACPL         | -8.32      | -25.92    | 0         | 0        | -11.52   | -0.33   | 0         | -46.09  |
| 2 ACPH         | -1.89      | -3.54     | 0         | 0        | -9.87    | -0.23   | 0         | -15.53  |
| 3 LDC          | 0.02       | 0.09      | 0         | 0        | -0.29    | -0.1    | 0         | -0.27   |
| 4 NCAmerica    | 0.03       | 0         | 0         | 0        | -31.28   | 0.61    | 0         | -30.64  |
| 5 EU_25        | -399.06    | 0         | 0         | 0        | 79.11    | 4.87    | 0         | -315.07 |
| 6 Brazil       | -2.93      | -6.76     | 0         | 0        | -19.09   | 2.31    | 0         | -26.47  |
| 7 India        | 0.02       | 0.38      | 0         | 0        | -7.33    | -0.53   | 0         | -7.46   |
| 8 AustranZ     | -1.23      | 0         | 0         | 0        | -6.91    | -0.19   | 0         | -8.33   |
| 9 Thailand     | 0.08       | -1.31     | 0         | 0        | -5.88    | 0.23    | 0         | -6.88   |
| 10 RestofWorld | 43.18      | 42.59     | 0         | 0        | 13.05    | -6.63   | 0         | 92.19   |
| Total          | -370.1     | 5.55      | 0         | 0        | 0        | 0       | 0         | -364.55 |

**b. 4 % increase in EU sugar production**

| WELFARE        | 1 alloc_A1 | 2 endw_B1 | 3 tech_C1 | 4 pop_D1 | 5 tot_E1 | 6 IS_F1 | 7 pref_G1 | Total   |
|----------------|------------|-----------|-----------|----------|----------|---------|-----------|---------|
| 1 ACPL         | -4.6       | -13.76    | 0         | 0        | -6.29    | -0.18   | 0         | -24.83  |
| 2 ACPH         | -1         | -1.86     | 0         | 0        | -5.17    | -0.12   | 0         | -8.15   |
| 3 LDC          | 0          | 0.04      | 0         | 0        | -0.16    | -0.05   | 0         | -0.17   |
| 4 NCAmerica    | 0.02       | 0         | 0         | 0        | -15.77   | 0.18    | 0         | -15.57  |
| 5 EU_25        | -187.7     | 0         | 0         | 0        | 42.12    | 2.47    | 0         | -143.1  |
| 6 Brazil       | -1.45      | -3.34     | 0         | 0        | -9.49    | 1.15    | 0         | -13.14  |
| 7 India        | 0.01       | 0.2       | 0         | 0        | -3.7     | -0.28   | 0         | -3.76   |
| 8 AustranZ     | -0.61      | 0         | 0         | 0        | -3.45    | -0.1    | 0         | -4.15   |
| 9 Thailand     | 0.04       | -0.64     | 0         | 0        | -2.87    | 0.11    | 0         | -3.36   |
| 10 RestofWorld | 20.95      | 20.06     | 0         | 0        | 4.78     | -3.18   | 0         | 42.61   |
| Total          | -174.33    | 0.7       | 0         | 0        | 0        | 0       | 0         | -173.63 |

**c. 2% increase in EU sugar production**

| WELFARE        | 1 alloc_A1 | 2 endw_B1 | 3 tech_C1 | 4 pop_D1 | 5 tot_E1 | 6 IS_F1 | 7 pref_G1 | Total  |
|----------------|------------|-----------|-----------|----------|----------|---------|-----------|--------|
| 1 ACPL         | -2.41      | -7.09     | 0         | 0        | -3.28    | -0.09   | 0         | -12.88 |
| 2 ACPH         | -0.51      | -0.95     | 0         | 0        | -2.65    | -0.06   | 0         | -4.17  |
| 3 LDC          | 0          | 0.02      | 0         | 0        | -0.08    | -0.03   | 0         | -0.09  |
| 4 NCAmerica    | 0.01       | 0         | 0         | 0        | -7.92    | 0.06    | 0         | -7.85  |
| 5 EU_25        | -90.83     | 0         | 0         | 0        | 21.72    | 1.25    | 0         | -67.87 |
| 6 Brazil       | -0.72      | -1.66     | 0         | 0        | -4.73    | 0.57    | 0         | -6.54  |
| 7 India        | 0          | 0.11      | 0         | 0        | -1.86    | -0.14   | 0         | -1.89  |
| 8 AustranZ     | -0.3       | 0         | 0         | 0        | -1.72    | -0.05   | 0         | -2.07  |
| 9 Thailand     | 0.02       | -0.31     | 0         | 0        | -1.42    | 0.05    | 0         | -1.66  |
| 10 RestofWorld | 10.31      | 9.72      | 0         | 0        | 1.95     | -1.55   | 0         | 20.42  |
| Total          | -84.43     | -0.18     | 0         | 0        | 0        | 0       | 0         | -84.61 |

**Table 4. Impacts of the elimination of EU production quota (10% increase in Sugar Output with endogenous technological change)**

**a. Welfare distribution (USD million)**

| WELFARE        | 1 alloc_A1 | 2 endw_B1 | 3 tech_C1 | 4 pop_D1 | 5 tot_E1 | 6 IS_F1 | 7 pref_G1 | Total   |
|----------------|------------|-----------|-----------|----------|----------|---------|-----------|---------|
| 1 ACPL         | -9.63      | -31.73    | 0         | 0        | -11.73   | -0.4    | 0         | -53.49  |
| 2 ACPH         | -2.28      | -4.3      | 0         | 0        | -11.74   | -0.28   | 0         | -18.61  |
| 3 LDC          | 0.07       | 0.18      | 0         | 0        | -0.31    | -0.04   | 0         | -0.11   |
| 4 NCAmerica    | 2.3        | 0         | 0         | 0        | -32.98   | 6.51    | 0         | -24.17  |
| 5 EU_25        | -213.01    | 0         | 1601.75   | 0        | 56.38    | 5.3     | 0         | 1450.42 |
| 6 Brazil       | -3.49      | -8.66     | 0         | 0        | -23.69   | 2.84    | 0         | -33.01  |
| 7 India        | 0.11       | 0.25      | 0         | 0        | -9.62    | -0.46   | 0         | -9.72   |
| 8 AustranZ     | -1.1       | 0         | 0         | 0        | -7.43    | -0.22   | 0         | -8.75   |
| 9 Thailand     | 0.1        | -1.69     | 0         | 0        | -7.48    | 0.2     | 0         | -8.88   |
| 10 RestofWorld | 64.8       | 59.99     | 0         | 0        | 48.61    | -13.44  | 0         | 159.97  |
| Total          | -162.13    | 14.03     | 1601.75   | 0        | 0        | 0       | 0         | 1453.65 |

**b. Export volume (% change from row to column)**

| qxs[SugarRef**] | ACPL  | ACPH  | LDC   | NCAmerica | EU_25  | Brazil | India | AustranZ | Thailand | RestofWorld |
|-----------------|-------|-------|-------|-----------|--------|--------|-------|----------|----------|-------------|
| ACPL            | -1.12 | 0.03  | 0.01  | -0.21     | -24.83 | -3.43  | 0     | -0.76    | -3.64    | -2.05       |
| ACPH            | -1.36 | -0.2  | -0.2  | -0.45     | -25.01 | -3.68  | -0.27 | -0.96    | -3.89    | -2.28       |
| LDC             | -1.41 | -0.23 | -0.28 | -0.51     | -25.05 | -3.73  | -0.34 | -1       | -3.95    | -2.34       |
| NCAmerica       | -1.46 | -0.3  | -0.33 | -0.56     | -25.09 | -3.79  | -0.38 | -1.06    | -4.01    | -2.39       |
| EU_25           | 45.42 | 53.4  | 50.71 | 49.48     | 14.4   | 49.48  | 50.7  | 51.17    | 49.5     | 45.27       |
| Brazil          | -1.35 | -0.2  | -0.21 | -0.45     | -25.01 | -3.67  | -0.28 | -0.95    | -3.89    | -2.28       |
| India           | -1.4  | -0.25 | -0.27 | -0.49     | -25.05 | -3.72  | -0.3  | -1.01    | -3.94    | -2.34       |
| AustranZ        | -1.49 | -0.32 | -0.36 | -0.59     | -25.11 | -3.82  | -0.4  | -1.09    | -4.03    | -2.42       |
| Thailand        | -1.07 | 0.09  | 0.05  | -0.15     | -24.79 | -3.37  | 0.03  | -0.69    | -3.58    | -2.01       |

|             |       |       |       |       |        |       |      |       |       |       |
|-------------|-------|-------|-------|-------|--------|-------|------|-------|-------|-------|
| RestofWorld | -1.29 | -0.13 | -0.16 | -0.38 | -24.96 | -3.62 | -0.2 | -0.89 | -3.84 | -2.23 |
|-------------|-------|-------|-------|-------|--------|-------|------|-------|-------|-------|

**c. Demand for Inputs in the ACP and EU (% change)**

|              | Food  | Sugarcb | SugarRef | Extraction | TextWapp | LightMnfc | HeavyMnfc | Services | CGDS  |
|--------------|-------|---------|----------|------------|----------|-----------|-----------|----------|-------|
| qfe[**ACPL]  |       |         |          |            |          |           |           |          |       |
| Land         | 0.03  | -1.6    | -1.66    | 0.03       | 0.06     | 0.06      | 0.06      | 0.05     | 0.02  |
| UnSkLab      | 0     | -2.02   | -3.58    | 0.02       | 0.04     | 0.03      | 0.04      | 0        | -0.04 |
| SkLab        | 0     | -2.02   | -3.58    | 0.02       | 0.04     | 0.04      | 0.04      | 0        | -0.03 |
| Capital      | 0     | -2.02   | -3.57    | 0.02       | 0.05     | 0.04      | 0.04      | 0.01     | -0.03 |
| NatRes       | 0     | -0.01   | 0        | 0          | 0        | 0         | 0         | 0        | 0     |
| qfe[**ACPH]  |       |         |          |            |          |           |           |          |       |
| Land         | 0.1   | -1.18   | -1.53    | 0.06       | 0.16     | 0.16      | 0.17      | 0.15     | 0.11  |
| UnSkLab      | 0     | -1.55   | -3.5     | 0.02       | 0.03     | 0.02      | 0.04      | -0.01    | -0.04 |
| SkLab        | 0     | -1.55   | -3.49    | 0.02       | 0.03     | 0.03      | 0.05      | 0        | -0.03 |
| Capital      | 0     | -1.55   | -3.49    | 0.02       | 0.03     | 0.03      | 0.05      | 0        | -0.03 |
| NatRes       | 0     | -0.01   | 0        | 0          | 0        | 0         | 0         | 0        | 0     |
| qfe[**EU_25] |       |         |          |            |          |           |           |          |       |
| Land         | -0.01 | 0.7     | 0.55     | -0.02      | -0.04    | -0.04     | -0.04     | -0.04    | -0.03 |
| UnSkLab      | 0.03  | 0.9     | 1.25     | -0.01      | -0.01    | -0.01     | -0.02     | 0        | 0.01  |
| SkLab        | 0.03  | 0.9     | 1.25     | -0.01      | -0.01    | -0.01     | -0.01     | 0        | 0.01  |
| Capital      | 0.03  | 0.9     | 1.25     | -0.01      | -0.01    | -0.01     | -0.02     | 0        | 0.01  |
| NatRes       | 0     | 0       | 0        | 0          | 0        | 0         | 0         | 0        | 0     |

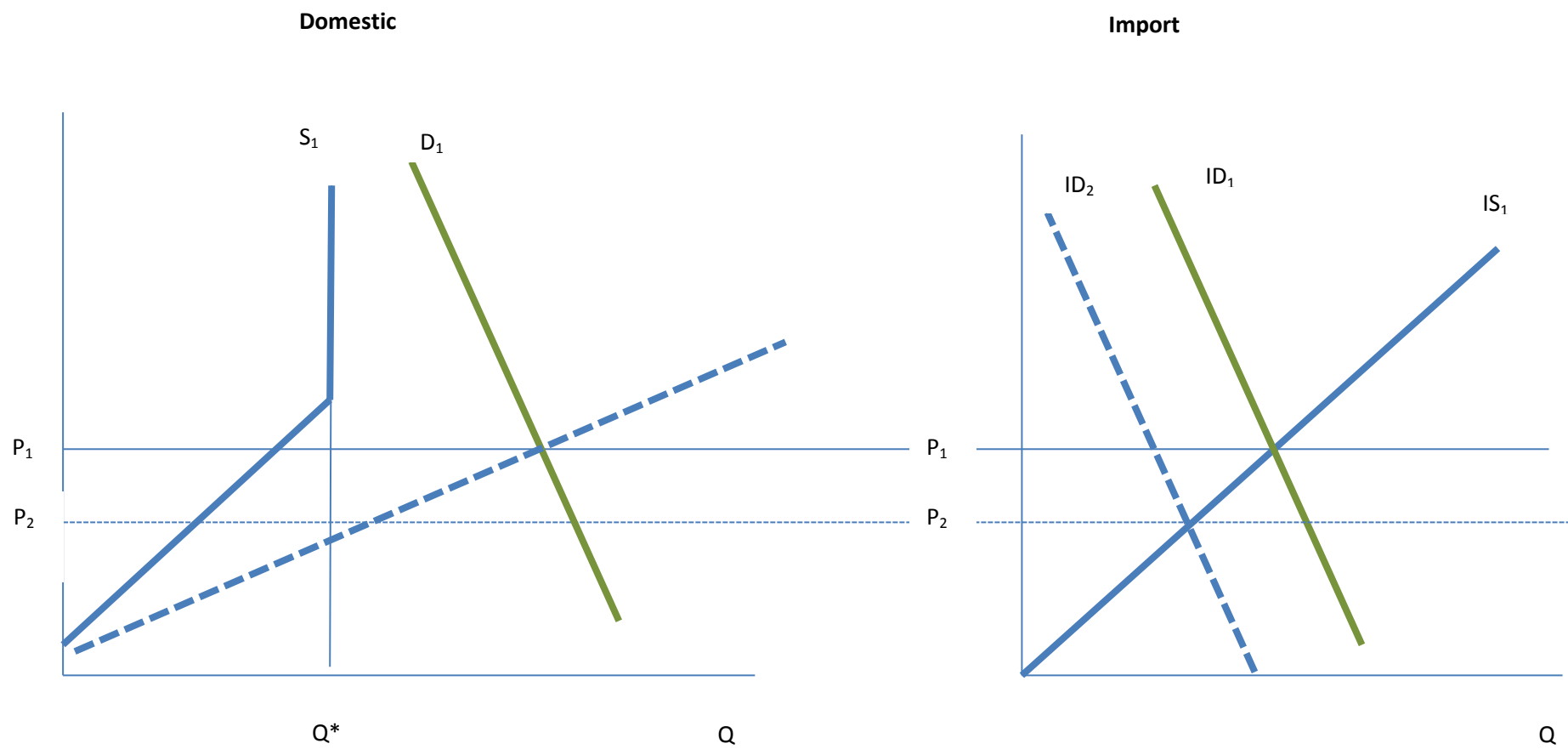


Figure 1. EU Sugar Markets with Production Quota (adapted from Matthews, 2014)