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What has been the impact of the 2006 and 2017 reforms of the Sugar Common Market Organisation?

How does it compare to European Union's objectives?

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Abstract

In this thesis, I analyze the reforms conducted by the European Union regarding the organization of the sugar beet market. In particular, I investigate the impact of the 2006 and 2017 reforms that aim at deregulating the EU market. I conduct an econometric analysis aiming at isolating the impact of these reforms in terms of the targeted outcomes by the European Union. I find that the 2006 reform did achieve its objectives in terms of production levels and capacity. Nevertheless, the European sugar market was still isolated and all EU actors were not well enough prepared for the extreme conditions of the post-quotas era. The 2017 reform did not achieve its objectives in terms of key dimensions, for instance the level of production. Overall, the reforms did not lead to an improvement of the sugar beet producers' situation.

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Introduction

Between 1968 and 2017, sugar production was regulated by a quotas system within the European Union. Under this system, production quotas were allocated to European Member States. Minimum prices were guaranteed for sugar and sugar beets. There were import barriers and export subsidies for sugar. In 2005, a *World Trade Organisation* ruling set a limit on European exports, judged as "subsided exports". As a reaction to this ruling, in 2006, the Member States decided to put an end to the quotas system on the initial date of September 2015. This decision was also taken to address the growing imbalance in the European Union sugar sector. The imbalance was due to the 2004 enlargement of the European Union coupled with the limitation on exports imposed by the 2005 WTO ruling. To prepare for the exit from the quotas system, a first reform was designed. This reform took place between 2006 and 2010. It simplified the initial quotas system and the minimum price for sugar became a reference price. In 2013, the exit from the quotas system was postponed to September 2017. Finally, in September 2017, production and exports limitations were withdrawn for European sugar producers. (High-level group meeting on sugar 2019)

In 2020, the European Union was the third largest sugar producer in the world (OCDE/FAO 2022). Sugar beets were cultivated in 17 Member States by 105374 growers (Comité Européen des Fabricants de Sucre 2022a). The European Union was the third largest sugar importer in the world (OCDE/FAO 2022). In 2017, the European sugar sector was the last sector in the European Union that was subject to a quotas system. The end of this system was therefore an important shock of globalisation for all the growers and manufacturers.

Given the importance of the European Union sugar market, the effect of such a globalisation shock seems interesting to study. The objective of this thesis is therefore to evaluate the impact of the 2006 and 2017 reforms. The specific research question of the thesis is: **What has been the impact of the 2006 and 2017 Sugar Common Market Organisation reforms?** Moreover, it will try and address a second question that is: How does this impact compare to European Union's pre-reforms objectives?

At the time of writing this thesis, the academic literature had not addressed this question yet. Studies on this topic were rather public and private institute reports on the post quotas system situation of the European sugar sector. These studies describe the recent evolution of the sugar sector. They list the issues and difficulties encountered by the actors of the sector. Nevertheless, the causal relationship between the reforms and the evolution of key outcomes of the sector had not been studied in details. The thesis aims at fulfilling this gap.

This thesis tries to go further than a simple description of the facts. First, reading the literature allows a comprehensive understanding of the functioning of the European Union sugar sector. It allows to understand the changes operated by the reforms and why the system has been reformed. Then, data were collected in order to perform an empirical analysis. Production and production capacity data were obtained in statistics reports. Quotas allocations data were obtained from European regulations. International and European prices were obtained in histor-

ical price databases. After being collected, these data were used in econometric regressions. The objective of these regressions was the following one : to isolate the effect of the reforms on several outcome variables of interest. These variables concern: the level of production, the harvested areas, the number of growers, the average length of the campaign, the number of factories and companies, the employment and the prices. After performing these regressions, the main results obtained can be summarized as follows:

- The quotas were binding for sugar producers when they were applied.
- The 2006 reform had a negative short term effect on the outcome variables except for the number of companies. The only significant effects that were found in the long term were negative effects on production and campaign duration.
- The direct effect of the 2017 reform was not clear. Production was negatively affected while the number of growers was positively affected but these results have to be taken with caution.
- There were clear signs of a change in strategies from producers and growers between the two reforms. This anticipation of the 2017 reform lead to a decrease in production, harvested areas, number of growers and employment during campaigns.
- The convergence of the European prices towards international prices has been accelerated after the end of the quotas system.

These results were interpreted and compared with the observations of the literature. In that way, they complement the existing analysis of the addressed problematic.

This thesis' purpose was also to assess the effectiveness of the reforms. The objectives set by the European Union in 2006 seemed to be achieved at the end of the reform. Production and production capacity had been reduced within the European Union. European prices seemed to be closer to the international prices. However, the European sugar market was still isolated. The European Commission considered that the actors were ready to compete in a deregulated environment. In practice, they faced important difficulties in the post-quotas era. The 2017 reform was expected to increase European production and exports. This was the case for the first year without quotas but production and exports were significantly reduced the following years. In summary, the reforms achieved some of their objectives but they cannot be judged as successful.

The structure of this thesis is as follows:

Chapter 1 describes the sugar market. It gives its specific characteristics, its main actors, the trends and drivers of the industry. Chapter 2 details the regulations that were applied in the European sugar sector. It details the studied reforms, their motivations and objectives. Chapter 3 presents the purpose of the research analysis. It defines precisely the research question of this thesis and how it is addressed. Chapter 4 reviews and assesses the existing studies on the reforms. It also defines the European Union's expectations and objectives for the reforms. Chapter 5 graphically presents the evolution of the sugar sector through the reforms. It allows to observe the results highlighted in the literature review. Chapter 6 analyses the collected data. It details the data set and the methodology used to perform the econometric regressions. It displays their results and interprets them.

Chapter 1

The sugar market

This chapter develops the specific characteristics of the sugar market and industry. It examines the production, the consumption and the trade of sugar both on a global scale and at the European level.

1.1 Production

Sugar can be extracted from various natural resources like maple, corn, carrot or honey. However, its industrial production only relies on two sources: sugar cane and sugar beet (Observatoire des Prix 2016). The sugar extracted from sugarcane is called raw sugar or brown sugar because of its natural coloration at the end of its production. There is therefore a distinction that is made between the sugar extracted from sugar cane and the beet sugar that is naturally white. White sugar can also be obtained from raw sugar after it has been refined (Observatoire des Prix 2016).

In 2019-2020, 107 countries produced more than 171 millions tones of sugar. 66 of these countries were only growing sugar cane. 33 other countries were only growing sugar beet. 8 countries were growing sugar cane as well as sugar beet (Cultures Sucre 2021). On average, about 80% of the global sugar production is sugarcane (International Sugar Organization 2022) as shown in Figure 1.1.

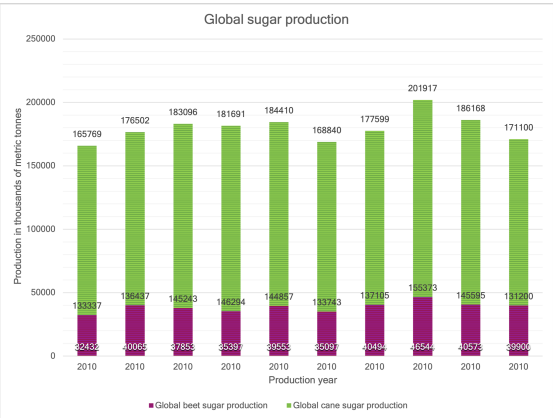

Figure 1.1: Production of sugar in the world between 2010 and 2020 decomposed between beet sugar and cane sugar. (Cultures Sucre 2020) (Cultures Sucre 2021)

Despite the fact that many countries produce sugar, its production is highly concentrated. In 2020, the ten biggest sugar producers accounted for 75,8% of the global production with Brazil and India being by far the two largest (see Figure 1.2). With 36,5 and 31 million tonnes, they accounted for around 21,3% and 18,1% of the sugar produced in the world. The 27 European Union countries represented the third biggest producer with 14,3 million tones, or about 8,3% of the global production (Cultures Sucre 2021).

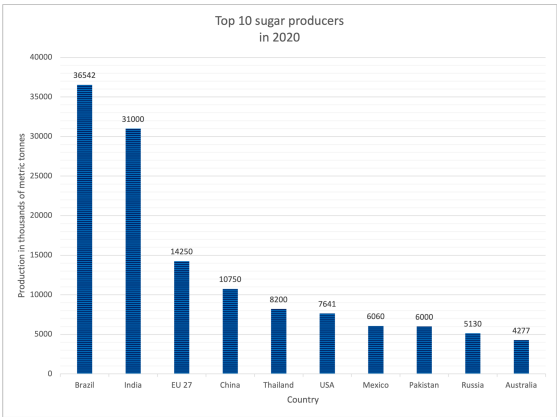

Figure 1.2: The production of the 10 biggest sugar producers in the world in 2020. (OCDE/FAO 2022)

There are substitutes for sugar's sweetening power but they do not share all the other qualities of sugar. The main substitute is isoglucose that is produced from starch (Observatoire des Prix 2016). In 2013, the world production of isoglucose amounted to 13 million tonnes (PricewaterhouseCoopers 2015).

1.1.1 European beet sugar production

Most of the European sugar (97,5% in 2013 (Observatoire des Prix 2016)), is extracted from sugar beets. The sugarcane production in Europe is only located in French and Portuguese overseas territories. For this reason, this work will most often only focus on beet sugar when analyzing European production.

In 2020, 17 European countries were producing sugar out of beets. Their production accounted for 43,8% of the beet sugar produced in the world in 2019 (Cultures Sucre 2021). As shown in Figure 1.3, beet sugar production is mostly located in the North of Europe where the climate is the most favorable to the cultivation of beets. " *The most competitive producing areas are in northern France, Germany, the Netherlands, Belgium and Poland.* (European Commission 2022c).

Organisation of production

Sugar beets cultivation is organised in campaigns (or marketing years) that take place between the 1st of October to the 30th of September. Two kinds of actors are active during the production process of sugar :

- **Farmers/Growers** : They sow beet seeds between March and May and harvest during the autumn. Then, they deliver their production to sugar producers between September

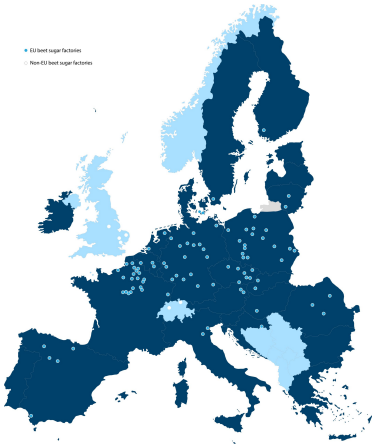

Figure 1.3: A mapping of the sugar factories in EU for the 2019-2020 campaign. (Comité Européen des Fabricants de Sucre 2022a)

and January. In 2020, there were 105374 growers in the European Union (Comité Européen des Fabricants de Sucre 2022a).

- **Sugar producers/manufacturers** : They transform the beets that are brought to their factories by the growers into sugar. This part of the process is highly concentrated in Europe where 5 companies would own 70% of the sugar factories (Observatoire des Prix 2016).

Growers are linked to producers with contracts that pre-determine the prices, quantities and conditions of delivery. Growers are most often located less than 100km away from the factories they deliver because of transport costs (Observatoire des Prix 2016).

As sugar comes from an agricultural production, its level of production varies from year to year. The quantity of sugar that will result from a campaign depends mainly on two factors (Bertin 2022) :

- The "**crop management**" : i.e. the choice of the date of sowing and harvesting, the state of the land and the fertilisation.
- The **climate** : the duration of favorable temperatures (over 5° Celsius and especially the absence of freezing), the radiation and the water supply during the spring.

The European sugar and isoglucose production has been regulated until October 2017 with a system of quotas that is detailed in chapter 2. The European Union also hosts a sector of imported raw cane sugar refining.

1.2 Consumption

The outcomes for sugar production are multiple, Figure 1.4 gives an idea of how it was broken down in France in 2016.

1.2.1 Direct consumption

The sugar production can be delivered directly to the final consumer. This is the kind of sugar that people buy at the grocery store to cook with or to put into their coffee. It can also be sold in larger quantities to wholesale intermediaries or to restaurants (Observatoire des Prix 2016).

1.2.2 Indirect consumption through the food industry

Sugar is used by the food industry as an intermediate product. This is the biggest outlet for the production. In 2016-2017 in France, 58% of it was used in the preparation of beverages, chocolates, yoghurts, sirups, biscuits and candies to name the most important outputs (Cultures Sucre 2020).

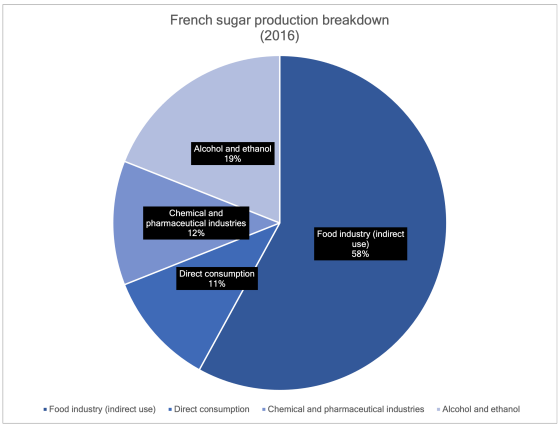

Figure 1.4: Breakdown of the sugar production in France for the year 2016-2017. (Cultures Sucre 2021)

1.2.3 Indirect consumption through the non-food industry

The last use of sugar production is made by non-food industries. It can be transformed into alcohol that is used in the production of bioethanol[1]. Sugar can also be used by pharmaceutical and chemical industries. (Observatoire des Prix 2016)

1.2.4 Evolution of the demand

During the 2018-2020 period, the estimated annual consumption of sugar in the world was 22 kg per capita. Sugar consumption was higher in OECD countries where it was 32,3 kg per capita. This number increases to 37,6 kg per capita in the European Union (OCDE/FAO 2022).

According to the *International Sugar Organization*, "*The most important drivers which influence sugar demand include:*

- *population growth,*
- *per capita incomes,*
- *the price of sugar and alternative sweeteners,*

[1]Bioethanol is mostly produced by Brazil and USA.

- *health concern debate.* " (International Sugar Organization 2022).

As shown in Figure 1.5, the global sugar demand is annually growing. The negative effect associated to health concern is mostly affecting developed countries such as Canada, European Union and United Kingdom. It doesn't offset the positive effect of population growth yet (OCDE/FAO 2022).

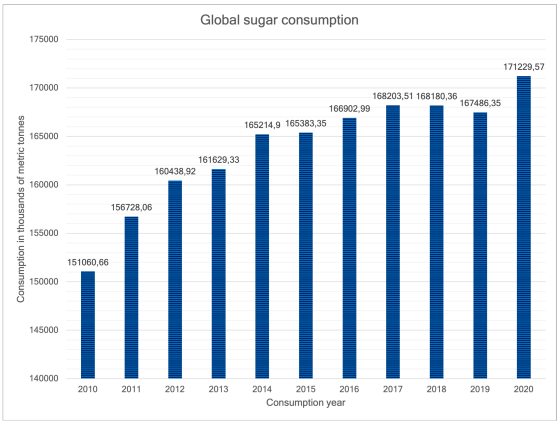

Figure 1.5: World consumption of sugar between 2010 and 2020. (OCDE/FAO 2022)

1.3 Trade

In 2016, the "Observatoire des Prix" stated : "*Many regions of the world have introduced protectionist measures for sugar imports : this is the case of European Union, United States and China, even though a process of market opening is gradually developing under the guidance of the World Trade Organisation. Therefore, only about 30%*[2] *of world production would be traded on international markets.* (Observatoire des Prix 2016).

1.3.1 Exports

In a similar way to the production, exports are highly concentrated. Figure 1.6 displays the 10 biggest sugar exporters. It shows the very important share of Brazil. With 29,2 million tonnes, Brazil represents about 46,6% of the 62,6 million tonnes exported in the world in 2020. The European Union, despite being the third largest sugar producer, is only the 8th exporter of sugar since it only exports about 7% of its production. (OCDE/FAO 2022)

1.3.2 Imports

Figure 1.7 shows that imports are less concentrated than exports. The European Union ranks at the third place of sugar importers. The European trade balance in terms of sugar is therefore negative in 2020. However, this has not always been the case. Figure 1.8 shows that the balance was positive until 2005. Afterwards, the European balance was negative nearly every year. This was mostly due to the ruling of *World Trade Organisation* that limited European exports. More details are given in chapter 2.

[2] 36,6% in 2020 (OCDE/FAO 2022)

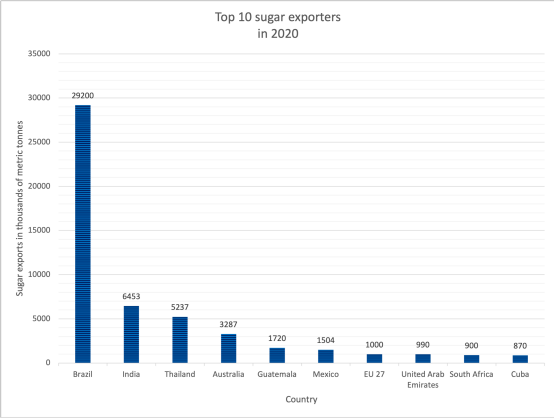

Figure 1.6: The 10 largest exporters in the world in 2020. (OCDE/FAO 2022)

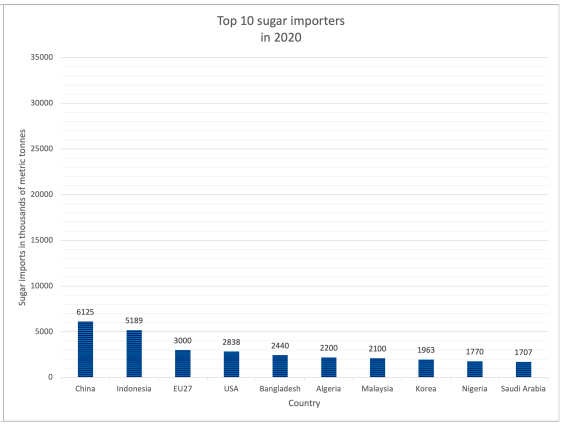

Figure 1.7: The 10 largest importers in the world in 2020. (OCDE/FAO 2022)

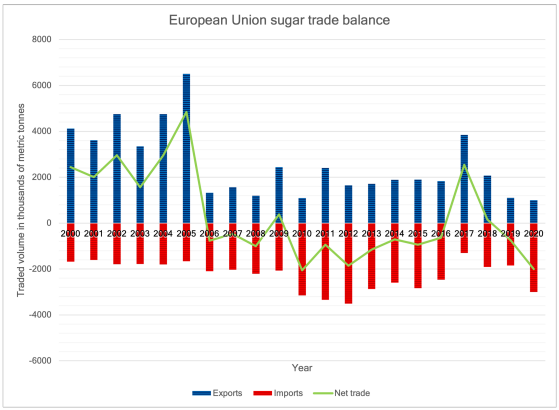

Figure 1.8: European Union exports,imports and net trade balance between 2000 and 2020. (OCDE/FAO 2022)

1.3.3 Prices

As mentioned in section 1.1, a distinction is made between raw and white sugar. Raw sugar is exchanged on the New York stock exchange as "*Sugar No. 11*". White sugar, which corresponds to beet sugar and refined cane sugar, is traded on the London stock exchange under the name "*Sugar No. 5*". Those two prices are strongly correlated as it is shown in Figure 1.9[3]. This Figure 1.9 also shows that up until 2017, the price for European sugar seemed not as correlated to the world price than it is now.

Among the factors influencing the price of sugar, the following can be mentioned :

- As a commodity, **the difference between supply and demand**.
- **Exchange rate fluctuations**, especially the Brazilian real to US dollar rate, given that Brazil represents nearly half of the exports in the world (PricewaterhouseCoopers 2015).

[3]The "EU reference price" in Figure 1.9 is a threshold that was used by the European Commission to know when to intervene on the market when quotas were still active. It will be detailed in chapter 2.

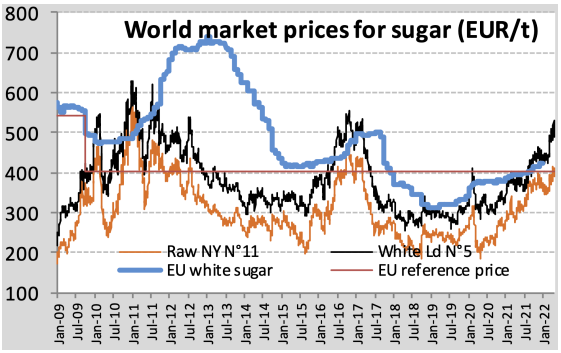

Figure 1.9: Evolution of sugar prices between 2009 and 2022. (AGRI E 4 - Expert Group Common Market Organisation on Arable Crops 2022)

- **States interventionism** like tariffs, subventions or production support (Pricewaterhouse-Coopers 2015).
- **Climate conditions and agricultural diseases** that influence the harvests and production costs of the largest producers and exporters like Brazil, India and Thailand (Observatoire des Prix 2016).
- Prices of **oil and ethanol** since there is an arbitrage between the quantity of sugar cane allocated to food industry or to bioethanol production in Brazil (Observatoire des Prix 2016).
- **Socioeconomic** indicators influencing the demand that are mentioned in section 1.2.

Chapter 2

European sugar market regulations

This chapter details the quotas system that had been set up by the *Common Agricultural Policy* (CAP). First, a brief historical overview focuses on the most important dates for European sugar production regulations. Then, the initial regulation mechanisms and how they changed with the two most important reforms are detailed.

2.1 Historical overview

1968 The *Sugar Common Market Organisation* (CMO) is set up by the *Common Agricultural Policy* (CAP). It implements the quotas system (European Commission 2017c).

2005 A *World Trade Organisation* ruling judges European sugar production as subsided production in the "*European export subsidies*" case (World Trade Organisation 2022).

2006 European Member States decide to put an end to the quota system as of 2015. A major reform aiming at restructuring the sector and preparing it for the end of quotas takes place until 2010 (European Commission 2017c).

2013 European Parliament and Member States decide to postpone the end of the quotas system after the 2016/2017 campaign.

2017 The 30 September, the sugar production quotas system comes to an end (European Commission 2017c).

2.2 The "Sugar Common Market Organisation"

In 1968, the *Sugar Common Market Organisation* was established with the objective of achieving "*self-supply in the European market while guaranteeing remunerative prices to producers*"(High-level group meeting on sugar 2019). To meet these goals, it used three principal instruments : "*production quotas, guaranteed minimum prices, and trade policy instruments (export subsidies, import barriers*[1]"(Observatoire des Prix 2016).

[1]Import barriers were achieved through a system of variable duties that were converted into fixed tariffs later.(Areté & IHS Markit 2021)

The national production quotas allocated to Member States[2] limited the production closely to the internal consumption (High-level group meeting on sugar 2019). They were organised in a two-tier system (Areté & IHS Markit 2021):

- **"A" quota** production benefited from a full support with a minimum guaranteed price both for sugar producers and beet growers (Areté & IHS Markit 2021)(Observatoire des Prix 2016). The level of this support price was "*significantly above the world market price*"(European Commission 2017c).
- **"B" quota** production benefited from a reduced support in term of minimum price (Observatoire des Prix 2016).
- **"C" sugar** corresponded to "out-of-quota" production for which no minimum price was guaranteed (Observatoire des Prix 2016). That part of the production "*had to be exported to the world market without export refunds, or could be carried forward to the following marketing year (but only within pre-defined limits).*"(Areté & IHS Markit 2021). These quantities were therefore exchanged at world price.

Two alternative outlets were offered for quota sugar that could not find a demand on the domestic market:

- "*Community buying-in of sugar at a pre-defined "intervention price"*
- *Subsidised exports on the world market via a system of export refunds*"(Areté & IHS Markit 2021).

2.3 2006 reform

"*In February 2006, EU agriculture ministers formally adopted a comprehensive reform of the EU sugar sector*"(European Commission 2022b). This section develops the reasons why this reform was designed, its objectives and how it was achieved.

2.3.1 Motivations

A first objective of the 2006 reform was to ensure more coherence with the new CAP framework that was set in 2003 (Areté & IHS Markit 2021). Its objective was to operate the transition from coupled to decoupled support to farmers.

A second objective of the CMO was to address a growing imbalance of the European sugar market. This imbalance was coming from a variety of factors:

- In 2000, the "Everything But Arms" framework opens up the EU sugar market to least developed countries(Areté & IHS Markit 2021).
- In 2001, the EU market opens to some Balkan countries with preferential agreements(Areté & IHS Markit 2021).
- In 2004, the enlargement of the European Union (European Commission 2022a) with the adhesion of large sugar-producing countries like Poland (more than 2 million tonnes of sugar produced in 2004 (Comité Européen des Fabricants de Sucre 2011)).

[2]Member States then allocated them to individual producers.

- In 2005, a *World Trade Organisation* ruling compels the European Union to reduce its exports and to abolish export subsidies(Observatoire des Prix 2016). The maximum allowed volume of European Union subsidised exports is set at 1,374 million tonnes(Areté & IHS Markit 2021).

A third objective of the reform was to maintain "*a competitive EU production whilst respecting international commitments*"(Areté & IHS Markit 2021). Indeed, by 2006, sugar production had been made possible in nearly all EU Member States, even in less suitable regions, because of the high EU prices. In addition, the CMO was facing criticism from European Union sugar consumers considering they were penalized by a higher price than their international competitors (High-level group meeting on sugar 2019). To face those issues, the reform attempted to:

- reduce domestic prices "*to a level that reflected the cost structure of the most efficient undertakings*"(Areté & IHS Markit 2021).
- offer exit support for the non-viable undertakings.

The last objective of the reform was to prepare the exit of the quotas system that had been scheduled for 2015. The "*security of supply*" objective of the quota system had become less important over the years (European Commission 2017b). "*The price and quota management required complex monitoring and administrative resources both for the operators and the authorities.*"(European Commission 2017c). There was then a long established consensus that the CMO needed to be simplified.

2.3.2 Implementation

The 2006 reform simplified the quotas system by merging the "A" quota and "B" quota categories into a simple "under quota" sugar category. The "C" sugar simply became the "out-of-quota" sugar production (Areté & IHS Markit 2021). Three outcomes were offered to this surplus production (Observatoire des Prix 2016):

- A limited quantity (1,374 million tonnes) could be exported on the global market. The exports refunds were abolished as from September 2008 (Areté & IHS Markit 2021).
- It could be sold to the non food industries detailed in section 1.2 or to supply the EU's outermost regions (Areté & IHS Markit 2021).
- It could be stored and carried over to the next sugar campaign as under quota production (Areté & IHS Markit 2021).

A restructuring scheme was implemented between 2006 and 2010. It aimed at "*incentivising quota renunciation by sugar producers and sugar beet growers*"(Areté & IHS Markit 2021). A voluntary compensation system (worth 5,4 billion EUR (European Commission 2017c)) was offered to sugar producers who renounced to quotas. The compensation system was extended to sugar beet growers in 2008/2009(Areté & IHS Markit 2021). By allowing non-viable undertakings to leave the sector under favourable conditions, the 2006 reform reduced the total production quotas from 17 to 13,5 million tonnes (High-level group meeting on sugar 2019) between 2006 and 2010 as shown in Figure 2.1.

The intervention price was gradually reduced and finally transformed into a reference threshold. Maintained at a 632 euro per tonne level for the first two years of the reform, it was then reduced by 36%, in two-step, to 404,4 euro per tonne (Areté & IHS Markit 2021). If prices felt

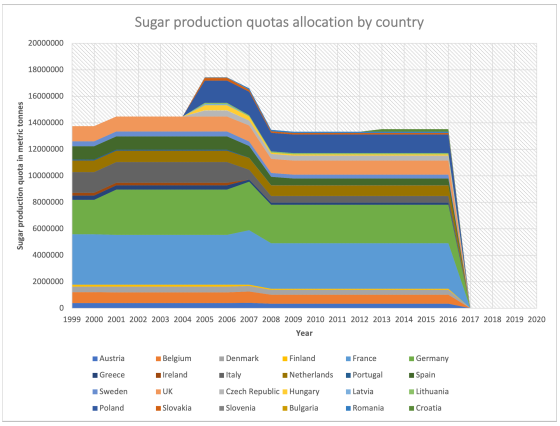

Figure 2.1: Evolution of sugar productions quotas allocation by country between 1999 and 2020. Quotas levels sources are detailed in chapter 5.

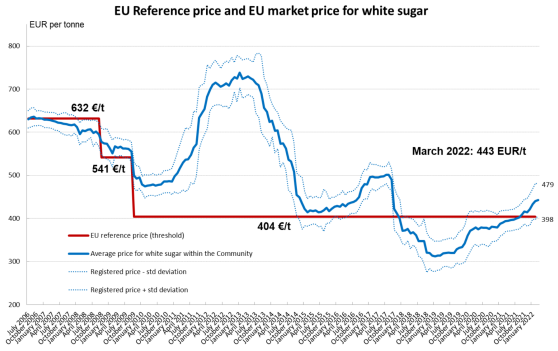

Figure 2.2: Evolution of European sugar prices. (AGRI E 4 - Expert Group Common Market Organisation on Arable Crops 2022)

under 85% of this reference threshold, then the European Commission would intervene (Observatoire des Prix 2016). The red line in Figure 2.1 shows its evolution. The minimum guaranteed price for sugar beets was also reduced by 20% during the reform (Observatoire des Prix 2016).

Two additional measures were introduced by the 2006 reform:

- The withdrawal measure "*consisted of fixing a threshold beyond which the production under quota of each undertaking was 'withdrawn' from the market and stored until the beginning of the following marketing year. Withdrawal measures were applied for the first two marketing years after the reform.* (High-level group meeting on sugar 2019)
- Private storage "*consisted in financing the storage of sugar by undertakings on a voluntary basis with the aim to reduce the quantities available in the market so as to support sugar prices. This measure has not been used since the 2006 reform.* (High-level group meeting on sugar 2019)

The 2006 reform did not modify the import barriers as the import duties were maintained at the same levels than before the reform: 419 EUR per tonne for white sugar and 339 EUR per

tonne of raw sugar. That kept the imports limited to preferential arrangements or tariff rate quotas with lower or no duties (Areté & IHS Markit 2021).

2.4 2017 reform

In 2013, the CAP reform postponed the end of the quotas system until then end of the 2016/2017 sugar campaign(European Commission 2017c). After the 30 September 2017:

- European sugar producers were no longer restricted in their production(Areté & IHS Markit 2021).
- European sugar producers were no longer restricted in their exports(Areté & IHS Markit 2021).
- Import tariffs remained at the same level than after the 2006 reform (World Trade Organisation 2021).

The CAP provided several tools to support the exit of the quotas system (European Commission 2017c):

- Voluntary coupled support linked to production to address difficulties.
- A far-reaching system of collective bargaining to improve the negotiating powers of beet growers against their sugar producers.
- Private storage aid.
- Disturbance clauses available in the CMO in case of severe market crisis.
- The creation of a *Sugar Market Observatory* whose aim is "*to provide the EU sugar sector with more transparency by means of disseminating market data and short-term analysis in a timely manner.*"(European Commission 2022d) The expert group meets at least twice a year and publishes dashboard and reports on the evolution of sugar production and consumption on the European market over time.

In its publications, the Sugar Market Observatory groups countries in three regions when reporting the prices. Region 1[3] and 2[4] are composed of countries with a higher level of self-sufficiency that are less dependent on the imports market than region 3[5] countries (Areté & IHS Markit 2021). Figure 2.3 is extracted from a publication of the Sugar Market Observatory. It displays the difference in prices between the three regions and an illustration of their geographical distribution.

[3]Region 1 countries: Austria, Czech Republic, Denmark, Finland, Hungary, Lithuania, Poland, Sweden and Slovakia

[4]Region 2 countries: Belgium, Germany, France and Netherlands

[5]Region 3 countries : Bulgaria, Spain, Greece, Croatia, Italy, Portugal and Romania

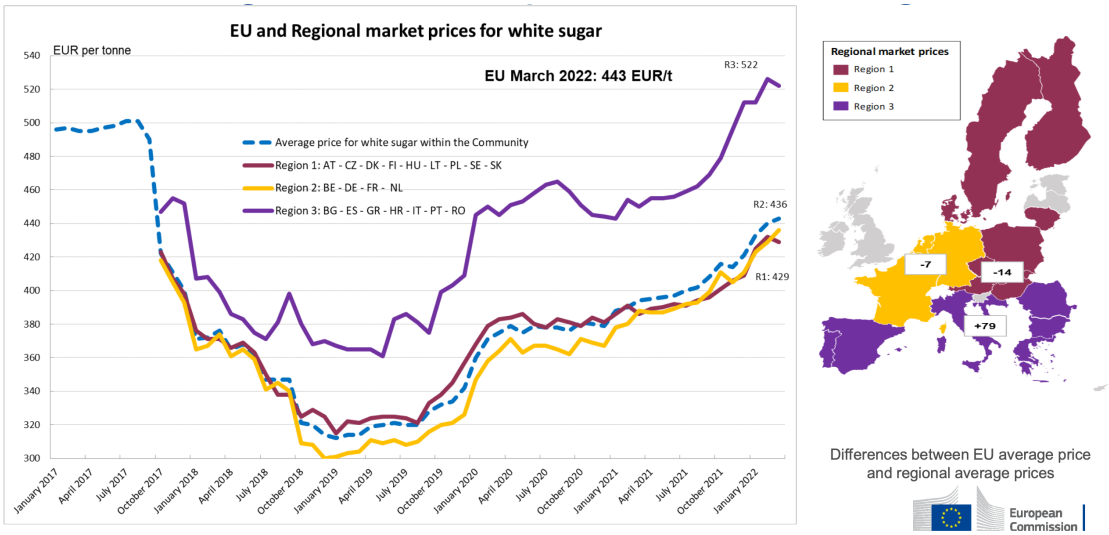

Figure 2.3: Evolution of European sugar prices per regions. (AGRI E 4 - Expert Group Common Market Organisation on Arable Crops 2022)

Chapter 3

Research question

This chapter first presents the purpose of the research analysis. It defines precisely the research question of this thesis and how it is addressed. Finally, it states the expected results.

3.1 Purpose

Why is it worthwhile to be interested by the phasing-out of European sugar production quotas? This section develops two main arguments: the importance of the EU sugar sector (on a global scale and inside European Union) and the fact that this policy change is an interesting shock of globalisation to study from an economic point of view.

3.1.1 The importance of the EU sugar sector

Chapter 1 highlights the importance of the European Union in the global sugar market. From a production perspective, European Union is the third largest actor on the market and represents about 8,3% of the 2020 global production (Cultures Sucre 2021). It produces an even larger part, 43,8%, of the global beet sugar production (Cultures Sucre 2021). The contribution of the sugar industry to EU-27 Gross Domestic Production is of 3.6 billion EUR directly and 15.6 billion EUR indirectly. (Comité Européen des Fabricants de Sucre 2022b) From a consumption point of view, European Union is the third largest sugar importer (Cultures Sucre 2021). Its per capita sugar consumption of 37,6 kg per head is over the OECD countries average even if, lately, it has a decreasing tendency (OCDE/FAO 2022).

European Union is therefore a very important actor on the sugar market. This is why a change in its policy production with possible worldwide consequences deserves to be studied.

3.1.2 A radical policy change

The European sugar production quotas system lasted for almost 50 years. When it came to an end in 2017, the sugar sector was the only agricultural sector in the European Union where production was subject to quotas (European Commission 2017c). Even if the 2006 reform had paved the way for the 2017 exit of the system, this was still a radical policy change. The shift from a highly regulated production to a system with no limits to production or exports is a liberalisation shock which is interesting to study economically speaking.

Moreover, the European Union pre-reform expectations were ambitious. The day before the end of the quota system, European Commission stated in a press release: "*The end of the quota*

system gives producers the possibility to adjust their production to real commercial opportunities, notably in exploring new export markets." (European Commission 2017a). Therefore, it seems interesting to compare European Union's objectives with the obtained results.

3.2 Definition of the question

Given the argument developed in section 3.1, the specific research questions of this master are the following:

- **What has been the impact of the 2006 and 2017 Sugar Common Market Organisation reforms?**
- How does this impact compare to European Union's pre-reforms objectives?

The impact that this thesis attempts to qualify and quantify is defined in the following section 3.3 that details the expected results. As for the questions, they are answered in three steps :

1. A review of the literature on the European sugar market reforms and recent evolution highlights and assesses the relevance of the findings of other researchers on this problem. It also allows for a clear definition of the European Union's expectations regarding the exit from the quotas system.
2. A descriptive analysis presents the evolution of the European sugar market. It allows to ascertain the statements made by the literature and to observe the latest market trends.
3. An empirical analysis of the available data based on econometric investigations attempts to quantify the effect of quotas and reforms on several outcome variables of interest.

3.3 Expected results

Before starting the analysis, the expected impact identified in this thesis was an effect of the reforms on two aspects of the sugar sector:

- The **sugar balance** : Changes in regulations of the market could have an effect on the production and thus on employment, exports and imports. A closer alignment of European prices on international prices was also anticipated.
- The **market structure** : The concentration of the production actors could change with the reforms. The harvested areas, the number of growers, the number of factories and the number of companies could all be affected.

Chapter 4

Literature review

This chapter reviews and assesses the existing studies on the 2006 and 2017 CMO reforms. It is structured in a chronological order. For each of the two reforms, this literature review highlights the pre-reform expectations and the post-reform observations. Another objective of this section is to define the European Union's expectations that motivated these reforms.

The academic literature on this subject is quite small. Therefore, the review also include a variety of non academic documents studying the reforms. These documents are reports, for instance from the European Commission, public institutes or private firms.

4.1 Pre 2006 reform expectations

This section reviews a European Commission publication from September 2006. No further work on the anticipated effects of the 2006 reform was found. The publication listed the main objectives of the reform right before its implementation. These were as follows:

- "*Guarantee a regular supply of sugar while protecting the European market from extreme price fluctuations;*
- *Make the sugar sector more competitive, able to withstand international competition;*
- *move towards more market orientation while restructuring the sector;*
- *provide a fair standard of living for farmers and maintain rural communities;*
- *maintain preferential access for ACP and LDC producers to the high value EU market;*
- *simplify the regime and make it more transparent;*
- *limit budget costs*" (Directorate-General for Agriculture and Rural Development 2006).

Reaching these objectives would provide the sector with "*a long-term policy framework and the opportunity for a competitive future*" (Directorate-General for Agriculture and Rural Development 2006). The European Commission was hoping that prices would become key drivers of the allocation of resources and investment decisions in the industry.

This publication did not elaborate much on the expected impact of the reform. It stated that the impact would be variable across European countries and would depend on the Member States' possibilities for sustainable production (Directorate-General for Agriculture and Rural Development 2006). Following this publication, the impact of the reform would affect less the

regions with specific advantages. Regarding on the negative impacts of the reform, European Commission thought that it would be offset by:

- "*possibilities to top up compensation to growers (especially where a significant percentage of quota is being given up, or where a factory is closing)*
- *additional restructuring assistance in some regions*
- *new outlets for out-of-quota production (ethanol and industrial use)*
- *refining of cane sugar in sugar beet factories to achieve economies of scale*
- *increases in isoglucose quotas (in proportion to the restructuring of sugar quota)*
- *moving to alternative crops (notably to wheat or maize)*
- *the restructuring fund*". (Directorate-General for Agriculture and Rural Development 2006)

About the expected impact of the reform outside the European Union, the expected lower prices for sugar would affect the developing countries European Union was trading with. Nevertheless, the post-reform European sugar prices were expected to be higher than world prices. The European Union was expected to design a package of assistance measures for less developed countries (Directorate-General for Agriculture and Rural Development 2006).

4.2 Results of the 2006 reform

This section reviews the results of the 2006 reform exposed in the literature. Therefore, first, it analyses the impact of the reform on production, actors of the production and their concentration, productivity, trade and prices. Then, it analyses the assessment by the European Commission on the results of the reform.

4.2.1 Production

Sugar production of European Union was reduced by the 2006 reform. Between 2005 and 2010, the production decreased by 24% (Observatoire des Prix 2016). As intended by the reform, this is explained by a reduction in production capacity within European Union (High-level group meeting on sugar 2019). This is observed by the entire literature through a decrease in variables linked to production capacity.

Between 2005 and 2014, the total harvested areas in European Union decreased by 30% (PricewaterhouseCoopers 2015) (Szajner et al. 2016). This reduction was in the order of 10% in France (High-level group meeting on sugar 2019) while Belgium reduced its harvested areas by 42,5% between 2000 and 2015 (Observatoire des Prix 2016). The reduction of cultivated areas led to a decrease in the volume of harvested beet (Observatoire des Prix 2016). Between 2005 and 2014, the quantity of harvested beet in European union decreased by 19% (Observatoire des Prix 2016).

During the 2003 to 2014 period, the number of beet growers underwent a significant reduction of 53% in the European Union (Szajner et al. 2016). In Belgium, this reduction was of 47,3% between 2000 and 2014 (Observatoire des Prix 2016).

The number of factories in European Union was particularly affected by the reform. In 2014, 109 sugar factories were operating while they were, depending on the source, 213 in 2004 (Szajner

et al. 2016), 194 in 2005 (Observatoire des Prix 2016) or 189 in 2006 (High-level group meeting on sugar 2019). The number of companies, or legal entities, decreased by 38% between 2005 and 2014 dropping from 71 to 44 (Observatoire des Prix 2016). The employment in the sector was affected by companies and factories closures. It was reduced by half to approximately 30 thousand people between 2004 and 2014 (Szajner et al. 2016).

The 2006 reform operated a redistribution of the sugar production and beet growing areas within European Union (Areté & IHS Markit 2021).

4.2.2 Concentration

The changes in production capacity affected the concentration of the industry both at the regional and the company levels.

Before the 2006 reform, 23 Member states were producing sugar. After that, only 18 of them carried on producing (European Commission 2022b) [1]. The production concentrated in the most competitive areas (High-level group meeting on sugar 2019) as the seven Member States with the highest sugar yields accounted for nearly 70% of the production in 2009 (European Commission 2022b). Five countries (France, Germany, Poland, United-Kingdom and the Netherlands) accounted for 73% of the volume produced in 2015 whereas they were representing 62% of it in 2004 (Szajner et al. 2016). In 2013, the three main producers (France, Germany and Poland) accounted for 60% of the harvested areas (High-level group meeting on sugar 2019) and 57% of the post-reform quotas (Observatoire des Prix 2016).

The factory closures increased the producers' concentration by reinforcing regional actors (PricewaterhouseCoopers 2015). Besides, the factories that were closed during the restructuring process were mainly small factories. "*The proportion of EU factories with a small daily beet cutting capacity (< 5 000 tonnes of beet cut per day) fell from 36,6% in 2005 to 14,2% in 2014. In contrast, the proportion of large factories (above 15 000 tonnes) was 20,9% in 2014, compared to only 10% in 2005*" (Observatoire des Prix 2016).

A consolidation of the sugar sector took place during and after the reform (Pricewaterhouse-Coopers 2015). To pursue scale economies, sugar producers were "*putting additional emphasis on external growth and rationalisation of production capacity via mergers and acquisition of additional quotas*" (Areté & IHS Markit 2021). In 2016, 89% of the allocated production quotas were owned by the nine largest manufacturers (Szajner et al. 2016). The market structure of the industry was therefore oligopolistic (Szajner et al. 2016).

In 2015, the concentration of the European sugar sector in the quotas system was studied by Řezbová, Maitah, and Sergienko 2015. To do this, they used the Herfindahl- Hirschman Index (HHI) and discovered a paradox. According to the HHI, the sugar sector was highly concentrated at Member States level but the concentration was relatively low at European Union level (Řezbová, Maitah, and Sergienko 2015).

4.2.3 Productivity

The reform was accompanied by a modernisation of the production and an intensification of cultivation (Szajner et al. 2016) that resulted in productivity gains for the sector. Between 2002 and 2013, the employment per hectare halved in European Union (PricewaterhouseCoopers 2015). During the 2003 to 2015 period, the average sugar yield increased from about 9 to 11-12 tonnes of sugar per hectare (Szajner et al. 2016). Finally, between 2004 and 2014, the productivity doubled to approximately 650 tonnes of sugar per employee (Szajner et al. 2016).

[1] Ireland, Portugal, Latvia, Slovenia and Bulgaria renounced to their entire sugar production quotas during the 2006 reform

4.2.4 Trade

The WTO ruling in the "*EC — Export Subsidies on Sugar*" case, developed in chapter 2, strongly affected European Union exports that dropped by 75,4% between 2005 and 2014 (Observatoire des Prix 2016). As aforementioned, production decreased with the reform and European Union became not self-sufficient in sugar (Szajner et al. 2016). To serve the domestic demand, the European Union needed to import large quantities. The European Union became a net importer after the reform (Szajner et al. 2016).

4.2.5 Prices

Before the reform, European prices were way higher than the international ones as the European market was still isolated from the international market (Szajner et al. 2016). The progressive opening to imports and the reduction of the reference price led to an initial short term convergence until 2011 (Areté & IHS Markit 2021) (Szajner et al. 2016). Nevertheless, this convergence would be more the result of the increase in world prices than of the decrease of the European reference price (Szajner et al. 2016). In 2012, the disparities between domestic and international prices increased again (Areté & IHS Markit 2021). This was most likely due to the drop in European production that led to more imports (Areté & IHS Markit 2021). Between 2013 and 2015, European prices decreased as the domestic production increased. After that, European prices seemed to follow international prices more closely (Areté & IHS Markit 2021).

According to Szajner et al. 2016, the reform did not result in a significant increase in integration. The observation of the rolling correlation between European and international prices revealed large variations (Szajner et al. 2016). The literature explained convergence with the net trade position, stating that "*in general terms, the better the EU net sugar trade position of European Union, the closer the alignment between EU prices and international sugar prices.*" (Areté & IHS Markit 2021).

4.2.6 European Commission's communication

In 2009, the European Commission stated : "*Commission welcomes success of EU sugar reform as restructuring process concludes*" (European Commission 2022b). In 2017, it considered that the 2006 reform "*created a more competitive EU sugar sector ready to compete on a deregulated EU market*" (European Commission 2017b). The sector had been able to "*carefully prepare*" (European Commission 2017a) the exit of the quota system and the productivity had "*improved substantially*" (European Commission 2017a).

According to the Commission, pre-reform's objectives had been achieved by March 2009 (European Commission 2022b). The targeted decrease of 6 millions tonnes was nearly reached at that time and no imposed quotas cuts were necessary (European Commission 2022b). The downward trend in prices was in line with the original objective (European Commission 2022b). Finally, production was concentrated in regions which benefited from the highest yields since 70% of the production was coming from 7 Member states (European Commission 2022b).

The commission's review of the 2006 reform was rather optimistic and focused on positive effects and achieved objectives.

4.3 Pre 2017 reform expectations

4.3.1 Production

The potential supply of sugar producers was larger than the limits imposed by the quota system (Szajner et al. 2016). Therefore European sugar production volume was expected to increase with the end of the system (PricewaterhouseCoopers 2015). An increase in harvested areas (European Commission 2017b) and better yields thanks to good climatic conditions (European Commission 2017b) led to the forecast of a 20% rise of output for the first post-reform year to reach a 20,1 million tonnes production (European Commission 2017b). Beyond that first year, the expected increase of production was of 6% on the 2016 to 2026 period (European Commission 2017b).

The end of production quotas also involved the production of isoglucose. Its production was expected to triple during the 2016-2026 period, going from 700 thousand tonnes to about 2,3 millions (European Commission 2017b). The employment in the isoglucose sector was therefore expected to increase as well as the arbitrage between sugar and isoglucose production (PricewaterhouseCoopers 2015).

Finally, lower prices for sugar were expected to raise the arbitrage between food sugar and industrial use for ethanol production (PricewaterhouseCoopers 2015). A risk for a substitution of beets by other agricultural crops by the farmers was also anticipated because of an eventual drop in prices (PricewaterhouseCoopers 2015).

4.3.2 Concentration

With a European sector more connected to the world market, the competition with refined cane sugar was expected to intensify (PricewaterhouseCoopers 2015). A decrease of the production of less performing (PricewaterhouseCoopers 2015), or less profitable, countries would have resulted in an increase of the concentration of production in the European Union (Szajner et al. 2016). This higher concentration could have been beneficial in terms of efficiency but could also have encouraged monopolistic or oligopolistic practices (Szajner et al. 2016).

4.3.3 Productivity

To stay competitive in a potentially more integrated market, the producers would have to optimize and make a better use of their capacity of production (PricewaterhouseCoopers 2015) (European Commission 2017b). Larger volumes of production and longer campaigns would reduce fixed production costs (PricewaterhouseCoopers 2015). An increase of yields was expected but mainly due to good weather conditions during the first post reform campaign (European Commission 2017b).

4.3.4 Trade

The end of the WTO limitation for exports lead to the expectations that that European producers could explore new opportunities on the world market (European Commission 2017b) (European Commission 2017c) (PricewaterhouseCoopers 2015). An increase of exports from 1,3 million to 2,5 million tonnes between 2016 and 2026 was forecasted (European Commission 2017c). The out-of-quota production, that was exported under the quotas system, was expected to shift towards domestic consumption. Consumption was expected to be stable or to decline slightly (European Commission 2017c). Imports were expected to be negatively impacted by this shift of exports towards domestic consumption (PricewaterhouseCoopers 2015) (Burrell et al. 2013). Imports were forecasted to drop from 3,0-3,5 million tonnes to 1,8 million on the 2016-2026 period

(European Commission 2017c). The expected side effect of an imports reduction was a decrease of the importance of the raw sugar refining sector in the European Union (PricewaterhouseCoopers 2015). Although, imports resulting from preferential trade agreements were likely to remain at pre-reform level (Szajner et al. 2016).

4.3.5 Prices

Domestic prices were expected to drop at the beginning of the first post quotas campaign (European Commission 2017c). They would then be closer aligned with world prices with a premium for European sugar (European Commission 2017c). The annual contractualisation system of the European sugar market was expected to delay this alignment of prices (PricewaterhouseCoopers 2015). This alignment was expected to be made at the export parity whereas it was historically made at the import parity (PricewaterhouseCoopers 2015) [2]. Prices decline should have had a positive welfare impact that would mostly benefit European Union sugar consumers (Burrell et al. 2013).

Three scenarios with different prices dynamics and anticipated the effects on the industry were defined (Szajner et al. 2016). The scenarios were as follows :

1. The 2016 price would be stable on the international market (350 EUR per tonne). Relatively low prices would lead to a restructuring of the sector. Decrease in the size of cultivated areas would be offset by higher yields per hectare. Low energy prices would lead less sugar to be processed into ethanol, production would thus increase. The domestic demand decline would have a negative effect on imports and a positive effect on exports. (Szajner et al. 2016)

2. A fall of international prices (250 EUR per tonne) would mean a deeper restructuring of the European sector. Sugar production would only remain in the most competitive and profitable regions. The production volume would decrease. Imports in large quantities should help meeting the demand. "*Deep restructuring transformation would result in the elimination of many of the sugar factories and the reduction of the area under sugar beet leading to very adverse economic, social and environmental effects.*" (Szajner et al. 2016)

3. An improved economic situations, a decrease of supply or an increase in fuel prices would drive international prices up (500 EUR per tonne). European production would then increase limiting imports to the duty-free quotas. The exports would then increase. (Szajner et al. 2016)

4.3.6 European commission's communication

The previous subsections already included European commission's expectations of the effect of the 2017 reform. This subsections recaps them clearly :

- The production of sugar and of isoglucose were expected to increase as well as cultivated areas for sugar beet. (European Commission 2017c)

- The end of exports limitations would enable European producers to explore new markets and possibilities. They would make the most of their potential growth (European Commission 2017b). Exports were expected to increase because of a larger production as imports were expected to decrease. (European Commission 2017c)

[2] The fluctuation of sugar prices between export and import parity is detailed in section 4.4

- European producers were expected to reduce their production costs by making a better use of their production capacity. (European Commission 2017b)
- Domestic prices were expected to decline and to be closely aligned to world prices with a premium for European sugar. (European Commission 2017c)

The European commission does not elaborate on a possible impact of the reform on the concentration of the European Union sugar sector but stated that producers should have "*every chance of success*" (European Commission 2017a). As for the expected impact of the 2006 reform, the communication of the European commission focuses more on positive effects.

One of the goal of this thesis is to evaluate whether this optimistic picture is supported by the facts.

4.4 Results of the 2017 reform

4.4.1 Production

The expansion strategies decided by the producers coupled to record yields resulted in a sharp growth in production (Areté & IHS Markit 2021). This increase in production exceeded expectations with a record volume of 21,3 million tonnes in 2017/2018 (High-level group meeting on sugar 2019). In 2018/2019, the poor yields due to bad weather conditions reduced the production whereas the harvested areas had not decreased despite lower prices (High-level group meeting on sugar 2019). Cultivated areas decreased in 2019/2020 (High-level group meeting on sugar 2019) and drought prevented a recovery of the production which decreased slightly (Association de Recherche Technique Betteravière 2021).

The adaptation of supply to demand is limited and the level of production is driven by factors that are exogenous to the actors of the sugar sector (Association de Recherche Technique Betteravière 2021). Uncertainty and low prices are discouraging farmers who question their choice of culture. This has had the effect of reducing harvested areas (Association de Recherche Technique Betteravière 2021).

4.4.2 Concentration

The competition, considered as unfair by the *Comité Européen des Fabricants de Sucre* (CEFS) (Comité Européen des Fabricants de Sucre 2019)[3], from countries outside of European Union did not affect the average degree of concentration of the sector which is the same as during the quota period when calculted with the Herfindahl- Hirschman Index (HHI) (Areté & IHS Markit 2021). Nevertheless, the concentration of actors (both at farming and processing level) increased in the largest producing countries according to Areté & IHS Markit 2021.

4.4.3 Productivity

The general productivity improvement induced by the 2006 reform continued with an increase in the average processing capacity per plant over the 2010-2020 period (Areté & IHS Markit 2021). It mostly occurred during the 2010-2015 sub period than during the 2015-2020 period [4].

[3] CEFS suggested to reduce "*the rate of market opening*" of the European sugar market. According to it, there is an issue on the world market "*of government support and dumping of excess sugar, which frequently push prices to levels below the production costs*" (Comité Européen des Fabricants de Sucre 2019).

[4] Only Poland and Czechia improved their average processing capacity on the 2015-2020 period (Areté & IHS Markit 2021).

This suggests that productivity improvements and quest for scale economies were anticipated in prevision of the end of the quotas system (Areté & IHS Markit 2021).

4.4.4 Trade

Production variations changed the trade position of the European Union in the post quotas era. The sharp growth of production of 2017 boosted exports and made European Union a net exporter (Areté & IHS Markit 2021) (High-level group meeting on sugar 2019). This was the case from October 2017 to January 2019. Afterwards, the European Union became a net importer again (Association de Recherche Technique Betteravière 2021).

4.4.5 Prices

This subsections presents two aspects of the prices evolution that were discussed in the literature: the post reform prices dynamics and the impact on the profitability for the sector.

Dynamics

The alignment of European prices on international prices became stronger at the start of the year 2017 (High-level group meeting on sugar 2019). World prices declined because of the surplus of supply in 2017 (High-level group meeting on sugar 2019). International prices stayed depressed and European price reached an unprecedented low of 312 EUR per tonne in January 2019 (Areté & IHS Markit 2021).

The theory, confirmed by practice as shown in Figure 4.1, states that the European price follows the international price fluctuating between two values :

- "*In the event of surplus supply, to aim for export parity: prices on the European market fall until they reach the value of sugar sold on the world market. In this case, the selling price of sugar (ex-works) is the futures market price (FOB).*
- *In the event of a deficit in supply, to aim for import parity: prices on the European market increase until they reach the value of the price of imported sugar. In this case, the selling price of sugar (ex-works) is the futures market price (FOB) + 100 EUR per tonne.*" (Association de Recherche Technique Betteravière 2021).

Profitability

The decline of domestic prices put the actors of the market and industry under heavy pressure (Comité Européen des Fabricants de Sucre 2019). In this environment, covering the total production costs turned out to be difficult (Areté & IHS Markit 2021) with prices reaching levels below production costs according to the CEFS that was talking about a cyclical crisis (Comité Européen des Fabricants de Sucre 2019). The effect was a decline in profitability in all Member States (Areté & IHS Markit 2021). It affected the actors, and their viability, at all levels of the production chain (Areté & IHS Markit 2021). Despite no remarkable variations in beet production costs (Areté & IHS Markit 2021), the absence of a minimum beet price created difficulties for farmers (High-level group meeting on sugar 2019). A profitability decline of beet farming was observed in nine Member States (Areté & IHS Markit 2021). Manufacturers were affected differently depending on their country. The most efficient producing countries have had a increase of competitiveness while the less efficient ones were negatively impacted by low prices (Areté & IHS Markit 2021). Low prices have had negative consequences on the refining activity

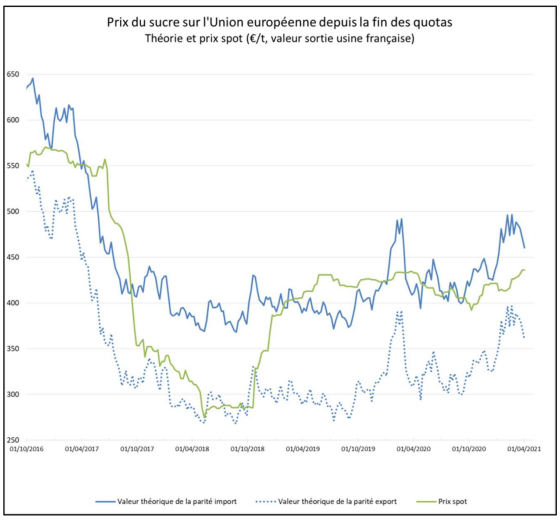

Figure 4.1: Evolution of the spot price in the EU (equiv. Ex-French works, according to Platts). (Association de Recherche Technique Betteravière 2021)

as well (High-level group meeting on sugar 2019). Diversified manufacturers seemed to do better than the specialised ones (Areté & IHS Markit 2021). The exporters also seemed to face less difficulties. They might have been more accustomed to spot sales or more innovative in their selling mechanisms (Association de Recherche Technique Betteravière 2021).

Chapter 5

Descriptive analysis

This chapter graphically presents the sugar industry evolution to assess the statements of the literature mentioned in chapter 4. The various figures show the evolution of sugar production, concentration, productivity, trade and prices within the European Union between 1999 and 2020. This period includes the 2006 and 2017 reforms as well as the European Union enlargements in 2004, 2007 and 2013 as well as the Brexit in 2020.

5.1 Sources

The data used to build these graphical representations were extracted from various sources that are displayed in this section. Table 5.1 displays the sources used to build the quotas levels database. The values of sugar production, harvested areas, number of growers, employment (during and between campaigns), average length of the campaign, number of factories and companies, average yields and average sugar content were obtained from the *Comité Européen des Fabricants de Sucre* annual statistics reports[1]. These data are the same as the data used in chapter 6 for the econometric investigation.

Year	Quotas levels
2014	(Parlement Européen et Conseil de l'Union Européenne 2013)
2013	(Commission Européenne 2013)
2010	(Commission Européenne 2010)
2009	(Commission Européenne 2009)
2008	(Commission Européenne 2008) (Conseil de l'Union Européenne 2007a)
2007	(Commission Européenne 2007) (Conseil de l'Union Européenne 2007b)
2006	(Conseil de l'Union Européenne 2006)
2005	(Directorate-General for Agriculture and Rural Development 2006) (Commission Européenne 2005b) (Commission Européenne 2005a)
2004	(Conseil de l'Union Européenne 2001) (Commission Européenne 2004)
2001	(Conseil de l'Union Européenne 1999)
Before 2001	(Conseil des communautés Européennes 1981)

Table 5.1: Sources used to build the quotas levels database

[1] (Comité Européen des Fabricants de Sucre 2011),(Comité Européen des Fabricants de Sucre 2014),(Comité Européen des Fabricants de Sucre 2015),(Comité Européen des Fabricants de Sucre 2016),(Comité Européen des Fabricants de Sucre 2017),(Comité Européen des Fabricants de Sucre 2022a).

5.2 Production

The literature observed a reduction of the production levels and production capacity during the 2006 reform. The observed effect of the 2017 reform was more nuanced. A significant increase of the production in 2017 was followed by a decrease in the following years.

5.2.1 Production level

The evolution of the sugar production within European Union is shown in figure 5.1. It shows that production was almost always higher than the total quotas allocation (2006 was the only year during which production was lower than the total quotas allocation). Variations in production levels occurred during the years following the 2006 and 2017 reforms. The production decreased during the 2006 reform. From 19,99 million tonnes in 2005, it went to 15,40 million tonnes in 2010. A sharp growth can be observed in 2017, the first year without production quotas. Production went from 16,25 in 2016 to 21,00 million tonnes 2017.

Production levels changed with the enlargements of the European Union. This was particularly the case in 2004, the year Poland, among others, became a European Member State. The production decreased in 2020 with United Kingdom leaving the European Union.

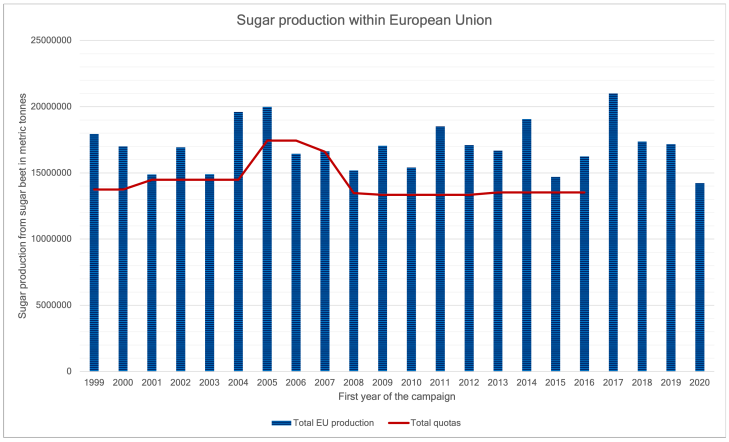

Figure 5.1: Total sugar production from sugar beet within European Union between 1999 and 2020

5.2.2 Production capacity

Graphically, decreases in cultivated areas (see figure 5.2), number of growers (see figure 5.3) and employment (see figure 5.4) are observed between 2005 and 2010. Some variations are also observed around the 2017 reform. In a similar way to the production, harvested areas and employment increased in 2017 and decreased during the following years. The number of sugar beet growers continued to decline despite the 2017 reform. Peaks are observed in 2004 and 2005, after the first European Union enlargement of the studied period. It is interesting to notice that a decreasing trend of the production level and production capacity can be observed within European Union before this enlargement.

The average duration of the campaign (see figure 5.5) did not follow the same decreasing trend. During the 1999-2020 period, the average length of the campaign had a growing trend.

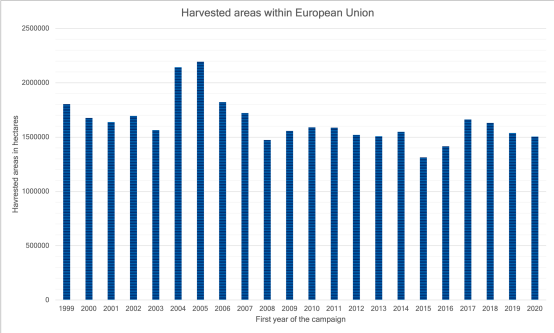

Figure 5.2: Total area of beet cultivation within European Union between 1999 and 2020

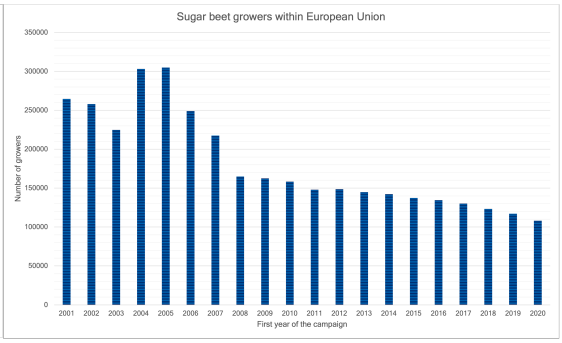

Figure 5.3: Number of sugar beet growers within European Union between 1999 and 2020

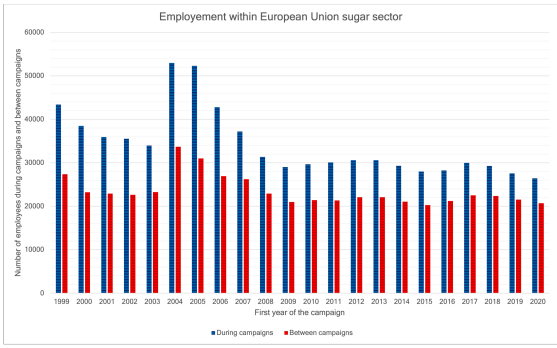

Figure 5.4: Employment (during and between campaigns) in the European Union's sugar sector between 1999 and 2020

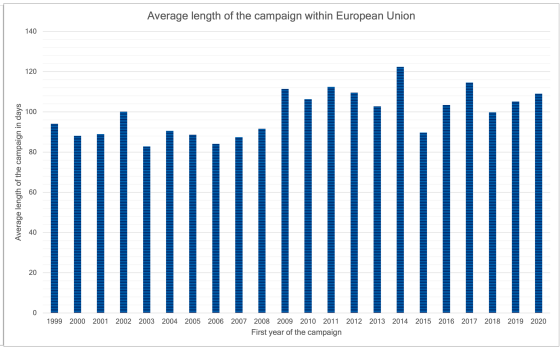

Figure 5.5: Average length of the sugar beet campaign within European Union between 1999 and 2020

5.3 Concentration

The literature observed an increase of the concentration of the sugar industry actors during the 2006 reform. It was observed both at the countries level and at the companies level. The literature observed an increase of the share of the production of the main producing countries through the reforms.

Figure 5.6 shows the decreasing trend of the number of companies and factories throughout the years. As for production, the decreasing trend can be observed before a peak at the time of the European Union enlargement.

During the 2006-2010 reform, the number of factories decreased faster than the number of companies. A decreasing trend can also be observed around the 2017 reform but it has a lower magnitude[2].

Figures 5.7 and 5.8 focus on the five main producing countries [3]. It can be observed that the restructuring operated by the 2006 reform changed the share of total quotas allocated to these five main producers. They accounted for 63,03% of the quotas allocation at the start of

[2]The drop in the number of companies between 2015 and 2016 is not clear. The data used are issued by the same organisation and yet do not match exactly.

[3]The 5 main producing countries were not always the same during the 1999-2020 period. They are detailed in the annexes A.16

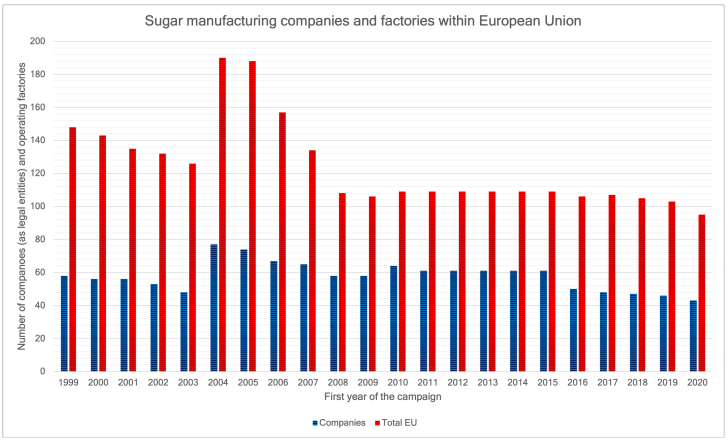

Figure 5.6: Number of operating sugar factories and companies within European Union between 1999 and 2017

the reform in 2006. In 2010, at the end of the reform, they ended up with 72,00% of the total quotas allocation. Sugar production was redistributed in 2004 along with the enlargement of the European Union. After that, the share of the five main producing countries in the total production first increased during the 2006 reform. Between 2006 and 2010, it went from 68,75% to 71,58%. Then, it increased again in the post quotas system era going from 70,82% in 2016 to 78,55% in 2020.

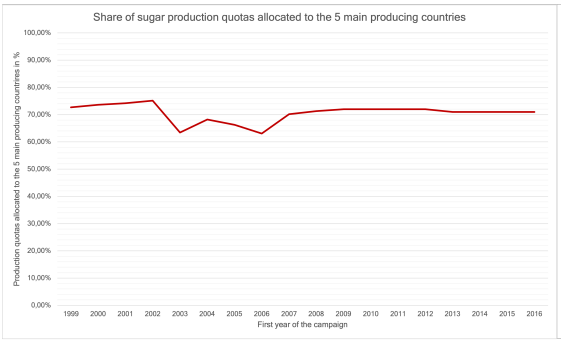

Figure 5.7: Share of sugar production quotas allocated to the 5 main producing countries between 1999 and 2020

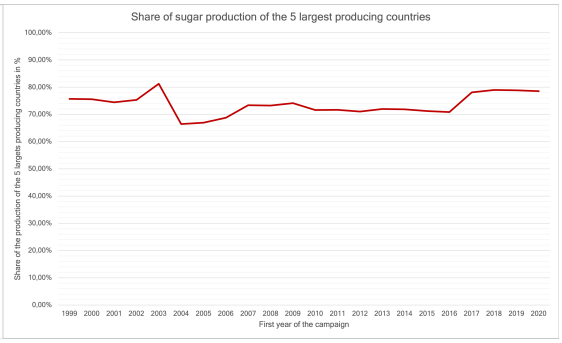

Figure 5.8: Share of sugar production of the 5 main producing countries between 1999 and 2020

5.4 Productivity

The literature observed an increase of the sugar sector productivity. This productivity improvement was higher in the main producing countries according to the literature.

The evolution of the average sugar yield[4] within the European Union is shown in figure 5.9. It shows that, the average sugar yield increased on average during the 1999-2020 period. The

[4]The sugar yield is a function of sugar production divided by contracted beet areas.

average sugar yield was systematically higher in the five main producing countries than the average sugar yield of all producing Member States. By looking at the trends in figure 5.9, it can be observed that the increase in productivity was faster in the leading producing countries.

The sugar yield is affected by the sugar content of beets. The average sugar content in sugar beets depends on climatic conditions as explained in chapter 1. During the 1999-2020 period, it fluctuated between 16,19% and 17,31% with no particular observable trend (see figure 5.10).

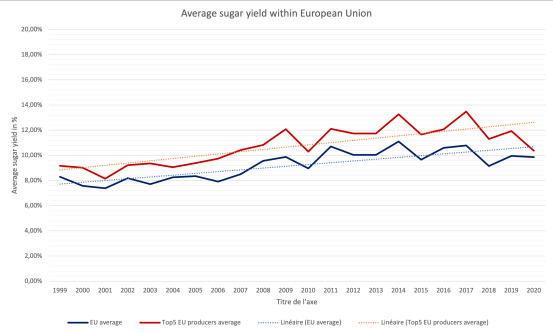

Figure 5.9: Average sugar yield within European Union between 1999 and 2020

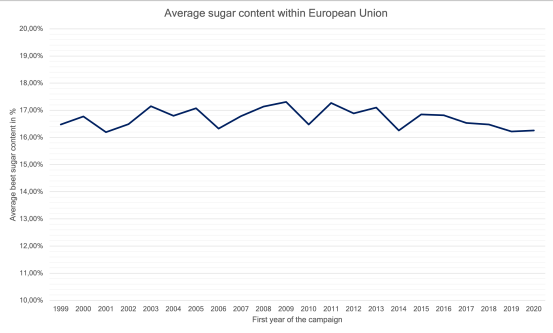

Figure 5.10: Average sugar content within European Union between 1999 and 2020

5.5 Trade

Figure 5.11 reports the evolution of exports and imports as well as of the net trade position. The European Union exports were substantially reduced after the 2005 WTO ruling and 2006 reform (see chapter 2). After that, the European Union was a net importer every year between 2006 and 2016 except in 2009. In 2017, exports increased with the end of the quotas system and the European Union became a net exporter again for two years. Nevertheless, it became a net importer in 2019 and 2020.

These observations are consistent with the literature statements about European Union sugar trade. The exploration of international markets hoped for by European commission seems difficult to settle in time.

5.6 Prices

Figure 5.12 displays the evolution of the average European price and international price for white sugar. European prices decreased during the 2006 reform while the EU reference price was reduced. International prices increased between 2008 and 2010. A closer alignment between European and international prices was therefore observed between 2010 and 2012. Afterwards, European and international prices took opposite directions and were significantly different until 2016. Since 2017, European prices are closer to international prices and the two prices seem to evolve in the same way.

These graphically observed dynamics are consistent with the observations of the literature regarding prices.

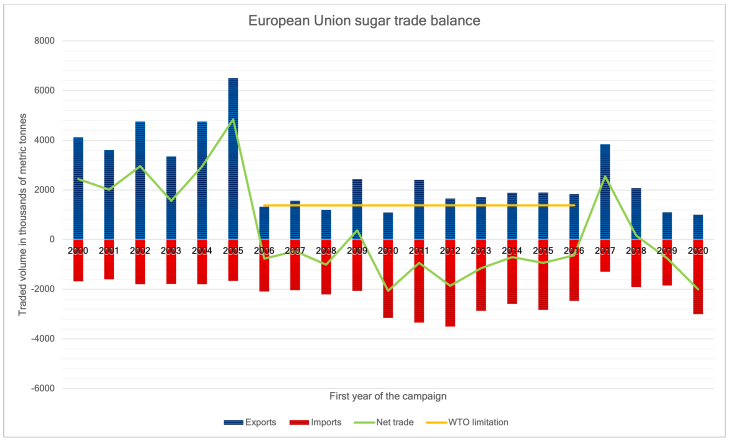

Figure 5.11: European Union sugar trade balance between 2000 and 2020. (OCDE/FAO 2022)

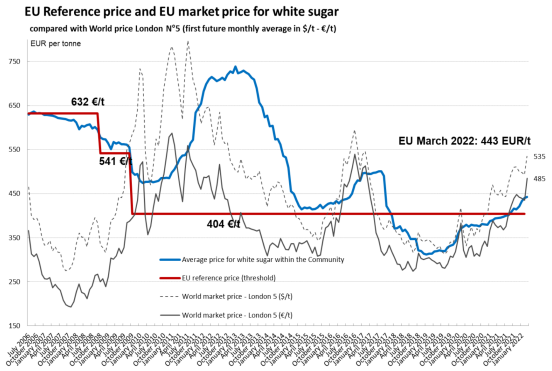

Figure 5.12: European average prices and World average prices evolution between 2006 and 2022. (AGRI E 4 - Expert Group Common Market Organisation on Arable Crops 2022)

5.7 Causality questioning

The graphical observations made in this chapter are consistent with the statements of the literature. Nevertheless, it is unclear whether the documented variations can be be directly ascribed to the reforms.

One possible reason is that global factors affecting countries subject and non subject to the reforms could have played a role over this period of investigation. For example, the epidemic of beet yellow virus severely affected the crops in Europe in 2020. In France, this resulted in a 30% drop in the average yield per hectare (Le Figaro 2020). Switzerland, which was never subject to the production quotas system, also suffered from the beet yellow virus epidemic (Radio Télévision Suisse 2021). Therefore, it is desirable to go beyond the simple assessment through simple variations of outcomes variables. This will be the main purpose of the econometric investigation. In particular, such an econometric analysis would allow to estimate a specific causal effect of the reform and to isolate its possible impact beyond the effect of other factors.

Chapter 6

Empirical analysis

6.1 Methodology

This section details the methodology applied to perform the empirical analysis. First, it explains the construction and characteristics of the data set. Then, it develops the econometrics models that were used.

6.1.1 Data set

This subsection details and justify the studied period and countries, the variables included, the diverse sources used and the choices and assumptions made by the author.

Time dimension

Data relate to sugar campaigns from 1999/2000 to 2020/2021. For the sake of simplicity and consistency, I chose to consider yearly observations e.g. the production of country i for campaign 2006/2007 is classified as the 2006 production. This choice is explained by the fact that the campaigns run from October to January. They therefore mainly concern the calendar year in which the campaign begins. Data for the 2021/2022 campaign were not yet available at the time of the analysis.

Country dimension

The countries included in the data set are European Member States that produced sugar beet at one point during the 1999-2021 period. Four Member States are therefore not included: Cyprus, Estonia, Luxembourg and Malta. In addition to those 23 countries[1], United-Kingdom and Switzerland complete the selection of countries. United-Kingdom was a Member State until 2020 and was therefore subject to the CMO. Thanks to its beet sugar production and its geographical location, Switzerland is included in the data set to serve as control in *Difference-in-Differences* (DiD) estimations. This type of estimation is used to estimate the effect of a shock or policy that is called the treatment. Changes in outcomes are compared between the treated group, in this case European Member States and the control group (which is not treated), in this case Switzerland.

[1] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, Czechia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Bulgaria, Romania, Croatia

Observations

- **Quota** (in metric tonnes) : The sugar production quota allocated to the country for the campaign.
- **Total sugar production** (in metric tonnes) : The total volume of sugar produced from sugar beet.
- **Harvested areas** (in hectares) : The area cultivated for sugar beet.
- **Growers** : The number of farmers growing sugar beet. (Observations were available as from 2001/2002).
- **Sugar yield** (in metric tonnes per hectare) : The sugar yield is a function of sugar production divided by contracted beet areas.
- **Sugar content** (in %) : The average sugar content in beets.
- **Campaign length** (in days) : The average number of days when beets were processed.
- **Factories** : The number of operating factories.
- **Companies** : The number of sugar and refinery companies (as legal entities).
- **Employment** : The sugar processing industry employment during campaign (seasonal and regular staff).
- **Employment between campaigns** : The sugar processing industry employment between the campaigns (only regular staff).
- **Domestic prices** (in EUR per tonne) : The average regional price for white sugar. Prices are calculated as the mean of monthly prices for a campaign[2]. The price is the same for all European countries until 2017. Afterwards, the regional price, as detailed in chapter 2, is used. (Observations were available as from 2006/2007).
- **World price** (in EUR per tonne) : The average world price for white sugar. Prices are calculated as the mean of monthly prices for a campaign [3]. (Observations were available as from 2001/2002).

Sources

The data set has been built on the basis of multiple documents. The different sources that were used for quotas levels and outcome variables are detailed in chapter 5. World prices were taken from *Macrotrends*' historical data (Macrotrends 2022b). European prices were taken from European Commission's *Sugar Market Observatory* publications (European Commission 2021).

6.1.2 Construction of other variables

Additional variables where constructed to conduct the econometric regressions. In particular to apply conditions that restrict the observations that were taken into account.

[2]The 2006 price is the mean from July to September 2006 due to missing data

[3]Prices from (Macrotrends 2022b) in USD/lbs converted in EUR/lbs with monthly exchange rates from (Macrotrends 2022a). Prices in EUR/lbs converted in EUR/ton with conversion formula from (Metric Conversions n.d.)

Dummy variables

Subjectquota defines whether a country is subject to the quota system :

$$subjectquota_{i,t} = \begin{cases} 0, & \text{if country } i \text{ is Switzerland} \\ 0, & \text{if country } i \text{ is not a Member State [4] at year } t \\ 0, & \text{if year } t > 2016 \\ 1, & \text{otherwise} \end{cases}$$

Ref2006 defines whether a country is subject to the 2006 reform :

$$ref2006_{i,t} = \begin{cases} 0, & \text{if country } i \text{ is not Austria, Belgium, Denmark, Finland, France,} \\ & \text{Germany, Greece, Italy, Ireland, Netherlands, Poland, Portugal,} \\ & \text{Spain, Sweden or United-Kingdom} \\ 1, & \text{otherwise} \end{cases}$$

Globalisation defines whether a country is subject to the opening of the market in 2017 :

$$globalisation_i = \begin{cases} 0, & \text{if country } i \text{ is Switzerland} \\ 1, & \text{otherwise} \end{cases}$$

Shock defines whether a country has been subject to the 2017 opening of the market :

$$shock_{i,t} = \begin{cases} globalisation_i * 0, & \text{if year } t < 2017 \\ globalisation_i * 1, & \text{otherwise} \end{cases}$$

Shockant defines whether a country has been able to anticipate that it would be subject to the 2017 opening of the market :

$$shockant_{i,t} = \begin{cases} globalisation_i * 0, & \text{if year } t < 2010 \\ globalisation_i * 1, & \text{otherwise} \end{cases}$$

Other variables

DiffpriceEUW is the difference between the domestic price and the world price :

$$DiffpriceEUW_{i,t} = Domesticprice_{i,t} - Worldprice_{i,t}$$

lDiffpriceEUW is the lagged difference between domestic and world price :

$$lDiffpriceEUW_{i,t} = DiffpriceEUW_{i,t-1}$$

lDiffquota :

$$lDiffquota_{i,t} = lDiffpriceEUW_{i,t} * subjectquota_{i,t}$$

lDiffnonquota :

$$lDiffquota_{i,t} = lDiffpriceEUW_{i,t} * (1 - subjectquota_{i,t})$$

[4] Czech Republic, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia before 2005.
Romania and Bulgaria before 2007.
Croatia before 2013.

6.1.3 Econometrics models

Several models were used in the empirical analysis. They are detailed in this subsection.

Ordinary Least Squares (OLS) regressions

With time and country fixed effects :

$$y_{i,t} = \alpha + \alpha_i + \alpha_t + \beta_1 quota_{i,t} + \varepsilon_{i,t} \tag{6.1}$$

With time and country fixed effects :

$$y_{i,t} = \alpha + \alpha_i + \alpha_t + \beta_1 quota_{i,t} + \beta_2 sugarcontent_{i,t} + \varepsilon_{i,t} \tag{6.2}$$

With time and country fixed effects. Coefficient β_1 is an elasticity :

$$\ln y_{i,t} = \alpha + \alpha_i + \alpha_t + \beta_1 \ln quota_{i,t} + \varepsilon_{i,t} \tag{6.3}$$

With time and country fixed effects. Coefficients β_1 and β_2 are elasticities :

$$\ln y_{i,t} = \alpha + \alpha_i + \alpha_t + \beta_1 \ln quota_{i,t} + \beta_2 \ln sugarcontent_{i,t} + \varepsilon_{i,t} \tag{6.4}$$

Poisson regressions

With time and country fixed effects. Coefficient β_1 is a semi-elasticity :

$$y_{i,t} = e^{\alpha+\alpha_i+\alpha_t+\beta_1 quota_{i,t}+\varepsilon_{i,t}} \tag{6.5}$$

With time and country fixed effects. Coefficient β_1 is an elasticity :

$$y_{i,t} = e^{\alpha+\alpha_i+\alpha_t+\beta_1 \ln quota_{i,t}+\varepsilon_{i,t}} \tag{6.6}$$

First-difference estimators

$$\Delta y_{i,t} = \alpha + \beta_1 \Delta \ln quota_{i,t} + \varepsilon_{i,t} \tag{6.7}$$

$$\Delta price_{i,t} = \alpha + \beta_1 diffpriceEUW_{i,t} + \varepsilon_{i,t} \tag{6.8}$$

$$\Delta price_{i,t} = \alpha + \beta_1 ldiffquota_{i,t} + \beta_2 ldiffnonquotai, t + \varepsilon_{i,t} \tag{6.9}$$

Difference-in-Differences (DiD) estimators

With time and country fixed effects :

$$y_{i,t} = \alpha + \alpha_i + \alpha_t + \lambda globalisation_i + \beta_1 shock_{i,t} + \varepsilon_{i,t} \tag{6.10}$$

With time and country fixed effects. Coefficient β_1 is a semi-elasticity :

$$\ln y_{i,t} = \alpha + \alpha_i + \alpha_t + \lambda globalisation_i + \beta_1 shock_{i,t} + \varepsilon_{i,t} \tag{6.11}$$

With time and country fixed effects, estimated with *Poisson*. Coefficient β_1 is a semi-elasticity :

$$y_{i,t} = e^{\alpha+\alpha_i+\alpha_t+\lambda globalisation_i+\beta_1 shock_{i,t}+\varepsilon_{i,t}} \tag{6.12}$$

6.2 Impact of quotas variations and quotas bindingness

The objective of this section is to measure, if it exists, the effect of changes in quota allocation for the sugar sector actors. These regressions qualify and quantify the impact of variations (positive or negative) of the allocated quota on outcome variables[5] during the period where the quotas were applied.

A positive significant impact is interpreted as the fact that quotas are binding for industry actors. That means that they obey and adjust their production capacity to European regulations. No significant impact, or a coefficient of 0 would mean that quotas are not binding. Another interpretation could also be that the outcome variables are actually affected by other explanatory variables than quotas.

All the observations used for these regressions are selected with the same condition : being subject to the quota system. This is verified with the dummy variable *subjectquota* which is defined in subsection 6.1.2.

The models used for these regressions are *OLS* for continuous variables and *Poisson* for variables with a count value. Time and country fixed effects are included to the models. Country fixed effect captures country-specific factors that are constant over time e.g. the quality of the cultivated soil. Time fixed effect captures factors that are common to countries but vary over time e.g. an epidemic that affects crops. The equations of the used models are detailed in subsection 6.1.3.

6.2.1 Results

Sugar production

Variables	(1) OLS	(2) OLS	(3) OLS	(4) OLS
quota	.4869119 ***	.4859251 ***	-	-
	(.0657495)	(.06644)		
ln(quota)	-	-	.909321 ***	.9046335 ***
			(.0555853)	(.0535511)
sugar content	-	-2759.088	-	.12243
		(16291.79)		(.016435)
α (constant)	455589	501770.9	1.440618	1.298745
	(13572.42)	(278461.5)	(.7249266)	(.7427033)
Observations	311	304	310	304
Number of countries	24	23	24	23
R-squared	0.9855	0.9855	0.9827	0.9842
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 6.1: Estimation of the impact of quotas variations on production
(1) = Equation 6.1 (2) = Equation 6.2 (3) = Equation 6.3 (4) = Equation 6.4

[5]The sugar production from sugar beets, the harvested areas, the number of growers, the average length of the campaign, the number of factories, the number of companies, the employment during the campaign, the employment between the campaigns.

Harvested areas

Variables	(1) OLS	(2) OLS
quota	.1061398 *** (.0007039)	-
ln(quota)	-	3.196915 *** (.1733728)
α (constant)	36248.19 (6838.784)	-30.18524 (2.279425)
Observations	355	320
Number of countries	24	24
R-squared	0.9791	0.8945
Country FE	YES	YES
Time FE	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Table 6.2: Estimation of the impact of quotas variations on harvested areas
(1) = Equation 6.1, (2) = Equation 6.3

Number of growers

Variables	(1) OLS	(2) OLS	(3) Poisson	(4) Poisson
quota	.030281 *** (.001933)	-	7.65e-07 *** (3.78e-09)	-
ln(quota)	-	.6387411 *** (.0778569)	-	1.252219 *** (.0037378)
α (constant)	1256.449 (1776.06)	1.308369 (1.021048)	8.460259 (.003869)	-7.265042 (.0474932)
Observations	282	282	282	282
Number of countries	22	22	22	22
R-squared	0.9284	0.9766	0.9600	0.9795
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 6.3: Estimation of the impact of quotas variations on the number of growers
(1) = Equation 6.1, (2) = Equation 6.3, (3) = Equation 6.5, (4) = Equation 6.6,

Average length of the campaign

Variables	(1) OLS	(2) OLS	(3) Poisson	(4) Poisson
quota	.0000118 *	-	1.02e-07 **	-
	(6.87e-06)		(4.53e-08)	
ln(quota)	-	.3504811 ***	-	.2679398 ***
		(.0661484)		(0.351358)
α (constant)	100.6786	.0976014	4.616815	1.182193
	(6.728354)	(.8634733)	(.0413187)	(4578475)
Observations	301	301	301	301
Number of countries	21	21	21	21
R-squared	0.6618	0.9766	0.9600	0.9795
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 6.4: Estimation of the impact of quotas variations on the average length of the campaign (1) = Equation 6.1, (2) = Equation 6.3, (3) = Equation 6.5, (4) = Equation 6.6,

Number of factories

Variables	(1) OLS	(2) OLS	(3) Poisson	(4) Poisson
quota	9.17e-06 ***	-	4.40e-07 ***	-
	(7.92e-07)		(1.26e-07)	
ln(quota)	-	3.191078 ***	-	.9031321 ***
		(.7486771)		(.1383945)
α (constant)	2.132743	.0976014	-35.21112	-10.37095
	(.7617177)	(.8634733)	(9.764013)	(1.79441)
Observations	310	310	310	310
Number of countries	23	23	23	23
R-squared	0.9575	0.9404	0.6827	0.6922
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 6.5: Estimation of the impact of quotas variations on the number of factories (1) = Equation 6.1, (2) = Equation 6.3, (3) = Equation 6.5, (4) = Equation 6.6,

Number of companies

Variables	(1) OLS	(2) OLS	(3) Poisson	(4) Poisson
quota	2.17e-06 ***	-	1.05e-07	-
	(4.49e-07)		(1.81e-07)	
ln(quota)	-	-.0512218	-	.0398669
		(.2863933)		(.1448466)
α(constant)	1.453782	3.105213	.3455436	-.1271739
	(.4336496)	(3.755022)	(.2777804)	(1.897812)
Observations	327	315	327	315
Number of countries	24	24	24	24
R-squared	0.8775	0.8676	0.4137	0.4125
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 6.6: Estimation of the impact of quotas variations on the number of companies (1) = Equation 6.1, (2) = Equation 6.3, (3) = Equation 6.5, (4) = Equation 6.6

Employment

Variables	(1) OLS	(2) OLS
quota	.0031648 ***	-
	(.0002917)	
ln(quota)	-	.4982432 ***
		(.0798266)
α (constant)	740.7734	.7899696
	(281.1749)	(1.044402)
Observations	309	308
Number of countries	21	21
R-squared	0.9207	0.9323
Country FE	YES	YES
Time FE	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Table 6.7: Estimation of the impact of quotas variations on the employment during campaigns (1) = Equation 6.1, (2) = Equation 6.3

Variables	(1) OLS	(2) OLS
quota	.0013192 *** (.0001647)	-
ln(quota)	-	.4918392 *** (.1027578)
α (constant)	569.6744 (158.477)	.2400321 (1.343744)
Observations	305	305
Number of countries	21	21
R-squared	0.9524	0.8967
Country FE	YES	YES
Time FE	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Table 6.8: Estimation of the impact of quotas variations on the employment during campaigns on the employment between campaigns
(1) = Equation 6.1, (2) = Equation 6.3

6.2.2 Interpretation

A significant effect (at 1%) is found for all the outcome variables except the number of companies (tables 6.1 to 6.8. In general, the estimated effect of quotas variations is compliant with the effect expected after reviewing the literature in chapter 4. The estimations suggests that there was indeed a constraint imposed by the quotas on the studied variables. The reduction in quotas leads to a reduction in production factors and capacities. The similar effects found for the outcome variables can also be explained by the correlation between these variables of interest. The diverse interpretations of these effects are further detailed in the following parts of this subsection.

A causal interpretation of these results must not be straightforward since there is a risk of endogeneity since most of the quotas variations occurred during the 2006 reform. During this reform, the reduction of quotas were not imposed. As explained in chapter 2, Member States chose to renounce to their quota allocation. Analysing the trend of the production level for the five countries that totally renounced to their allocation [6] could have been useful to determine whether those countries anticipated a collapse of their production. Unfortunately, the data set did not include many observations for countries before their adhesion to European Union, which is the case of three of those countries. No decreasing trend in the production was found for either Ireland or Portugal. However, in 2005, the cumulative production of the five countries only accounted for 1,8% (Comité Européen des Fabricants de Sucre 2011) of the total European production.

The data set used is also a source of uncertainty. In this one, the production level for countries which renounced to 100% of their quota allocation became a missing value. The data was processed in this way, without manipulation of the values or assumption on the level of production for these countries. To try and give a complete analysis, some additional regressions were performed. For these regressions, missing production levels for countries with a quota

[6] Ireland, Portugal, Latvia, Slovenia, Bulgaria

allocation of 0 were replaced by 0. The obtained effect was much stronger when calculated in this way. For instance, the elasticity of the sugar production became four times larger.

Sugar production

The effect of quotas on production, shown in table 6.1 is significant at 1%. A decrease of the quota reduce the production with an elasticity that is close to unity. This suggests that quotas were actually binding for sugar producers and therefore fulfilling their role of regulating production.

To include the influence of the climate conditions on the production, the average sugar content of the beets is added as an explanatory variable to the regressions. No significant effect is found for the sugar content and the quota effect remains similar to when sugar content is not included.

Harvested areas

The effect of quotas on harvested areas, shown in table 6.2 is significant at 1%. A decrease of the quota has a negative effect on the harvested areas. The magnitude of this effect is quite important since the elasticity is about 3,2. This is consistent with the fact that the 2006 reform is accompanied by an improvement of the productivity as mentioned in chapter 4. The productivity improvement might have amplified this effect. For farmers, reducing the harvested areas is a way of reducing production capacity.

Number of growers

The effect of quotas on the number of growers is significant at 1%. A decrease of the quota has a negative effect on the number of growers. The effect is larger when estimated with a *Poisson* regression that takes better account of the discrete nature of the number of farmers. When the quota decreased, fewer contracts with farmers benefiting from the minimum price on beets could be done. The cultivation of beet was therefore less interesting for farmers. Diminishing the number of farmers under contract reduced the raw material input for sugar producers and therefore decreased their production capacity.

There is a risk of endogeneity since farmers that renounced to their quota allocation benefited from the support plan of the European Commission as explained in chapter 2.

Average length of the campaign

The effect of quotas on the average length of the campaign, shown in table 6.4 is significant at 1%. A decrease of the quota has a negative effect on the average length of the campaign. Reducing the length of the campaign was a way of reducing production capacity for producers. The smaller raw material input also probably forces producers to reduce the number of days they were processing beets.

Number of factories

The effect of quotas on the number of factories, shown in table 6.5 is significant at 1%. A decrease of the quota has a negative effect on the number of factories. Reducing the number of factories was a way of reducing production capacity for producers.

Number of companies

The effect of quotas on the number of companies, shown in table 6.6 is not significant at 1, 5 or 10% except for the effect estimated in levels with *OLS* that is extremely small.

Actually, the literature reviewed in chapter 4 states that changes in the number of companies resulted from mergers and acquisitions. They were the only way for producers to acquire a larger amount of quotas. The objective of those mergers and acquisitions was often the pursue of scale economies.

Employment

The effect of quotas on the employment (during and between campaigns), shown in tables 6.7 and 6.8, is significant at 1%. A decrease of the quota reduces the employment in the sector both during and between campaigns. Reducing employment was a way of reducing production capacities. This is consistent with the negative effect of quota reductions on factories. Factories closures could explain employment decrease.

6.3 Short term impact of the 2006 reform

The objective of this section is to measure the impact of the 2006 reform in the short term. This is done in a very similar way to the study of the impact of quotas of section 6.2. The regressions use *OLS* and *Poisson* models depending on the distribution of the variables of interest. They study the effect of variations of the quotas on outcome variables [7] but the restrictions applied in order to select the observations used are different. Those conditions are more restrictive, these are :

1. Being subject to the quota system. This is verified with the dummy variable *subjectquota*, defined in subsection 6.1.2.
2. Being subject to the quota reform. This is verified with the dummy variable *ref2006*, defined in subsection 6.1.2.

The interpretation of significant and not significant coefficients is therefore similar to the one of section 6.2. A significant coefficient is interpreted as the fact that the 2006 reform impacted the outcome variable.

[7] The sugar production from sugar beets, the harvested areas, the number of growers, the average length of the campaign, the number of factories, the number of companies, the employment during the campaign, the employment between the campaigns.

6.3.1 Results

Sugar production

Variables	(1) OLS	(2) OLS
ln(quota)	.847809 ***	.8472862 ***
	(.0537371)	(.0530467)
sugar content	-	.0189335
		(.0173875)
α (constant)	2.247242	1.934034
	(.7001865)	(.7479389)
Observations	237	244
Number of countries	14	15
R-squared	0.9870	0.9874
Country FE	YES	YES
Time FE	YES	YES
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 6.9: Estimation of the short term impact of the 2006 reform on sugar production (1) = Equation 6.3, (2) = Equation 6.4

Harvested areas

Variables	(1) OLS	(2) OLS
quota	.1063089 ***	-
	(.0085869)	
ln(quota)	-	3.458843 ***
		(.1952632)
α (constant)	37803.65	-33.6029
	(8251.462)	(2.565258)
Observations	245	253
Number of countries	14	14
R-squared	0.9763	0.8941
Country FE	YES	YES
Time FE	YES	YES
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table 6.10: Estimation of the short term impact of the 2006 reform on harvested areas (1) = Equation 6.1, (2) = Equation 6.3

Number of growers

Variables	(1) OLS	(2) OLS	(3) Poisson	(4) Poisson
quota	.0305877 ***	-	7.97e-07 ***	-
	(.0022096)		(3.81e-09)	
ln(quota)	-	.6441503 ***	-	1.270653 ***
		(.0768622)		(.0037774)
α (constant)	-3959.036	.462182	8.460041	-7.494826
	(1760.373)	(.9779271)	(.0038902)	(.0479974)
Observations	218	218	218	218
Number of countries	14	14	14	14
R-squared	0.9207	0.9701	0.9469	0.9740
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 6.11: Estimation of the short term impact of the 2006 reform on the number of growers
(1) = Equation 6.1, (2) = Equation 6.3, (3) = Equation 6.5, (4) = Equation 6.6,

Average length of the campaign

Variables	(1) OLS	(2) OLS	(3) Poisson	(4) Poisson
quota	.0000115	-	9.73e-08 **	-
	(7.06e-06)		(4.63e-08)	
ln(quota)	-	.5100473 ***	-	.4324291 ***
		(.0756279)		(.0426757)
α (constant)	100.8358	-1.977152	4.61908	-.9534527
	(6.787854)	(.9862823)	(.041547)	(.5555381)
Observations	242	242	242	242
Number of countries	14	14	14	14
R-squared	0.6871	0.6536	0.3618	0.3906
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 6.12: Estimation of the short term impact of the 2006 reform on the average campaign length
(1) = Equation 6.1, (2) = Equation 6.3, (3) = Equation 6.5, (4) = Equation 6.6,

Number of factories

Variables	(1) Poisson
ln(quota)	.8844608 ***
	(.1486177)
α (constant)	-10.12905
	(1.925677)
Observations	237
Number of countries	13
R-squared	0.7069
Country FE	YES
Time FE	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

Table 6.13: Estimation of the short term impact of the 2006 reform on the number of factories
(1) = Equation 6.6

Number of companies

Variables	(1) Poisson
ln(quota)	-.0308392
	(.1498129)
α (constant)	.7923829
	(1.961644)
Observations	241
Number of countries	13
R-squared	0.4444
Country FE	YES
Time FE	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

Table 6.14: Estimation of the short term impact of the 2006 reform on the number of companies
(1) = Equation 6.6

Employment

Variables	(1) OLS
ln(quota)	.4374403 ***
	(.0886893)
α (constant)	1.571143
	(1.159417)
Observations	239
Number of countries	13
R-squared	0.4444
Country FE	YES
Time FE	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

Table 6.15: Estimation of the short term impact of the 2006 reform on the employment during campaigns
(1) = Equation 6.3

Variables	(1) OLS
ln(quota)	.5169576 ***
	(.1113494)
α (constant)	-.0825345
	(1.455647)
Observations	239
Number of countries	13
R-squared	0.8988
Country FE	YES
Time FE	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

Table 6.16: Estimation of the short term impact of the 2006 reform on the employment between campaigns
(1) = Equation 6.3

6.3.2 Interpretation

In general terms, the estimated effect of the 2006 reform is similar to the effect estimated in section 6.2. The signs and significance of the effects are the same for all the outcome variables. Once again, the only variable that is not affected is the number of companies. The amplitude of the effects compared to the estimation of section 6.2 varies from one variable to the other.

It is smaller on production, number factories and employment during campaigns but larger on harvested areas, number of growers, length and employment between campaigns. The individual interpretation of the short term effect of the 2006 reform should therefore be very similar to the interpretation that is made for the effect of variations of the quota. It has compelled sugar producers to reduce their production and to chose their production capacity in line with this reduction.

However, the selected countries were not exactly the same as in section 6.2. Only the countries affected by the 2006 reform were studied. Finding an effect on these countries shows that the 2006 reform in particular has had an impact.

The risk of endogeneity linked to the voluntary renunciation remains even if only Ireland and Portugal have a quota that ended up being 0.

6.4 Long term impact of the 2006 reform

The objective of this section is to estimate the long term effect of the 2006 reform on the variables of interest[8]. In order to do so, two reference periods are determined: a "pre-reform" period and a "post-reform" period. In this analysis, these periods have been defined in two different ways :

1. The distinction between the two periods is the beginning of the reform.
   - 1999-2005 is pre-reform.
   - 2006-2016 is post reform.
2. The distinction between the two periods is the end of the major changes in terms of quotas allocation.
   - 1999-2008 is pre-reform.
   - 2009-2016 is post-reform

For each period, the values of the variables of interest are collapsed as the mean over the period.

The long term effect is estimated with a first-difference estimator that is modelled by the equation 6.7. In this model, the outcome variable is the first difference of the collapsed variable of interest. The explanatory variables is the relative change in quota allocation.

A significant coefficient is interpreted as a long term effect of the 2006 reform. A non significant coefficient, or a coefficient equal to 0 is interpreted as the absence of a long-lasting effect of the 2006 reform.

[8]The sugar production from sugar beets, the harvested areas, the number of growers, the average length of the campaign, the number of factories, the number of companies, the employment during the campaign, the employment between the campaigns.

6.4.1 Results

Variables	(1) Production OLS	(2) Areas OLS	(3) Growers OLS	(4) Length OLS	(5) Factories OLS	(6) Companies OLS	(7) Employment OLS	(8) Empl. between OLS
ln(quota)	141423.2	2045.513	4686.778	60.2324 ***	-1.208594	-.2010141	-530.6207	-264.2448
	(154097)	(19733.82)	(9113.731)	(10.41896)	(4.867662)	(.8632043)	(1184.228)	(959.6438)
α (constant)	-145892.2	-43700.56	-9070.454	28.5536	-6.1061	-1.49402	-1970.896	-975.1619
	(83624.5)	(16014.86)	(4945.79)	(5.654103)	(2.641556)	(.7005283)	(961.0531)	(520.7742)
Observations	14	15	14	14	14	15	15	14
R-squared	0.0656	0.0008	0.0216	0.7358	0.0051	0.0042	0.0152	0.0063

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6.17: Estimation of the long term impact of the 2006 reform when the pre-reform period is 1999-2005 and post reform period is 2006-2016
Equations (1), (2), (3), (4), (5), (6), (7), (8) = 6.7

Variables	(1) Production OLS	(2) Areas OLS	(3) Growers OLS	(4) Length OLS	(5) Factories OLS	(6) Companies OLS	(7) Employment OLS	(8) Empl. between OLS
ln(quota)	545524 **	-1004.477	784.4464	35.85431 **	3.922644	-.0172375	-140.0906	-191.9009
	(129483)	(3403.475)	(5612.71)	(13.95133)	(5.216613)	(.1529169)	(1136.985)	(590.9588)
α (constant)	36035.8	-37207.8	-8406.844	25.6169	-3.604194	-1.157567	-1421.913	-769.0787
	(52684.89)	(10738.84)	(3614.033)	(5.676587)	(2122561)	(.482922)	(732.1061)	(380.5192)
Observations	13	15	14	13	13	15	14	14
R-squared	0.6174	0.0067	0.0016	0.3752	0.0489	0.0010	0.0013	0.0087

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6.18: Estimation of the long term impact of the 2006 reform when the pre-reform period is 1999-2008 and post reform period is 2009-2016
(1), (2), (3), (4), (5), (6), (7), (8) = Equations 6.7

6.4.2 Interpretation

No significant effect was found with the first definition[9] of the two periods except for the average length of the campaign. This absence of significant effect could have been explained by the definition of the periods. This is why the same regressions were performed with an other definition[10] of the two periods. In this case, significant effects (at 5%) were found on the production and on the average length of the campaign.

The long term effect of a decrease of the quota was a decrease of the average length of the campaign. The effect is nearly two times weaker when the second period's beginning is year 2009. The long term effect of a decrease of the quota was a decrease of the production.

These results suggests that, on the long term, only production and the length of the campaign were affected by the 2006 reform. This could be a hasty conclusion. Especially since once of the objective of the reform was not a simple reduction of the production, as explained in chapter 2. The fact that no other significant effect was found, despite the presence of a short term effect, might be due to the counterbalancing of anticipations of the end of the quota system (the 2017 reform). Those anticipation effects are studied and discussed in section 6.6.

[9] Pre-reform period is 1999-2005 and post-reform period is 2006-2016
[10] Pre-reform period is 1999-2008 and post reform period is 2009-2016

6.5 Direct impact of the 2017 reform

The objective of this section is to study the effect of the 2017 reform. The effect is estimated with a *Difference-in-Differences* estimator. The treatment group is made of all the countries that were subject to the quotas system and faced the liberalisation of the market with the end of the system. The control group is made of the country, Switzerland, that was not subject to the quotas system and therefore did not face such a liberalisation shock. Those groups are defined with the help of the dummy variable *globalisation* that is defined in subsection 6.1.2. The transition from the quota system to the liberalised market is symbolized by the variable *shock*, also defined in subsection 6.1.2. Three different periods are studied in this section. The countries taken into account is different according to the period :

- On the 1999-2020 period, only EU15[11] countries are taken into account.
- On the 2010-2020 period, EU28[12] countries except Croatia are taken into account.
- On the 2013-2020 period, EU28 countries are taken into account.

1999-2020, 2010-2020, 2013-2020.

A significant coefficient is interpreted as a direct effect of the 2017 reform on the variables of interest[13] A non significant coefficient or a coefficient equal to 0 would mean that the liberalisation shock of the 2017 reform did not affect the interest variables.

6.5.1 Results

EU15 countries as of 1999

Variables	(1) Production OLS	(2) Harvested areas OLS	(3) Growers Poisson	(4) Length OLS	(5) Factories Poisson	(6) Companies Poisson	(7) Employment OLS	(8) Employment between OLS
globalisation	0	0	0	0	0	0	0	.5979062 ***
	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(.1206007)
shock	-.4707219 **	-.5193941	-.256421 ***	-.005965	-.3573381	-.492992	-.2670653	-.0630634
	(.94451)	(.8591645)	(.0081238)	(.1197602)	(.3963448)	(.5630896)	(.1882433)	(.21504)
α (constant)	13.25058	11.79063	8.647501	4.615831	1.30269	.4580702	7.290075	6.076253
	(.1120083)	(.4933498)	(.008865)	(.0704744)	(.1606454)	(.2463835)	(.1099903)	(.1367012)
Observations	301	319	273	299	302	315	303	301
Number of countries	14	14	14	14	14	14	14	13
R-squared	0.9311	0.7405	0.9021	0.6081	0.6803	0.4360	0.9140	0.8858
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Table 6.19: Estimation of the direct effect of the 2017 reform for EU15 Member States on the period 1999-2020
(1), (2), (4), (7), (8) = Equation 6.11, (3), (5), (6) = Equation 6.12

[11] The EU15 countries of the data set are : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and United-Kingdom

[12] The EU15 countries of the data set are : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United-Kingdom, Czech Republic, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Bulgaria, Romania and Croatia

[13] the sugar production from sugar beets, the harvested areas, the number of growers, the average length of the campaign, the number of factories, the number of companies, the employment during the campaign, the employment between the campaigns.

EU28 countries (except Croatia) as of 2010

Variables	(1) Production OLS	(2) Harvested areas OLS	(3) Growers Poisson	(4) Length OLS	(5) Factories Poisson	(6) Companies Poisson	(7) Employment OLS	(8) Employment between OLS
globalisation	0	.7403355 ***	0	0	0	0	0	0
	(omitted)	(.0918387)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
shock	-.2035937	-.1260682	.0286918 ***	-.0638043	-.0567207	-.256747	-.0806355	.0794232
	(.2043167)	(.1215957)	(.0089751)	(.0682217)	(.4475355)	(.63339)	(.1071794)	(.1091149)
α (constant)	12.97587	9.933362	8.531325	4.859476	.6447607	.0349256	6.638796	6.055683
	(.230378)	(.1018829)	(.0099368)	(.0748439)	(.5004267)	(.7087173)	(.1208505)	(.1230329)
Observations	208	238	208	205	209	241	208	208
Number of countries	18	22	18	18	18	18	18	18
R-squared	0.9290	0.9978	0.9907	0.4081	0.6615	0.3516	0.9750	0.9739
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Table 6.20: Estimation of the direct effect of the 2017 reform for EU28 Member States (except Croatia) on the period 2010-2020
(1), (2), (4), (7), (8) = Equation 6.11, (3), (5), (6) = Equation 6.12

EU28 countries as of 2013

Variables	(1) Production OLS	(2) Harvested areas OLS	(3) Growers Poisson	(4) Length OLS	(5) Factories Poisson	(6) Companies Poisson	(7) Employment OLS	(8) Employment between OLS
globalisation	.5953748 ***	0	0	0	0	0	.8724151 ***	.6265316 ***
	(.2140558)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(.0973074)	(.10064)
shock	-.2386665	-.0666766	.0319222 ***	-.0723442	-.0545806	-.2705087	-.0856609	.075794
	(.2514283)	(.1358981)	(.0100501)	(.0969519)	(.5047262)	(.7140366)	(.1142966)	(.118211)
α (constant)	12.35977	10.56329	8.496895	4.576528	.645589	.0601762	5.759825	5.450964
	(.1863367)	(.0770222)	(.0112084)	(.0552817)	(.5670451)	(.8026542)	(.0846067)	(.0876077)
Observations	159	174	159	156	160	188	159	159
Number of countries	18	24	19	19	19	20	18	18
R-squared	0.9325	0.9971	0.9926	0.8200	0.6546	0.3403	0.9774	0.9760
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

Table 6.21: Estimation of the direct effect of the 2017 reform for EU28 Member States on the period 2013-2020
(1), (2), (4), (7), (8) = Equation 6.11, (3), (5), (6) = Equation 6.12

6.5.2 Interpretation

A significant effect (at 5%) on the production was found for EU15 countries on the 1999-2020 period. It is shown in table 6.19. The 2017 reform reduced sugar production in EU15 Member States. Although, this effect is not significant anymore for 2010-2020 and 2013-2020 periods shown in tables 6.20 and 6.21. This might have been explained by the fact that some factors that influenced the production of EU15 Member States in the post quota system period did not affect Switzerland, the control group. However, the beet yellowing that affected EU15 Member States' production also affected Switzerland (Radio Télévision Suisse 2021).

A significant effect (at 1%) on the number of growers was found for all the studied periods. The reform would have increased the number of growers in the European Union. Since it was the only direct effect found for all periods, *OLS* regressions were performed in addition to *Poisson* regressions. The results of these regressions, shown in table A.1, do not show any significant effect. This significant direct effect of the 2017 reform might rather be explained by the model

than by something else. However, the end of the quota system offered sugar producers the opportunity to freely contract with more farmers. That could have increased the number of sugar beet growers.

6.6 Anticipations effects impact of the 2017 reform

The results obtained by studying the direct effect of the reform are limited. Therefore, this section tries to test whether a hypothetical anticipation of the reform could have had an effect. This is realised very similarly to the study of the direct impact of the reform. The control group is still Switzerland and defined with the dummy variable *globalisation*. The difference is that the shock is defined with *shockAnt*, defined in subsection 6.1.2 and therefore relocated in 2009. This particular year was chosen because it was the end of the major changes induced by the 2006 reform. From that moment, the actors of the industry could anticipate that no regulation changes would occur until the end of the quota system. As explained in chapter 2, the end of the quota system was intended in 2015. It was actually postponed to 2017 in 2013.

A significant coefficient could mean that the actors of the industry anticipated the end of the quotas system.

6.6.1 Results

Variables	(1) Production OLS	(2) Harvested areas OLS	(3) Growers Poisson	(4) Length OLS	(5) Factories Poisson	(6) Companies Poisson	(7) Employment OLS	(8) Employment between OLS
globalisation	0	0	0	0	0	0	0	.6567812 ***
	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(.1436967)
shock anticipation	-.4147887 ***	-1.266698 *	-.4019889 ***	.061537	-.4639712	-.4818611	-.3135561 **	-.1353817
	(.1493998)	(.6558875)	(.0058369)	(.0922621)	(.3050035)	(.4325679)	(.1471981)	(.1687648)
α (constant)	13.2599	11.82756	8.792775	4.613191	1.305528	.4614039	7.291166	6.017949
	(.1117416)	(.4908229)	(.0071224)	(.070495)	(.1606534)	(.2464014)	(.1094779)	(.1570519)
Observations	301	319	273	299	302	315	303	301
Number of countries	13	14	14	14	14	14	14	13
R-squared	0.9316	0.7435	0.9034	0.6087	0.6807	0.4363	0.9148	0.8860
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6.22: Estimation of the anticipation effect of the 2017 reform.
(1), (2), (4), (7), (8) = Equation 6.11, (3), (5), (6) = Equation 6.12

6.6.2 Interpretation

Table 6.22 shows a significant effect of the anticipation of the 2017 reform on several variables. The anticipation of the reform would have reduced the production of sugar, the harvested areas, the number of growers and the employment during campaign. No significant effect was found on the average length of the campaign, the number of factories and companies or the employment between campaigns. This suggests that it was farmers rather than manufacturers who left the sector in anticipation of the reform.

6.7 Prices convergence

The objective of this section is to study the effect of the 2017 reform on the European prices dynamics. The convergence of domestic prices towards international prices is particularly discussed. To do so, *first difference* regressions estimate the effect of the lagged difference between

domestic and international price on changes in the domestic price. A negative coefficient is interpreted as a convergence of the domestic price towards the international price. The greater the coefficient in absolute term , the higher the convergence rate. First the overall effect is estimated in order to determine if there is well a convergence. Then, thanks to the variables *lDiffquota* and *lDiffnonquota* defined in subsection 6.1.2, a difference is made between periods during which quotas are applied or not. The objective is to test the contribution of the globalisation as an accelerator of the convergence.

6.7.1 Results

Variables	(1)
DiffpriceEUW	-.2976106 ***
	(.0253114)
α (constant)	56.3985
	(6.951564)
Observations	381
R-squared	0.2673
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 6.23: Estimation of the convergence of the domestic prices towards world prices over the 2006-2020 period
(1) = Equation 6.8

Variables	(1)
ldiffquota	-.3367752 ***
	(.0279993)
ldiffnonquota	-.5747446 ***
	(.0771606)
α (constant)	72.98418
	(8.548568)
Observations	360
R-squared	0.2892
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 6.24: Estimation of the convergence of domestic prices towards world prices under quota system and under liberalised system. The studied period is 2006-2020.
(1) = Equation 6.8

6.7.2 Interpretation

The effect of the lagged prices difference between world prices and domestic prices is significant. First of all, table 6.23 highlights a general convergence of the European prices towards inter-

national prices. Afterwards, table 6.24 demonstrates that convergence is nearly twice as strong after the end of the quota system. This could be explained by the end of the export limit for European Member States.

Conclusion

This thesis analysed the effect of the 2006 and 2017 reforms of the European Union sugar sector. To do so, each of the two reforms was analyzed in several stages. The European Union's objectives and expectations were precisely defined. The literature observations were highlighted. The descriptive analysis allowed to verify these observations. Finally, an econometric analysis allowed to estimate the specific causal effect of the reform and to isolate their possible impact beyond the effect of other factors.

The 2006 reform effects expected by the European Commission were the following:

- Domestic production would be reduced with the end of the quotas system.
- Sugar production would come to an end in the less suitable regions during the restructuring process.
- European prices would be closer to international prices. They would become key drivers of the allocation of resources and investment decisions in the industry.
- The European sugar sector would be ready to compete in a globalised market at the beginning of the 2017 reform.

The 2006 reform effect observed by the existing studies on the subject was as follows:

- The European production level was reduced as well as the production capacity. The harvested areas, the number of growers, the number of factories and companies and the employment were reduced with the 2006 reform.
- The concentration of the European sugar sector actors increased both at the country and at the company level.
- The productivity of the sugar sector improved during the 2006 reform.
- Exports were reduced to the WTO limitation and the European Union became a net importer.
- The European Union sugar market was still isolated from the international market. There was no evidence of a correlation between European and international prices. Decreases in price differentials were explained by other factors than the 2006 reform.

The effects highlighted in the literature review were observed graphically in the descriptive analysis. Nevertheless, to isolate the possible impact of the reform beyond the effect of other factors, an econometric investigation was performed. The effects that were found in this one were the following:

- In the short term, a negative effect of the quotas reduction was observed on production, harvested areas, number of growers, average length of the campaign, number of factories and employment (during and between campaigns). No significant effect was found on the number of companies. The quotas were therefore binding when they were applied.
- In the long term, a negative effect of the quota reduction was only observed on production and on the average length of the campaign. No other significant effects were observed in the long term.

The effect of the 2006 reform seemed close to what the European Union was targeting. The production and production capacity objectives were reduced. Nevertheless, the objectives in terms of price did not seem to be fully achieved as the European sugar sector turned out to stay isolated from the international sugar market. Moreover, on the basis of the difficulties encountered by the sugar sector actors after the 2017 reform, the European sugar sector might not have been well enough prepared for the globalisation shock at the end of the quotas system.

The same methodology was applied to analyse the effect of the 2017 reform. Before it took place, the literature was expecting the following effect:

- Production levels would increase as well as harvested areas. In case of a deteriorated profitability, production could potentially decrease.
- The concentration of the sugar sector actors within the European Union would probably increase.
- The productivity of the European sugar sector would be improved.
- The European Union exports would increase and its imports would decrease. It would become a net exporter again.
- European prices would be closer to international prices. This would have various consequences on the profitability of the sector depending on the evolution of international prices.

More precisely, the European Commission's expectations were as follows:

- Production would increase as well as the harvested areas.
- Exports would increase as imports would decrease. The European Union would become a net exporter.
- European manufacturers would reduce their production costs by making a better use of their production capacity.
- Domestic prices would decline and become closer to world prices with a premium for European sugar.

The effect of the 2017 reform observed in the literature was as follows:

- Production increased during the first year after the reform and decreased in the following years.
- The concentration of actors increased in the largest producing countries.
- The actors anticipated the reform and pursued scales economies and productivity improvements before the end of the quotas system.

- The profitability in the sugar sector declined as it was put under high pressure by very low prices.

The descriptive analysis confirmed the observations of the existing studies. With the same purpose of isolating the possible impact of the reform beyond the effect of other factors, an econometric investigation was performed. The effects that were observed were the following:

- The direct effect of the reform is not clear. Only a decreasing effect on production and an increasing effect on the number of growers were found. However, these results have to be taken with caution. No other significant direct effect of the 2017 reform was found.
- The anticipation effect of the 2017 reform was a reduction of the production, harvested areas, employment and number of growers.
- The convergence of European prices towards international prices was accelerated by the 2017 reform.

The post quotas European sugar sector is not as bright as what European Commission expected. The production, and thus the net trade position, seem to be dictated by exogenous factors such as climatic conditions and virus epidemics. Moreover, whereas production costs were expected to be reduced, the drop in domestic prices put the actors in a tricky situation.

The effectiveness of the 2006 and the 2017 reforms is questionable. Some objectives were achieved but they do not seem to last over time. The European sugar sector is currently facing important challenges that could be decisive for its future. Among these are the unfair competition of some countries on the world market, the way contracts are made that make adaptation to market trends even more difficult, the production costs that increase faster than the sugar prices, the substitution of sugar beets with other crops by farmers.

In order to extend the research of this thesis, some interesting avenues of investigation could be followed. These include:

- Analyzing the effect of the 2017 reform on exports and imports level. This could not be made in this thesis since no appropriate data was found in order to constitute a decent control group.
- Analyzing the effect of the reforms on the market structure. Taking a closer look at the actors of the industry would be interesting but the difficulty of access to data at the company level made it impossible to analyse this in this thesis.

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Appendix A

Annexes

A.1 Reforms summary

Table 3.3 – The evolution of the EU sugar regime from the 2006 reform to the end of quotas (MY = marketing year)

Key elements of the regime	**Before the 2006 reform** *(up to MY 2005/06)*	**After the 2006 reform** *(MY 2006/07 to 2016/17)*	**After the end of quotas** *(MY 2017/18 onwards)*
Guaranteed price system	Intervention price (IP): 631.90 €/T	Reference price (RP)*: 631.90 €/T (2006/07; 2007/08); 542.00 €/T (2008/09); 404.40 €/T (2009/10 onwards) Intervention price (IP) = 80% of RP of the following MY (up to 2009/10)	Reference price (RP)*: 404.40 €/T (2017/18 onwards)
Supply management measures	Quota system (A quota + B quota) "C" sugar: carry-forward to the next MY or export on the world market without refunds Market withdrawals: public intervention → national intervention agencies of sugar-producing Member States are required to purchase at intervention price any quantity of white and raw sugar produced under quota	Quota system (A and B quotas merged into a single "basic quota") Out-of-quota sugar: carry forward to the following campaign; specific industrial uses; supply of EU outermost regions; export within the quantitative limits set by the Commission in compliance with the WTO thresholds Public intervention only up to 2009/10 Aid for private storage Firms may be required to withdraw and store at their own expense until the beginning of the following MY a defined % of quota sugar to safeguard market balance	No quotas: producers can freely decide production and export volumes Aid for private storage Non-sector specific market management measures under the CMO Regulation
Import regime	Fixed import duty: 419.00 €/T for white sugar and 339.00 €/T for raw sugar (full third-country most favoured nation (MFN) duty) Additional variable duty: applied automatically if world market price is below a certain "trigger price" Tariff exemption or reduction for imports under certain regimes (ACP, LDCs/EBA, Balkans, CXL), with quantitative limitations	Fixed import duty: 419.00 €/T for white sugar and 339.00 €/T for raw sugar (full third-country most favoured nation (MFN) duty) Additional variable duty: applied automatically if world market price is below a certain "trigger price" Tariff exemption or reduction for imports under certain trade regimes: with (Balkans, CXL, other preferential agreements) or without quantitative limitations (ACP→EPA, LDCs/EBA)	Basically unchanged (except for a few additional preferential agreements, all with quantitative limitations)
Support to exports	Export refunds: granted to quota sugar and re-exports of ACP preferential imports WTO limitation to subsidised exports = 1 374 million T	Export refunds: granted to sugar up to 2007/08 WTO limitation to subsidised exports = 1 374 million T (this includes re-export of quantities corresponding to those imported from ACP countries and exports of out of quota sugar)	No support to exports

Figure A.1: Reforms summary part 1 (Areté & IHS Markit 2021)

A.2 Database

A.3 Econometric regressions results

Key elements of the regime	Before the 2006 reform *(up to MY 2005/06)*	After the 2006 reform *(MY 2006/07 to 2016/17)*	After the end of quotas *(MY 2017/18 onwards)*
Crop-specific support for sugar beet cultivation	Minimum price for sugar beet (MPB): 46.72 €/T for A beet	Minimum price for sugar beet (MPB): From 32.86 €/T (2006/07) to 26.29 €/T (2009/10 to 2016/17) for in-quota beet Voluntary coupled support for sugar beet cultivation (support decision and implementation at national level) from 2015 onwards	No minimum price for sugar beet Voluntary coupled support for sugar beet cultivation (support decision and implementation at national level)
Contractual relations between sugar beet growers and sugar producers	Compulsory collective negotiations of beet prices → compulsory value-sharing clauses in inter-branch agreements reached in the sugar supply chain	Compulsory collective negotiations of beet prices → compulsory value-sharing clauses in inter-branch agreements reached in the sugar supply chain	Sugar beet purchase prices laid down in delivery contracts between individual beet sellers and each sugar producer → voluntary value-sharing clauses in the context of the agreements within the trade, between associations of farmers and associations of sugar producers

* Strictly speaking, the reference price is not a guaranteed price

Figure A.2: Reforms summary part 2 (Areté & IHS Markit 2021)

Harvested areas in hectares

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	46478	42836	44704	44464	43223	44737	44196	39412	42336	43027	43978	44918	46642	49340	50996	50655	45593	43618	42848	31246	27892	26656
Belgium	104720	94482	96205	98195	92480	89523	86655	83419	85019	60256	63438	59542	64361	63169	61811	59782	53691	56383	64749	63691	58611	57133
Denmark	64100	58600	56800	55700	50200	48500	47000	41700	39300	36500	38000	39200	39800	40600	37600	35500	24800	32800	34400	34000	29300	33400
Finland	33821	32025	31113	30539	28794	30396	31100	23800	16000	13600	15000	14600	14200	11700	12000	13700	12500	11600	10500	10200	10600	11300
France	392543	361116	386000	409358	360700	347832	380430	379241	397936	349498	372200	380720	362000	341000	360700	371000	349600	375000	442900	421900	393400	370500
Germany	488561	451410	449133	455225	443545	436676	418820	359773	391496	363834	364207	362000	398000	345254	334600	339041	282700	299692	382012	390285	372287	350743
Greece	39154	49991	42227	40938	39094	32930	41965	26879	13722	13848	23412	14000	6000	9309	5799	7000	4885	5300	6217	1300	1600	.
Ireland	32995	32300	31084	31506	31000	31127	31000	0	0	0	0	0	0	0	0	0	0	.	.	.	.	.
Italy	280500	249151	222593	245716	214172	185805	253043	92103	85638	61172	62000	63000	45543	52500	40712	51985	38124	32295	38000	34408	29967	27265
Netherlands	120000	111000	109000	106000	102000	97000	91459	83303	82260	72271	72380	70465	73125	73123	73276	75591	58579	66751	86200	86244	80748	83223
Portugal	8107	7738	6456	8568	7037	7905	3581	2500	1652	0	0	0	0	0	0	0	0	.	.	.	.	.
Spain	133000	130000	108000	114700	102000	103000	102000	103900	60300	51100	47000	47000	45000	36100	35029	38744	35675	33238	36497	33635	31805	26600
Sweden	59310	55170	54543	53956	49725	47457	48200	43700	40000	36600	40000	39000	40000	38200	35300	33700	19000	30100	30900	30500	26600	29000
UK	160000	146000	148800	147700	135700	133100	125900	107123	106800	101600	103484	104000	99400	103800	106830	103000	74200	70600	94600	97300	88400	92100
Czech Republic	.	60309	78942	79504	74016	68970	63170	59447	54026	51289	54000	54000	59243	52000	61978	66156	53600	52300	58122	66151	60630	62205
Hungary	.	54573	67559	55483	48049	64616	58334	45954	36229	6500	14000	14000	13000	18000	15685	11000	15513	13700	15484	13586	11365	11738
Latvia	.	.	.	.	.	14000	14000	11000	0	0	0	0	0	0	0	0	0	.	.	.	.	.
Lithuania	.	27700	26500	27300	25600	23300	17300	14400	13200	7000	15000	15000	18000	19000	17800	16000	12300	14700	15200	16200	14800	14900
Poland	.	.	.	.	297131	296277	277979	240297	215296	175682	192000	195176	197000	193359	184837	197555	171430	203100	231716	239414	240777	251856
Slovakia	.	30535	31616	30497	31594	34215	32263	27492	18913	11030	15887	18000	17768	19444	20077	22348	21707	21663	22545	21938	22269	21463
Slovenia	.	.	.	.	.	6100	5048	7000	0	0	0	0	0	0	0	0	0	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	1106	1500	0	0	0	0	0	0	0	0	0	.	.	.	.	.
Romania	.	.	.	.	.	.	19034	29240	22282	18955	20000	23000	19000	28000	28600	29000	23600	22599	26476	21569	22476	23152
Croatia	.	.	.	.	.	.	.	.	.	.	.	32851	28178	26526	24842	27000	16200	29253	22349	16593	13984	11993
Switzerland	17749	18077	17748	18353	17693	18859	18500	18740	21184	20690	20821	18086	19770	19637	20440	21700	20680	20740	20569	21373	20436	21186

Figure A.3: Harvested areas data

Number of companies (legal entities)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Belgium	5	5	5	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Denmark	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Finland	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
France	17	16	16	17	16	13	12	11	9	8	8	8	8	8	8	8	8	5	5	5	5	5
Germany	12	11	11	7	6	6	6	6	6	5	5	5	5	5	5	5	5	4	4	4	4	4
Greece	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Ireland	1	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	0	0	0	0	0
Italy	9	9	9	9	9	8	8	5	5	4	4	4	4	4	4	4	4	3	2	2	2	1
Netherlands	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Portugal	3	3	3	3	3	3	3	3	3	2	3	3	.	.	.	.	.	2	2	2	2	2
Spain	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Sweden	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
UK	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Czech Republ	.	8	9	2	8	7	7	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Hungary	.	5	5	5	3	3	3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Latvia	.	.	.	.	2	2	2	2	.	.	.	.	.	.	.	.	.	0	0	0	0	0
Lithuania	.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Poland	.	.	.	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	4	4	4	4
Slovakia	.	5	5	5	5	5	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slovenia	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	0	0	0	0	0
Bulgaria	.	.	.	.	.	6	6	6	7	6	6	6	6	6	6	6	6	2	2	2	2	2
Romania	.	.	.	.	.	.	.	.	6	6	6	6	6	6	6	6	6	4	4	4	3	3
Croatia	.	.	.	.	.	.	.	.	.	.	.	5	5	5	5	5	5	2	2	2	2	1
Switzerland	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Figure A.4: Companies data

Average sugar content of beets (in %)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	16,97	17,15	16,77	16,48	17,14	17,29	17,1	17,9	16,6	17,1	16,2	17,3	17,9	16,7	17,4	15,2	17	16,95	17,49	16,28	16,62	15,35
Belgium	16,94	16,81	16,84	17,23	18,14	17,07	17,3	16,7	17	17,8	18,6	17,1	17,8	18	17,7	17,2	18	18,08	15,78	14,27	14,81	15,68
Denmark	17,2	17,8	16,7	17,2	18,8	17,8	18,7	16,7	17,8	17,8	19,2	17,8	16,9	18,1	18,5	17,2	18,3	17,9	17,2	18	16,8	17,9
Finland	16,65	17,11	15,49	17,7	17,37	15,78	17	15,5	16,8	16,5	17,1	16,9	15,7	16,1	17,1	16,5	16,3	18,1	16,4	16,4	16,2	17
France	17,4	17,68	17,4	18,5	18,9	18,2	18,8	17,3	18,5	18,8	19,5	18,1	18,7	18,1	18	17,7	18,3	18,3	18	19	18,5	17,1
Germany	17,96	16,57	17	16,96	17,92	17,84	18	17,6	17,5	18	18,2	17,3	18	18,2	17,7	17,3	18	17,85	17,89	19	17,59	17,86
Greece	13,53	14,45	14,18	12,7	13,22	14,64	14	13,2	13,4	14	13,5	13,3	14,9	14,4	15,3	13,6	13,7	14	14,18	14	14	.
Ireland	16,41	16,75	16,29	17,43	16,5	16,75	16,7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	14,7	15,99	15,35	13,23	15,92	16,23	15	15,3	16,6	15,5	16	15	16,6	16,2	15,7	14	15	14,83	12,46	13,17	12,85	14,46
Netherlands	16	16,05	16,05	16,06	17,13	16,28	16,8	16,3	17,4	17,2	17,7	16,8	17	17,1	16,9	16,7	16,7	17,05	16,6	17,4	16,34	16,1
Portugal	15,43	16,54	16,67	16,37	16,19	16,05	16,3	16	16,1	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	16,81	17,14	17,47	17,17	16,39	17	17,2	16,8	17,6	17,8	17,3	17,7	18,2	18	17,5	17,2	17,5	17,27	17,52	17,02	17,34	17,55
Sweden	17,53	17,6	16,75	17,95	18,16	17,52	18,4	15,5	17,7	17,4	17,9	17,1	16,8	17,1	17,6	16,6	17,7	17,8	16,7	17,8	16,5	17,4
UK	17,16	17,1	17,16	17,37	18,74	17,39	17,2	16,7	18	17,3	18,4	16,9	18,4	17	17,5	17,2	17,3	17,3	17,81	17,86	16,85	16,01
Czech Republic	.	17,66	15,35	16,13	18,16	18,53	18,7	18,4	16,5	18	16,9	16,7	17,3	17	17,5	16,5	18,2	18,2	17,5	18,24	16,91	15,84
Hungary	.	16,12	15,67	15,53	15,56	15,87	15,9	16,8	15,8	17,1	16,6	15	17,1	16	16,3	14,6	15,25	15,8	16,74	15,04	15,74	15,63
Latvia	.	.	.	.	.	.	16	17,6	15,6	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	17,82	14,97	17,43	17,18	16,5	18,6	15,4	17,4	18,3	17,3	16,4	17,3	17,1	17,8	17,6	17,7	17,3	16,5	18,9	17,5	17,6
Poland	.	.	.	.	17,9	17,7	18,9	16,6	17,1	16,9	16,8	16,4	18	17,3	17,6	17,1	17,67	17,19	17,13	17,75	16,93	15,53
Slovakia	.	15,61	15,34	15,4	16,54	17,36	17	17	16	18	17	16	18,1	16	16,8	15,4	16,19	16,38	16,39	15,38	15,28	14,45
Slovenia	.	.	.	.	.	15	15,5	15,6	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	15	15,9	15,1	15	17,4	.	.	.	.	.	.	13,21	15,1	12,81	16,8	15,2
Croatia	.	.	.	.	.	.	.	.	.	.	.	14,8	16,2	15,6	14,9	15	14,5	15,98	16,75	14,77	14,61	15,92
Switzerland	16,8	17,5	17,5	17,6	16,7	17	17,5	16,4	17,8	17,3	18	18,5	18	16,9	17,6	17,6	18,9	17,6	17,9	17,3	16,4	16,6

Figure A.5: Sugar content data

Employment (during campaigns)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	1288	1241	1164	1110	1067	1049	1015	872	868	858	835	794	793	798	812	828	777	786	794	783	640	637
Belgium	1095	1084	989	970	970	970	810	776	963	767	646	658	713	665	655	664	657	515	602	559	615	621
Denmark	1282	939	903	905	873	821	763	687	644	635	627	600	572	551	552	527	491	480	456	446	426	417
Finland	47	192	185	156	192	196	489	451	320	275	297	260	282	278	304	295	272	281	276	256	251	234
France	10348	7443	8140	7963	9347	8606	8160	7683	7259	6531	6609	6645	6733	6743	6741	6682	6450	6219	6619	6536	6536	5746
Germany	7423	7031	7096	7033	6778	6721	6294	5783	5483	4813	4856	4408	4967	5070	5135	5266	5164	5277	5922	6025	5693	5647
Greece	2797	2843	2240	2177	2564	2553	2488	2263	1530	1593	1491	1350	1176	874	850	470	578	880	880	600	600	.
Ireland	707	650	.	650	650	650	325	325	325	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	8500	8000	7600	7100	4550	4700	5000	1700	1370	1320	1240	1240	1240	1240	1240	1100	1000	800	700	450	343	461
Netherlands	1629	1624	1560	1544	1492	1459	1180	1066	824	732	693	678	664	771	791	792	744	772	796	816	800	834
Portugal	654	271	268	294	283	285	246	240	173	150	156	.	.	.	.	.	.	.	.	.	.	.
Spain	4150	3858	3480	3400	3100	2900	2720	2190	1860	1700	1450	1490	1592	1700	1818	1722	1814	1715	1662	1541	1486	1709
Sweden	1192	1118	895	917	840	747	719	631	558	525	508	490	489	476	479	483	416	440	407	395	386	383
UK	2249	2211	1408	1299	1252	1264	1284	1252	1213	1000	1435	1247	1365	1296	1342	1122	730	580	1305	1368	1317	1321
Czech Republic	.	1436	1760	1645	1603	1281	1949	1842	1238	1230	1218	1214	1371	1485	1410	1423	1372	1332	1340	1340	970	1062
Hungary	.	1875	1843	1585	1412	1249	1101	1101	787	223	208	202	273	315	321	282	279	253	270	299	279	276
Latvia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	1933	1781	1702	1607	1443	1094	948	917	740	391	300	218	287	287	289	265	283	283	277	264	258
Poland	.	.	.	.	21948	14937	13532	10122	8522	5918	4848	5177	4857	5366	5244	5065	4682	4630	4827	4832	4626	4718
Slovakia	.	1266	1186	1105	1057	1129	980	710	550	550	304	312	435	430	450	450	492	495	498	498	495	484
Slovenia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	350	370	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	1780	1780	1780	1780	1200	1200	1200	1200	1200	1200	1200	1550	1400	1400	1000	1000
Croatia	.	.	.	.	.	.	.	.	.	.	.	1380	1135	1067	967	634	603	929	943	835	827	606
Switzerland	.	393	393	396	386	375	372	363	353	350	347	340	346	345	330	315	326	329	325	323	338	345

Figure A.6: Employment during campaigns data

Employment (between campaigns)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	616	600	595	572	573	563	568	564	467	475	450	424	438	470	468	507	493	471	482	501	470	475
Belgium	436	410	457	442	442	442	153	204	758	624	543	565	641	584	584	540	586	496	480	523	536	511
Denmark	1167	846	766	812	774	717	668	598	597	600	603	580	537	540	527	510	478	462	454	434	417	417
Finland	47	119	116	94	124	129	437	314	296	250	298	260	270	285	288	275	273	275	253	247	239	217
France	7266	4415	5264	5110	6664	6112	5781	5472	5129	4830	4774	4808	4906	4950	4969	4923	4688	4922	5029	5206	4987	4765
Germany	6460	6568	6364	6415	6162	5942	5939	5446	5179	4544	4491	4084	4578	4687	4713	4828	4792	4799	4921	4569	4480	4404
Greece	1177	1106	1197	1270	1169	936	866	742	630	603	603	450	278	284	270	250	222	216	216	216	216	.
Ireland	515	500	465	450	450	450	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	3150	3000	2800	2700	2300	2300	1800	800	586	445	440	440	440	440	440	300	300	300	320	280	260	274
Netherlands	1264	1167	1156	1134	1066	1048	878	802	678	620	621	615	604	779	767	701	692	658	717	717	731	732
Portugal	654	142	142	146	160	164	150	150	133	130	146	.	.	.	.	.	.	.	.	.	.	.
Spain	1985	1890	1781	1740	1700	1590	1520	1230	1225	1150	1100	1100	1066	1100	1110	855	879	833	1106	1082	1077	892
Sweden	948	902	774	763	714	662	620	500	466	440	426	415	431	407	410	399	381	380	360	350	351	339
UK	1660	1566	1025	970	959	1000	1000	930	998	1000	1113	1079	1188	1109	1166	1009	574	410	1140	1166	1137	1130
Czech Republ	.	.	1175	1197	1064	998	1219	1152	845	831	870	850	957	1045	1001	979	1020	952	952	952	783	812
Hungary	.	.	.	.	.	.	.	.	418	202	208	223	198	218	217	226	219	212	256	273	245	238
Latvia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	.	1197	1119	1036	976	797	725	664	580	338	295	179	234	241	237	239	239	239	231	226	226
Poland	.	.	.	.	11079	8991	7617	6530	5612	4049	3282	3561	3068	3447	3475	3410	3281	3429	3554	3610	3598	3620
Slovakia	.	.	746	.	.	645	735	512	300	300	260	260	280	280	300	300	330	330	353	348	351	349
Slovenia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	240	240	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	.	.	1230	1230	400	400	400	400	400	400	400	1150	1000	1000	800	800
Croatia	.	.	.	.	.	.	.	.	.	.	.	1001	849	818	741	400	398	673	676	635	632	489
Switzerland	.	332	317	322	326	314	309	300	282	277	272	269	271	265	265	255	250	245	241	240	252	242

Figure A.7: Employment between campaigns data

Number of operating factories

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Belgium	8	8	8	8	8	6	5	5	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Denmark	4	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Finland	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
France	37	35	34	34	32	30	30	30	30	25	25	25	25	25	25	25	25	25	25	25	25	21
Germany	32	31	30	28	27	26	25	24	20	20	20	20	20	20	20	20	20	20	20	20	20	18
Greece	5	5	5	5	5	5	5	5	3	3	3	3	3	3	3	3	3	2	2	1	1	0
Ireland	2	2	2	2	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	22	21	20	20	19	17	19	6	6	4	4	4	4	4	4	4	4	2	3	3	2	2
Netherlands	5	5	5	5	5	5	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Portugal	1	1	1	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	15	15	13	13	11	11	11	8	7	6	5	5	5	5	5	5	5	5	5	5	5	5
Sweden	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
UK	9	9	7	6	6	6	6	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Czech Republic	.	13	13	13	13	11	11	10	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Hungary	.	7	7	6	6	5	5	5	4	1	1	1	1	1	1	1	1	1	1	1	1	1
Latvia	.	.	.	.	2	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	4	4	4	4	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Poland	.	.	.	.	56	43	40	31	29	19	18	18	18	18	18	18	18	18	18	18	17	17
Slovakia	.	5	5	5	5	5	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Slovenia	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	5	5	5	4	4	4	4	4	4	4	4	4	4	3	3	3
Croatia	.	.	.	.	.	.	.	.	.	.	.	3	3	3	3	3	3	3	3	3	3	2
Switzerland	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Figure A.8: Factories data

Number of beet growers

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	.	.	10316	9936	9694	9472	9318	8915	8566	8281	8069	7818	7574	7486	7345	7184	6992	6659	6130	4989	4592	4073
Belgium	.	.	15170	14956	14734	14684	14301	13697	12996	8572	8342	8192	7994	7812	7611	7656	7515	7425	7194	7048	6707	6421
Denmark	.	.	6104	5814	5427	4609	4370	3790	2840	1870	1590	1510	1445	1406	1321	1268	1205	1130	1005	934	824	797
Finland	.	.	2707	2529	2349	2302	2170	2040	1510	1060	1010	930	875	750	757	812	781	703	695	600	588	600
France	.	.	30200	30000	30200	29800	29500	29130	31000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	23700
Germany	.	.	51995	50359	48183	46676	46676	42956	40125	34436	33256	32542	31319	31319	30663	30231	28509	28509	27142	26571	25832	23638
Greece	.	.	20944	19766	16443	13423	15532	10136	5458	5015	7165	4114	2133	3100	1875	2360	1431	1565	1919	1100	1100	.
Ireland	.	.	3736	3700	3700	3706	3700	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	.	.	70000	70000	46000	46645	40000	17000	13300	9201	9362	10909	7000	9500	9500	8200	8000	7000	5000	3254	3000	3012
Netherlands	.	.	18483	17206	16397	15241	14466	13894	12350	9430	9120	8890	8457	8284	8154	8130	8007	7781	7571	7438	7388	7161
Portugal	.	.	386	721	607	700	385	300	146	206	218	.	.	.	.	.	.	.	.	.	.	.
Spain	.	.	21500	21500	20000	20000	19000	16000	12700	9500	8900	8500	9722	7500	6800	6800	6550	6098	5241	4576	3736	2933
Sweden	.	.	4558	4435	4111	3917	3470	3170	2610	2370	2210	2150	2080	2012	1919	1873	1780	1644	1485	1331	1152	1094
UK	.	.	8466	7144	7072	6970	6646	6508	4876	4566	4202	4092	3681	3650	3583	3487	2995	2620	3031	3059	2802	2724
Czech Republic	.	.	1002	1087	1045	938	901	866	767	718	711	730	712	723	758	746	844	867	856	908	866	943
Hungary	.	.	1071	752	795	809	809	809	679	74	114	155	173	221	237	389	267	235	247	257	248	214
Latvia	.	.	.	.	.	418	386	386	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	.	3166	3056	2813	2470	1580	1510	1160	1000	636	593	602	402	381	371	361	353	353	249	218	171
Poland	.	.	.	.	83429	77963	72790	63722	60832	40988	39986	38208	35860	35861	35723	34591	34243	34071	34275	32978	30641	29307
Slovakia	.	.	517	470	472	412	387	355	225	152	180	187	186	197	194	213	207	195	205	206	218	214
Slovenia	.	.	.	.	.	2092	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	20	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	18483	13764	5462	1555	1463	1362	1177	1177	1177	1177	1177	863	923	907	697	588
Croatia	.	.	.	.	.	.	.	.	.	.	.	1363	1087	1148	990	867	490	766	906	833	586	508
Switzerland	.	.	7370	7197	7080	7253	7126	7017	6897	6749	6472	6153	6100	6006	5942	5851	5564	5321	5038	4799	4550	4470

Figure A.9: Growers data

Average length of the campaign (in days)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	95,3	74,2	77,1	82,8	67,7	76,2	78	99	102	120	122	119	136	130	138	176	122	142	119	93	76	88
Belgium	87	78	68	80	78	98	95	96	92	112	126	115	131	118	112	121	101	95	134	124	130	116
Denmark	95	101	101	108	96	97	89	112	120	115	118	112	138	136	118	123	82	104	113	98	111	125
Finland	87	78	82,6	84,4	71,2	79,5	83	66	89	64	77	73	88	58	68	81	56	57	60	50	70	58
France	80	82,5	73	85,3	76,5	86	86	88	91	92	103	102	112	104	104	113	98	100	134	116	116	94
Germany	90	89	81	92	83	95	87	81	98	102	131	128	144	124	104	129	92	102	131	105	121	115
Greece	71	98	96	112	65	70	95	67	42	47	82	56	21	88	55	71	46	53	63	60	50	.
Ireland	79	87	83	82	82	77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	78	68	64	90	55	60	104	81	70	70	74	84	65	70	50	90	56	92	90	73	82	91
Netherlands	.	90	83	85	89	85,3	104	98	93	128	140	126	129	120	120	130	99	109	150	120	130	126
Portugal	134	84	108	140	76	94	43	25	23	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	77	78	71	87	76	85	94	80	75	90	119	118	105	104	82	105	99	78	88	87	104	103
Sweden	100	93	106	107	96	88	89	123	122	114	133	109	129	126	124	138	73	117	117	105	141	146
UK	150	133	152	166	149	154	145	124	139	140	172	151	164	162	169	179	125	123	180	148	172	155
Czech Republic	.	73,3	101,1	103,5	90,3	94,3	87	72	83	86	93	94	114	111	102	130	108	117	122	115	106	121
Hungary	.	47,7	69,4	64,2	47,6	108	101	70	67	70	115	117	117	125	118	120	124	127	142	121	101	101
Latvia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	77	74	79	74	86	83	83	91	66	112	104	115	129	116	125	81	104	108	99	115	118
Poland	.	.	.	.	.	87	88	88	94	89	117	101	103	109	93	111	81	112	129	119	111	117
Slovakia	.	67	89	98	85	101	110	95	100	74	97	111	118	86	108	157	125	141	113	119	117	115
Slovenia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	24	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	.	.	70	70	75	95	119	119	.	.	.	98	88	80	81	87
Croatia	.	.	.	.	.	.	.	.	.	.	.	.	89	64	69	105	48	94	97	64	64	88
Switzerland	75	86	86	89	80	88	81	74	92	91	75	74	100	90	76	103	75	75	93	83	98	88

Figure A.10: Average length of the campaign data

Prices (in €/tonne)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Belgium	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	345	312	364	393
Denmark	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Finland	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
France	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	345	312	364	393
Germany	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	345	312	364	393
Greece	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Ireland	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	.	.	.	.
Italy	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Netherlands	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	345	312	364	393
Portugal	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Spain	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Sweden	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
UK	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	.	.	.	.
Czech Republic	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Hungary	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Latvia	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	.	.	.	.
Lithuania	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Poland	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Slovakia	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	352	329	380	395
Slovenia	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	.	.	.	.
Bulgaria	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Romania	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Croatia	.	.	.	.	.	.	.	633	623	596	545	480	562	711	700	538	419	446	411	386	380	452	466
Switzerland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Figure A.11: European prices data

Total sugar production (in tonnes)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	501102	411203	423410	432871	386213	458137	488932	407590	365404	410587	381233	443627	546928	469024	479328	403247	402985	475241	470841	309577	294309	307278
Belgium	1091175	941529	839589	1018833	1028626	990585	925266	855562	875021	724644	843158	689185	880660	761533	777074	815695	740009	729058	971175	827166	807084	739893
Denmark	552244	533143	478623	515831	492000	472000	475000	375000	380000	397000	444976	453395	519003	480366	462000	476000	311000	400000	397000	351000	359000	423000
Finland	166725	153580	146148	162657	136000	148000	179000	130000	101000	69000	88000	80675	94235	140460	73800	138228	120208	137953	64000	53000	75000	67000
France	4803031	4494681	3896800	4696703	3933397	4143348	4140243	4150093	4445299	4069629	4460400	4225287	4774869	4222847	4544275	4576512	4295763	4132626	6237000	5092000	4957000	3445000
Germany	4400798	4383432	3723241	4023350	3779442	4334165	4040625	3262168	3905768	3654836	4232290	3469277	4266670	4006872	3428298	4491076	2942281	3566206	5161378	4191148	4235932	4102787
Greece	231722	367586	314337	295586	204909	259500	310340	169524	78388	100382	171787	142182	159278	158126	160199	195032	156899	221421	36514	8424	9687	.
Ireland	215831	218862	207487	223745	209000	213178	205160	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	1705212	1551755	1283577	1409055	899938	1158163	1804422	657110	670327	498233	508842	554530	506523	546362	501200	676652	480398	377838	305000	216244	194136	240110
Netherlands	1118000	1059906	953460	1022840	1074964	1033952	976148	871950	888808	860763	991807	870536	998368	968459	947676	1144121	788639	872156	1325501	1102476	1099278	1089000
Portugal	75393	56133	54883	77211	59650	74367	37239	25000	14154	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	1097000	1097000	942000	1198000	913750	1057000	1083000	1031000	711000	608000	549741	527497	612813	531845	448855	578146	552207	468244	520817	390384	423611	356220
Sweden	430462	412146	401965	432856	416000	371000	406000	313000	354000	327000	403000	315429	416860	365869	377700	382000	257764	336000	307000	279000	288000	316000
UK	1547679	1325486	1222980	1430035	1368400	1390026	1340862	1157427	1049244	1150000	1308056	994791	1314558	1143849	1323519	1446549	977780	897064	1363548	1144212	1188848	905536
Czech Republic	.	432200	498904	544336	517041	558418	558879	470488	353902	414673	478818	458876	615440	565462	539166	596415	455877	592656	636002	572797	509057	506324
Hungary	.	268238	425229	341192	252211	499432	490836	348840	220856	66315	125114	120500	121880	111959	115649	129889	128834	158250	142000	104383	98333	84572
Latvia	.	.	.	.	.	66505	71019	43442	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	126644	108623	138371	102000	104000	92000	77000	98000	43000	113089	92450	152403	190253	109271	182284	128018	163229	162320	147085	166922	166134
Poland	.	.	.	.	1945474	2001411	2053975	1706798	1919481	1389071	1646225	1465670	1910567	1803332	1773016	2041224	1460371	2043891	2313542	2188097	2065979	1983823
Slovakia	.	128790	176191	183692	164932	233004	263767	205407	125935	101846	162040	140649	233207	228698	172628	213266	200189	221315	179451	170538	159717	161137
Slovenia	.	.	.	.	.	35250	46920	43442	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	2105	28000	.	198788	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	72040	119070	80339	111479	146212	123664	145848	258621	261658	218983	176884	137222	179327	107491	138167	115564
Croatia	.	.	.	.	.	.	.	.	.	.	.	234550	240185	142119	192880	359891	119576	324422	229143	119487	107037	125897
Switzerland	176865	218511	164578	221865	185372	218954	216546	178904	248670	248922	275274	215120	290589	247582	217155	305100	233600	213000	267000	219000	240000	234000

Figure A.12: Sugar production data

Prodution quotas (in tonnes)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	390410,00	390410,00	387326,40	387326,40	387326,40	387326,40	387326,40	387326,40	405812,40	351027,40	351027,40	351027,40	351027,40	351027,40	351027,40	351027,40	351027,40	351027,40	.	.	.	.
Belgium	826000,00	826000,00	819811,60	819811,60	819811,60	819811,60	819811,60	819812,00	862077,00	676235,00	676235,00	676235,00	676235,00	676235,00	676235,00	676235,00	676235,00	676235,00	.	.	.	.
Denmark	424629,30	424629,30	420745,50	420745,50	420745,50	420745,50	420745,50	420746,00	420746,00	372383,00	372383,00	372383,00	372383,00	372383,00	372383,00	372383,00	372383,00	372383,00	.	.	.	.
Finland	146776,00	146776,00	146086,70	146086,70	146086,70	146086,70	146086,70	146087,00	90000,00	80999,00	80999,00	80999,00	80999,00	80999,00	80999,00	80999,00	80999,00	80999,00	.	.	.	.
France	3801832,80	3801832,80	3768991,40	3768991,40	3768991,40	3768991,40	3768991,40	3768992,00	4120686,40	3437031,20	3437031,20	3437031,20	3437031,20	3437031,20	3437031,20	3437031,20	3437031,20	3437031,20	.	.	.	.
Germany	2602312,90	2602312,90	3416895,50	3416895,50	3416895,50	3416895,50	3416895,50	3416896,00	3655455,50	2898255,70	2898255,70	2898255,70	2898255,70	2898255,70	2898255,70	2898255,70	2898255,70	2898255,70	.	.	.	.
Greece	319000,00	319000,00	317501,80	317501,80	317501,80	317501,80	317501,80	317502,00	158702,00	158702,00	158702,00	158702,00	158702,00	158702,00	158702,00	158702,00	158702,00	158702,00	.	.	.	.
Ireland	200200,00	200200,00	199259,70	199259,70	199259,70	199259,70	199259,70	199260,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	.	.	.	.
Italy	1568250,00	1568250,00	1557443,20	1557443,20	1557443,20	1557443,20	1557443,20	1557443,20	753845,50	508379,00	508379,00	508379,00	508379,00	508379,00	508379,00	508379,00	508379,00	508379,00	.	.	.	.
Netherlands	872000,00	872000,00	864559,50	864559,50	864559,50	864559,50	864559,50	864560,00	876560,00	804888,00	804888,00	804888,00	804888,00	804888,00	804888,00	804888,00	804888,00	804888,00	.	.	.	.
Portugal	80000,00	80000,00	79671,20	79671,20	79671,20	79671,20	79671,20	79671,00	24953,00	9953,00	9953,00	9953,00	9953,00	9953,00	9953,00	9953,00	9953,00	9953,00	.	.	.	.
Spain	1000000,00	1000000,00	996960,90	996960,90	996960,90	996960,90	996960,90	996961,00	887163,70	630586,20	498480,20	498480,20	498480,20	498480,20	498480,20	498480,20	498480,20	498480,20	.	.	.	.
Sweden	370000,00	370000,00	368262,20	368262,20	368262,20	368262,20	368262,20	368262,00	325700,00	293186,00	293186,00	293186,00	293186,00	293186,00	293186,00	293186,00	293186,00	293186,00	.	.	.	.
UK	1144000,00	1144000,00	1138626,90	1138626,90	1138626,90	1138626,90	1138626,90	1138627,00	1221474,00	1056474,00	1056474,00	1056474,00	1056474,00	1056474,00	1056474,00	1056474,00	1056474,00	1056474,00	.	.	.	.
Czech Republic	.	.	.	.	.	.	454862,00	454862,00	367937,80	372459,30	372459,30	372459,30	372459,30	372459,30	372459,30	372459,30	372459,30	372459,30	.	.	.	.
Hungary	.	.	.	.	.	.	401684,00	401684,00	298591,00	105420,00	105420,00	105420,00	105420,00	105420,00	105420,00	105420,00	105420,00	105420,00	.	.	.	.
Latvia	.	.	.	.	.	.	66505,00	66505,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	.	.	.	.
Lithuania	.	.	.	.	.	.	103010,00	103010,00	103010,00	90252,00	90252,00	90252,00	90252,00	90252,00	90252,00	90252,00	90252,00	90252,00	.	.	.	.
Poland	.	.	.	.	.	.	1671926,00	1671926,00	1772477,00	1405608,10	1405608,10	1405608,10	1405608,10	1405608,10	1405608,10	1405608,10	1405608,10	1405608,10	.	.	.	.
Slovakia	.	.	.	.	.	.	207432,00	207432,00	140031,00	112319,50	112319,50	112319,50	112319,50	112319,50	112319,50	112319,50	112319,50	112319,50	.	.	.	.
Slovenia	.	.	.	.	.	.	52973,00	52973,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	.	.	.	.
Bulgaria	.	.	.	.	.	.	.	.	4752,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	.	.	.	.
Romania	.	.	.	.	.	.	.	.	109164,00	104688,80	104688,80	104688,80	104688,80	104688,80	104688,80	104688,80	104688,80	104688,80	.	.	.	.
Croatia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192877,00	192877,00	192877,00	192877,00	.	.	.	.
Switzerland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Figure A.13: Quotas levels data

International price for white sugar (in €/tonne)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
World	.	195,5384	204,5379	147,8242	135,5927	131,7426	177,6125	256,3285	159,3105	181,917	285,4878	368,6489	428,5489	368,4587	289,7474	271,3481	260,5797	361,475	307,8636	228,8674	243,0965	249,0811	334,0529

Figure A.14: World prices data

Average sugar yield (in tonnes per hectare)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	10,78	9,6	9,5	10,3	8,9	10,2	11,1	10,3	8,4	13,4	8,7	9,9	11,7	9,4	9,4	8	8,8	12	10,99	9,91	10,55	11,53
Belgium	10,42	9,97	8,73	10,38	11,12	11,05	10,7	9,9	10,3	12	13,2	11,5	13,4	12,6	12,6	13,6	13,8	11,5	15	12,99	13,77	12,95
Denmark	.	.	8,43	9,26	9,8	9,7	10,1	9	9,7	10,9	11,7	11,6	13	12,3	12,3	13,4	12,5	12,2	11,54	10,32	12,25	12,66
Finland	4,88	4,7	4,55	5,27	4,7	4,9	5,8	5,5	6,3	5,1	5,8	5,5	6,6	6,2	6,2	6,7	4,8	6,12	6,1	5,2	7,08	5,93
France	10,83	11,73	9,43	11,47	10,89	11,91	12,1	11,8	12,6	13	13,9	12,4	13,2	12,6	12,6	13,7	11,5	12,58	14,08	12,07	12,6	9,3
Germany	8,96	9,62	8,24	8,8	8,5	9,9	9,6	9,1	10	10	11,6	9,6	10,7	10,9	10,9	13,2	11,6	11,89	13,51	10,74	11,38	11,7
Greece	5,92	7,35	7,45	7,22	5,2	7,9	7,4	6,3	5,7	7,2	4,4	7,4	6,6	6,9	6,9	7,2	5,1	6,07	5,87	6,48	6,05	.
Ireland	6,49	6,78	6,68	8,3	7,8	6,88	6,6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Italy	6,1	6,23	5,77	5,73	4,2	6,23	7,1	7,1	7,8	8,1	8,2	8,8	11,1	12,3	12,3	13	7,3	7,8	8,03	6,28	6,48	8,81
Netherlands	9,66	9,77	9,08	9,63	10,8	10,8	11,7	10,8	10,8	11,9	13,7	12,4	13,7	13,2	13,2	15,1	13,5	13,06	15,38	12,78	13,61	13,09
Portugal	7,9	7,25	8,5	9	8,48	9,79	11,7	11,6	8,6	.	.	.	.	.	.	.	.	.	.	.	.	.
Spain	8,25	8,44	8,71	10,44	9	10,3	10,6	9,9	11,8	11,9	11,7	11,2	13,6	12,8	12,8	14,9	15,5	14,36	14,27	11,61	13,32	13,39
Sweden	7,3	7,39	7,36	8,01	8,4	7,8	8,4	7,2	8,9	8,9	10,4	8,5	10	10,7	10,7	11,3	10,3	11,16	9,94	9,15	10,83	10,9
UK	10,28	9,08	8,22	9,68	10,08	10,44	10,7	10,8	9,8	11,3	12,6	9,6	13,2	12,4	12,4	14	13,2	12,7	14,41	11,76	13,45	9,83
Czech Republic		7,08	6,41	6,9	6,69	8,1	8,9	8,4	8	9,4	9,3	8,8	10,4	9,7	9,7	11,1	10,1	11,32	10,94	8,66	8,4	8,14
Hungary	.	4,92	6,29	6,15	5,25	7,73	8,4	7,6	6,1	10,2	9,2	8,1	8,8	7,4	7,4	8,4	7,2	10,5	9,17	7,68	8,65	7,2
Latvia	.	.	.	.	.	4,9	5,2	5,2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithuania	.	4,62	4,1	4,74	5,1	5,4	5,3	5,4	7,4	6,1	7,3	6,8	8,2	10	10	10,6	8,8	10,4	10,68	9,08	11,28	11,15
Poland	.	.	.	.	6,5	6,8	7,4	7,1	8,9	7,9	8,6	7,5	9,7	9,6	9,6	10,3	8,5	10,06	9,98	9,14	8,58	7,88
Slovakia	.	4,21	5,57	6,07	5,22	6,81	8,2	7,5	6,7	9,2	10,2	8,3	13,2	8,6	8,6	9,5	8	10,2	7,96	7,77	7,17	7,51
Slovenia	.	.	.	.	.	5,78	9,3	6,2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulgaria	.	.	.	.	.	.	1,9	3,2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romania	.	.	.	.	.	.	3,8	4,1	3,6	5,5	7,3	5,3	7,8	5,7	5,7	7,1	6	6,4	6,77	4,98	6,15	4,99
Croatia	.	.	.	.	.	.	.	.	.	.	.	7,2	8,5	7,4	7,4	9,9	6,9	11	10,25	7,2	7,65	10,5
Switzerland	10	12,1	9,25	12,09	10,5	11,6	11,7	9,5	11,7	12	13,2	11,9	15	10,6	10,6	14,1	11,3	10,3	12,98	10,25	11,74	11,05

Figure A.15: Average sugar yields data

Top 5 sugar producing countries within EU

Ranking	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1.	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France	France
2.	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany	Germany
3.	Italy	Italy	Italy	Italy	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland
4.	UK	UK	UK	UK	UK	UK	Italy	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	Netherlands
5.	Netherlands	Spain	Netherlands	Spain	Netherlands	Italy	UK	Spain	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Netherlands	Belgium

Figure A.16: Top 5 producing countries in EU

Variables	(1) Poisson	(2) Poisson	(3) OLS	(4) OLS
globalisation	0	0	0	853.0604
	(omitted)	(omitted)	(omitted)	(538.0672)
shock	.0319222 ***	.0286918 ***	-.0557026	-98.87074
	(.0100501)	(.0089751)	(.1176556)	(632.0098)
α (constant)	8.496895	8.531325	8.528584	4136.531
	(.0112084)	(.099368)	(.1326629)	(468.3906)
Observations	159	208	208	159
Number of countries	20	19	19	20
R-squared	0.9926	0.9907	0.9880	0.9934
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table A.1: Estimation of the direct effect of the 2017 reform on the number of growers
(1), (3) = Effect on EU28 (except Croatia) for 2010-2020 period, (2), (4) = Effect on EU28 for 2013-2020 period
(1), (2) = Equation 6.12, (3), (4) = Equation 6.10

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