The EU common agricultural policy (CAP) and its effects on trade

Acknowledgements

I want to thank my supervisors Professor Börje Johansson and PhD Candidate Peter Warda for their comments and patience throughout the process of writing this master thesis. They provided interesting input and useful corrections when needed, and for that I am grateful.

Thank you also to my discussant Alfredo Hidalgo Arreola and co-examinor Professor Thomas Holgersson for your suggestions and remarks.

I finally offer my regards to all of those who supported me in any way during the completion of this thesis, especially to my fellow students with excellent computer and language skills.

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Abstract

The common agricultural policy (CAP) is a much discussed policy in the European Union (EU). It allocates great sums to the European agricultural sector every year and has been accused of being trade distorting and outdated. This thesis takes a closer look at what protectionist measures the CAP has used. The policy's effects on trade will be assessed employing the sugar industry as a reference case. Sugar is heavily protected and is one of the most distorted sectors in agriculture. The CAP effects on trade in the sugar industry for ten countries in and outside the EU from 1991 to 2011 are estimated using a gravity model. This particular type of estimation has, to the author's knowledge, not been performed for the sugar industry before, which makes the study unique. The results of the empirical testing indicates that trade diversion occurs if one country is a member of the CAP and its trading partner is not. When both trading partners are outside the CAP cooperation, they are estimated to have a higher trade volume. This result indicates that the CAP decreases trade. Current economic theory, in particular the North-South model of trade developed by Krugman (1979), suggests that protectionism of non-competitive sectors should be abolished and funds should instead be directed to innovation and new technology. The CAP is in this sense not adapted to modern economic thought.

1. Introduction

1.1 Background and purpose

EU's new budget was agreed on and presented in the beginning of 2013. The budget is somewhat smaller than before, but the agricultural sector and regional policies still receive a large share of the EU funds. In fact, last year the agricultural sector received 41% of the EU's total budget.[1] Research, infrastructure and the transport sector received a smaller part of the funding after these budget negotiations.

This may seem strange, as one of the major economic models relating to trade, the North – South model of trade developed by Krugman (1979), states that developed countries will keep their advantage by a constant flow of new innovations. Not by protecting industries where goods can be produced at a lower cost elsewhere. Agricultural goods constitute 7 % of the EU's exports and 6 % of its imports according to the European commission (2012), so it is indeed an important sector in the EU economy. It is also one of the most subsidized sectors, indicating that it is not profitable without support. The original goals of the EU common agricultural policy (CAP) were developed in the 1950s and 1960s; a time when the world had recently experienced two world wars, food security was a major issue and farmers constituted a larger part of the working population than today. Although the world economy has changed since then, the goals of the CAP remain similar to the original ones and the agricultural sector receives substantial support to obtain these goals. Institutions like the World Trade Organization and the Swedish Chamber of Commerce have claimed that these trade restricting measures can be damaging and are steps in the wrong direction.[2]

The purpose of this thesis is to assess the effects of CAP on trade using the sugar industry as a reference case. To achieve this I will examine different aspects of the CAP. I will discuss whether or not the CAP is relevant today; my focus will be on how trade is affected by the policies implemented by the CAP. This will be done with a specific example from the sugar industry. The sugar industry is a relevant case since it has received considerable direct and indirect support from the CAP, and has been called one of the most distorted sectors in terms of trade and production. Using the gravity model of trade, I will estimate the impact of the CAP regulations on trade between selected EU and non-EU countries. The results of this estimation will be discussed in terms of current economic trade theory.

1.2 Outline

Section 2 presents a short history of the CAP, to show how it has developed over time and where the original ideas came from. Then follows an account of the major protectionist measures used by the CAP and I will give an idea of how they are used in the sugar industry – which is the industry chosen for the empirical analysis.

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[1] Interview with Paolo de Castro, chair of the European parliament's Committee on Agriculture and Rural Development, 10/11-11, can be accessed from: www.europarl.europa.eu.

[2] See e.g. *Handelspolitiska skyddsåtgärder*, 2007:1, on the damaging effects of EU protectionist measures.

To show the arguments for keeping the protectionism built into the CAP I have included section 3, on how the agricultural sector can be seen as a multifunctional sector. This is followed by the subsection 'CAP and economic theory', which presents some of the ideas that oppose using protectionism in the agricultural industry. The subsection also explores how the protectionism could be abolished, and why the phasing out process is slow.

My empirical analysis of the sugar industry will start with the empirical framework in section 4, a section on the gravity model and its background. I have further explained how I have chosen to specify my model. After that a subsection on the data used and the limitations imposed follows. The next section, the empirical analysis, continues with the results from the empirical testing. These results are analyzed in the comment following the results. In the conclusion, section 6, the results and the theoretical background from previous sections will be linked to each other to form an answer to the questions posed in the introduction. The discussion includes suggestions for further research and to how the model could be improved by expanding the study.

2. The EU common agricultural policy (CAP)

2.1 History of the CAP

The CAP was originally started in 1962 by the predecessor of the European Union, the European Economic Community (EEC). Ackrill (2000) states that this was a process that started in the 1950s, in the after math of World War Two. Food security and increased productivity were some of the primary goals of the cooperation, and real concerns during this time. Europe was not as stable as it is today, and many countries' productivity and trade had been affected negatively by the war. Keeping this in mind these were the main objectives worked out in the beginning of the CAP according to Andrews (2009):

- Increase agricultural productivity. Europe should be self-sufficient in food production and not rely on food imports from other regions.
- Guarantee reasonable prices both for producers and European consumers.
- Make sure farmers and rural population receive a decent income.
- Stabilize markets. Agriculture markets tend to fluctuate a lot. To provide stability for those relying on incomes from agricultural goods, the CAP should provide a safety net to decrease such fluctuations.

These goals have not changed as much as one could expect during the half century that the CAP has been up and running. New goals have been added and given increased importance though, like environmental concerns. The environment has become a key issue, at least on paper, for the EU CAP during the last decades. But apart from that a lot of CAP's focus is still on the original goals, in particular securing farmers' income and that we have an agricultural industry in the EU.

The way CAP's budget is spent has changed considerably during the 50+ years of its existence. It is very clear that the CAP has had a major impact on the agricultural industry in the EU. The perhaps most significant effect has been the increase in the European production of agricultural goods after the CAP was introduced. The "butter mountains" and "wine lakes" of the 1980's became an infamous sign of the surplus of food that was now being produced in the EU. Especially dairy, cereal and sugar were being produced on a scale that more than satisfied the demand. This created a problem for the policy makers, there was no use in producing food that could not be sold at high enough prices, and they did not want to see a substantial drop in prices. That would otherwise have been a normal reaction to the vast increase in supply. The sector was heavily subsidized and therefore very expensive – especially when the EU had to buy the goods back at prices high enough to support decent incomes for farmers all over Europe. Farmers were now being paid not to produce, and to take land out of production. This way the farmers still had an income, but food did not have to be thrown or given away to the same extent.

An idea that has emerged as a response to overproduction is the decoupling of production and support. The CAPs gradual reforms over the last decades have moved towards compensating farmers for negative shocks in price levels, not based on what they produce, but based on their economic situation. Price guarantees are gradually being removed, as are export refunds. This is to comply with the WTO, but also necessary to decrease spending in the agricultural field and create a more sustainable and competitive agricultural production in Europe according to

Chatellier (2009). However, many of the old measures still remain. The process is slow and with the new budget presented, it seems that the CAP is not changing in the pace of the economic world it is a part of. Possible reasons and effects of this will be discussed in the following sections.

2.2 CAP policies and effects on trade

The policies applied through the CAP take on various forms. Some of them are easy to define and quantify, whilst others are less apparent. The below headlines give a general idea of the main instruments of protectionism enforced by the CAP. They are separated in this subsection to explain their different functions. In reality, they are often intertwined and used simultaneously in different combinations.

Income compensation and rural development
To modernize CAP and to comply with WTO directives, there have been attempts to decouple agricultural subsidies from production. Instead of basing level of support on how much land a farmer has or how much is being produced, other factors are considered. More focus is on whether the farmer can support him-/herself through agricultural production and keeping the countryside "alive". As the world experiences urbanization, CAP measures can serve to slow down the rural depopulation. However, in reality these compensations are still based on historical reference values, at least to some extent. As explained in Elliott and Heath (2000), there is a "*bias in the decision-making towards the status quo*". The biggest producers still receive disproportionally large amounts of subsidies and compensation.

Guaranteed price levels
The CAP has ensured farmers a minimum price, generally set above the world market price, for certain agricultural goods. Borrell and Hubbard (2000) estimate that the prices received by European farmers, and paid by European consumers, are generally set around 50% above world prices.[3] This is one of the main reasons why the agricultural production has increased so much in the EU throughout the existence of the CAP. It also means that maintaining an agricultural sector of this size in the EU is costly for the consumers and taxpayers within the union. Price differences caused by these measures within and outside the union can cause trade distortions.

Border protection
The EU imposes a tariff scheme that is common for most outside trading partners. However, exceptions are made. In particular, many developing countries enjoy exceptions from these tariffs when exporting to the Eurozone. This is allowed by the WTO to help developing countries catch up with developed economies. Quotas are still imposed for certain industries, to reduce the supply available to European customers and keeping prices at a higher level. This is in particular true for the dairy industry. Tariffs and quotas are in general aimed at decreasing imports into the region.

Export refunds and subsidies
These types of measures create substantial effects for certain industries. The sugar industry has been one of the industries receiving relatively high export subsidies. See 'The sugar industry' be-

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[3] Borrell and Hubbard (2000) p. 18.

low for more information on this. The EU CAP also provides aid to some developing countries in the form of export subsidies; they can then sell their goods at a higher price. These subsidies, both for internal and external producers, distort prices and can cause non-competitive products to stay in the market.

2.3 The sugar industry

The sugar industry is one of the most distorted sectors when it comes to world trade in general and prices in particular. That is one of the reasons why I chose to study this specific industry. Since the CAP encompasses such a wide range of products, looking at the sugar industry is a way to see an example of how CAP policies can distort trade. Sugar is also a relatively standardized product, which makes the industry suitable for studies across time and national boundaries.

Borrell and Hubbard (2000) state that subsidies and their equivalents made up around 60 % of European farmers' income from sugar production in 2000[4]. Tariffs and other measures combined with the subsidies make it a highly protected industry. The sugar beet producers have severe difficulties competing with sugar cane producers, which makes the European climate inappropriate for sugar production. Still, EU countries continue to produce sugar on a much larger scale than market forces alone would allow and this is projected to continue over a long period of time according to a fresh prognosis by Agritrade. In fact, sugar production is estimated to increase somewhat in the coming years and then stabilize on a level where the EU will be a net exporter of sugar.[5] The theory that this distorts trade and world prices is supported by Borrell and Hubbard. To get an idea of the amount produced in the EU and elsewhere, see appendix 5.

To complicate matters, this is not solely a European issue. The EU is far from the only entity imposing protectionist measures in the sugar industry. Elobeid and Beghin (2006) name Japan and US as persistent users of subsidies and other measures to restrict and distort sugar trade and production. China and India also have substantial protection schemes, and many of the world's low cost producers also receive export refunds. The EU gives these to some low cost producers as aid. Elobeid and Beghin estimate that production in highly protected OECD countries would decrease significantly if free trade would replace the current protectionist scheme. The production in countries more fit for growing sugar cane would increase, mainly in Brazil, Cuba and Australia, but also in Indonesia, Turkey and others.

The reasons why so many economies still impose these measures are complex. For the CAP, they will be described in the following section. Groombridge (2001) describes the problem with changing the policy in the US. He states that *"nowhere is there a larger gap between the US government's free-trade rhetoric and its protectionist practices than in the sugar program"*[6]. The problem is described to be that few recipients have much to lose, but that the benefits of liberalization are not as direct and apparent. An argument frequently used to protect the sugar program is that competitors, i.e. other countries, also use protectionist measures. This poses a problem to policy makers; if liberalization occurs from their side, but not for others, the industry becomes even more vulnerable even for countries that have a competitive advantage in sugar production.

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[4] Borrell and Hubbard (2000) p.24.
[5] Agritrade.cta, *EU sugar sector developments and projections*, 7/4-13.
[6] Groombridge (2001) p.1.

3. Understanding protectionism in the agricultural sector

3.1 Agriculture as a multifunctional sector

"A thriving agricultural sector will be of strategic importance in Europe's future development, not only in ensuring food security, preserving the environment and protecting the countryside, but also in facing new challenges such as climate change while providing a fair standard of living for farmers."

 - Dacian Cioloş, EU commissioner of agriculture and rural development, mandate 07-01-13.

The above quote by the CAP commissioner shows that there is more to the agricultural policy in the EU than maximizing profit. There are some particular reasons why agriculture historically has not been seen as any other sector. Agriculture can be seen as a multifunctional sector, and that trade in, and production of, agricultural goods should not follow the same rules as other sectors. This is the reason why the agricultural sector has enjoyed special exceptions and privileges in the WTO and also in EU regulations. There are four major categories of reasons why agriculture is a special sector:

- Food security (incl. reasonable prices)/strategic reasons
- Rural development and job security
- Environmental concern/animal welfare
- Tradition/culture

In the beginning of the CAP, the first point was the most important and urgent one. However, as European history since then has been more peaceful and improvements in infrastructure have facilitated imports, the other reasons have been given more room in the CAP budget and planning. These points may be used as justification to use protectionist measures for agricultural goods, see e.g. Potter and Burney (2002). For example, the EU can say that they will demand all goods to keep a certain standard when it comes to CO_2-emissions. This can make it harder for some countries to export to the EU. But if the EU can show that the impact on the environment is the crucial reason for banning these goods, it may not be considered as a protectionist measure in the traditional sense by the WTO. There are many cases where it can be hard to tell whether measures are in fact protectionist or have other justifications. For example, the WTO has allowed export subsidies, which can distort trade flows severely, for agricultural goods:

While under the GATT 1947 export subsidies for industrial products have been prohibited all along, in the case of agricultural primary products such subsidies were only subject to limited disciplines (Article XVI of GATT) which moreover did not prove to be operational.[7]

This is, however, about to change. Export subsidies are now only allowed for members of the WTO if there is a plan to reduce them, or special considerations have to be taken. Developing countries struggling to adapt to the new regulations could be such an exception. The WTO is moving away from these allowances that have previously been standard. It is reasonable to ask

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[7] wto.org 27/3-2013, Agriculture – explanation – *Export competition/subsidies.*

the question whether or not there really are valid reasons to keep supporting the agricultural industry in such a fierce way as the EU has been doing.

The argument of food security, however vital, is not really an issue in Europe anymore since we are now one of the world's largest exporters of food products.[8] It can still be claimed that in the case of war or unexpected shocks to the economy (or weather for that matter) there may still be problems of food security. But this is in no way the pressing issue it was in the 1950s. After the massive surpluses that arose in the 1980s, the EU has been struggling with over-production as opposed to shortage. The EU system of ensuring a minimum price for certain agricultural products has increased production massively, but for the most part not in an economically competitive way. A lot of European agricultural goods would not be competitive if support was to be removed. But we are far from the only ones in the world using these measures. For example, the US and Japan have heavily subsidized agricultural sectors as well.[9] This is a self-enhancing mechanism; if others use protectionism, further measures are necessary to be able to compete. It is, however, not a justification to use them, and the WTO has been able to handle this type of issue more successfully in other industries.

The argument of farmers' income and rural development is a little trickier. This is, to a large extent, a matter of one's political viewpoint. The rural population is decreasing with urbanization, and increased scale of farming makes small-scale farming in many areas obsolete. This development creates unemployment and possible abandonment of rural areas. Land that has traditionally been used for growing crops or for keeping animals may change, and the flora and fauna in those areas will most likely have to change as well to adapt.[10] EU funds have consequently been used to support the farmers who are struggling, and to keep the landscape animal- and plant-friendly. It is for example possible to get EU-funding for keeping wetlands.[11] But a problem that has been brought up is that the EU funds do not seem to go to the small-scale struggling farmers, but instead to those with large farms who produce on a much larger scale. The CAP has been criticized for supporting these farms and farming methods and thereby increasing the strain on the European environment without actually helping those who would need the financial support. This is for example brought up in Sourander (2006). This has been one of the key issues in trying to renew the CAP. De-coupling has almost become synonymous with the new CAP. Meaning that support measures should not be as closely connected to the amount of output; other factors must be taken into account to create a CAP that goes from the first to the three other goals in the above list. The rural development argument is strongly connected to the environmental concern. This has become increasingly important, and has greater support as a motive for protectionism than that of food security.

The agricultural sector clearly requires some special considerations for policy makers. The complexity and multifunctionality of the sector make trade liberalization and policy renewal difficult and time consuming. The WTO has had greater problems enforcing trade liberalization in this sector than many others. There are real problems with complete liberalization in this sector, but whether or not these problems are bigger or more important than the problems associated with

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[8] European commission (2012) p.1-3.
[9] Sumner, D.A (2008) "Agricultural Subsidy Programs".
[10] E.g. Beaufoy (2000) pp. 155–178.
[11] See e.g. Pedro Silva et.al (2007) for further details on this.

using protectionist measures is difficult to determine. The CAP is going through a process of change, and the focus on food security has decreased. But are the measures really incorporating the changes that have taken place in the world since the 1950s and 1960s? Whenever drastic reforms have been pursued, the powerful COPA (describing themselves as the European agricultural union[12]) has organized equally drastic counteractions – such as strikes.[14] All in all, multifunctionality and the strong resistance towards change makes the protectionism built into the CAP tenacious.

3.2 The CAP and economic trade theory

Trade diversion and trade creation

Viner (1950) coined the expressions trade creation and trade diversion. They refer to the process of trade distortion that can occur when a customs union is introduced. These two terms are highly significant when discussing trade effects of the CAP. The terms are used to represent changes in trade patterns caused by customs unions, such as the EU. Soloaga and Winters (2001) define these terms as follows:

Trade creation raises intrabloc trade but has no effect on extrabloc imports; trade diversion boosts intrabloc imports and has an equal and opposite effect on extrabloc imports.[13]

In their paper they reach the conclusion that trade diversion occurs for the EU, i.e. being a member of the EU means that you can see an increase in trade with other EU members, and a decrease in trade with non-EU countries. The CAP controls customs and other types of protectionism in the agricultural industry in the EU. For the agricultural industry, the CAP is the equivalent of what the EU is for the economy as a whole. Therefore, the idea of trade diversion and creation makes sense in the case of the agricultural industry. When performing the regressions for my empirical analysis of the sugar industry, I will investigate whether trade diversion or creation can be seen in the CAP or outside of it. In this case, the CAP members are seen as one bloc, whilst all others are seen as a separate bloc. This is because the CAP imposes the same tariffs and other protectionist measures against the outside countries. The outside countries are not a bloc in the traditional sense, but they share a common tariff level for exporting to the EU.

The theory of trade diversion and creation suggests that being a member of a union that imposes the same protectionist measures against extrabloc countries, affects trade patterns. They can strengthen internal trade and divert imports away from extrabloc countries. The empirical reference case of this thesis illustrates what effects the CAP really has on trade. The following paragraphs discuss why trade distortion can be desirable or accepted, and what the possible problems are.

Concerns of liberalization and reasons for protectionism

Multifunctionality in the agricultural industry can, as mentioned, be seen as a reason to keep protectionism in the agricultural sector; this is discussed in e.g. Potter and Burney (2002). It definitely makes liberalization of trade more complicated. We still have intense protectionism in the EU CAP, although one of the initial goals of the EU was to increase trade and accessibility. The EU

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[12] *COPA history and objectives*, 3/4-2013, copa-cogeca.be
[13] Soloaga and Winters (2001) p.4.

also has schemes to aid developing countries, for example the system where certain developing countries can export to the EU without paying tariffs. This does not seem to go hand in hand with the CAP policies that preside. The following quote from Dicken's *Global Shift* expresses the situation with all desired clarity:

It is often pointed out [...] that the average subsidy per cow in the EU is more than the $2 per day on which half the world's population has to live.[14]

So despite goals of free markets and aid, protectionism remains strong in the agricultural industry. The multifunctionality is not the only justification for this. Here the sugar industry will be used to illustrate one of the most fundamental difficulties faced when considering trade liberalization. This also shows why the sugar industry is a relevant case study for further analysis.

The EU members cannot produce sugar efficiently compared to other producers. The EU mainly grows sugar beet, since the climate is not suitable for sugar cane production. There are many sugar cane producers that can produce sugar at lower costs than EU sugar beet producers. Elobeid and Beghin (2006) have analyzed the possible effects of trade liberalization on the sugar industry. They make three separate projections, with different degrees of liberalization. The EU is forced to decrease their sugar production in all three cases.[15] Although production in the EU is expected to decrease substantially, consumption is not. This would then create two problems for the EU: sugar producers would lose income and European consumers would become dependent on other countries to satisfy their demand for sugar. The decrease in production in the EU is expected to lead to an increase in production in countries more fit for the task. A relocation from the EU (and other highly protected regions) to Brazil and Cuba among many others would occur.[16] This relocation of jobs and production is one of the major concerns that, in particular, developed countries have associated with free markets. Losing job opportunities and becoming increasingly dependent on imports is not desirable for any government.

Other possible problems are different regulations when it comes to labor conditions and environmental concerns. Some worry that free trade will lead to an adaption to the 'lowest common denominator' in these areas. This could then lead to more strain on the environment or lower wages and possibly also a worsening of the working conditions compared to the status quo. However, this problem exists in many other industries as well and they are not as thoroughly protected today as agriculture. For example, much of the production in the clothing industry has moved from developed countries to primarily Asia. There were attempts to protect the industry from liberalization, mainly through the Multi-Fibre Arrangement (MFA). But most of these regulations were eventually abolished or reduced substantially, due to pressure from the WTO.[17] The concern was that the removal of these trade barriers would lead to massive unemployment or a decrease in welfare for the countries that had major production of clothing. But although the results may have been grave in certain areas or during a certain period of time, new industries and ideas often come to take the place of obsolete ones. This is one of the ideas of Krugman's paper from 1979 on innovation and technology transfer, more commonly referred to as the North-

[14] Dicken (2011) p. 288.
[15] Elobeid and Beghin (2006), fig.1 p.42.
[16] Elobeid and Beghin (2006), table 1 pp. 36-41.
[17] Dicken (2011) ch. 10.

South model of trade. I will briefly explain the main characteristics of the model and how this is relevant for policy makers in the EU today.

A model of innovation and technology transfer

In Krugman's model, the world consists of two regions, North and South. To simplify the model, the only factor of production is labor. In this economy, there are only two types of goods; they are referred to as new goods and old goods. The difference between North and South is that North can invent new goods, whilst South can only produce old goods. All new goods become old goods after a certain amount of time. The labor in North can have a higher wage level if they produce new goods, because they will then have monopoly power for this type of good. The North can only keep this advantage by keeping a constant flow of innovations, since the South will be able to produce their goods at a lower price as soon as they become old.[18] The North is, very generalized, the developed countries. The South would then represent the developing countries, or countries with a lower wage level. Much of the technology and methods used in the agricultural industry would in Krugman's model be considered as old goods. As the EU transfers income from other industries, many of which are more innovation-intensive than agriculture, to the agricultural industry; according to the Krugman model this would lead to a gradual decrease in the advantage the North has. Research and development received slightly lower funding in the new budget, whilst the CAP budget has not changed significantly. Consequently, if Krugman's model predicts economic development correctly, the CAP as it looks today will decrease welfare in the developed countries. The model depicts a highly generalized economy, and there are many factors that cannot be incorporated into this two-region, two-good world. But it gives an indication as to how mechanisms of innovation and technology transfer affects the economy. For the developed countries to remain competitive with their high wage level, they need to invent/produce goods and technology that developing countries cannot produce at a lower cost.

This way of looking at the economy can be a way to give policy makers incentive to abolish some of the protectionism in the CAP. If the focus moves away from protecting 'old goods' and towards seeing the potential in R&D and more innovative sectors, the fear of reductions in welfare may produce a different end result. That could mean that attempts would be made to become better at adapting to a changing economy – and moving away from old ideas and preferences could be done in a faster pace than today.

Comparative advantages

Krugman's model is not the only one supporting abolished protectionism of non-competitive sectors. The strong protectionism in the agricultural sector also means that many countries cannot take full advantage of economies of scale and comparative advantages. The idea of comparative advantages was introduced by Ricardo in the early 1800s and is still relevant to economists today. This concept suggests, in short, that countries should produce goods in which they have an advantage compared to other producers, to maximize production and welfare. Comparative advantages have been studied and the concept has been developed further since the 1800s, and one of the main contributions is Porter's *The Competitive Advantage of Nations* (1990). He discusses how economic efficiency and maximized welfare can be achieved when countries produce in areas where they have some type of advantage. It can be access to natural resources, a special corpo-

[18] Krugman (1994) pp. 140-150.

rate culture, certain labor skills etc. The ability to be innovative has become increasingly important as a comparative advantage, especially for countries that cannot compete with for example cheap labor or particularly abundant natural resources. This is expressed as follows:

A nation's competitiveness depends on the capacity of its industry to innovate and upgrade. Companies gain advantage against the world's best competitors because of pressure and challenge.[19]

The EU does not have a competitive advantage in sugar production. As mentioned before, production is expected to fall substantially with liberalization. Consequently, due to protectionism in the CAP, total welfare can be expected to be lower than it potentially could be. Less protection could create further incentive to specialize in areas where you can be efficient; which in turn could give lower price for consumers and higher levels of production.

Bond scheme

There are suggestions as to how the protectionism in the CAP can be gradually abolished, without causing sudden shocks in unemployment and instant abandonment of rural areas. One idea, which recurs in several of the papers studied as a background for this thesis, is the idea of a bond scheme. This is for example discussed in Potter and Burney (2002) and Beard and Swinbank (2001). The idea is to try to give farmers a way to gradually adapt to decreased subsidies and a liberalization of trade. Farmers would be given bonds that would give yearly payouts to compensate for income loss due to decreased subsidies or other support measures. The bonds would give income compensation for a given period of time, e.g. ten years. The farmers could then choose to sell the bonds and start over in a different sector. They could also choose to keep the bonds and gradually adapt their farm, e.g. by growing a different, more competitive, mix of crops for example. This could be a way to let the labor employed in the farming industries gradually adapt to a less regulated market.

Change is slow

If several theories suggest that the CAP is welfare decreasing in its present form, and there are ways to gradually remove the protectionism, why then is change so slow? Borrell and Hubbard (2000) and Elliott and Heath (2000) have a common idea about one of the underlying reasons for the resistance to change. Namely that few strong recipients have much to lose, while the benefits are more spread out over the population and long-term. These few recipients have strong lobby organizations, and changing policy toward a more liberal market is therefore unpopular and difficult. Daugbjerg and Swinbank (2007) states that there is a tendency to move responsibility for policy changes in this area, because essentially no one wants to be in charge of unpopular decisions. The benefits from abolishing the CAP are not as concentrated and often more long-term. Consumers in the EU can be expected to gain in form of decreased tax burden overall, although the difference will be small for each individual taxpayer. Producers who are not members of the CAP can gain in terms of a more fair market where they can compete without artificial barriers to trade or exports making EU goods cheaper in export markets. These types of benefits are either spread out over the population or concern foreign interests, therefore it can be harder to bring them to attention or receive support for these ideas.

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[19] Porter (1990) p.2.

Also, the CAP has been a major contributor in creating the type of agricultural industry that we have in Europe today. Intense subsidies for certain goods and very particular demands have created an agricultural industry that is highly specialized in few products. This makes the industry sensitive to sudden changes in the subsidies or sudden exposure to the world's low-cost producers. If protectionist measures were removed instantly and prices as a result of that would become more volatile, the farmers (and in some cases whole communities) would be very vulnerable.[20]

The WTO has been pushing for change in policy in the agricultural industry. But exceptions that are not made for other industries are still made for agriculture. Export subsidies are supposed to be abolished as soon as possible, but they still remain to quite a large extent. The latest projections for EU sugar production indicate that production will in fact rise slightly and then stabilize at around the same level that we see in the EU today. Nowhere near the effects estimated by Elobeid and Beghin (2006) with liberalization. It seems that despite pressure from different directions to decrease protectionism in the sugar industry and other agricultural industries, the CAP continues its use of trade distorting measures. To try and quantify and measure these results on trade, an empirical testing for the sugar industry will follow. The trade effects of CAP policies for the sugar industry will be estimated using the gravity model.

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[20] Le Heron (1993) pp. 132-133.

4. Empirical framework

4.1 The Gravity Model

The gravity model of trade has the same basic idea as Isaac Newton's discovery of how gravity works. For trade this idea can be seen as that size increases trade whilst distance decreases trade. A central large market has greater chance of a larger trading sector, whilst peripheral smaller economies should expect less trade with other countries (or whichever geographical unit is investigated). Some of the first to start implementing this idea in economics were Tinbergen (1962) and Pöyhönen (1963). They specified the gravity model in its most basic form. Equation 1 is taken from Combes et.al. (2008) and it is one way of expressing the original version of the model:

$$X_{rs} = G \frac{Y_r^\alpha Y_s^\beta}{d_{rs}^\delta}$$

(1)

This model shows how export from country r to country s (X_{rs}) is affected by the GDP of each respective country (Y) as well as the distance between the two countries (d). As can be seen in Equation 1, distance is in the denominator and thus decreases trade. There are three parameters that affect how important GDP and distance is: α, β and δ.

The gravity model of trade has been used to estimate and explain global trade patterns. It has proven very successful empirically, but the theory behind it has been questioned. There have been several theoretical foundations that have tried to explain the variations in world trade, more or less successfully. The gravity model of trade cannot really be connected to any one of these theories. Depending on how it is specified, many different perspectives can be incorporated into the model. I will discuss this further when specifying the model. Different economists using the gravity model justify the model against this critic in different ways. The most common reply, mentioned in for example de Frahan and Vancauteren (2006), seems to be that the compliance with empirical results is a justification in itself, and that attempts to create a new model of trade explaining these relationships will still end up in a model very similar to the gravity model.

There is also another very good reason to use the gravity model: it is easy to expand. The gravity model is used to estimate how a wide range of variables affect trade. The model allows the researcher to add dummy variables for e.g. a common language or border, or trade agreements. This means that there are a wide range of specifications of the gravity model to choose from. Many have tried to further increase the accuracy of the outcome by adding more variables like colonial links, history of war etc. Some examples of these types of expansions will be given under the section 4.2 Econometric approach. However, if too many variables are added, the risk of creating problems such as multicollinearity increases. Therefore, it is important to try to find all relevant variables without compromising the principle of parsimony. That is, find the true model that is as simple as possible; include no variables that do not help explain the trade pattern.

4.2 Econometric approach

There is no paper before me that has done exactly this type of estimation for the sugar industry in the EU. However, there are many that have a similar purpose. Therefore there are several specifications to consider before choosing my independent variables. I have mainly looked at previous research evaluating the effect of trade agreements. For example, de Frahan (2006) uses Equation 2, an extended gravity model for trade agreements:

$$\ln M_{ijkt} = \alpha_k + \beta_e \ln E_{ikt} + \beta_y \ln Y_{jkt} + \tau \ln D_{ij} + \pi X' + e_{ijkt}$$

(2)

Equation 2 is made into log-linear form. This equation is used to see the effects on trade of EU regulation harmonization in some agricultural goods. The right hand side includes an intercept (a), distance (D), consumption of sector k goods in country i (E), value of sector k in the economy j (Y), multilateral resistance effects etc. (X, vector), and an error term (e). This should then explain the left hand side which stands for import of good k to country i from j.

This specification is quite complex, in that it handles an area that is not just being a member or not, it's about how the regulations and other forms of trade resistance are affecting the countries' production and trade of the goods. This is mainly captured in the vector X'. As opposed to a simple dummy variable, the resistance is in this vector allowed to vary in a more flexible way. For the sugar industry it would definitely be interesting to try and create a gathered variable for the level of protectionism. That variable would then include for example level of export subsidies in home and foreign, existing quota, level of tariffs etc. However, due to the difficulty in retrieving this type of data and the scope of this study, that is not a feasible option. I therefore wanted to find a simpler model that would still allow me to estimate the importance of CAP for trade in the sugar industry over the last twenty years.

Rose (2002) instead tries to capture all factors affecting trade in his model, so that all that will be affecting the residuals is the level of protectionism, thereby finding estimates for protectionism in the residuals of the regression. That could be one approach to see just how much protectionism affects trade and how it looks. However, that would not allow me to distinguish between CAP specific measures and the measures that are undertaken in countries that are not a part of the CAP. This would therefore not be appropriate for my purpose.

For my own specification of the gravity model I was to some extent inspired by Soloaga and Winters (2001), where dummies have been created to account for trade within the regional collaboration AND outside of it. I have three dummies concerning the membership. There is one dummy-variable for each possible scenario: two CAP members, one CAP member, or no CAP member in the bilateral trade flow. Dummies for common language, shared borders and the like are not really relevant since only ten countries are included. Distance will be expected to catch a lot of this type of historical or cultural variation. However, a variable for colonial links is included in the regression. This is because four of the ten included countries have colonial links with each other. Since these countries make up 40 % of the included countries and around 4 %[21] of the

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[21] (4 country pair combinations*21 years)/1890 wanted observations=0,044.

sought after export observations, I want to control for any possible effects of this. The country pairs affected by this are Portugal and Brazil; and Algeria and France.

These are the variables included in my specification of the gravity model:

Dependent variable: Export values for sugar.

Independent variables: GDP of exporting and importing country, distance (measured between economic centers), dummy variables for both members/one member/none member of the EU CAP, dummy variable for colonial link.

The equation then takes on this linear form, shown in Equation 3:

$$\ln X_{rst} = c + b_1 \ln Y_{rt} + b_2 \ln Y_{st} + b_3 d_{0_{rst}} + b_4 d_{1_{rst}} + b_5 d_{2_{rst}}$$

$$+ b_6 d_{3_{rs}} - b_7 dist_{rs} + e_{rst}$$

$$(3)$$

Apart from the dependent and independent variables, the equation also consists of an intercept (c) and an error term (e). Possible problems with this specification or variations of it will be discussed further in the results section. The variables are explained more thoroughly in Table 1:

Table 1: Variable descriptions

Variable	Explanation
X_{rs}	Export of sugar from country r to country s, measured in 2005 dollars. Data from UN comtrade.
Y_r	GDP of reporting/exporting country, measured in 2005 dollars. Data from UN stat.
Y_s	GDP of partner/importing country, measured in 2005 dollars. Data from UN stat.
d_0	1 when **none** of the countries is a member of CAP, otherwise 0.
d_1	1 when **one**, but not both, of the countries is a member of the CAP, otherwise 0.
d_2	1 when **both** countries are a member of the CAP, otherwise 0.
d_3	1 when there is a colonial link between the two countries, otherwise 0. Data from CEPII.
$dist_{rs}$	Distance between the economic centers of the two countries r and s, measured in km. Data from CEPII.

4.3 Data and limitations

To be able to perform this empirical testing data limitations had to be imposed in such a way that gathering the data would be possible within the given time frame. Since effects of the CAP for countries within and outside the CAP are examined, both types had to be chosen. I also wanted to include countries where data was available, meaning countries that have sugar production and export, at least to some degree. The members of the CAP vary in many ways, some countries have been in the EU since the very beginning, and some only joined as late as 2007. To encapsulate this I chose two older members, France and Germany, and two new ones, Poland and Estonia. I have also included Portugal that joined the EU in 1986, right before my sample period be-

gins. Except for the time of joining the CAP, these countries were also chosen because they had sufficient data accessibility.

Outside the CAP cooperation I chose countries with good data accessibility and significant trade with Europe; China, Brazil and USA. I also chose Cuba due to its alleged decrease in production due to protectionist measures. Algeria was included because it is a former colony to France, the only African country in the sample, and because it has some export of sugar. Although this is only ten countries, it still makes up 90 observations (*21 years), since the gravity model examines bilateral trade. Values for the years 1991-2011 for all country pairs were collected. These years had relatively good data accessibility, although it varies somewhat from country to country. Table 2 shows a summary of the range of data collected.

Table 2: Descriptive stat. for the main quantitative variables

Stat.	Distance	Sugar exports	GDP
Mean	6059	22674958	$1.89*10^{12}$
Median	6564	1692198	$4.90*10^{11}$
Max.	17614	$1.22*10^{9}$	$1.32*10^{13}$
Min.	440	5	$7.10*10^{9}$
Std. Dev.	3838	73490709	$3.24*10^{12}$
Observations	1890	1133	1890

As can be seen in Table 2, the export data stands out in terms of number of observations and spread. For the other variables, all 1890 observations were available, whilst for export of sugar, only 1133 values were recorded. This creates a bias in the data set. For further discussion on this, see appendix 4, where the data has been separated into three data sets according to the dummy variable criteria.

The spread of the export data is also worth noticing. The lowest recorded value is 5 (!) dollars, whilst the highest is $1,22*10^{9}$ dollars. Table 3 represents the data for the main variables in logged form, since that is in fact what will be used in the regressions. As can be seen, perhaps even more clearly in table 3, the export data stands out as the most diverse. Ranging from 1,61 to 20,92 it has a much wider range than the other variables.

Table 3: Descriptive stat. for the main quantitative variables in logged form

Stat.	ln Distance	ln Exports	ln GDP
Mean	8,41	13,94	26,72
Median	8,79	14,34	26,90
Max.	9,78	20,92	30,21
Min.	6,09	1,61	22,68
Std. Dev.	0,88	3,16	2,05
Observations	1890	1133	1890

Trade data

Data from the UN COMTRADE database was used for the export values, measured in dollar value with 2005 as index year. This database allows collection of export data for specific goods classifications between two specific countries. The reporter country is the exporter and the partner country is the importer. The HS classification 17: sugar, is used. The reason for choosing the HS classification was that the data availability was somewhat better than for the SITC. Then all available years were collected. The data availability varies significantly from country to country and from good to good. For example, there is no data available for exports from Estonia to Brazil, but since these reporters have available data for many other countries and are relevant for the theory; this set of data is still included. If all years for all country pairs were available, there would be a total of 1890 data points for bilateral trade (ten reporters*nine partners*21 years). There are now 1133 available data points for these ten countries, the rest are not available.

Distance data

The distance between countries is measured between economic centers in km. This is a time-invariant variable (at least for my sample years), but is highly relevant to the gravity model, and must therefore be included although it complicates the choice of model somewhat. Including a time-invariant variable means that the fixed effects model cannot be used. This is discussed further in the appendix under the Hausman test. The distance data was collected from CEPII.

GDP data

The GDP data is collected in dollar value with 2005 as index year. GDP data for all countries is collected from the UN database.

It would have been interesting to find data for the amount of support provided to the sugar production within and outside the EU. Then the trade effects of those measures could be estimated in a more precise way. However, this type of data is difficult to find and aggregate for an industry. Tariffs are reported on a 6-digit classification level, which means products would have to be aggregated and then weighted. Export subsidies going further back than a few years are difficult to get hold of. Therefore these data are the best choice for the scope of this thesis. See discussion for further information on this.

5. Empirical analysis

5.1 Results – CAP effects on trade in the sugar industry

There are several ways to try and run the regression defined in Equation 3. I use three dummies for membership in the CAP. These three dummies together encompass all observations (all country pairs belong to one of the categories). This creates a problem, in the sense that they cannot all be run together, that creates perfect multicollinearity. Therefore three regressions have been run, one for every possible pair of CAP-dummies. This also affects the other coefficients; therefore all three regressions have been listed with all included coefficients. When running a pooled regression, the intercepts and the slopes are expected to be the same for all country pairs and over time. Since the countries included are very different in size and export patterns, this may not be a realistic assumption. Therefore I have chosen to run the model with random effects in the cross-sections as well, making up six regressions in total. This model does not assume identical intercepts for the country pairs.

I also ran a Hausman test to check if the random effects model was the right choice over the fixed effects model. Since the fixed effects model cannot be used for time-invariant variables, distance in this case, the random effects model has to be used despite the fact that the test indicates that the fixed effects model should be used for this data. Further discussion on this topic and the results from the Hausman test can be found in the appendices, together with diagnostic testing for normality in the residuals. This is performed with a Jarque-Bera test.

The results from the regressions on the export data are shown in Table 4, 5 and 6. All of the significant results for the CAP-dummies' coefficients are in bold in mentioned tables.

The most important variables for my theory are the CAP membership dummies and they will be discussed first.

Table 4: Regressions run with d_0 and d_1

Variable	Coefficient	Pooled regression	Random Effects Model
Intercept	c	-16,24489**	-36,24717**
GDP exporter	b_1	0,88147**	1,32238**
GDP importer	b_2	0,59026**	0,84948**
d_0	b_3	**1,25335****	0,28016
d_1	b_4	-0,41051	-0,18617
d_3	b_6	1,24156**	0,89259
Distance	b_7	-1,23376**	-1,11977**

**Significant at the 1%-level

Starting with the first pooled regression in Table 4, with one dummy for none of the countries being a member of the CAP (d_0) and one for when one of the countries is a member (d_1). This model generates a strongly significant positive result for when none of the countries is a member. This means that countries are likely to trade more if none of them is a member of the CAP.

There are no significant results for the CAP dummies from the random effects model for this specification of the model.

Table 5: Regressions run with d_0 and d_2

Variable	Coefficient	Pooled regression	Random Effects Model
Intercept	c	-16,65540**	-36,43334**
GDP exporter	b_1	0,88147**	1,32238**
GDP importer	b_2	0,59026**	0,84948**
d_0	b_3	**1,66387****	**0,46633***
d_2	b_5	0,41051	0,18617
d_3	b_6	1,24156**	0,89259
Distance	b_7	-1,23376**	-1,11977**

*Significant at the 5%-level
**Significant at the 1%-level

For the second specification shown in Table 5, with a dummy for no CAP member (d_0) and for two members (d_2), the only significant result is also for the dummy representing no CAP membership. It has an even stronger positive effect in this regression. And with this specification it is also significant in the random effects model. The coefficient in the random effects model is not as strongly positive as in the pooled model, but it still indicates that when none of the countries belong to the CAP, they trade more than when one or both are. In fact, this signifies an increase in expected sugar exports of almost 60 % for non-CAP members.[22]

Table 6: Regressions run with d1 and d2

Variable	Coefficient	Pooled regression	Random Effects Model
Intercept	c	-14,99154**	-35,96700**
GDP exporter	b_1	0,88147**	1,32238**
GDP importer	b_2	0,59026**	0,84948**
d_1	b_4	**-1,66387****	**-0,46633***
d_2	b_5	**-1,25335****	-0,28016
d_3	b_6	1,24156**	0,89259
Distance	b_7	-1,23376**	-1,11977**

*Significant at the 5%-level
**Significant at the 1%-level

The third and last specification, shown in Table 6, includes the dummy for when both countries are CAP members (d_2) and when just one of them is (d_1). When d_0 is excluded from the specification, both remaining dummies produce significant negative results in the pooled model. Since d_0 produce consistent positive results on trade, excluding this dummy cause the remaining dummies to generate negative results. The negative effect on trade when one country is a member of the

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[22] The percentage change on the expected value of exports when the dummy variable goes from 0 to 1 is calculated as $100((e^{0,46633}) - 1)$=59,413.

CAP is stronger than when both countries are members. Only d_1 produce a significant result in the random effects model, and it is smaller than the coefficient in the pooled model. It signifies a decrease in exports of approximately 60% if one country is a member of the CAP and the other is not. This is calculated in the same manner as for the d_0 result in Table 5.

As can be seen in Table 4-6, most of the results for the coefficients for GDP (b_1 and b_2) are positive and significant down to the 1% level. This supports the gravity model idea that a bigger GDP causes more trade. The effect of this is greater for the GDP of the exporter. Countries export more if they are bigger in terms of economic activity. The importing country imports more if it is big, but the effect is then not as big as for the exporting country. The other basic foundation of the gravity model, that distance affects exports negatively, is also supported by these results. All distance coefficients are negative and significant. GDP for reporter and partner, as well as distance, have consistent and significant results in both the pooled and random effects model. The dummy for colonial links is positive and significant for the pooled model, whilst for the random effects model no significant results are present. The results in the pooled model suggest that a colonial link causes more trade between two countries.

5.2 Comments on results

All in all, the dummy for trade between non-CAP countries (d_0) shows the strongest impact on trade among the CAP dummies. One way of expressing this is that trade diversion occurs for the 'bloc' of non-CAP countries. They have more internal trade compared to when one of the countries is on the other side of the CAP border. When one or both countries are in the EU CAP, the trade effect is instead negative. One could expect that the result for when both countries are in the CAP should be positive, but they are significantly negative in one case, and otherwise not significant. This is likely to be a result of the strong positive impact on trade when none of the two countries are a part of the CAP. The results also show that if one country is a CAP member and the other is not, that has a negative impact on trade. Since the CAP imposes border protection to non-members, this is an expected result. The result is supported by e.g. Elobeid and Beghin (2006) stating that: *"Border restrictions reduce import demand flows […] increasing domestic prices received by producers and paid by sugar users."*[23] Trade diversion, decreased trade over the bloc-boundaries and increased trade for those outside the CAP, is thus the effect that can be distinguished from these results.

The gravity model holds true in the sense that GDP has a positive effect on trade and distance has a negative effect. This is in accordance with the gravity theory of international trade. The GDP of the exporting country has a stronger positive effect than the GDP of the importing country on trade. But the difference is not big, and in general GDP affects both imports and exports positively.

There are several insignificant results for the CAP dummies; this may indicate that there is some problem with the model or the data selection. This will be discussed further in section 7. There are only ten countries included in the sample, which means that any deviation in their data reporting, trade patterns etc., will shine through strongly in the results. The export data is very diverse,

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[23] Elobeid and Beghin (2006) p. 30.

with a lot of missing values, and a wide range of values going from as little as 5 dollars, to very high values. This affects the results as well. And of course the choice of countries affects the results. I have focused on choosing countries that lie both within and outside the CAP and that had at least some reported values for sugar exports. This means that I have included several big economies, like China and Brazil. It also means that there are relatively few small economies; since they do not really have many observations recorded when it comes to sugar export. I could, for example, have included more Asian and African countries, now there is only one of each. But the data accessibility, or lack thereof, lead me to choose the ten countries that are now in the sample.

6. Conclusion

In the light of EU's latest budget propositions for the CAP, described in the introduction, it is important to look at how trade in the agricultural sector is affected and how this goes with current economic thought. The lack of change in funds allocated to the CAP could indicate that it works well in its present form. However, several theories suggest that the protectionism in the CAP is counterproductive and that it may cause loss of welfare in the EU. My results from the empirical analysis - with the sugar industry as a reference case - shows indications that the CAP is trade distorting. Applying the gravity model to see if the CAP affects trade in the sugar industry has, to my knowledge, not been done before. Using this model there are some indications in the results that trade is diverted so that outside partners trade more with each other and less with EU countries than if the CAP would not exist.

Krugman's North-South model of trade suggests that developed countries should focus on new innovations instead of protecting industries where they have no comparative advantage. The protectionism in the CAP, and its trade distorting effects, shows that the EU does not comply with this economic theory. The theory warns that this type of protectionism can lead to decreases in welfare for the countries imposing them.

To give an idea as to why the protectionism still persists, I have in section 4 explained some of the reasons behind this. There are reasons why the CAP is difficult to change. In this thesis I have given a background that explains the main traits of the CAP and its origin. Many protectionist measures are still being used in the CAP despite pressure for change from trading partners and the WTO. Agricultural multifunctionality is considered a reason why this cannot change, at least not in the short term. But the CAP reforms that try to adapt the CAP to new goals such as rural development and environmental issues, have not been entirely successful. The old goals of the CAP still shine through. Support is still based on what has been given in the past in many cases, and ensuring that there is substantial agricultural production in the EU is still an important pillar for the CAP. This forms a policy that is not compliant with other economic goals, such as increased globalization and world trade. Despite economic theory saying developed countries should aim to increase innovation instead of protecting weak industries, the EU still lingers to a system of protectionist measures in non-competitive areas in the CAP.

7. Discussion and suggestions for further research

The sheer complexity of the CAP may be one reason why relatively few studies have been made on its effects on trade. The large quantity of products covered, new members entering as well as the vast number of different policies and goals make the CAP a policy difficult to grasp. This makes the topic intriguing, but it also means that a lot of restrictions have to be made in order to choose an amount of data for analysis that is manageable. Restrictions have to be made concerning what products, policies, years and countries to include in the analysis. Modeling the effect of the CAP as a whole would require an almost endless number of variables and data. The sugar industry makes a good case study due to the many protectionist measures that are imposed on it. However, this also means that the effects are difficult to distinguish and a lot of data would be required to make a completely reliable prediction of the trade effects of the CAP. The fact that the countries that are not in the EU also use protectionist measures in their sugar industries further complicates the matter.

Some of the results from the empirical analysis concerning the sugar industry are insignificant. There can be many reasons for this, some of which have been discussed in the analysis. To really see how the CAP affects trade, more data on the amount and type of protection received would have to be included in the model. Maybe particularly for the sugar industry, since prices and output are so distorted from the measures involved. Without the subsidies, EU production would most likely decrease significantly. These results do not really shine through when the subsidies are not included in the model. Today this data is difficult to access. There is currently a rather ambitious project going on to increase the transparency of how the agricultural subsidies are distributed.[24] But so far, only Sweden, Denmark and the United Kingdom have published detailed information on their subsidy recipients. And even with access to this data, the analysis would be harder to perform. Including subsidies and other measures would require time series of data on direct and indirect subsidies, tariffs and other barriers to trade. Trying to assemble and quantify these results for specific products would be difficult and time consuming but could give a more reliable model in the end.

An idea for further research could also be to include sugar production instead of GDP as a variable to control for the size of the economy. And possibly also to distinguish between sugar beet and sugar cane producers, to give an idea of how that differentiates production, price and trade.

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[24] farmsubsidy.org

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Databases:

CEPII: distance, colonial links.

UN COMTRADE: export data for the sugar industry.

UN statistics divisions, national accounts: GDP.

9. Appendices

Appendix 1: Hausman test

Test for choice of model – fixed or random

The Hausman test was applied to see if the random effects model was to be preferred to perform this test. The hypotheses for the Hausman test are as follows:

H_0: Random effects model is preferable.

H_1: Fixed effects model is preferable.

Table 7: Hausman test

Hausman test			
Cross-section random effects			
Test summary	Chi-square statistics	Chi-square d.f.	P-value
Cross-section random	31,38719	4	0,000

The significance level of 5% is higher than the p-value found in the test, meaning we can reject the null hypothesis (0,00…<0,05). The test thus tells us to use the fixed effects model. However, the time-invariant variable distance does not respond well to the fixed effects model. Therefore we will have to work with the random effects model in this case. The REM can produce inconsistent results under the alternative hypothesis, this may affect the reliability of the results. This is important to consider, and therefore the Hausman test provides us with useful information although we cannot apply the result with this specification of the model.

Appendix 2: Test for normality

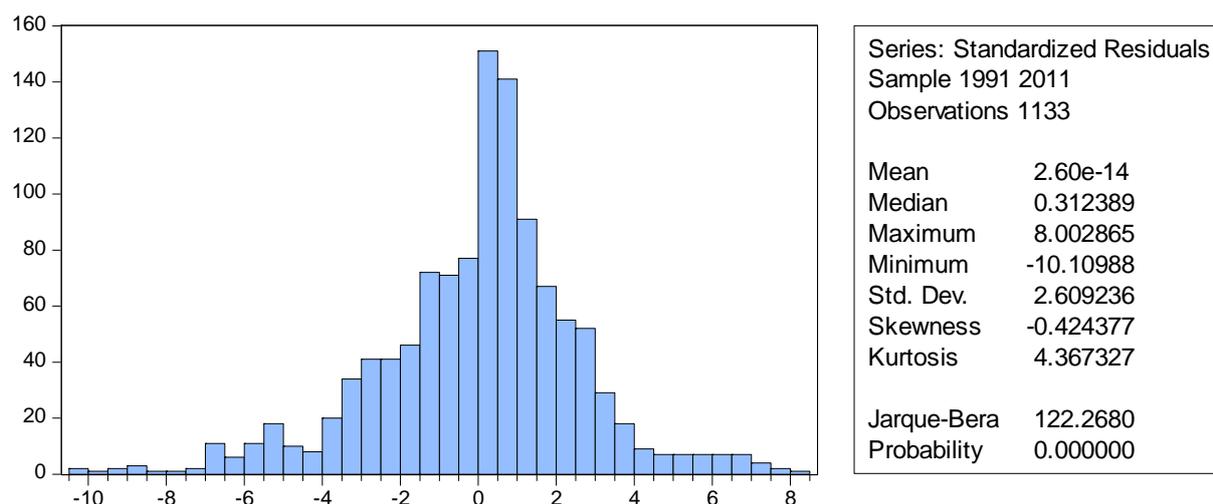| Series: Standardized Residuals	
Sample 1991 2011	
Observations 1133	
Mean	2.60e-14
Median	0.312389
Maximum	8.002865
Minimum	-10.10988
Std. Dev.	2.609236
Skewness	-0.424377
Kurtosis	4.367327
Jarque-Bera	122.2680
Probability	0.000000

Figure 1: Histogram and Jarque-Bera

Looking at the histogram in Figure 1 for the distribution of the residuals in the sample, they look quite normal, with some exceptions. There is no perfect bell-shape, but there is no evident skewness either. The distribution has a fat right-hand tail.

To test for normality, the Jarque-Bera test for normality is applied. The Jarque-Bera test for normality has these hypotheses:

H_0: There is normality in the residuals.

H_1: There is non-normality in the residuals.

The p-value for the JB-test is less than the significance level 5% (0,00…<0,05). This means that the H_0 can be rejected. There is, consequently, a problem of non-normality in the residuals. This may for example be a result of few included countries, only ten. It can also be due to the extreme differences in export values, some values are very low whilst others export vast amounts every year. One remedy could be to expand the number of observations. That is, however, not within the scope of this thesis.

Appendix 3: Spread of data

Figure 2 below shows how diverse the data for the sugar industry exports really is. Most values are relatively low, and some are extremely high. Since there are 90 country pairs and 21 years, not all are written explicitly below the graph although they are all included (true for all figures below), but especially Brazil stands out as a country that has massive export of sugar.
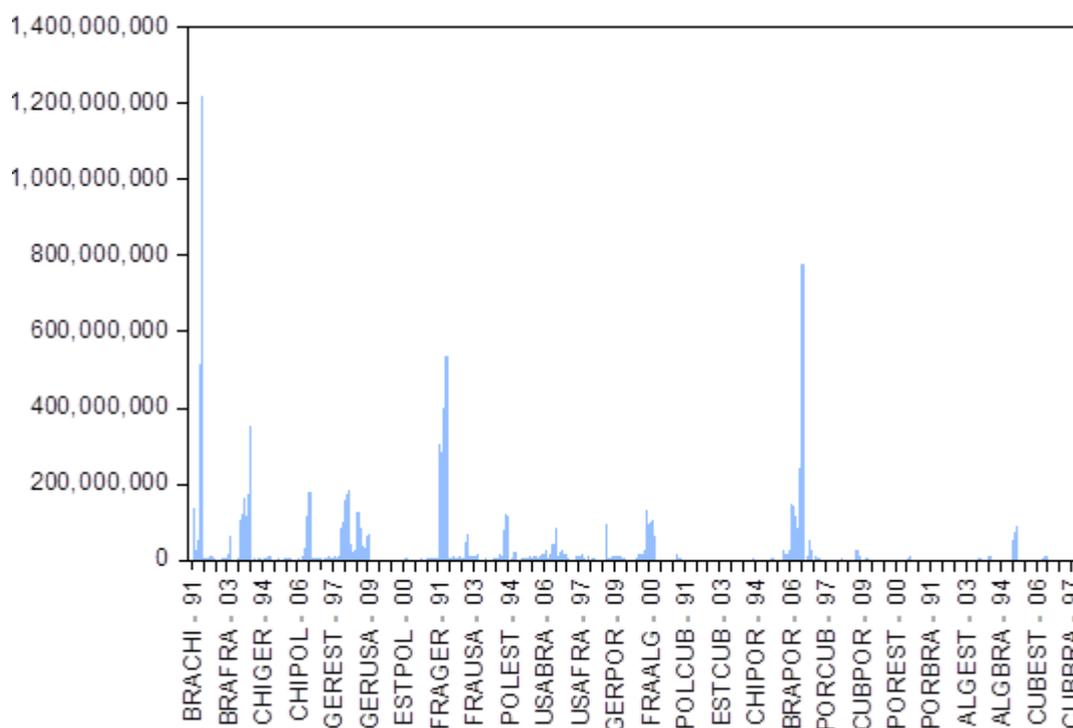

Figure 2: Export values

The spread of the GDP can be seen in Figure 3 below. It is almost as extreme as the export data, due especially to China and USA, that has GDPs much higher than the rest of the included countries. This shows that GDP is an important variable to include; controlling for the sizes of the economies included.
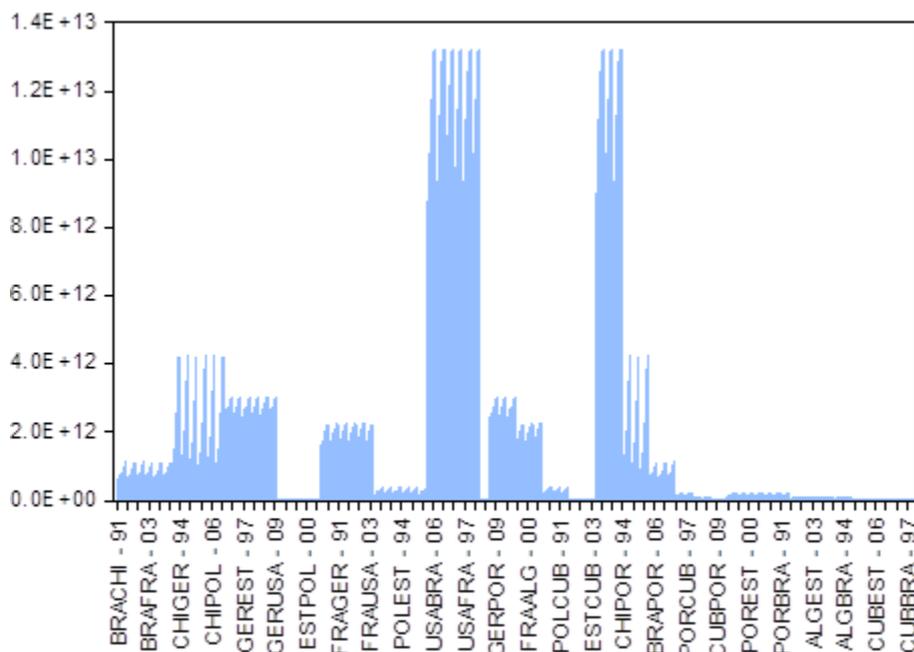

Figure 3: GDP

The distribution of the distance measures is shown in Figure 4 below. It is more evenly distributed than for example the export data. There are some outliers, but they are not as extreme as for the other data sets.
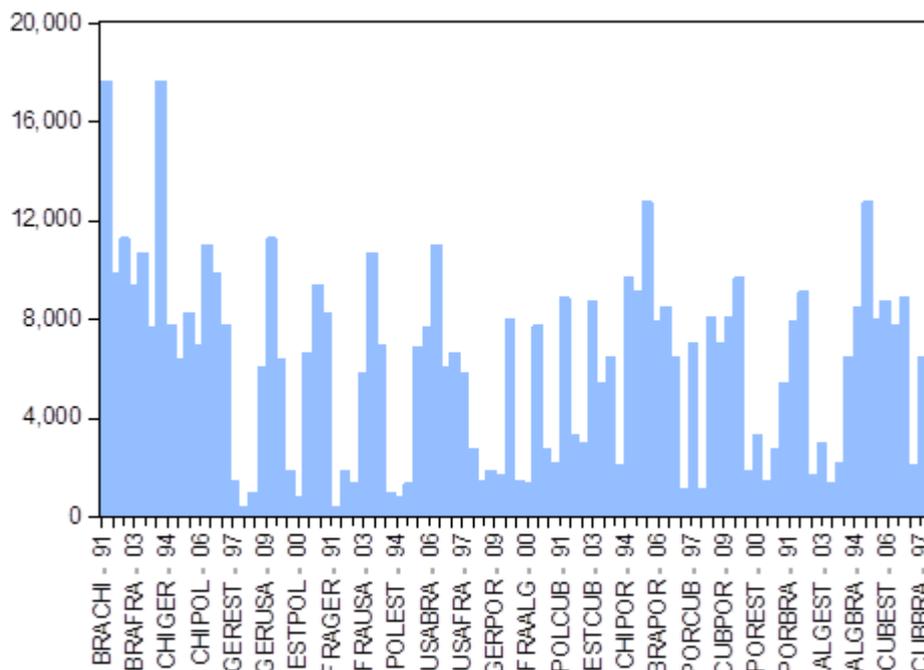

Figure 4: Distance

Appendix 4: Regressions without dummy variables

Since the data spread seen in the chosen variables was substantial, this appendix examines how the data responds to separation based on the CAP dummy variable criteria. To do this the first step was to separate the data so that all data where d_0 took the value 1 was in a separate bloc, e.g. containing trade flows from China to Brazil. This was done for all the dummy critera until one dataset had been separated into three. Included in Tables 8, 10 and 12 below are the descriptive statistics for these new data sets. Tables 9, 11 and 13 contain the results from running a regression for the model shown in Equation 4.

$$\ln X_{rst} = c + b_1 Y_{rt} + b_2 Y_{st} - b_3 dist_{rs}$$

(4)

It was run using a least squares regression with random cross sections for a dated panel. Comments on the results will be given for each of the data sets after their respective tables.

Table 8: Descriptive statistics for d_0 data set

Stat.	Export	Distance	GDP
Mean	35028220	7934,57	2,11E+12
Median	2223760	8112,74	2,61E+11
Max.	1,22E+09	17614,40	1,32E+13
Min.	99	831,04	7,10E+09
Std. Dev.	1,05E+08	3914,33	3,84E+12
Observations	297	706	706

Table 9: Results from REM, d_0 data set

Variable	Coefficient	Random Effects Model
Intercept	c	-12.22473**
GDP exporter	b1	0.351529**
GDP importer	b2	0.723601**
Distance	b3	-0.283543

**sign. at 1%-level

The d_0 data set has the most missing values as can be seen in table 8. Out of 706 possible observations, only 297 sugar export values were recorded. The missing data creates a bias. We cannot know exactly what this implies for the results, but it is possible to state that some countries have more missing values than others. For example, Algeria and Cuba in this data set have many missing values. To get a more reliable result for the d_0 data set, greater efforts to obtain a more complete data set would have to be undertaken.

The distance data is also the most diverse in this data set. These observations include Brazil, China, Algeria, Cuba and for certain years also Estonia and Poland. These economies vary greatly in size and sugar production, and the distance coefficient becomes insignificant in this model. The GDP proves to be a more significant factor in this data set.

Table 10: Descriptive statistics for d_1 data set

Stat	Export	Distance	GDP
Mean	7183867	5804,19	1,89E+12
Median	1194907	6653,48	7,35E+11
Max.	1,46E+08	11266,82	1,32E+13
Min.	5	956,92	7,10E+09
Std. Dev.	17032098	3156,04	3,09E+12
Observations	628	946	946

Table 11: Results from REM, d_1 data set

Variable	Coefficient	Random Effects Model
Intercept	c	-12.96950**
GDP exporter	b1	0.879954**
GDP importer	b2	0.458002**
Distance	b3	-1.222394**

**sign. at 1%-level

The data set making up the base for the d_1 variable consists of all country pairs where one country is a member of the CAP and one is not, so for example Germany and USA fall under this category. We see fewer missing values here (Table 10) than in the previous data set. However, almost a third of the observations for the sugar exports are missing. These observations include all the countries in the original data set, but only in combinations where only one is a member of the CAP.

The significance is high for all measured coefficients in this data set as seen in Table 11.

Table 12: Descriptive statistics for d_2 data set

Stat.	Export	Distance	GDP
Mean	51807106	1509,42	1,25E+12
Median	4486901	1452,86	3,99E+11
Max.	5,34E+08	3311,85	3,05E+12
Min.	23	439,90	1,28E+10
Std. Dev.	1,06E+08	784,44	1,14E+12
Observations	208	238	238

Table 13: Results from REM, d_2 data set

Variable	Coefficient	Random Effects Model
Intercept	c	-11.62765*
GDP exporter	b1	1.051315**
GDP importer	b2	0.023948
Distance	b3	-3.646683**

*sign. at 5%-level
**sign. at 1%-level

This data set containscountry pairs including the members of the CAP; France, Germany Portugal, and Estonia and Poland from 2004 and onwards. The last data set, making up the basis for the variable d_2, has the fewest observations but the best data accessibility for exports as can be seen in Table 12.

In Table 13 it can be seen that this data set gets the strongest negative impact of distance. This is probably a result of the strength of the French and German economies. They are neighbors and the EUs biggest economies. The other, more peripheral economies have very low values of trade compared to them. The GDP of the exporter has a strong positive result.

In general, there are some variations in these three data sets that are worth noting. The data accessibility for the sugar exports varies significantly, and the number of sought after observations also varies. However, even though the results vary somewhat, the differences are not extreme. For example, the intercepts are quite close to each other over the three data sets. So even though the intercepts vary a lot across country pairs in the whole data set, they are quite even over these three separate parts of the data.

Appendix 5: A note on sugar production

Exact figures on sugar production, with the same definition as for the export values, is not easy to find. Table 14 gives an estimation of sugar production for the world's biggest producers for the last couple of years.

These values are collected from the United States Department of Agriculture.[25]

Table 14: Sugar production in 1000 metric tons, raw value

Producer	2008/2009	2009/2010	2010/2011	2011/2012
Brazil	31850	36400	38350	36150
India	15950	20637	26574	28800
EU-27	14014	16687	15699	18251
China	13317	11429	11199	12341
…	…	…	…	…
World total	143888	153517	161762	172148

The EU is the third largest producer, despite its unsuitable climate for sugar production, further strengthening the idea that the support in this sector is a big factor in the world sugar market as a whole and the EU market in particular.

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[25] USDA FAS (Nov 2012), Table 2.