



**LUND UNIVERSITY**  
School of Economics and Management

## **Sugar subsidies in the European Union – Mechanisms and Effects**

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## **Abstract**

For various political and economic reasons European sugar farmers and producers have received large subsidies from the EU. The goal of this thesis is to analyze these sugar subsidies and their effect on world market prices and production level in the EU, using statistical data from the mid 1980's and onward. The analysis encompasses the mechanisms and consequences of EU sugar subsidies with a particular emphasis on the world market price of sugar and domestic EU sugar production.

Because the so called ACP countries have a special trade preference, their exports of sugar to EU will also have effects on the world market price. These are reviewed as well. Alleged fixed costs in the EU sugar industry, implying scale economies, are also checked for.

Evidence of a negative correlation between export subsidies and the world price are found. There is also a correlation between production subsidies and production volume, especially when measuring subsidies as a percentage of costs. EU imports from ACP's show virtually no correlation with the world market price, although the correlation is, as expected, negative. Some evidence of scale economies in the EU sugar industry has also been found.

Keywords: ACP, EU, Subsidies, sugar reform, CAP, CMO, Sugar

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## **Abbreviations**

<b>ACP</b>	<b>group of African, Caribbean and Pacific countries</b>
<b>ATC</b>	<b>Average Total Cost</b>
<b>CAP</b>	<b>Common Agricultural Policy</b>
<b>CAPRI</b>	<b>Common Agricultural Policy Regional Impact analysis</b>
<b>CMO</b>	<b>Common Market Organization of sugar</b>
<b>CSE</b>	<b>Consumer Support Estimate</b>
<b>EBA</b>	<b>Everything But Arms</b>
<b>EU</b>	<b>European Union</b>
<b>EUR</b>	<b>Euro</b>
<b>FAO</b>	<b>Food and Agricultural Organization of the UN</b>
<b>EAGF</b>	<b>Farmers European Agricultural Guarantee Fund</b>
<b>MC</b>	<b>Marginal Cost</b>
<b>LDC</b>	<b>Least Developed Countries</b>
<b>OLS</b>	<b>Ordinary Least Squares method</b>
<b>USD</b>	<b>US Dollars</b>
<b>WTO</b>	<b>World Trade Organization</b>

## **1. Introduction**

*In this short introduction the purpose of this thesis will be explained. Its structure and order will be outlined with a problem formulation containing the basic ideas to be tested and evaluated. In a brief passage, the history of European sugar trade is connected to today's economic policies. The product, sugar, is also described chemically for the benefit not only of curiosity but of comparisons between different sugar technologies and trade with different kinds of sugar across and within industries and countries. A historical background to EU sugar trade ends the chapter.*

### **1.1 Purpose of the study**

The main purpose of this thesis is to see if sugar production in the EU and the world market price of this commodity are affected by subsidies and preferential trade on that same market. Many different measures of these kinds of trade distortions will be tried and evaluated.

The economic framework regulating the subsidies is the Common Agricultural Policy (CAP) which will thus also be studied. This regulation contains special trade agreements with the group of African, Caribbean and Pacific group of states (called ACP's in the text). Their influence on the sugar market will also be analyzed. Finally, the sugar market will be studied on an industry level to see if overproduction of sugar can be explained in this way.

### **1.2 Thesis structure**

In this first chapter the problem of the thesis is precisely defined and placed in a historical context. The product, sugar, is also more clearly defined. Chapter 2 describes the political and legal framework of agricultural subsidies, with an emphasis on the sugar market. Chapter 3 presents the necessary trade and micro theory for the statistical analysis. In chapter 4 all data sources and their formats are presented. Chapter 5 contains the statistical analysis relating back to the theory from chapter 3 against the background of chapter 2. Chapter 6 sums up the results of chapter 5 mean both in terms of policy implications and its scientific value.

### **1.3 Problem definition**

How does sugar production vary with production subsidies? Variations in sugar production in the EU is analysed with two independent variables, each used separately. The first one is a price support level (also called intervention price, explained further in chapter 2 and 3) set up by the

EC (European Commission) to maintain high producer prices. This variable is policy dependent and rarely changes. The second is a bit more accurate, comprised by the relation between the intervention price and actual price by the producers.

How is the world market price of sugar affected by EU market regulations? Sugar subsidies are used not only to increase production, but to dump surplus sugar not met by domestic demand on the world market. Variations in the world market price of sugar are analysed by two types of predicting variables. Firstly, a monthly measure of export subsidies and secondly, a yearly data on aggregate consumer spending on sugar subsidies. Finally, the third predicting variable is imports from the ACP's, whose volumes are so great that they may affect world market price. Production in excess of the subsidised quotas are given is also investigated. This is related to the alleged scale economy of the EU sugar industry. This will be investigated by searching for fixed costs in labor and land input factors in sugar production. Also, excess production will be tested for correlation with the world market price. Standard OLS regression analysis is used to test for linearity.

#### **1.4 Delimitations**

Many more variables could have both been amended to predict more accurately the effects of subsidies on the sugar market, but for the sake of simplicity the only predictions made are about EU sugar production and the world market price of the product. The consequences for imports and exports are left out. Domestic consumption as a factor in production and trade is not considered. Although mentioned, dead weight loss, distortion of income distribution and terms of trade, due to subsidies are also excluded from statistical computations.

The ACP's play a major role in EU sugar trade, but their own production levels or net gain following changes in the EU subsidy program are not analysed. The issue of tariffs, that accompany subsidies to prohibit imports, is also ignored. Other countries, about to gain full access to EU sugar market under the Everything But Arms (EBA) agreement, will affect trade, but this is also excluded from treatment in this thesis.

As for the test for scale economies, the investigation is not very sophisticated, as costs are not measured in money, but the sizes of two production factors. Access to real costs would allow for analysis with a profit function.



## **1.5 Literature overview**

Vast research has been conducted on the economics of agriculture in the EU. It is particularly interesting since the EU is the producer with the most protected sugar production in terms of subsidies [Johansson et al, 2006: p 10].

Much of the research using quantitative analysis has used the CAPRI (Common Agricultural Policy Regional Impact) analysis, which is actually software doing much of the work. This may be used to estimate optimal agricultural production through mathematical programming. Because it is a very complex method, economists often do not describe the methods in detail, but rather rely on the fact that it is widely accepted as an instrument for estimating changes in the agricultural economy. One example is the policy reform assessment by *Johansson et al (2006)* who compare a status-quo situation with estimations of economic changes drawing on a reform of the sugar regulation introduced in 2006. More explicit mathematical studies have been done, for instance by *Alexander Gohin and Jean-Christophe Bureau (2006)* who focus on individual firm profit maximization, to estimate the effects of subsidies on the sugar market. The studied variables with this approach have been EU sugar production volume and net gain (loss) in case of subsidy removal.

The *Swedish Competition Authority (2002)* discusses the geographical and technical preconditions for the sugar production in the EU against the background of the political economy of heavy subsidies.

Poonyth et al (1999) and Hoekman & Howse (2007) analyze the issue of out of quota production (no longer receiving subsidies because of the volume). The former is mainly an econometrical study, whereas the later is both an economic and legal analysis.

## **1.6 What is sugar and who produces it?**

Sugar, the commodity whose production and trade is studied in this thesis, is chemically known as sucrose. It is derived primarily from sugar cane, sugar beet and corn, although this thesis will only deal with the first two.

Sugar beet is an important plant cultivated largely by developed countries, accounting for roughly two thirds of all sugar exports [Johansson, et al: 2006: p 3]. Beet sugar factories generally produce white sugar directly from the raw beets delivered from farms. The period of operation of the factories, is determined by the harvest season for beet and the length of time over which beet can be stored before being processed. These periods are determined in part by climactic conditions, ranging between 60 and 120 days between EU countries. [Tate and Lyle PLC & Ferruzzi Finanziaria SpA & S & W Berisford PLC, 1987: p 3]. Even though refined sugar can be both granulated brown sugar and white sugar, it is assumed to be identical to white sugar since most figures go under this description.

Sugar cane is a type of grass that grows in tropical and subtropical climate [Johansson, et al, 2006: p 8]. After harvest it yields raw sugar, containing many impurities compared to refined sugar from beet. It needs further processing. Europe has raw sugar refineries for both import and its very insignificant production of cane sugar. However it is not feasible to produce sugar from beet at cane refineries [Tate and Lyle PLC and Ferruzzi Finanziaria SpA and S & W Berisford PLC, 1987: p 3]. Once refined, it consists of 99.9 percent sucrose, identical to beet sugar. It constitutes about 70 percent of total world production with beet covering the rest [Swedish Competition Authority, 2002: p 9]. A large portion of the imports of raw sugar is from the ACP countries. These are subject to preferential trade as a compensation for the EU's lowering of the world market price.

Another type of sugar is molasses, a bi-product of little significance. Here it is ignored, either excluded or absorbed by the accounting of other types of sugar.

## **2. The economic and political framework of EU sugar subsidies**

*This chapter begins with a historical introduction to EU and world sugar trade and production. Following this, the politics behind the sugar market regulation in the EU, the CAP, is analyzed. Unfolding the history of farm policies coming into action will account for irregularities over time as the political framework of the EU sugar market is described. This will proactively expose factors distorting the theory presented in chapter 3. Policy changes introduced but not yet fully employed (or have yet to be accounted for with available statistics) are also described for further treatment and predictions in chapter 6.*

### **2.1 The history and Politics of sugar trade**

The European sugar policy dates back more than 300 years to a colonial era when taxation of the lucrative sugar trade was used to generate state revenue [Andreosso-O'Callaghan, 2003: p 140]. From this time India exported sugar cane to meet European demand, but it was not until the 1970's that the situation reversed. Europe, one of the biggest importers of sugar in the world, turned into a net exporter [Oxfam, 2002: p 4]. Since then, sugar has remained one of the most regulated agricultural products in the world. The EU has applied large subsidies and prohibitive tariffs to protect its market, keeping the price double that of the world market for the last twenty years (Johansson et al, 2006: p 3).

There are not many farmers in modern economies - in the United States, agriculture employs only about 2 percent of the work force [Krugman & Obstfeldt, 2003: p 232]. The figure, although still small, is significantly larger in the European Union, around 4.5 percent [Andreosso-O'Callaghan, 2003: p 15]. Farmers are, however, usually a well-organized and politically effective group, which has been able in many cases to achieve very high rates of effective protection. In the EU's agricultural legal-economic framework CAP, export subsidies mean that a number of agricultural products sell at two or three times world prices [Krugman & Obstfeldt, 2003: p 232].

The subject of the European Union's sugar subsidies has been a subject of much debate, both within and outside the EU. Lobbyists argue that they are necessary for Europe's food safety and wellbeing. African spokespeople for farmers as well as non-African NGO's argue that they are

unfair and often economically detrimental to the sugar industry outside the EU. Non-EU producers experience lost revenues following lower world price than they can endure [Oxfam, 2002 and Krugman & Obstfeldt, 2009: p 194]. European farmers are paid enough to be able to undercut countries with better natural comparative advantage. The EU can therefore be seen as protectionist [Oxfam, 2002: p 4]. Interestingly it is exactly this high price that has, to a great extent, borne the sugar industry of the ACP countries, as they have had access to the high intervention prices within the EU ever since United Kingdom became a part of the EU (then ‘European Community’) in 1973 [Johansson et al, 2006: p 15]

## **2.2 The CAP – Market mechanisms on the EU sugar market**

The market regulation for sugar, still remaining today, was first outlined in CAP in 1968. Its purpose is partly to guarantee farm producers a minimum price, thereby supporting their income, and partly to guarantee domestic demand is being met. Another purpose is to stabilize a fluctuating world market price [Johansson et al, 2006: p 11]. The high unpredictability of supply, due to weather conditions and to biological developments is what can make intervention desirable [Andresso-O’Callaghan, 2003: p 66].

The CAP is composed of several instruments. Although they have changed form as of the Sugar Reform of 2006 the concept remains the same.

Production quotas are applied. This means that all sugar production in the EU is subject to a maximum level. Production outside this quota is not eligible for subsidies and support [SJV, 2000: p 107]. The main two quotas subject to subsidies are divided into A and B, where A is for domestic consumption and B is for exports [Johansson et al, 2006: p 12]. Surplus production, known as the quota C, may be exported by means of a subsidy. Export subsidies are granted at price per quantity and decided as a on a weekly or monthly basis depending on the volume of the exports [SJV, 2000: p 111].

Prices are regulated by an administration. These are a means to keep intervention price of the final product, refined sugar, at the desired level. They encompass intermediate products and services such as transport costs for sugar beet to refineries, adjustments for revenues from

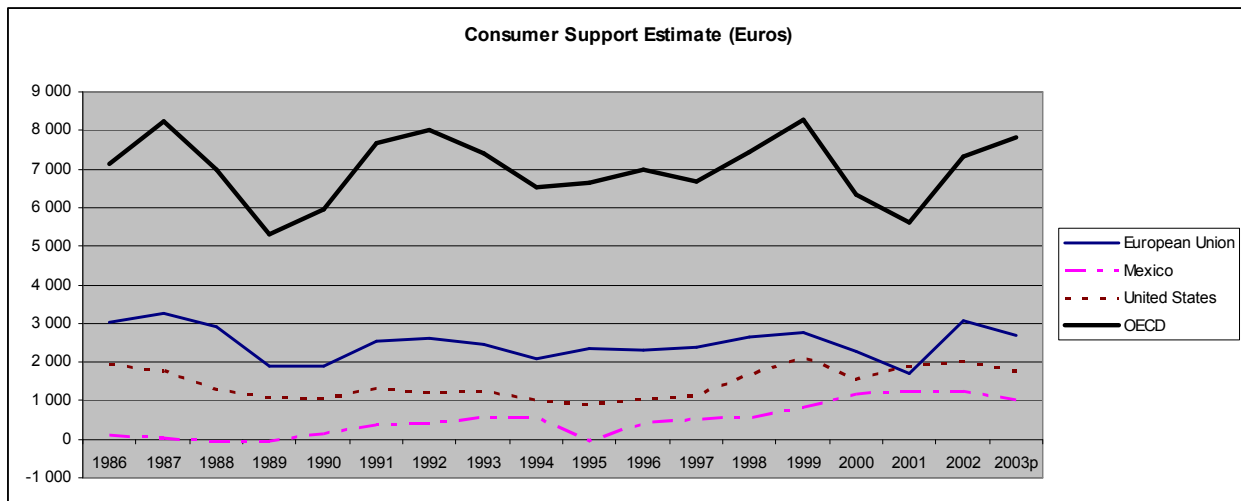
molasses and refining margin. In order to create a more smooth supply of sugar there is a compensation for a minimum volume of stock at manufacturers and industries using sugar [SJV, 2000: p 109].

The chemical industry has the right to production subsidies for manufacturing that requires sugar [SJV, 2000: 110].

The EU applies import levies to prevent competition from foreign low cost producers. Special, so called preferential imports are excluded from these levies, however. The ones looked at in this thesis, which constitute the biggest and most important group of countries, are the ACP's [Johansson et al, 2006: p 15]. Such imports are excluded from import levies, even though they are subject to a quota [SJV, 2000: p 111].

Using the homogeneous measure Consumer Support Estimate (CSE), constructed by the OECD, it is possible to compare EU market distortions at consumer expense with other major producers (allowing the size to be measured by subsidy endowments and not production volume). These are presented in figure 2A. (For further explanation of the CSE measure see chapter 4).

**Figure 2A (source: OECD, PSE/CSE database 2004)**



Two things are evident. Firstly, the EU is a major player in the OECD region as far as subsidy expenditure goes. About half of the payments on the OECD sugar market take place under the

EU budget. Secondly, the ratio between curves describing EU and total OECD payments seems all but constant over the years.

The CMO (Common Market association of) Sugar, a specific sugar clause, regulated within the CAP was put in place in 1967. Apart from the rest of the CAP, it has remained intact to most reforms [Swedish Competition Authority, 2002: p 7]. However some actions have been taken to reform the agricultural policies of the EU. The *MacSharry reform* of 1992 involved cuts in the price of sugar and the transformation of all import quotas and levies into ad-valorem tariffs [Andreosso-O'Callaghan, 2003: p 119]. In the agreement *Agenda 2000* outlined in 1999 increased competitiveness among European farms were encouraged directing it more in line with market forces [Andreosso-O'Callaghan, p 127]. There is also the CAP reform of 2003, wherein EU farm ministers adopted a reform package that indicates a further shift towards decoupling of farm payments from production, directly to farms. From January 2005, the majority of subsidies will be paid as single farm payments (SFPs) based upon area rather than production, with the intention of stimulating more market-oriented farming [Todd 2004: p 4].

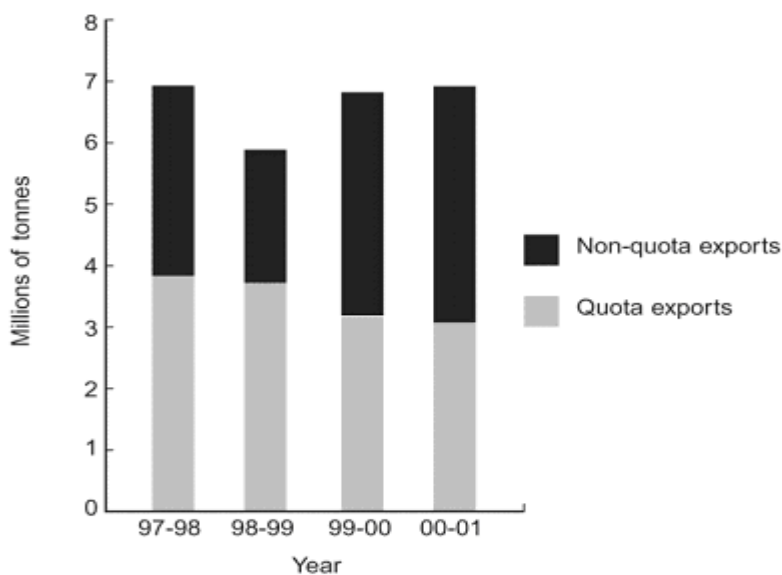
The EU has been under increasing pressure from low cost and efficient sugar producers for distorting world sugar trade. Australia, Brazil, and Thailand launched action in a WTO lawsuit against the EU Sugar Regime in July 2003. These countries have claimed that EU exporters of “C sugar” (exports not subsidised by export refunds) are able to export this sugar at prices below their production cost due to the cross-subsidy from the main A and B quota sugar with a high domestic price. Moreover, EU preferential imports of sugar from the ACP countries are re-exported with the help of export subsidies. On September 2004, a ruling was made that “C sugar” exports are in contravention of the EU commitments on the amount of subsidised sugar exports allowed under the WTO. The WTO panel suggested that the EU should consider measures to bring its production of sugar more in line with its domestic consumption while fully respecting its international commitments with respect to the existing sugar imports from developing countries. Even though the EU made an appeal on this ruling at the WTO, this ruling was upheld by the appellate body of the WTO on April 2005 [Kerkelä, Leena & Huan-Niemi, Ellen, 2005: p 5].

Since protection for the EU agricultural sector acts as a deterrent to imports from third countries and tends to depress world prices, the benefits accruing to the EU producers are earned at the expense of producers in other nations [Andreosso-O’Callaghan, 2003: p 111]. It has also been contended that the main pressure against the CAP has come mainly from the United States arguing that Europe’s export subsidies drive down the price of their exports [Krugman, 2003: p 199].

Before the very recent sugar reform, the period which this thesis mainly concerns, the EU has had sugar regulations dividing refined sugar product into three categories: A, B and C sugar (shown in figure 3.12a). The sum of A and B quotas determines the maximum amount of sugar that may be sold in the EC market in a given year. A is for domestic consumption, and B is exported by means of export subsidies. All excess production must be exported at world market price. Production of A and B sugar benefits from the high intervention price in the EU. Excess production by an EU producer over and above its B-quotas does not benefit from the high intervention price. Such excess output is called C-sugar (or more generally ‘out of quota’-Sugar). There is no physical difference between these types; it is merely an issue of fiscal finances [Hoekman & Howse, 2005: p 5].

As illustrated in figure 2B between the years 1997/98 and 2000/01 quota exports were reduced in the EU, while out-of-quota exports actually increased.

**Fig 2B – Quota and non quota exports in the EU (source: Oxfam, 2002: p 10)**



Since C-sugar is the only quota that has no pre-determined size and hence may vary, it is important to ask why it has taken place. One cannot model the EU supply as a function of marginal cost only. It is necessary to investigate the interaction further, between the supply of C-sugar and the level of the rent drawn from the production of in-quota sugar [Gohin & Bureau, 2006: p 28].

Since harvests in the EU area are known to be uneven [JSV 2006: p 129], one explanation for the C-sugar production at low prices is that some producers grow C sugar beet as an insurance strategy against revenues foregone when there are poor harvests. Over planting of beet ensures that if harvests are bad they will still be able to fully satisfy their contracts and capture all the rents that in-quota sugar offers [Hoekman & Howse, 2007: p 5].

A widely held view is also that cross subsidization, mentioned before, has occurred. This idea rests on the notion that the industry exhibits fixed costs. These can be paid for by a higher marginal revenue on A and B quotas and then help finance a relatively lower per unit marginal cost C-quota production. This was the central idea in the WTO panel outcome that EU exports above the B quota should be considered subsidised [Gohin & Bureau, 2006: p 229].

This is probably the most politically controversial of the factors of C-sugar production. Hence this variable will be tested for in chapter 6. Industry specific properties relating to fixed costs will be outlined in chapter 3.

A complementary explanation is that the world market price of sugar affects the incentives for out of quota C-sugar production. If the price outside the world market is high, more sugar will be exported and less if it is low [Gohin & Bureau, 2006: p 227].

### **2.3 The ACP's and and preferential trade**

As mentioned previously, the ACP countries enjoy access to EU:s high sugar price in terms of being able to sell their own at that price. The origin of this arrangement is the 1951 Commonwealth Sugar Agreement granting the former British colonies preferential access to the British and Canadian market. When Great Britain became an EU member in 1973 one of the



consequences was that its former colonies would be granted preferential access to the EU sugar market. The sugar protocol became effective in 1975 and opened the EU's market for these countries [Johansson et al, 2006: p 15].

Presented in table 2A table below are the countries who have signed this protocol.

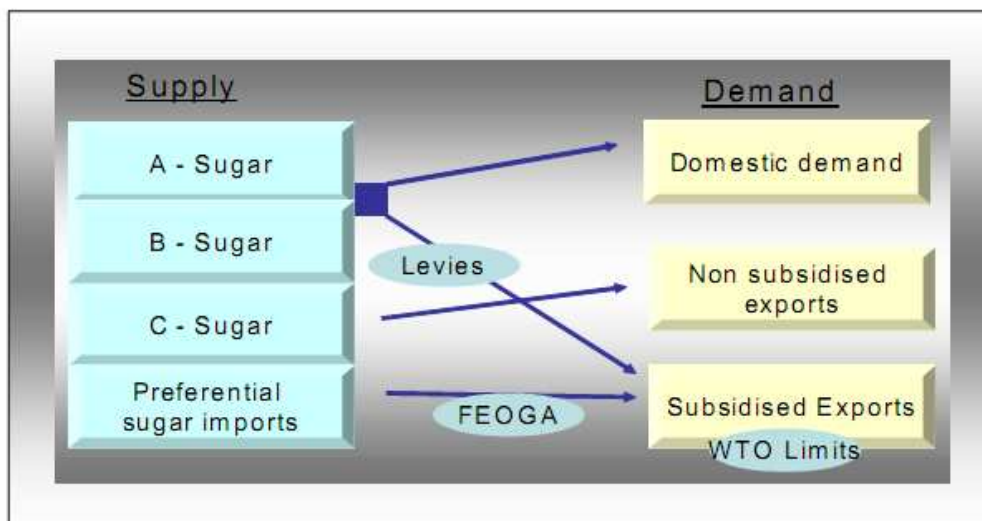
**Table 2A (source: Johansson et al, 2006: p 15)**

<b>Barbados</b>	<b>Kenya</b>	<b>St. Kitts and Nevis</b>
<b>Belize</b>	<b>Congo DRC</b>	<b>Swaziland</b>
<b>Côte d'Ivoire</b>	<b>Madagascar</b>	<b>Tanzania</b>
<b>Fiji</b>	<b>Malawi</b>	<b>Trinidad and Tobago</b>
<b>Guyana</b>	<b>Mauritius</b>	<b>Zambia</b>
<b>Jamaica</b>	<b>Mozambique</b>	<b>Zimbabwe</b>

One of EU's commitments in the Uruguay Round stipulates that sugar imported from ACP's are not to be included in limits on export subsidies. They are free to be exported by means of these [Johansson et al, 2006: p 18].

The chart in figure 2C sums up the EU trade flows for the different quotas: A sugar is for domestic consumption. B-sugar is exported by means of export subsidies. C-sugar is exported without subsidies. Preferential sugar imports are re-exported with export subsidies on top of the B-quota.

**Figure 2C – EU sugar subsidies (source: Gohin, Alexandre & Bureau, Jean-Christophe, 2006: p 25)**



## 2.4 The Sugar reform of 2006

The EU council reached an agreement in November 2005 to reform the CMO regulation of the sugar market. The new rules apply up to the year 2015, but are expected to last. The main action is to reduce the intervention price by 36% over 4 years, for both preferential imported raw sugar and refined sugar from beet.

The table below describes the changes in intervention price that come with the sugar reform. (The prices vary between EU and ACP in absolute figures because the ACP's produce raw sugar as their final product and the EU produces refined sugar). The guaranteed price to producers is lowered considerably between 2006/07 and 2009/10.

**Table 2B – EU and ACP sugar intervention prices (source: Dürr & Pons, 2006: p 12)**

Year	Price (euro/tonne)	
	EU Producers	ACP Producers
Pre reform	631,9	523,7
2006/07	505,5	496,8
2007/08	458,1	394,9
2008/09	410,7	372,9
2009/10	404,4	319,5

Following the reform, A and B sugar will be merged into one quota accounted as one post and export subsidies are no longer allowed. The production quota in the EU will be 17.4 tonnes [Johansson et al, 2006: p 21]. The term C-sugar is replaced by out of quota-sugar [SJV, 2006: p 122]. The EC has regretted these changes but pledged to commit to them [Europa – Gateway to the European Union, 2005]. As of October 2008 no export subsidies are allowed in the EU [personal correspondence with Patrick Eklöf, 2009-01-13, Swedish Agricultural Board, Jönköping]. Otherwise the structure of the sugar regulation remains, but now incorporates more direct farm payments, which are not supposed to be market distorting [Johansson et al, 2006: p 21].

Various means of compensation to sugar farmers (direct farm payments, restructuring funds, etc) will be deployed following the execution of the sugar reform of 2006, but these will not be accounted for in this thesis, as their effects are too abstract and unpredictable at this time to make

any real conjecture about the evolution of the EU sugar industry. However, accounting for the fiscal expenses, it is worth noting that a 64.2% compensation to farmers estimated revenue loss will be made [Johansson et al, 2006: p 21].

Another important part of the sugar reform of 2006 is that ACP imports of raw sugar may no longer be discounted to world market price upon re-export, burdening the EU fiscal budget [Johansson, et al, 2006: p 19]. Previously these export subsidies were allowed and even discounted from the B-sugar quota [Ibid, p 18].

### **3. Theory and expectations**

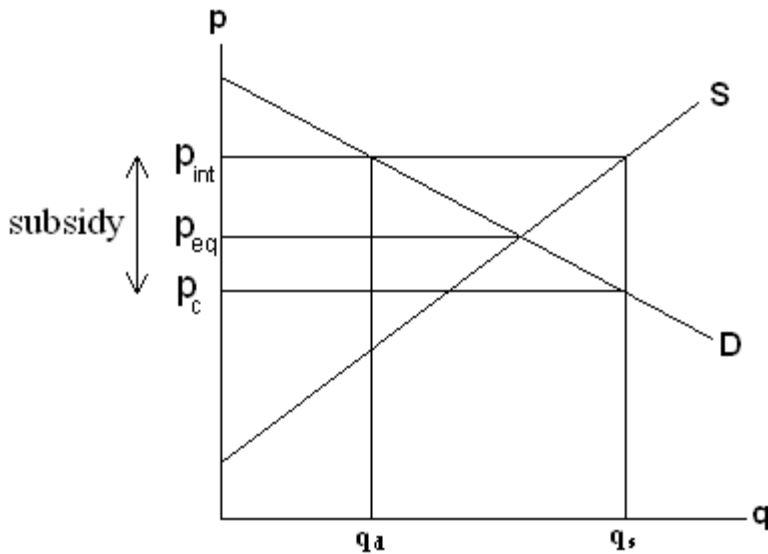
*This chapter sketches the necessary economic theory needed to analyze the mechanisms and effects of the CAP expenditures, described in the previous chapter, in and outside the EU. It covers the theory behind price control, ad-valorem production subsidies and export subsidies. Because the world market price of sugar is affected by so many things, it is given a special in depth treatment. The connection between EU-ACP preferential trade and re-exports by means of export subsidies is also briefly treated. Finally the EU sugar economy is analyzed on an industry level to see if the accusations of scale economies hold.*

#### **3.1 Production subsidies**

##### **3.11 The micro economics of Price control**

A price control subsidy is synonymous with what in the previous chapter was called intervention price. Suppose that the price of a product is fixed above its equilibrium price  $p_{eq}$  up to the intervention price,  $p_{int}$ , to ensure a minimum income for the producers. Figure 3A on the next page describes the situation.

Figure 3A – Price support (source: Axelsson et al, 1998: p 181)



Increasing price from  $p_{eq}$  to  $p_{int}$ , consumers now demand only quantity  $q_d$ , but producers want to produce at  $q_s$ . There is a surplus production of the quantity  $q_s - q_d$ . The gross cost of the subsidy endowment is hard to attain, hidden in the total revenue for producers,  $S = p_{int} * q_s$  [Axelsson et al, 1998: p 180].

The surplus will have to either be stocked, moving the problem only ahead one accounted year, or rather to be exported by means of other subsidies [Axelsson et al, 1998: p 181]. Only the later is assumed in this thesis, analysed further in 3.2.

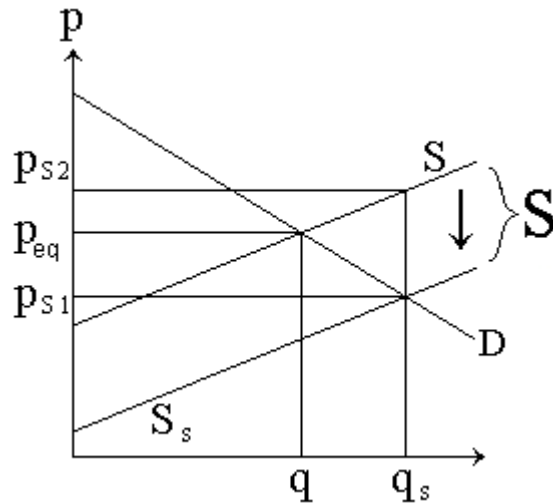
Figure 3A also clearly shows that the relationship between the intervention price,  $p_{int}$ , and quantity produced,  $q_s$ , is positive and linear, as it represents different points on the subsidy curve. Because producers have been largely insulated from world market signals for decades, there is little statistical variability to exploit in the intervention price variable. Estimates of supply elasticity and production costs often rely on weak evidence [Gohin & Bureau, 2006: p 224].

### 3.12 The microeconomics of a per unit subsidy

To amend the problem of little variability in the intervention price variable presented in 3.11, a per unit subsidy is introduced. It contains more information about the difference between supply and costs at a given quantity. It is completely equivalent to an ad-valorem subsidy (which is the second variable predicting production volume in this thesis), the later being given in percentage of the per unit price rather than a specific amount.

The subsidy increases the perceived price by the producer. Such a subsidy will lower the individual sellers MC (marginal cost) curve, and hence the entire MC curve (assuming perfect competition), that is the supply curve, of the market [Axelsson et al, 1998: p 179-180]. Figure 3B below illustrates the change in market equilibrium as the subsidy is introduced.

**Figure 3B – The effects of an ad valorem subsidy**



By imposing a per unit production subsidy,  $s$ , on a good, the producers will perceive its selling price as higher, shifting the supply curve from  $S$  to  $S_s$ . They will then aim to produce more, raising output quantity from  $q$  to  $q_s$ . The price for consumers, determined by  $S_s$ , will be  $p_{s1}$  and quantity  $q_s$ . The entire production subsidy endowment on the market is thus  $S = s * q_s$  [Axelsson et al, 1998: p 180].

Because the variations in the impact of the subsidy are sought, an ad-valorem subsidy is thought to capture them better than a per unit subsidy. The logic is that if a per unit subsidy may be 100 Euros, the unit may cost 50 Euros or it may cost 500 Euros. A percentage format on the other hand, will capture that difference, as both intervention price and costs change disproportionately over time. It is defined as  $S_{AV} = P_{int} / MC$

This variable will incorporate some producer costs and costs are likely to effect output and may vary over certain years where intervention price does not.

The ad-valorem subsidy predictor is therefore expected to perform better than intervention price when testing for correlation with production in chapter 6.

### **3.13 Sugar production subsidies in the EU**

Whereas the target price is the upper limit or optimum price that should be attained on every market on a daily basis, the CAP allows prices to oscillate slightly within an interval. The lower bound of this interval, explained in theory in the previous section, is known as the *intervention price*. Target prices are used as a basis for determining at which price level the intervention takes place [Andreosso-O'Callaghan, 2003: p 95], but intervention price is still used as the EU domestic reference price level in this thesis.

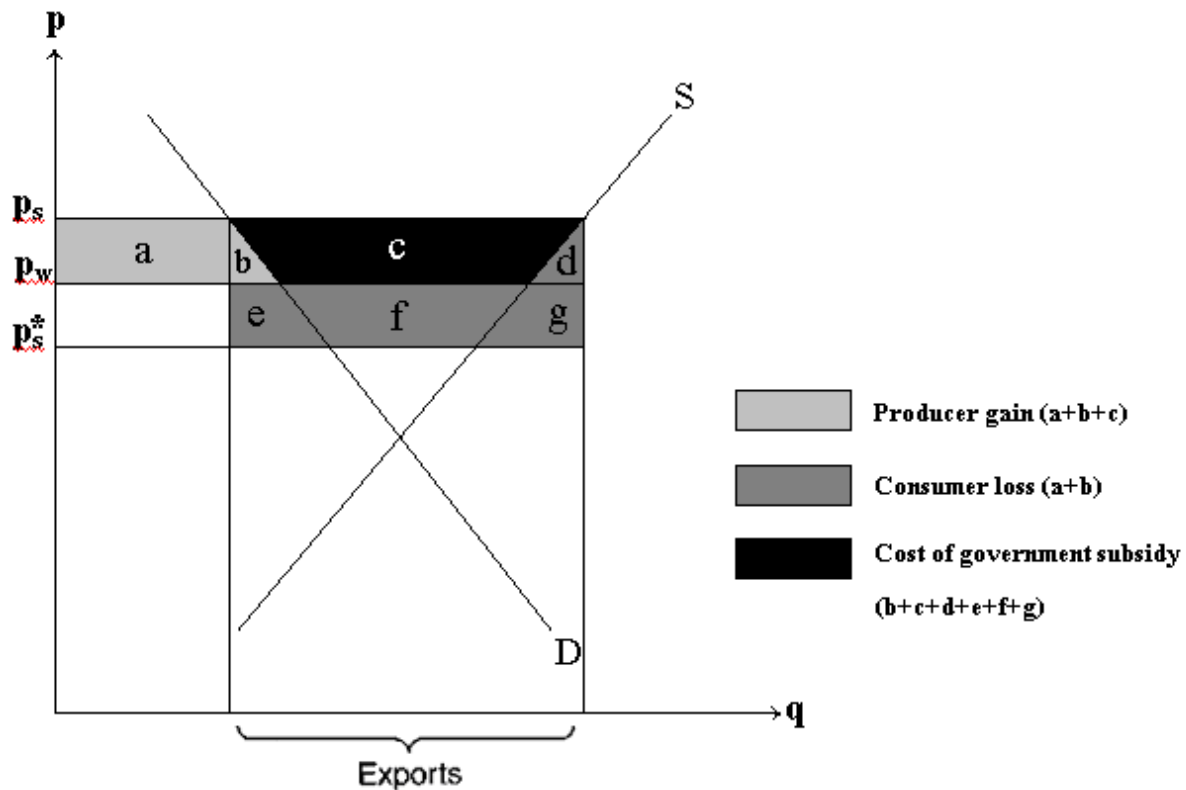
In the EU, and in the case of the CAP, agricultural prices are fixed not only above world market levels but above the price that would clear the European market, making export subsidies necessary to dispose of the resulting surplus [Krugman & Obstfeld, 2003: p 199] which is analyzed next in section 4.2.

## **3.2 Export subsidies**

### **3.21 The trade theory behind Export subsidies**

An export subsidy is a payment to a firm that ships a good abroad. It can be either specific (a fixed sum per unit) or ad-valorem (a proportion of the value exported). When the government offers an export subsidy, producers will export the good up to the point where the domestic price exceeds the foreign price by the amount of the subsidy [Krugman & Obstfeldt, 2003: p 197]. Figure 3D below illustrates the mechanisms of the export subsidy.

Figure 3D – Export subsidies (source: Krugman & Obstfeldt, 2003: p 198)

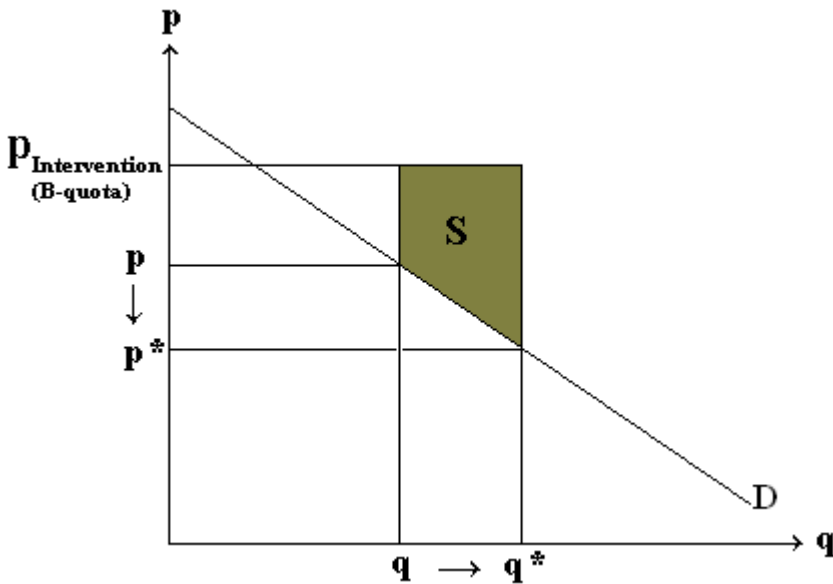


The price in the exporting country rises from  $P_w$  to  $P_s$ , but because the price in the importing country falls from  $P_w$  to  $P_s^*$ , the price rise is less than the subsidy. In the exporting country, consumers lose, producers gain, and the government loses the money spent on the subsidy. The consumer loss is the area  $a+b$ ; the producer gain is the area  $a+b+c$ ; the government subsidy is the amount of exports times the amount of the subsidy,  $b+c+d+e+f+g$ . The net welfare loss is therefore  $b+d+e+f+g$ . Of these,  $b$  and  $d$  represent consumption and production distortion losses of the same kind that a tariff produces. In contrast to a tariff, the export subsidy worsens the terms of trade by lowering the price of the export in the foreign market from  $P_w$  to  $P_s^*$ . This leads to the additional terms of trade loss  $e+f+g$ , equal to  $P_w - P_s^*$  times the quantity exported with the subsidy. An export subsidy therefore unambiguously leads to costs that exceed its benefits [Krugman & Obstfeldt, 2003: p 197].

Figure 3E below describes how the surplus sugar is being dumped on the world market. The price is being reduced from  $p$  to  $p^*$  by means of  $(q^* - q)$  quantities of sugar against world demand,  $D$ . The curve in the figure, which is actually not linear, but stair case shaped, represents all the buy-

orders on the international sugar exchange market. Each tonne of sugar sold needs an export subsidy amount of the intervention price,  $p_{int}$ , minus the current price on the world demand curve  $p^*$ . The sums of each sell cancelling out a buy-order, are represented by the integral of size  $S$ , which in turn amounts to the export subsidy, reinforcing the idea that when testing for in chapter 5, that there is a negative linear correlation between export subsidies and world market price.

**Figure 3E – EU sugar being dumped on the world market (source: author’s illustration)**



Making the model more complex, figure 3E also shows that although there is a negative correlation between export subsidies and the world market price, the latter also affects the size of the EU export subsidy endowment. A lower world market price is going to make it more expensive for the EU to dump the surplus sugar created by production subsidies, onto the world market. Hence export subsidies boost the cost of further export subsidies (that are now more expensive) [Krugman & Obstfeldt, 2009: p 194]. In figure 3E this effect is represented by the area  $(p - p^*) \cdot (q^* - q) / 2$ . But simplifying, and assuming small export quantities (and corresponding subsidies) this effect may be ignored, and the subsidy can be estimated by  $S = (q^* - q) \cdot (p_{int} - p^*)$ . The subsidy rate, given in Euros per tonne (just like a price), can then be described by  $S / (q^* - q) = p_{int} - p^*$ . The intervention price,  $p_{int}$ , is considered a constant, as it does not vary within years and often remains static for many years at a time. Hence it does not affect

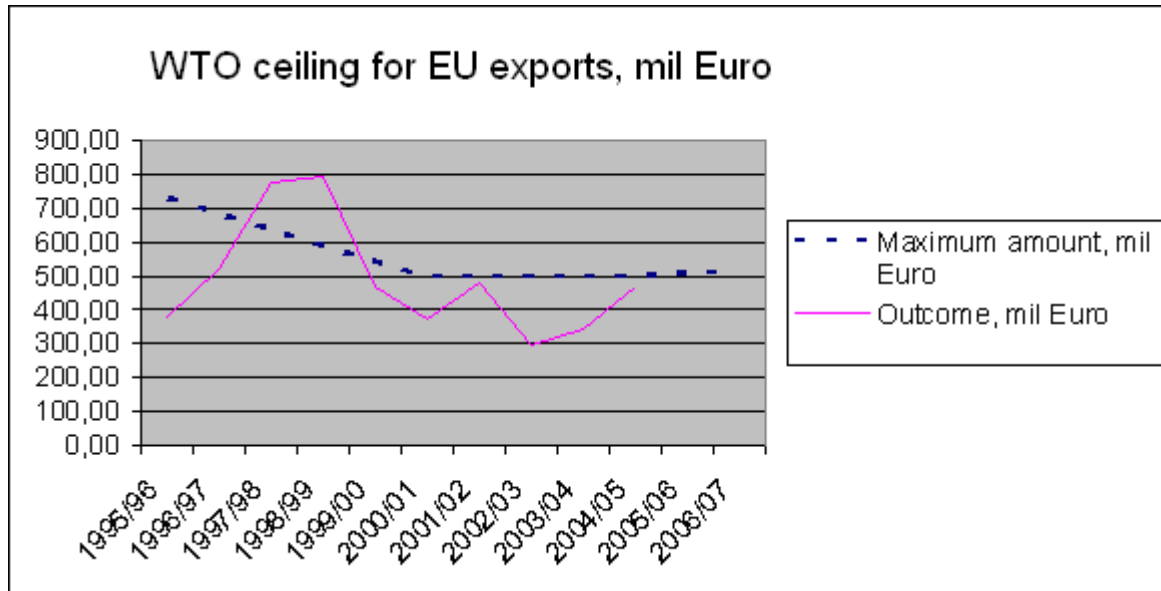


the linearity of this relationship. Finally, since  $p^*$  has a negative sign there is obviously a negative linear correlation between the export subsidy rate and the world market price  $p^*$ .

### 3.22 Export subsidies in the EU

The greatest cost, budget wise, for the CMO has been the export subsidies [Johansson et al, 2006: p 14]. The EU has regulations guarding the amount of export subsidies allowed per year. The Figure below demonstrates these over the time period 1995/06 – 2006/07.

Figure 3F – WTO Subsidy regulations and payments for the EU (source: SJV, 2008: p 128)



As Figure 3F illustrates, there has been some fluctuation in the outcome of export subsidies. It is also evident that there has been a violation of the maximum allowed amount, which is seen in the years 1997/98 – 1998/99.

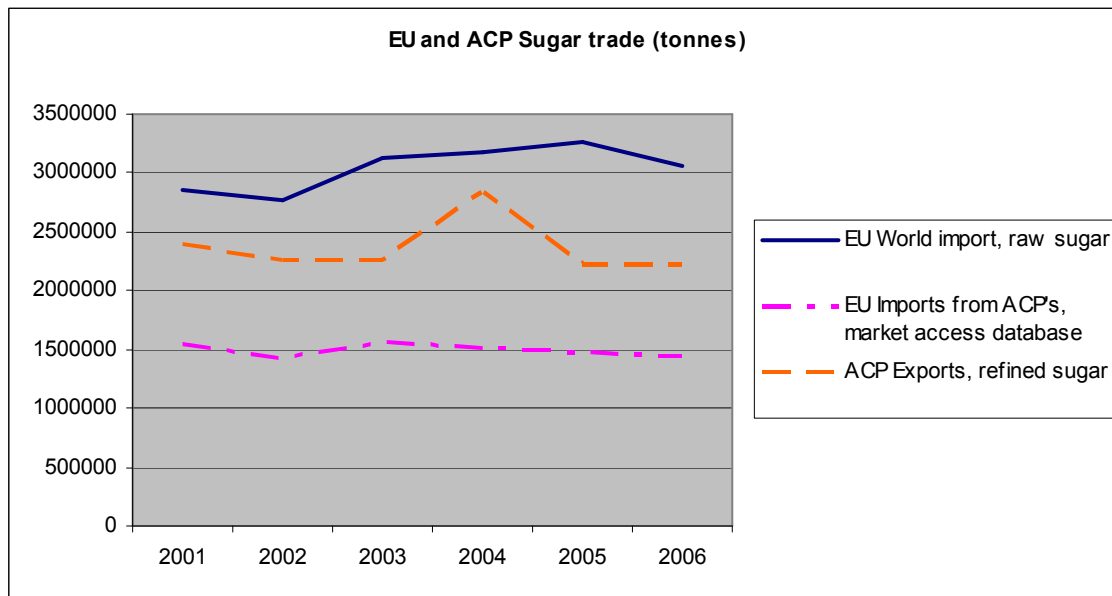
In the EU, export subsidies for refined sugar have a special arrangement with the producers. They may each bid for export subsidies (eur/100kg) to the commission, who makes a decision about the rate. All bids equal to or below the decision are accepted. These decisions occur on both

weekly and monthly basis depending on the size of the export. For this thesis only monthly figures were accessible.

### 3.23 EU-ACP Trade

The extent of preferential trade between the ACP's and the EU is quite vast. Figure 3G below illustrates the trade flows.

Figure 3G (source: FAO and Eurostat)



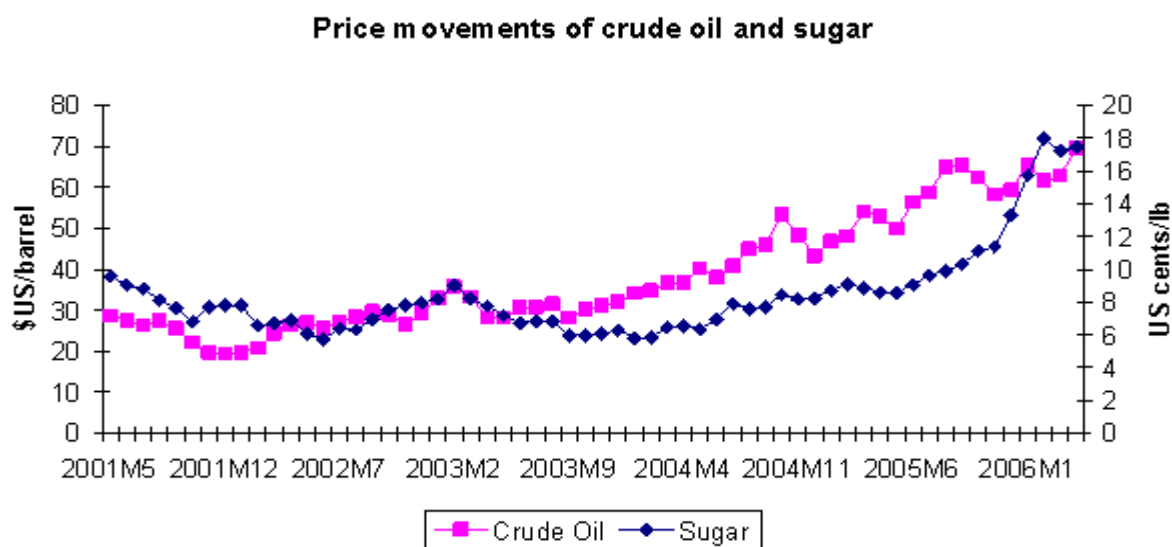
As described in detail in chapter 2, ACP imported sugar may be re-exported out of the EU by means of export subsidies. Favourable preferential imports are thus expected to have the same effect on the world price of sugar as does B-quota production due to production subsidies. It is therefore expected that there be a negative linear correlation between ACP imports (also implicitly total ACP exports) and the world market price. The correlation is not expected to be very strong, though. The factors to upset it are the same as those in the case of the EU export subsidy in all, but the ACP imported raw sugar comprises only a portion of the entire refined sugar output.

### 3.3 World market price of sugar

It might be useful to take a look at other determining factors for the price of sugar on the world market, since subsidies alone are expected to yield far from a perfect correlation.

One very important determinant is the demand for ethanol as on the biofuel market. This in turn makes it a competitor to oil. The effect of oil prices on production costs actually much stronger than that on increased demand for bio fuel related commodities, because the world share of bioenergy in transport fuel consumption and the present production of bio fuel is rather limited (OECD, 2006). The best example of bioenergy is sugar. There is a strong co movement between crude oil and sugar prices. Results have showed that this relationship is much stronger than the price links between other seemingly unrelated commodities (FAO website). Figure 4H plots prices for the two.

**Figure 3H (source: FAO website)**



The strong correlation between sugar and crude oil prices is attributable to the strong link between ethanol and sugar production in Brazil, the world's largest sugar producer and exporter. The growing number of Brazilian vehicles which run on any combination of gasoline and ethanol directly influences the demand for ethanol [FAO website, 2009].

There are also extra-EU producers, applying subsidies to their sugar production and hence distorting the world market price. Another major producer, by subsidy measures is the United States [OECD Website]. Since the same effects of their production subsidies are assumed, it along with the total of subsidy payments for all OECD countries will be competing to explain the world market price. These are expected to distort the linearity between the world market price and EU subsidies alone.

Another distorting factor is the issue of supply response, meaning the response to changes in EU sugar production, from for example Brazil and LDC's. These are sufficient to affect world market price as well [Gohin & Bureau, 2006: 226].

### **3.4 Producer costs and scale economies**

It is known that production costs vary substantially [Swedish Competition Authority, 2002: p 56], which acts to cause asymmetries in the production functions. One explanation for this is that producers in regions with favourable climate and soil conditions can earn additional profits from the difference between intervention price and actual costs which are lower for them [Swedish Competition Authority, 2002: p 57].

After beet has been harvested its sugar content decreases over time [Swedish Competition Authority, 2002: p 46]. They are not regarded as tradable in their natural state, nor can they be stored. [Ibid: p 48]. For this reason sugar processing plants are always located near the best beet growing regions, to reduce transport costs and to minimize the loss of yield from the beet [Ibid: p 46]. In order to minimize fixed costs a firm prefers few and large plants. For the sugar industry, the optimal plant size has been constantly increasing. Factors contributing to this development are increased harvests through fertilization and mechanization, and also lower transport costs [Swedish Competition Authority, 2002: p 50].

It is argued by the OECD (1998) that the sugar producers in many cases have a very strong bargaining position vis-à-vis the individual beet grower. Because of the transport costs involved in beet transport and the economics of scale in processing, many beet growers have only one buyer of their product [Swedish Competition Authority, 2002: p 58]. This creates preconditions for monopsony in the processing industry. Because of the geographical preconditions mentioned above, a monopolistic structure on the sugar market is possible. Digging further into this, recent history has shown that the number of independent firms is falling as a result of mergers between sugar producing firms. Many firms are also part of the same business group, increasing concentration further [ibid, p 52].

Complete information for all of the EU has not been available in this thesis, but the indication in the UK, as an example, is that the largest figures accounted as fixed costs are labor and rents [DEFRA website]. These two variables will be used to investigate if scale economies stemming from fixed costs is measurable in the EU sugar industry.

As explained in chapter 2 and 3, one of the alleged economic mechanisms in the CAP is that of cross subsidisation, resulting in production of out of quota C-sugar. To test for this, the proposed industrial structure of fixed costs will be studied.

If it can be showed that the EU sugar industry exhibits decreasing average total costs, thereby being a scale economy, the charges of cross subsidization can be justified.

Unfortunately costs have not been accessible in Euros in this thesis. For the EU sugar industry the only measures available in cost or input terms are land and labor. These are considered important production factors that will represent firms' costs well.

For the average total cost function we use the definition

$$ATC(Q) = TC/Q \quad [\text{Axelsson et al, 1998: 105}]$$

Where the function  $TC(Q)$  will be derived from OLS analysis in chapter 6. Applying different  $Q$  for  $ATC(Q)$ , comparing in and out of quota sugar production, will show how much average total costs are actually reduced from over production.

As a complement to this test, and as mentioned in chapter 3, C-sugar production is suggested to vary with world market price, as it is sold at this price and not the intervention price. This theory will be tested for. The expectations are that there is a positive linear relationship between C-sugar production volume and world market, price described by

$$Q_C(p_w) = p_w * x + m.$$

## 4. Method and data

*This chapter presents the data being used for analysis in this thesis. Important aspects of these data are how they are being used, resources and their credibility and the format they are presented and used in.*

The statistics used in this thesis has been hard to attain. Access to systematic and complete statistics in detail on EU subsidies seems nonexistent. One explanation is lack of bureaucratic transparency. The website [farmsubsidy.org](http://farmsubsidy.org) gathers statistics continuously on this matter and still only three countries have complete information available, namely Denmark, Sweden and soon the United Kingdom. A newly passed EU law actually stops countries from being obligated to report these subsidy endowments [personal correspondence with Jack Thurston, co-founder of [farmsubsidy.org](http://farmsubsidy.org)].

This thesis is thus often at the mercy of aggregate EU statistics. The variations are then comprised by the timeline over which the data is available.

The term *producers* in this thesis will encompass the both beet growers and the refining industry as they both benefit from the subsidising of the final product, refined sugar. Thus the distribution of profits between them and from intermediate beet or cane farmers is ignored.

### 4.1 Statistical methods used

A partially simplifying assumption is that all relationships investigated in this thesis are linear. (Some correlations have been algebraically shown to be linear). To obtain the linear curve describing such a relation,  $y = a + bx$ , regression analysis is used. The OLS method, using measure values  $(x_i, y_i)$ , is applied. The formulas for these parameters are well known in statistics:

$$a = \bar{y} - b\bar{x} \quad b = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \quad [\text{Körner \& Wahlgren, 2000: p 328}]$$

where the slope  $y = ax + b$  is calculated through actual observation values  $x_i, y_i$  and the mean-values  $\bar{x}, \bar{y}$ .

To test for correlation the r-square value is used, derived from

$$R^2 = 1 - \frac{SSR}{TSS} = 1 - \frac{\sum (\hat{y}_i - \bar{y})^2}{\sum (y_i - \bar{y})^2} \text{ [Körner \& Wahlgren, 2000: p 101]}$$

where  $y_i$  is actual value,  $\hat{y}_i$  is expected value from the slope and  $\bar{y}$  is the mean.

F and t-values are computed by  $t^2 = F = \frac{MSR}{MSE}$  [Körner & Wahlgren, 2000: p 357] from which a p-value can be calculated. P values at 0.01 and below describe a significant correlation.

Significance tests for correlations in this thesis will be on the 1% level, meaning that at least one coefficient is significantly greater or smaller than zero [].

#### **4.2 Data resources and format**

There are two types of sugar on the world commodity exchanges, raw and refined. Although they are not entirely interchangeable their prices are very proportional as would be expected, with raw sugar being somewhat cheaper. Statistical analysis showed that the two are well correlated, exhibiting a Pearson Correlation of  $\rho = 0,933$  (two tailed), meaning that correlation is significant on the 0,01-level (this is also showed in the results of the regression analysis in chapter 6). The point is that while absolute values will be misleading if the two are mixed up, a linear regression will not be upset.

In much of the statistics, annual figures are not accounted by the calendar year Jan 1 – Dec 31 to employ arithmetic means, but rather June/July-format. Such figures are generalized and compared to each other without notice.

All prices and payments in this thesis are nominal. While this may not be optimal, it is not thought to be of any great concern, since values are seldom cross compared between years.

#### 4.21 Production subsidies

Two different kinds of variables for production subsidies are tested for (although not simultaneously) when predicting production volume, the intervention price and the ad-valorem subsidy.

The data source is *Producer and Consumer Estimate OECD Database* website and are all given annually in euros per tonne, covering the years 1985-2003.

The first variable is the intervention price,  $p_{int}$ , explained in 3.1.

The second variable is the ad-valorem subsidy from 3.12 computed by dividing the intervention price by the MC in the EU. This figure is not available explicitly, so to estimate it *price at farm gate* is used. It has the same unit and is also expressed in refined sugar equivalent. It also covers the same years as intervention price. It represents the price of the product at the farm level excluding both transport and delivery costs [OECD website]. This is thought to incorporate costs that vary between years, and relating mainly to raising crop, such as good and bad harvests.

Making a slight change of the formula derived in 3.12, in order to get the subsidy variable in the format of percentage on top of the marginal cost, it is now defined as

$$S_{AV} = \left( \frac{p_{int}}{p_{farm\ level}} - 1 \right) \cdot 100$$

#### 4.22 Export subsidies

Statistics on export subsidies used for this thesis are from the Swedish Board of Agriculture [SJV, 2000 p 112 & SJV, 2008: p 128-129], and cover only white sugar as the EU does not export raw sugar [personal correspondence with Didier Bloch at the European Commission, DG External Trade - Policy Coordination, 2009-02-16].

It is formatted in a monthly time series, describing export refunds in terms of Euro per 100kg exported refined sugar. It yields 60 observations per year between 1996 and 2004.

The second variable predicting world market price is CSE (Consumer Support Estimate). This is a general measure of the value of the monetary transfers from consumers to producers and



taxpayers, as a result of a given set of agricultural policies [Andreosso-O'Callaghan, 2003: p 110]. Since tariffs see to it that the cost of sugar within the EU have been as high (or even higher [Swedish competition authority, 2002: p 57] ), than the intervention price, consumers bear the costs in the end [Johansson et al, 2006: p 14].

CSE includes explicit and implicit transfers from consumers associated with market price support on domestically produced consumption (transfers to producers from consumers), transfers to the budget and/or importers on the share of consumption that is imported (other transfers from consumers). Negative values have been made positive in this thesis. These otherwise mean that transfers from consumers measure the implicit tax on consumption associated with policies to the agricultural sector [OECD website]. The total support of the artificially high price that producers charge is thus likely to be well estimated.

Because this measure is available in many countries, the three largest producers (in subsidy measures), the EU, the US and Mexico, are used to compose a multivariate regression analysis predicting the world market price.

The figures apply to refined sugar or equivalent. Available statistics cover the years 1985 to 2006 and describe yearly subsidy endowments to producers in million Euros [OECD Website].

Although widely used, the CSE, is not guaranteed to capture only the market distorting figures but other support as well.

#### **4.23 World market price**

World market price for white sugar (sold on the London Commodity Exchange) is available in futures contracts called *Sugar #11*. Each price is assumed to represent the contract closest to default.

The source for yearly data is the *Eurostat website* and downloaded quotes using Thomson Datastream software. Eurostat covers the years 1999 – 2006 and Thomson Datastream figures 1988 – 1998. All figures are given in Euro per metric tonne.

Monthly observations have the format cents per pound. They are gathered from the *Intercontinental Exchange* website. These values are extracted by close price in the middle of the month.

#### **4.24 EU Imports from ACP's**

Statistics on EU imports from ACP's are available from the European Commission's website. The material covers only the years 1999-2006 in annual data. The figures are in tonnes of undeclared type of sugar, which would most likely mean raw sugar.

#### **4.25 Economies of scale - Land and labor usage**

The analysis of the total costs mentioned in chapter 4 will be a panel regression, encompassing both cross sectional variations and a small time series. All EU sugar producing countries are represented in the OLS model. Production predicts costs. The cost variables used are land and labor.

Technology is assumed to be homothetic across the EU. No significant technology improvements are assumed to distort the regression analysis as only two years are covered.

When testing for this relationship only refined sugar output is considered. Sugar refineries are the end of the production line and thus will incorporate the producer costs of the farmer, transport costs, logistics and the actual refining of the beet, intending to make fixed costs for the whole industry more apparent.

The source used for EU cross country refined sugar production (given in tonnes) as well as labor (given in number of employees) is "*Sugar Statistics 2008*" [CEFS website]. The regression analysis uses observations over two years, 2006/07 - 2007/08 and with one observation pair per EU country.

The labor variable is the sum of the figures "*employment in the sugar industry during beet campaign*" and "*employment in the sugar industry between beet campaign*". This will give a representative description of the sugar industry employment over the whole year. The data format is number of employees.

Land usage, or harvested area (given in hectares) comes from the FAO online database.

The source for production of refined sugar is given in tonnes per year and from CEFS website.

Data on out of quota, C-sugar sugar production come from the European Commission website. They are given in anual figures of tonnes, between 1999 and 2007.

## 5. Results and Analysis

*This chapter starts by showing the results of the regression analysis used to test for the correlations outlined in the theory part of chapter 3. These results are then discussed and further elaborated upon by qualitative analysis. Estimations are made on the sugar reform. The issue of C-sugar production explained by world market price and industry preconditions is also treated.*

### 5.1 Regression analysis

The expectations from the theory outlined in chapter 3 are put to the test through regression analysis in the tables below.

**Table 5A - Correlations**

<b>Variables</b>	<b>Pearson Correlation, two tailed</b>	<b>n</b>	<b>Significant correlation on 0.01 level (two tailed)</b>
Raw sugar exchange price		11	X
White sugar exchange price	0,933		
EU Land usage in the sugar industry		36	X
EU Employment in the sugar industry	0,928		

**Table 5B – Regression analysis results**

Dependent variable	Independent variable(s)	Time period	n	R-square	adjusted R-square	t-value	f-value	p	a	b
EU Production (refined sugar), Q	P <sub>int</sub> , EU Intervention price	1986-2003	19	0.423	0.389	3.533	12.483	0.003	21.064	3722
EU Production (refined sugar), Q	S <sub>AV</sub> , EU Ad-valorem subsidy, percentage	1986-2003	19	0.681	0.663	6.028	36.336	0	49.619	11892.634
World market price (refined sugar), p*	EU CSE					4.075			-0.078	
	Mexico CSE					0.017			0	
	US CSE	1986-2003	16	0.749	0.686	1.263	11.942	0.01	-0.039	488.967
World market price (refined sugar), p*	EU Refined sugar export subsidy (monthly, eur/100kg)	1996-2004	60	0.496	0.488	-7.573	57.344	0	-0.324	23.421
World market price (refined sugar), p*	EU imports from ACP's (tonnes)	1999-2006	8	0.071	-0.084	-0.676	0.457	0.524	-0.133	473.404
Employment in the EU sugar industry, TCL	EU Production, refined sugar)	2007-2008	38	0.694	0.686	9.041	81.732	0	0.003	621.06
Land usage in the EU sugar industry, TCl	EU Production (refined sugar)	2006/07 - 2007/08	42	0.96	0.959	31.145	970.013	0	0.096	10938.726
C-sugar production	World market price (refined sugar)	1998-2006	9	0.15	0.029	1.112	1.236	0.303	9067.446	771516.256

## 5.2 Analysis of the results

### 5.21 Sugar production

In the case of Intervention price as the explaining variable the results point toward a weak correlation, as all the market mechanisms are bypassed. Nothing is known about production costs or demand.

It is easy to grasp the simplicity of the assumption that a higher intervention price should be an incentive to increase production. However, as must be the case from the poor determinant coefficient, there are other factors at play to upset the model. Nothing is known about production costs or domestic demand. R-square is 0.423 which means that 42,3% of the variations in production are caused by the intervention price. The results show that the correlation is statistically significant and it is pleasing that the correlation is positive as expected.

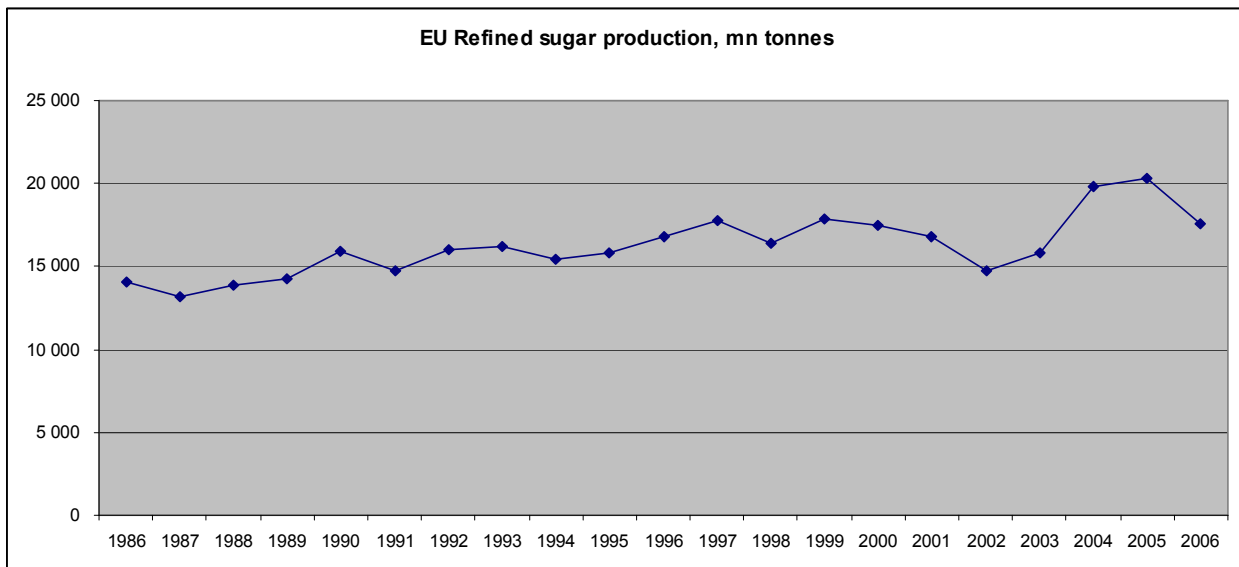
The equation,  $Q = 21.064 \cdot p_{int} + 3722$ , suggests that for every increase by one Euro of the intervention price, the production increases by 21 thousand tonnes.

Attempting to incorporate producer costs into the production subsidy model, the ad-valorem subsidy as explaining variable yields a much better result. The r-square value leaps to 0.681, and the ad-valorem subsidy variable as predictor accounts for 68 percent of the variations in production volume. This is a considerable improvement over just the intervention price as a predictor. Even though the marginal costs are impossible to predict from year to year, it is a pleasing result considering again the time span it covers and that the values are annual. The equation for this correlation,  $Q = 49.619 \cdot S_{AV} + 11892.634$ , shows that for every increase by one percentage unit of the Ad-valorem producer subsidy, the production will rise by 49.6 thousand tonnes.

Absent factors (variables) for both these subsidy measures are domestic demand and world demand. Other distorting factors are the outcome of harvests and, as mentioned in chapter 2, farm reforms and other market shocks. The fact that the time span is so vast means that many such shocks should have taken place. Since the subsidised production is limited to A and B quotas, which have also been left out of the statistical analysis, the main variation is assumed to be in C-sugar production.

Estimating refined sugar production the year 2008, applying the intervention price set by the EC for this year, 2009 - 410.7 Euros per tonne [Dürr & Pons, 2006: p 12] - the value attained is 12,959,114 tonnes. Statistics for EU production history of refined sugar is plotted in figure 5A below.

**Figure 5A (source: OECD website)**



Looking at the years 2000 and onward there is evidence of some volatility in production volume. The value of production yielded from the prediction is a much smaller production than that of the last few years.

FO Licht, one of the leading institutes for analysis the global sugar market, have however estimated the production 2008-2009 to 14 million tonnes [Yahoo Business website] which has not been seen since the late 1980's. Pleasingly this is not that far from estimated value from the equation derived. But, considering that the intervention price was used, the weaker predictor of the two production subsidy variables, the result may not be correct.

## 5.22 World market price

CSE for the three major sugar producers in the world (in terms of subsidies) showed an r-square value of 0.749 explaining the world market price, pointing toward a linear negative relationship as expected. The correlation is significant. Because many variables are used, the adjusted r-square is a better measurement of correlation. This value is 0.68 which means that the correlation is still agreeable.

Looking at the coefficients in the yielded function describing world market price,  $p^* = -0.078 * CSE_{EU} - 0.039 * CSE_{US}$ , the EU has the largest impact, where 1 million Euro of support from consumers results in a reduction in world market price of 0.078 Euro. The US shows just over half the impact, the same subsidy depressing world market price by 0.039 Euro. Mexico's CSE shows almost no impact on the world market price. This is reasonable since the size of the CSE is considerably greater in the EU than for the other two producers.

It also seems that the monthly export subsidy rate as the predicting variable is a predictor of world market price changes, accounting for half of its variation and yielding a significant correlation. As its size has been determined by EC policies the model will be useful in making predictions about the outcome of the sugar reform.

Interpreting the regression analysis in economic terms, the equation describing world market price is,  $y = 23.421 - 0.324x$ , meaning that for every Euro per 100kg of sugar spent on export subsidies, the world market price is depressed by 0.324 cents per pound. Thus a rate, rather than a fixed amount, is what explains the world market price here.

Using the above equation to estimate the outcome of the sugar reform, it is easy to see that without export subsidies the world market price would be equal to the intercept, 23.421 cents per pound. But the highest level it did reach was 14.19 [Intercontinental Exchange website]. This model is hence not suitable for computations and precise predictions.

One of the reasons to this failure could be Brazil's expansion in sugar production following the contraction of the European one. It increases its production of ethanol after the EU became a net importer of sugar, boosting the world market price even further by increased factor demand of sugar [FAPRI, 2008: p 1].

The attempt to let ACP imports under preferential trade predict the world market price was not successful. There is no significant correlation between the two variables. However, the world market price is still negatively proportional to these imports, as expected. The poor results may have several explanations. Firstly, because preferential imports have access to export subsidies by way of re-export is no guarantee that it is being applied. There is little statistics available on this matter, due to lack of transparency, as explained in chapter 5. Moreover, as the EU has been the one of the largest producers in the world, its exports of sugar refined from domestic beet production are much larger than those of its imported sugar cane [FAO & Eurostat websites].

### **5.23 Fixed costs**

Since the Pearson correlation between the two is so strong, 0.95 (table 5A), it is not justifiable to use both Land and Labor to describe the output of sugar. They are hence used separately.

The correlation coefficient for land use and production is strong; r-square is 0.96 and the correlation is significant. There thus seems to be constant marginal productivity of land in the production of white sugar across the EU. The same goes for labor as the explaining variable, albeit showing a weaker correlation, with r-square at 0.7.

The function yielded for land costs of production is

$$TC_L = 10938.726 + 0.096 * Q$$



Which yields average total cost

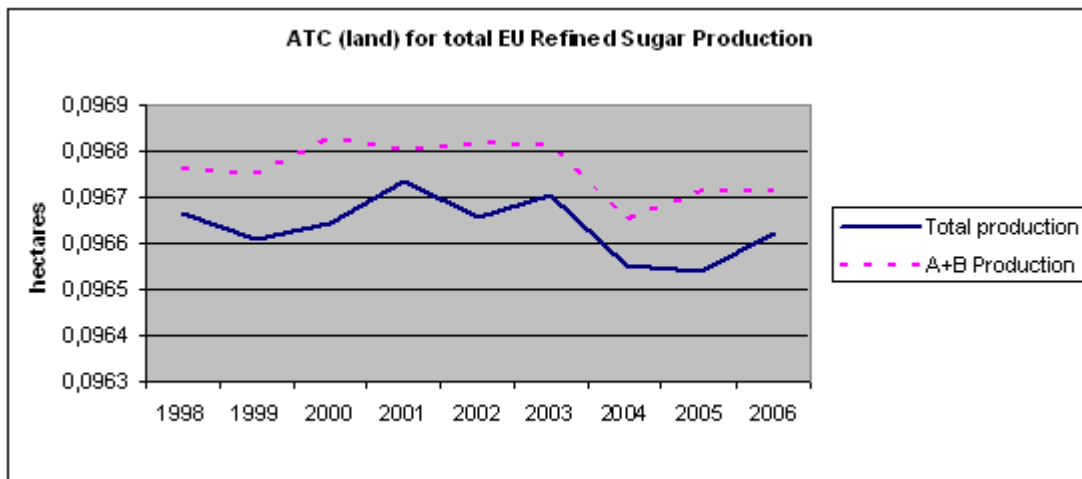
$$ATC_L = 10938.726/Q + 0.096$$

Corresponding calculations for labor as input cost yields the function

$$ATC_1 = 210.892/Q + 0.01$$

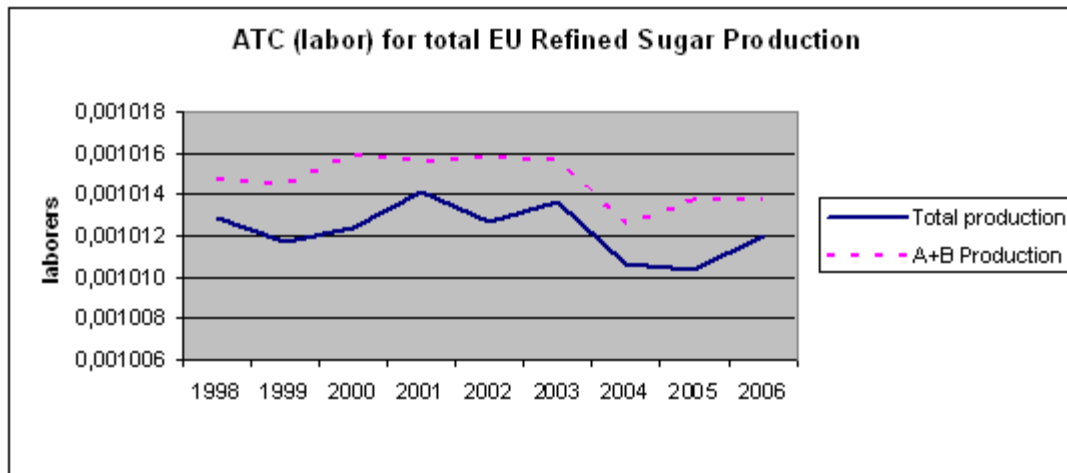
In order to make use of these formulas one must compare the average total costs between the A+B-production and the A+B+C-production. Nine years are available for such computations. The corresponding average total costs for both in and out of quota production are showed in figure 5B below.

Figure 5B (source: CEFS and FAO websites)



On the merit of labor, the correlation is not as strong but clearly indicates a positive and linear relationship with output. R-square is 0.76. Since the data material has 36 observation pairs this is enough to assume that the correlation is linear, and valid across the EU. The corresponding values, using labor units instead of hectares land as input, are presented below in figure 5C.

Figure 5C (source: CEFS and FAO websites)



Figures 5B and 5C show that the differences in TAC are consistent. It is enough to entertain the notion that the sugar industry exhibits some fixed costs and thus increasing returns to scale. What this thesis has not investigated though, is the value of the cost in money, and how it relates to average revenue. Subtracting this with the former would yield a profit function that could determine with much more accuracy what the optimal produced quantity is, and hence determine the expected C-sugar production volume.

## **6. Conclusions**

*This chapter concludes what has been analyzed in chapter 5, reconnecting the theories applied from chapter 3. The scientific, political and economic value of the investigations are discussed. It is finished by a comparison between the results obtained in this thesis and those of contemporary research.*

### **6.1 Economic effects**

This thesis has tried to determine the size of EU sugar production and the world market price of sugar, with various explaining variables. It has also tried to explain the controversial out of quota production. In the case of testing the theories outlined, the results are ambiguous. Every theory has been correct in the sense that all correlations have been positive or negative according to expectation. However, The OLS analysis has yielded varying results regarding the strength of the correlations, and two correlations which are not significant. Their results will hence not be discussed here.

Despite being described in some detail in 3.21, no actual calculations on the size of producer and consumer surplus or net welfare loss have been made. However, such effects and outcomes are obvious. The world market price has unambiguously been lowered by EU export subsidies. Prices within the EU have been considerably higher than those outside it. Production has also been proven to have increased due to subsidies. Applying the theory from figure 3D, it must then be the case on the EU sugar market, that the CMO causes consumers to lose and producers to gain. The loss for the government is simply the costs of the subsidies. The total effect of all these phenomena is an undeniable net welfare loss.

On the merit of economies of scale, this seems to be feasible on the EU sugar market. Thus, even though much of the output seems to be because of the subsidies, cutting them will inevitably make production more costly in terms of average costs. To calculate the complete net effect of reducing subsidies, this would have to be accounted for.

## **6.1 Policy implications**

The results obtained in this thesis affirms most of the criticism directed against the sugar regime. The CAP seems to be a fetus of a farm lobby determined to enrich itself at the expense of EU consumers and the rest of the world's producers. The world market price has clearly been proven to depreciate from EU export subsidies. The decision to remove them is therefore much welcome by the author.

As for the outcome in the WTO panel, this thesis has found some evidence of fixed costs in the EU sugar industry. These are found more likely to explain C-sugar production than variations in world market price. Since the price support remains significantly higher than world market price still, even after the sugar reform, the effects of average total costs below world market price is still possible at volumes above the allowed quota. It was therefore a good idea to ban out of quota production all together.

The coefficients in the multivariate regression using the CSE as predictor, show that the EU causes world market price to fall almost at twice the level of the US at the same level of payment. Even though the US affects the world price negatively itself, the case against EU that it has driven down its revenues by depressing the world price seems legitimate. It should of course also stop its own support to end the distortion of the world market price.

As for ACP imports and their European re-exports, they do not affect world market prices significantly. Hence they cannot be said to depress the market price these countries would otherwise want to sell at. Consequently, in a cost benefit perspective, there is a justification for the guaranteed prices offered to the ACP's so long as the over production within the EU is considered rigid. With total liberalisation of the sugar market, however, world market prices may well rise so far as to eliminate the need for preferential EU trade all together.

The fact that the EU is no longer allowed to re-export ACP sugar by means of export subsidies [Johansson et al, 2006: p 19], means that domestic consumption of this sugar will increase and hence beet production incentives will decrease. This policy is important as it should shift production from the EU to the ACP's who have the natural comparative advantage in sugar producing technology [Thelen, 1999: p 23].

On the other hand, the EU will become less attractive as trade partner offering the ACP's a lower price for their sugar. This could be an incentive for them to establish alternate markets.

## **6.2 Comparison with other research**

The proposed depreciation of the world market price due to export subsidies or in more, is often mentioned in research. However, it has very seldom been subject to a statistical examination, as to investigate it's correlation with other variables. OXFAM (2002), Gohin & Bureau (2006), Krugman (2009), Johansson et al (2006) all make note of this correlation, but do not investigate or try to predict it with an equation.

The world market price is explained with some accuracy in this thesis. Looking at Poonyth et al [2000, p 238] it has instead been predicted by the variables EU imports and exports. They have also analyzed the export subsidies on sugar, but with another approach. The production quotas predict the needed export subsidy [ibid, p 241] . This method lends itself more usefully to discussions on policy implications (as intervention price and quotas are that which are predetermined in the EU sugar regime). In *Johansson et al* (2006: p 37) changes in sugar prices are estimated on a reference versus market level in the EU.

The results in this thesis can be useful as a complement, as it is tries to explain more explicitly variations of the world market price.

In the case of Gohin & Bureau (2007) estimating production changes following the reform of CAP was done using firm profit maximization constraints. One problem with this method is that the actual economic behavior of the sugar industry could be distorted by the very assumption of profit maximization. Looking for instance at EU farming (which is just one part of sugar production) it is possible that this is a lifestyle rather than a business, making utility maximization more suitable than profit maximization to model it [Andreosso-O'Callaghan, 2003: p 50]. Such inherent distortions are bypassed in this thesis, which again means it could prove to be a complement to other scholarship using firm level microeconomics.

## **7. Further studies**

As seen the world market price is affected by more than just EU subsidies. There are other factors at play and these could be analysed more closely to yield a better estimation. Oil prices have proven to influence it and could be analyzed in more depth. For example, there seems to be a two way causality between these two markets which has been mentioned [FAO website] but not accounted for in this thesis.

Export subsidies are also suspected to exhibit ambiguous results in terms of causality. If an already high world market price, requires larger export subsidies the causality is reversed, as apposed to the assumption here that large export subsidies dump surplus production on the world market to lower its price. Further study could provide evidence as to which direction of causality carries more weight and how more precise predictions can be made.

The CSE has been criticized for being a questionable way of measuring trade distorting policies [FAO website]. How much of these endowments actually affect the world market price and production? Further investigation here could derive more pure and usable measures for investigating market distortions over a longer period of time, and involving many producers influencing world market prices.

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## **Internet resources**

### **CEFS – Comite European Des Fabricants de Sucre**

Main website: <http://www.comitesucre.org>

#### **Used web pages:**

<http://www.comitesucre.org/www/?menu=3> (“*Sugar Statistics 2008*”: cross country figures for EU refined sugar production and labor used in production)

### **DEFRA – Department for Environment Food and Rural Affairs**

Main website: <https://statistics.defra.gov.uk/esg/>

#### **Used web page:**

<https://statistics.defra.gov.uk/esg/reports/sugar/chapter2.pdf>

### **European Commission**

Main website: [http://ec.europa.eu/index\\_en.htm](http://ec.europa.eu/index_en.htm)

#### **Used web pages:**

[http://ec.europa.eu/agriculture/agrista/tradestats/2007/eur27ag/page\\_284.htm](http://ec.europa.eu/agriculture/agrista/tradestats/2007/eur27ag/page_284.htm) (EU sugar imports from ACP countries)

[http://ec.europa.eu/agriculture/agrista/2002/table\\_en/4341.pdf](http://ec.europa.eu/agriculture/agrista/2002/table_en/4341.pdf) (sugar supply A+B and C quota)

[http://ec.europa.eu/agriculture/agrista/2004/table\\_en/4341.pdf](http://ec.europa.eu/agriculture/agrista/2004/table_en/4341.pdf) (sugar supply A+B and C quota)

[http://ec.europa.eu/agriculture/agrista/2007/table\\_en/4341.pdf](http://ec.europa.eu/agriculture/agrista/2007/table_en/4341.pdf) (sugar supply A+B and C quota)

### **Europa – Gateway to the European Union**

[http://europa.eu/press\\_room/index\\_en.html](http://europa.eu/press_room/index_en.html) (European Gateway pressroom)

### **Eurostat**

Main website: <http://ec.europa.eu/eurostat>

Used webpages:

[http://ec.europa.eu/agriculture/agrista/2002/table\\_en/4351.pdf](http://ec.europa.eu/agriculture/agrista/2002/table_en/4351.pdf) (World market sugar price)

[http://ec.europa.eu/agriculture/agrista/2004/table\\_en/4351.pdf](http://ec.europa.eu/agriculture/agrista/2004/table_en/4351.pdf) (World market sugar price)

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## **FAO – Food and Agriculture Organization**

Main website: <http://faostat.fao.org/>

Used web pages:

[http://www.fao.org/es/esc/en/15/106/highlight\\_107.html](http://www.fao.org/es/esc/en/15/106/highlight_107.html) (Article, no author mentioned: “*The Rise in Crude Oil Prices Stimulates Ethanol-Related Demand for Agricultural Commodities*”)

<http://www.faostat.fao.org/site/339/default.aspx> (*ProdSTAT* - Land statistics for sugar production)

<http://www.faostat.fao.org/site/342/default.aspx> (*StradeSTAT* - Sugar trade statistics)

## **Intercontinental Exchange**

Main website: <http://www.theice.com>

Used web pages: [https://www.theice.com/publicdocs/futures\\_us\\_reports/](https://www.theice.com/publicdocs/futures_us_reports/)

[sugar/Sugar11Hist\\_Prices.xls](https://www.theice.com/publicdocs/futures_us_reports/sugar/Sugar11Hist_Prices.xls) (Futures Contract, “Sugar no.11” historical price data)

## **OECD**

Main website: <http://www.oecd.org>

Used web pages:

<http://stats.oecd.org/glossary/detail.asp?ID=428> (SCE definition)

[http://www.oecd.org/document/54/0,3343,en\\_2649\\_33727\\_35009718\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/54/0,3343,en_2649_33727_35009718_1_1_1_1,00.html) (CSE, Production volume, intervention price, price at farm level)

<http://stats.oecd.org/glossary/detail.asp?ID=940> (Definition: farm gate price)

**Oxfam**

Main website: <http://www.oxfam.org>

Used web page:

[http://www.oxfam.org/en/news/pressreleases2005/pr051122\\_eu\\_sugar](http://www.oxfam.org/en/news/pressreleases2005/pr051122_eu_sugar) (press release)

**Yahoo Finance**

Main website: <http://uk.finance.yahoo.com/>

Used web page: <http://uk.biz.yahoo.com/10082008/399/sugar-shake-survivors-look-forward-sweeter-times.html> (Urry, Maggie: “*Sugar shake-out survivors look forward to sweeter times*” -

Predictions on EU sugar production)