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# EU Milk Quota Abolition

What are the Effects on Intra-Union Trade?

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Author: Kristin Persson  
Supervisor: Joakim Gullstrand

## Abstract

On 1 April 2015, the EU milk quotas were abolished after 30 years in force. The purpose of this paper is to assess the Intra-Union trade effects of the reform, using the gravity model of trade. In particular, the aim is to find out whether competitive Member States have started to export more dairy products as compared to the non-competitive Member States following the reform. In order to perform the analysis, the paper uses monthly import data for the EU-15 countries between 1 April 2013 and 31 March 2016. Because of the large number of zero trade values present in the dataset, three different models are specified. The first is a fixed effects model where the zero values are left out of the sample. The second is a fixed effects model where the zero values are retained. The third is a poisson fixed effects model. The results from the poisson fixed effects model show a statistically significant relationship between the EU milk quota reform and trade. According to the estimation outputs, the exports of competitive Member States have increased by 14.5 per cent more in total or 2.3 per cent more per month than those of the non-competitive Member States. In terms of policy formulation, this is an important result, as it suggests that the EU milk quota abolition may have great implications for the location of dairy production within the Union in the future.

Keywords: Common agricultural policy, milk quotas, trade, gravity model, panel data.

# Table of Contents

- 1. Introduction..... 3**
- 2. The CAP and the Milk Quota System..... 5**
  - 2.1 The Original CAP..... 5
  - 2.2 The Reformed CAP..... 6
  - 2.3 The Milk Quota System..... 6
- 3. The Potential Impacts of Abolishing Milk Quotas..... 9**
  - 3.1 The Removal of a Quota..... 9
  - 3.2 Comparative Advantages and Specialization..... 11
  - 3.3 Policy Implications..... 13
- 4. The Gravity Model..... 15**
  - 4.1 Background..... 15
  - 4.2 The Gravity Model and Milk Quotas..... 16
- 5. Data..... 17**
  - 5.1. Data Collection..... 17
  - 5.2 Zero Trade Flows..... 18
  - 5.3 Model Specification..... 19
  - 5.4 The Fixed Effects Model..... 20
- 6. Results..... 21**
  - 6.1. Regression Results..... 21
  - 6.2 Robustness..... 23
- 7. Conclusion..... 24**
- 8. References..... 25**

# 1. Introduction

The Common Agricultural Policy (CAP) is the agricultural and rural policy of the European Union (EU). It was introduced in 1962 as a way of keeping agricultural prices high and stable. For these purposes, the CAP established a price floor so that the farmers would get a minimum price for their output. For many products, these prices were between 50 and 100 per cent higher than the world market prices. However, even since its initiation, the CAP has encountered a lot of criticism. It has been criticized for its cost (it still accounts for approximately 40 per cent of the EU budget) but also because of its environmental and trade-related impacts. For these reasons, the CAP has undergone several reforms aimed at making it more market-oriented and competitive. The most recent are the CAP 2014-20 reforms that are currently being implemented (Baldwin and Wyplosz 2015, pp. 218-219). These reforms include, among other things, the abolition of the milk quota system, further considered below.

The EU milk quota system was originally introduced in 1984 as a way of limiting milk production and stabilising milk prices (Commission 2009, p. 1). Prior to that, EU farmers had been granted a certain price for their milk, a price that was significantly higher than that on the world market. After the introduction of the quotas, the Member States had two limits to handle: one that defined the maximum amount of milk delivered to dairies and one that defined the maximum amount sold at farm level. If these limits were exceeded, farmers were obliged to pay a levy (Marquer 2015, p. 1). Over the years, it has become clear that the milk quota system is distorting the market and maintaining milk production in less competitive regions. Moreover, gradual quota increases together with lower productivity among dairy farmers have rendered the quotas non-binding in some regions. Against this background, the Commission in 2008 decided that the milk quotas were to be abolished as from 1 April 2015. In order to allow for a “soft landing” of the milk sector, the Commission proposed to increase the quotas by 1 per cent annually between 2009 and 2013 (Commission 2009, p. 1).

The purpose of this paper is to assess the Intra-Union trade effects of the milk quota abolition. In particular, the aim is to find out whether competitive Member States (defined as those that produced close to their allocated quotas or exceeded the limits in the quota year 2013/14) have started to export more dairy products as compared to the non-competitive Member States (defined as those that underutilised their quotas in the same year) following the reform.

This question is important to study for two main reasons. *First*, there has been a fear among dairy farmers that the reform would result in higher production in competitive countries, such as Ireland, Denmark and the Netherlands, significantly harming farmers in less competitive countries, such as Sweden and Finland. By conducting this study, it will be possible to see whether such concerns have any foundations in the real world. *Second*, although there are a lot of studies investigating the *expected* effects of abolished milk quotas, very few studies have been carried out after the reform was implemented on 1 April 2015. Therefore, the paper fills a gap by examining the relationship between the reform and the actual trade flows.

In order to answer the above question, the paper will examine the bilateral trade flows between the EU-15 countries before and after the quotas were abolished on 1 April 2015. More specifically, the paper will compare the value of each country's imports of raw milk and milk powder 24 months prior to the reform was implemented with the corresponding figures 12 months after the reform was implemented. The relevant data will be obtained from UN Comtrade, the Milk Market Observatory, the Swedish Board of Agriculture, the World Development Indicators (WDI) and the International Monetary Fund (IMF). When analysing the data, the paper will make use of the gravity model. Generally speaking, the gravity model is based on the idea that trade between two countries is a function of their size, their distance and a number of policy variables (WTO 2012, p. 103). For present purposes, the gravity model will include a slope dummy variable, capturing the extent to which competitive Member States have started to export more dairy products as compared to the non-competitive countries following the reform. The hypothesis is that this is indeed the case.

The rest of this paper will be structured as follows. The *second* section, next, will provide a background to the CAP and the milk quota system. Building on this section, the *third* section will focus on the anticipated effects of abolishing milk quotas, such as a potential shift in production from uncompetitive countries to competitive ones. The *fourth* section will then set out the gravity model and apply it to the milk quotas. The *fifth* and *sixth* sections will describe the data and the empirical findings. Finally, the *seventh* section will provide a conclusion.

## 2. The CAP and the Milk Quota System

In order to get a good understanding of the milk quota reform, this section will start by providing a short background to the CAP. It will then have a look at the milk quota system.

### 2.1 The Original CAP

After the Second World War, Europe faced a lot of problems, such as rural poverty, low productivity in agricultural farming and price fluctuations. When the Treaty of Rome entered into force in 1957, it therefore set out five objectives for the CAP: to increase agricultural productivity, to achieve a fair standard of living for the agricultural population, to stabilize prices, to ensure self-sufficiency in food products and to offer reasonable prices to the consumers (Ackrill et al. 2008, p. 394). To achieve these objectives, the CAP established a price floor so that the prices paid to EU farmers would never fall below a certain level. Given that the EU at that time imported most of its food products, a good way of achieving this was by introducing a variable tariff on imports (Baldwin and Wyplosz 2015, pp. 219-220).

However, in the 1960s and 70s, productivity among EU farmers increased dramatically. This was partly due to the CAP (higher internal prices made room for higher production costs) but also because of rapid technological change in the agricultural sector (Baldwin and Wyplosz 2015, p. 225). When supply went up, taxing imports was not a workable solution anymore. Instead a second mechanism of price support was activated: the EU had to buy all the surplus production at the internal price. As Ackrill et al. (2008, pp. 396-397) point out, this intervention buying generated two categories of problems: budgetary and trade-related. As for the first category, the balanced budget rule (BBR) introduced by the Treaty of Rome implied that the EU could not borrow to spend. In order to finance the intervention buying, it thus had to take money from some countries (such as Germany and eventually Sweden) and hand it over to other countries (such as Ireland). This created tensions between demand and supply regions in the EU. As for the second category, the EU faced the problem of what to do with the oversupply. While some of the food was disposed on the EU market, most of it was sold at the world market at subsidized prices. When the supply of food on the world market went up, the prices went down, which harmed the natural exporters of the subsidized goods. All in all, this meant that the CAP had to be reformed. This will be further considered below.

## 2.2 The Reformed CAP

The first major change of the CAP came with the *MacSharry reforms* in 1992. Generally speaking, the MacSharry reforms had two important components. *First*, they reduced the prices paid to farmers by eliminating the export subsidies. *Second*, they provided compensation to farmers by so-called “decoupled direct payments”. The basic idea behind these payments was that they did not link support to production levels, thus reducing the problem of oversupply (Ackrill et al. 2008, p. 401). Following the MacSharry reforms, there have been three major reforms of the CAP, all pushing the same mechanisms even further. The first was the *Agenda 2000 package* in 1997, which linked the decoupled payments to non-economic goals, such as animal welfare, the environment and rural development. The second was the *CAP mid-term review* in 2003, which introduced the “single farm payments”. In contrast to the decoupled payments (which required some sort of production), these payments were made completely independent of production levels. The third was the *CAP 2013 reform*, which set out the major outlines of the CAP for the period 2014-20. In addition, the EU in 2008 undertook a review that is commonly known as the “Health Check”. Importantly, this agreement pushed the market orientation of the CAP even further by liberalizing one of the most resistant sectors of the EU – the dairy sector (Baldwin and Wyplosz 2015, p. 235). Indeed, this brings us to the issue of milk quotas, considered below.

## 2.3 The Milk Quota System

As far as the dairy sector is concerned, it was heavily influenced by the price supports as described above. Just as with other commodities, dairy farmers were guaranteed a certain price for their milk, a price that was significantly higher than that on the world market. Due to the higher incomes, farmers were able to upgrade their production techniques and increase their output. During the 1960s and 70s, the EU thus went from being a net importer of dairy products to produce excessive supply (Binfield 2009, p. 72). In order to keep internal prices high, the EU had to buy the oversupply at the domestic price or export it with the help of subsidies. As Ackrill et al. (2008, p. 398) point out, this was extremely costly and by the 1980s the dairy sector accounted for almost a third of the CAP budget and a quarter of total EU expenditures. Moreover, it gave rise to large stocks of butter and milk powder, commonly referred to as the “milk lakes and butter mountains” (Baldwin and Wyplosz 2015, p. 227).

In order to deal with the oversupply of dairy products, the EU faced the option between reducing the prices paid to farmers and limiting the quantities they produced. Ultimately, it went for the latter option and a milk quota system was established in 1984 (Kempen et al. 2009, p. 29). The economic effects of introducing a production quota are illustrated in Figure 1, which shows a standard supply and demand diagram applied the dairy market. As usual, the price,  $P$ , is on the vertical axis, and the quantity,  $Q$ , is on the horizontal axis. The downward sloping demand curve,  $D$ , illustrates how much consumers are willing to buy at a given price. The upward sloping supply curve,  $S_1$ , illustrates how much producers are willing to supply at a given price. The point at which the two curves intersect defines the free market equilibrium, that is the price,  $P_M$ , and the quantity,  $Q_M$ , that will arise in the absence of quotas.

When a quota is introduced, it imposes a limit on the maximum amount of goods that may be produced,  $Q'$ . Given that producers will not be able to supply above the quota level, this causes the new supply curve,  $S_2$ , to become vertical at the quantity of the quota. The point at which the new supply curve and the original demand curve intersect defines the new market equilibrium. At this point, the quantity,  $Q'$ , is lower than before and the price,  $P'$ , is higher. The difference between the price farmers are willing to supply for,  $P''$ , and the price provided for by the market,  $P'$  is known as the “quota-rent”. The quota-rent will typically be captured by the farmers in the form of a higher price (Lips and Rieder 2005, p. 3, Réquillart 2008, pp. 25-26, Commission 2009, p. 12 and Baldwin and Wyplosz 2015, pp. 100-102).

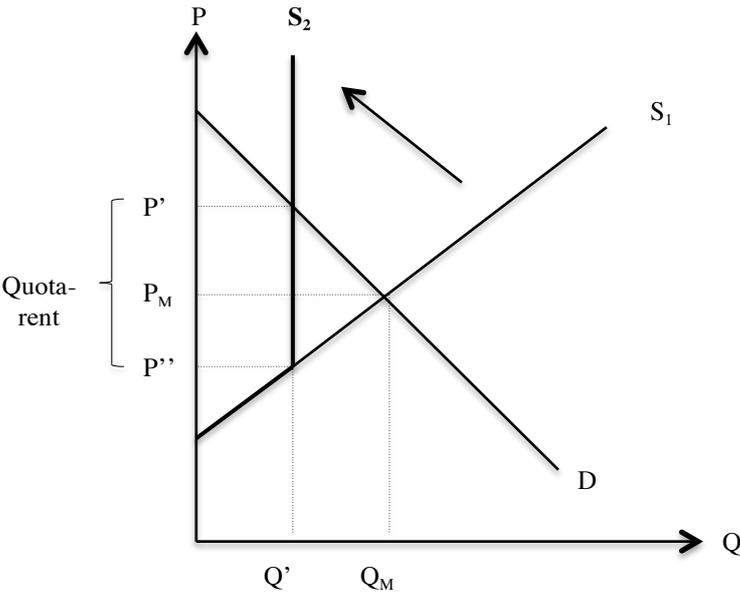


Figure 1: The economic effects of introducing a production quota (own illustration).

As far as the EU milk quota system was concerned, it set out two types of quotas: one that determined the maximum amount of milk delivered to dairies and one that defined the maximum quantities of milk sold at farm level. The quotas were determined on the basis of historical production levels and re-evaluated every year. If the amount of delivered milk exceeded the quota levels the farmers (via the Member States) were obliged to pay a levy (Marquer 2015, p. 1 and Binfield 2009, p. 72). Originally, the system was only intended to stay in place for five years. However, given that it was not restrictive enough to reduce the oversupply, it had to be further tightened during the 1980s and 90s (Binfield 2009, p. 72).

As Marquer (2015, p. 3) points out, the quotas were successful in reducing the oversupply. Over the course of the next three decades, production of milk among the EU Member States never reached the 1980 levels again. Moreover, once they were introduced, the quotas became a valuable asset to the farmers who were able to capture the quota rent (see Figure 1 above). According to Binfield (2009, p. 73), this can perhaps explain why, in contrast to other commodities, the milk quotas retained their basic structure for a very long time. While the CAP mid-term review in 2003 resulted in decoupled payments for many sectors, it only set out vague statements for the dairy sector. In fact, it was not until the Health Check in 2008 that the Commission decided that the quotas were to be abolished as from 1 April 2015. Apart from an underlying aim of making the EU dairy policy more market-oriented, the main reason was that quota increases in various Member States together with lower productivity among dairy farmers had rendered the quotas non-binding in some regions. Moreover, the quotas had had the effect of distorting production towards less efficient regions (Commission 2009, p. 1).

In order to allow for a “soft landing” of the dairy sector, the Commission in the Health Check agreement proposed that the quotas were to be increased by 1 per cent annually between 2009 and 2013, resulting in a total increase of 5 per cent. The gradual increase would apply to all Member States except for Italy, which would get their full 5 per cent immediately because of chronic overproduction. From 1 April 2013, the quota levels would be held constant until the expiry of the system on 1 April 2015 (Commission 2009, p. 1 and Binfield 2009, p. 73). With this in mind, the next section will turn to discuss the potential impacts of abolished quotas.

### 3. The Potential Impacts of Abolishing Milk Quotas

In order to understand the possible impacts of the milk quota reform, this section will start by illustrating what happens when a quota is removed and how it reinforces the importance of comparative advantages. It will then turn to some empirical studies on the subject.

#### 3.1 The Removal of a Quota

When a production quota is removed, two things will happen. *First*, the supply curve will shift back to its original position,  $S_1$ , and the market will return to its original equilibrium, illustrated in Figure 2. At this point, the price,  $P_M$ , is lower than before and the quantity,  $Q_M$ , is higher. Moreover, given that there is no longer any difference between the market price and the price farmers are willing to supply for, the quota-rent will be lost (Réquillart 2008, p. 26).

*Second*, when a production quota is removed, there will be a redistribution of production between Member States, illustrated in Figure 3. As can be seen, the competitive country has a supply curve,  $S_C$ , that is to the right of that of the non-competitive country,  $S_N$ . With quotas in place, both countries produce a quantity that is equal to the quota level, that is  $Q'$ . However, when quotas are removed, the competitive country will increase its production to the point at which its supply curve,  $S_C$ , equals the price provided for by the market,  $P_M$ , that is quantity  $Q_C$ . Conversely, the non-competitive country will decrease its production to the point at which its supply curve,  $S_N$ , equals the price provided for by the market,  $P_M$ , that is quantity  $Q_N$ . In sum, the total quantity is likely to be greater than before. Generally speaking, this is because production now moves to those countries that have a comparative advantage in producing the good, discussed in section 3.2. This, in turn, means that the aggregate supply curve will shift downwards from  $S_1$  to  $S_3$ , illustrated in Figure 4. The point at which the new supply curve,  $S_3$ , and the original demand curve,  $D$ , intersect defines the new market equilibrium. At this point, the quantity,  $Q^3$ , is higher than before and the price,  $P^3$ , is lower (Réquillart 2008, p. 26).

All in all, the policy implications that can be derived from the theoretical framework are that (i) the dairy prices will be lower, (ii) the total quantity supplied will be higher and (iii) the most competitive countries will start to increase their production as compared to the non-competitive countries. As far as this paper is concerned, the third effect is the most important.

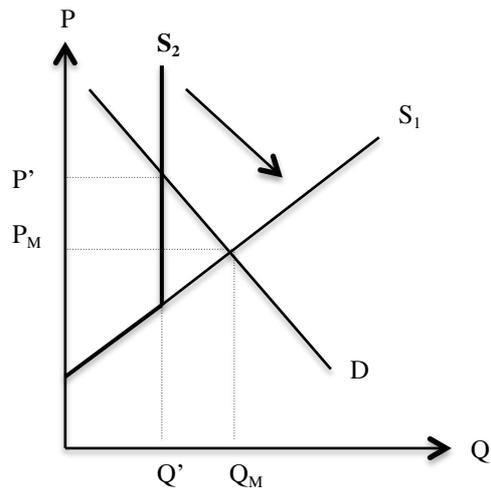


Figure 2: The short-term effects of removing a production quota (own illustration).

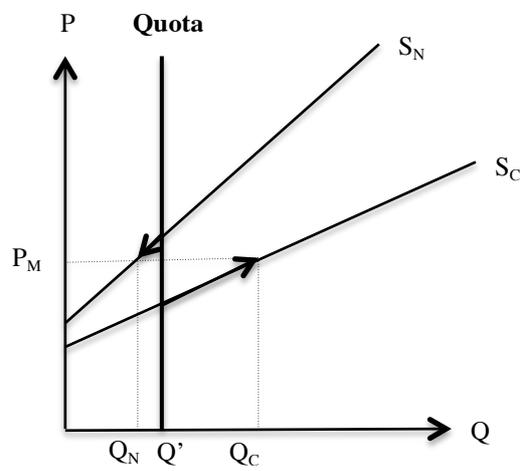


Figure 3: The different effects for competitive and non-competitive countries (own illustration).

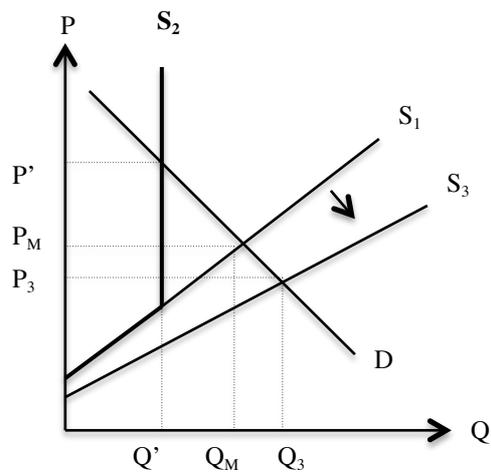


Figure 4: The long-term effects of removing a production quota (own illustration).

## 3.2 Comparative Advantages and Specialization

As can be seen from the above, removing milk quotas is a way of liberalizing the market. Once the quotas are removed, the most competitive countries will start to increase their production, while the non-competitive countries will decrease their production (see Figure 3). According to economic theory, this can be explained by the fact that when markets are liberalized, countries will concentrate its production resources to sectors where they have a comparative advantage over other countries. Generally speaking, comparative advantages may arise from a number of factors, such as differences in natural resources, land allocation and technology. The basic assumption is that countries will export goods in which they have a comparative advantage and import goods in which they have a comparative disadvantage. This, in turn, can have important implications for the location of an industry given that it encourages country-by-country specialization (Baldwin and Wyplosz 2015, pp. 247-249).

As far as the dairy sector is concerned, differences in comparative advantages are of great importance. As the Commission (2009, p. 1) and Kempen et al. (2011, p. 30) point out, the preconditions for producing milk vary significantly across countries and regions. This reflects differences in climate conditions, natural resources, demand characteristics (such as cheese production), herd size, specialization and management skills. In general terms, the most competitive countries are to be found in the north-western and eastern parts of the EU, while the less competitive countries are to be found in the northern parts (Commission 2009, p. 9).

In empirical studies, there are different ways of measuring the comparative advantage of a country. One way, used by Lips and Rieder (2005, p. 10) as well as Kempen et al. (2011, p. 37) is to look at the quota-rents. However, the quota-rents are not observable and difficult to calculate (Binfield 2009, p. 80). Therefore, another way, used by for example Vóneki et al. (2015, p. 3) is to look at quota utilisation, which measures the percentage extent to which a country has produced in accordance with its allocated quota in a given year. For the purposes of this paper, figures on milk quota utilisation have been gathered from the Swedish Board of Agriculture and the EU Milk Market Observatory. They are presented in Table 1 and Figure 4 (which display the same figures in two different ways) and cover two time periods: when the soft landing began in 2009/10 and when it ended in 2013/14. By analysing these figures, it is possible to identify some important trends when it comes to dairy production in the EU.

Country/ Year	2009/10	2013/14	Competitive
Austria	-1.5	+3.2	Yes
Belgium	-3.7	+0.0	Yes
Denmark	+0.4	+2.1	Yes
Finland	-10.5	-12.8	No
France	-8.8	-6.8	No
Germany	-2.1	+1.9	Yes
Greece	-17.5	-28.8	No
Ireland	-10.3	+0.6	Yes
Italy	-3.7	-1.1	No
Luxembourg	-0.9	+1.0	Yes
Netherlands	+0.4	+4.0	Yes
Portugal	-7.7	-14.6	No
Spain	-6.1	-2.2	No
Sweden	-17.7	-21.4	No
United Kingdom	-12.1	-10.6	No

Table 1: Milk quota utilisation in percentage among the EU-15 countries in 2009/10 and 2013/14 (the Swedish Board of Agriculture and the EU Milk Market Observatory).

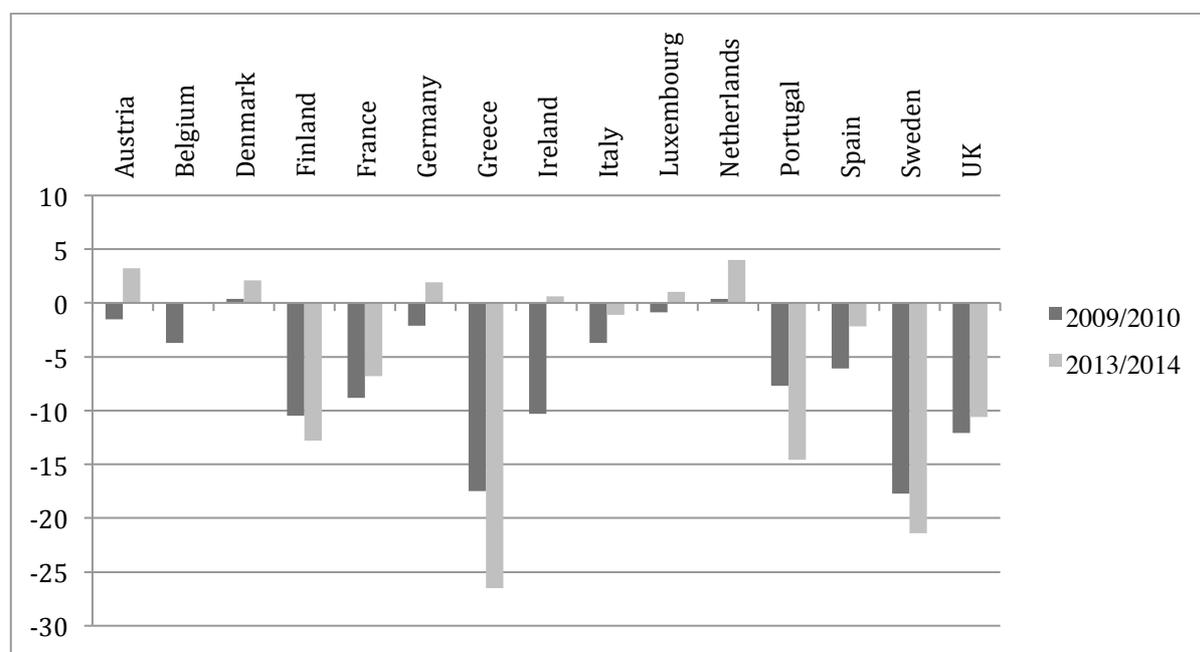


Figure 5: Milk quota utilisation in percentage among the EU-15 countries in 2009/10 and 2013/14, shown in a chart (own illustration using data from the Swedish Board of Agriculture and the EU Milk Market Observatory).

The figures show that in the quota year 2009/10, which marked the beginning of the soft landing period, only two of the EU-15 countries, namely Denmark and the Netherlands, exceeded their quota limits. The rest of the countries produced below, or significantly below, the quotas. On average, the EU-15 countries produced 7 per cent below the quotas. By contrast, when the soft landing period ended in 2013/14, seven of the EU-15 countries, namely Austria, Belgium, Denmark, Germany, Ireland, Luxembourg and the Netherlands, produced in accordance with their allocated quotas or exceeded the limits. However, those countries that in 2009/10 significantly undershoot their quotas, such as Sweden, Finland and Greece, undershoot their quotas even more in 2013/14. This suggests that during the soft landing period, the competitive countries have increased their production while the non-competitive ones have decreased theirs. On average, the EU-15 countries produced 5 per cent below the quotas, suggesting an overall increase in production. When the quotas are completely abolished on 1 April 2015, this pattern can be expected to continue or even grow. Indeed, this brings us to some of the empirical studies that have been made on the subject.

### 3.3 Policy Implications

In order to predict the effects of abolished milk quotas, several studies have been carried out by both the EU bodies and independent researchers. What is interesting to note is that most studies seem to come to the same conclusions, the main points of which will be set out below.

The first thing to note is that the EU Member States can be expected to produce more milk after the quotas have been abolished. Indeed, this is well in line with the theoretical implications set out in section 3.1. While the Commission (2010, p. 4) predicts an increase of 8 per cent between 2009 and 2020, Vöneki et al. (2015, p. 7) expect milk production to increase by 5 to 7 per cent between 2015 and 2020. The increase in milk production is likely to come about in those countries that have previously produced in accordance with their allocated quotas or exceeded the limits. When quotas are abolished, these countries will be ready to expand their production, using already existing resources, such as dairy herds and land (Binfield 2009, p. 82 and Vöneki et al. 2015, p. 7). In particular, milk production is likely to increase in Austria, Ireland, Denmark, Germany, the Netherlands and Luxembourg (Commission 2009, p. 4 and Lips and Rieder 2005, p. 15). These are largely the same countries that have been defined as competitive for the purposes of this paper.

When milk production increases, this will exert a downward pressure on producer prices. It can be observed that this also corresponds well with the theoretical implications set out in section 3.1 According to Kempen et al. (2011, p. 38), dairy prices can be expected to decrease by approximately 10 per cent following the removal of quotas. This view is shared by Réquillart (2008, p. 4) who anticipates a price drop of 10.3 per cent. In the long run, the lower dairy prices will exert an economic pressure on countries in less competitive regions that have previously benefitted from the quota system. In particular, milk production is likely to decrease in Sweden, Finland, Greece and Portugal (Commission 2009, p. 4 and Lips and Rieder 2005, p. 15). In these countries, farmers will start to leave the industry and consumers will switch from domestically produced dairy products to cheaper imported ones. This means that these countries can be expected to import more dairy products as compared to before (Binfield 2009, p. 82 and Vóneki et al. 2015, p. 6). All in all, most authors seem to agree on the fact that there will be a reallocation of production resources following the reform: competitive countries will start to export more dairy products and non-competitive countries start to import more, causing an overall increase in bilateral trade flows. This is also the central hypothesis of this paper, which will be tested empirically in the following sections.

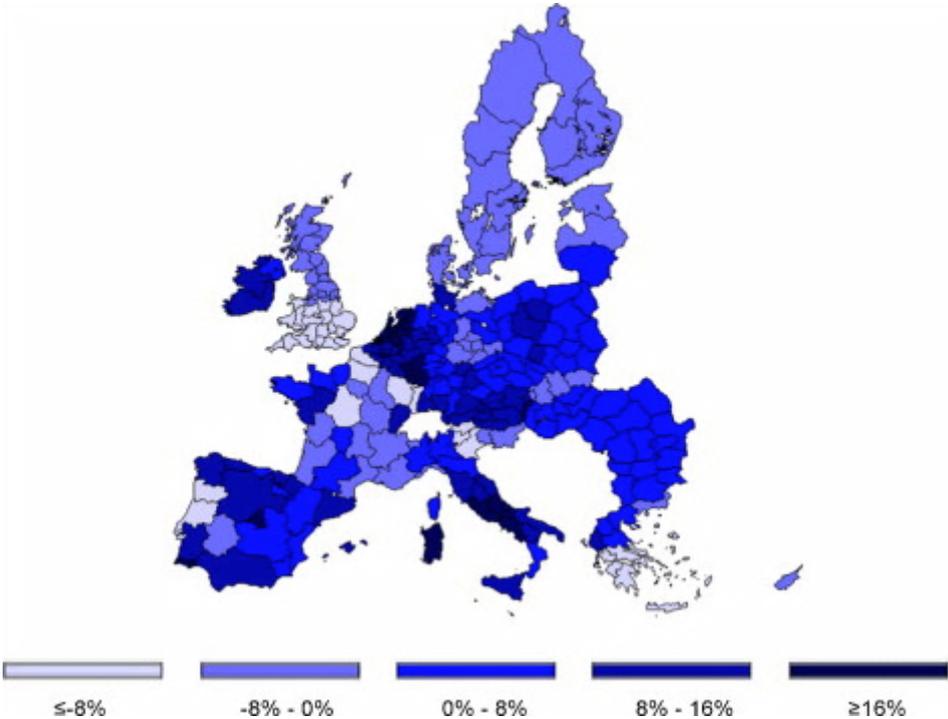


Figure 6: The projected percentage changes in milk production among the EU Member States between 2015 and 2020 (Commission 2009, p. V).

## 4. The Gravity Model

### 4.1 Background

When assessing how various policy measures (such as abolished milk quotas) affect trade, it is common to make use of the gravity model. It is an econometric model, which can be traced back to Isaac Newton's theory of gravitation, saying that two objects are attracted to each other in proportion to their sizes and proximity. In 1962, the Dutch economist Jan Tinbergen found that the same line of reasoning could be applied to bilateral trade flows between countries, thus implying that countries trade in proportion to their respective GDPs and geographical distance. Intuitively, this reasoning makes good sense for two main reasons. *First*, larger countries tend to import and export more because there are more consumers and producers. *Second*, countries that are far away from each other trade less because there are more costs involved, such as transportation and communication costs. Over the years, the gravity model has been extended and improved by a wide range of economists, such as Anderson in 1979, Bergstrand in 1985 and 1989 and Anderson and van Wincoop in 2003 (WTO 2012, pp. 104-105). In its current form, the gravity model reads as follows:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left( \frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (1)$$

where  $X_{ij}$  represents the bilateral trade flow from country  $i$  to country  $j$ ,  $Y_i$  and  $Y_j$  are the GDPs of the two countries,  $Y$  is the world GDP,  $t_{ij}$  is the cost in  $j$  of importing a good from  $i$  (the trade cost function),  $\sigma$  is the elasticity of substitution and  $\Pi_i$  and  $P_j$  are the multilateral resistance terms (the trade costs towards the rest of the world). Given the multiplicative nature of the gravity model, it is possible to take the natural logarithm of both sides and obtain a linear model that can be estimated using Ordinary Least Squares (OLS). However, as will be seen in section 5, this may not be the optimal approach when it comes to the present dataset.

What is important to note is that apart from geographical distance, the trade cost function,  $t_{ij}$ , can account for a wide range of other bilateral trade costs (or their inverse), such as whether the countries share a common border, speak the same language or have entered into a preferential trade agreement (WTO 2012, p. 106). This will be further considered below.

## 4.2 The Gravity Model and Milk Quotas

As was mentioned above, the trade cost function is of great importance when applying the gravity model. For these purposes, Anderson and van Wincoop (2004, p. 691) define trade costs as “all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself”. This includes, among other things, costs imposed by policy (tariffs, nontariff barriers to trade and quotas), transportation costs, information costs and costs associated with the use of different currencies and different regulatory systems. As far as agriculture is concerned, Anderson and van Wincoop recognize that trade costs often come in the form of quantitative restrictions rather than direct tariffs, which makes them hard to calculate. Indeed, this brings us to the issue of milk quotas, further considered below.

When milk quotas are abolished, it is the same thing as if a trade cost was removed. Thus, when  $t_{ij}$  gets smaller, one would expect  $X_{ij}$  to increase. As was pointed out in section 3, this makes good sense for the following reason. When milk quotas are abolished, production will tend to move towards those regions that are the most efficient in producing the good, such as Ireland, Denmark, Austria, the Netherlands and so on. When these regions start to produce and export more dairy products, other less efficient regions, such as Sweden and Finland, will start to produce less and import more. This means that the overall bilateral trade flows from country  $i$  to country  $j$  at time  $t$  can be expected to increase following the removal of quotas.

In empirical studies, trade costs are often modelled using dummy variables, taking the value one if a certain condition is true and zero otherwise. Common examples include dummies for islands, landlocked countries and common borders (WTO 2012, p. 106). In this paper, there will be a slope dummy variable, denoted  $\delta_i^*T$ , capturing the extent to which competitive countries have started to export more dairy products as compared to the non-competitive countries following the reform. Moreover, there will be a trend variable, denoted  $\delta_i^*R$ , capturing the same effect on a monthly basis. This will be further discussed in section 5.4

## 5. Data

### 5.1 Data Collection

In order to answer the research question, data on bilateral trade has been collected from UN Comtrade, which is a well-established database providing statistics to researchers, policy makers and so on. The data consists of monthly import data for the EU-15 countries, that is Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK, over the period from 1 April 2013 to 31 March 2016, that is a total of 36 months. The reason why the analysis has been restricted to the EU-15 countries is that these countries have faced the same CAP already from the start, while the new members of 2000 initially faced a somewhat different system. In order to get a fairly wide coverage, data has been collected for two product categories: “0401 – Milk and Cream, neither concentrated nor sweetened” (product 1) and “040210 – Milk powder < 1.5 % fat” (product 2). In sum, the data consists of 15 120 pairwise observations ( $36 \cdot 15 \cdot 14 \cdot 2$ ).

Moreover, data on GDP has been gathered from the World Development Indicators (WDI) and estimates for the year of 2016 has been taken from the International Monetary Fund (IMF). These datasets will be used to carry out a robustness analysis, described in section 6.2. However, in the main regressions, the data on GDP will not be included for two main reasons. *First*, it was hard to find a reliable observation for 2016. *Second*, when dealing with monthly data over a short sample period, GDP cannot be expected to vary significantly over time. By using country-pair fixed effects, it will be possible to capture country-specific characteristics, such as importer and exporter GDP, further discussed in section 5.4 (WTO 2012, p. 110).

Finally, in order to categorize the countries as competitive or non-competitive for the construction of the dummy variables, data on milk quota utilisation for the quota years of 2009/10 and 2013/14 has been gathered from the Swedish Board of Agriculture and the EU Milk Market Observatory. These figures are presented in section 3.2 above.

## 5.2 Zero Trade Flows

When analysing bilateral trade flows, a common problem is how to deal with zero trade flows in a year between two countries. As WTO (2012, p. 113) points out, this is particularly likely to occur when analysing trade in one particular good (such as milk). Generally speaking, zero trade values can be “true” in the sense that there was no trade between the two countries in that specific year or “false” because of reporting errors. If the zeroes are randomly distributed, they can be dropped out of the sample given that they are not informative. This can be done by simply taking the logarithms of the trade values, which will then make the zero values disappear. This is sometimes referred to as a truncated sample (WTO 2012, p. 112 and Westerlund and Wilhelmsson 2011, p. 5). However, if the zero values reflect the fact that there was actually no trade between the countries or are the result of systematic errors, leaving them out of the sample will produce inconsistent results. In that case, one might instead want to keep the zeroes by adding a small constant (+1) before taking the logarithms. This way, the zeroes will be retained. However, according to Westerlund and Wilhelmsson (2011, p. 8), this method generally produces unsatisfactory results. In particular, it has been shown that the estimates suffer from a severe bias even if the proportion of zero trade values is very small. This view gains support from Silva and Tenreyro (2006, p. 650) and WTO (2012, p. 112). Therefore, another way to deal with the zero trade values is to use the poisson fixed effects estimator. This model can be applied directly to the multiplicative form of the gravity model, thus removing the need to take the logarithms. Moreover, as Westerlund and Wilhelmsson (2011, p. 3) point out, it has been found to perform very well with only a small bias.

As far as the present dataset is concerned, there are a lot of zero values, more precisely 5 826. This accounts for 39 per cent of all 15 120 observations, which is quite substantial. Without any more information to go on, it is of course difficult to know whether the zeroes are reflecting the fact that there was actually no trade between for example Sweden and France in March 2015, or if they are the result of random reporting errors. In order to deal with the zeroes, this paper will make use of all the three models set out above. *First*, it will run a standard fixed effects model where the zeroes are left out of the sample. *Second*, it will use a fixed effects model where a small constant (+1) has been added to the import values before taking the logarithms. *Third*, it will apply a poisson fixed effects estimator. What is important to keep in mind is that the third model is the most likely to produce consistent results.

### 5.3 Model Specification

In order to examine whether competitive countries have started to export more dairy products as compared to the non-competitive countries following the EU milk quota reform, the model used in this paper will include a set of different variables. *First*, there will be a dummy variable, denoted  $\delta_i$ , taking the value one if the exporting country can be defined as competitive and zero otherwise. *Second*, there will be a dummy variable, denoted  $T$ , taking the value one if the quotas have been abolished and zero otherwise. *Third*, there will be a trend variable, denoted  $R$ , taking the value one for the first month after the reform, two for the second month after the reform and so on, all the way up to twelve, and zero otherwise. In contrast to  $T$ , which will only be able to capture the aggregate effect of the reform,  $R$  will thus be able to capture the monthly effect or the “trend”. However, what is important to point out is that the effect is assumed to be the same for all months, which is not necessarily true.

Given that the direct effects of  $\delta_i$ ,  $T$ , and  $R$  will be captured by the fixed effects (further discussed in section 5.4), it will not be possible to include the variables directly in the model. Therefore, the paper will create a slope dummy variable, denoted  $\delta_i * T$ , which is the product of  $\delta_i$  and  $T$ . This variable will capture the extent to which competitive countries have started to export more dairy products as compared to the non-competitive countries following the reform. It is therefore the most crucial estimate of this study. Moreover, the paper will create a variable, denoted  $\delta_i * R$ , which is the product of  $\delta_i$  and  $R$ . This variable will capture the same thing as  $\delta_i * T$ , but on a monthly basis. In sum, the model specifications read as follows:

$$m_{ijt} = \alpha_{ijp} + \lambda_t + \beta (\delta_i * T) + \varepsilon_{ijt} \quad (2)$$

$$m_{ijt} = \alpha_{ijp} + \lambda_t + \beta (\delta_i * R) + \varepsilon_{ijt} \quad (3)$$

where  $j$  and  $i$  are the notations for the importing and exporting countries respectively,  $t$  is the time period,  $p$  is the product,  $m_{ijt}$  is the import value,  $\alpha_{ijp}$  is the country-pair-product fixed effects,  $\lambda_t$  is the time fixed effects,  $\delta_i$  is a dummy variable taking the value one if the exporting country is competitive and zero otherwise,  $T$  is a dummy variable taking the value one if the milk quotas have been abolished and zero otherwise,  $R$  is a trend variable taking the value 1,2,3,...,12 for all months after the reform and zero otherwise, and  $\varepsilon_{ijt}$  is the error term.

## 5.4 The Fixed Effects Model

The data used in this paper contains observations both over time (months) and individuals (partner-reporter-product). Given that it has both a cross-sectional and a time series dimension, it can be described as panel data (Dougherty 2011, p. 515). When dealing with panel data, one has the option between making a fixed effects regression and a random effects regression. The main point of choosing a fixed effects regression in this case is that it makes it possible to hold constant (“fix”) variables that are constant over time but vary across individuals, such as language and culture. With a random effects model, such omitted country-specific variables may be captured by the error term, leading to endogeneity problems and biased OLS estimates. Therefore, the fixed effects model is often a better option when it comes to analysing changes over time, such as the effects of abolished of milk quotas.

In order to control for unobserved differences among countries, the model used in this paper will include a set of country-pair-product-specific dummies, denoted  $\alpha_{ijp}$ , that are equal to one if the observation relates to a certain individual (reporter, partner and product) and zero otherwise. These dummies will capture everything that varies across individuals but is constant over time, such as differences in language and culture. In this specific case,  $\alpha_{ijp}$  will also capture importer and exporter GDP (which will be assumed constant because of the short time-period examined and the lack of available data). Moreover, the model will include a set of time dummies, denoted  $\lambda_t$ , that are equal to one if the observation relates to a certain time period (month) and zero otherwise. These dummies will capture everything that varies across time but is shared by all individuals, such as business cycles, price fluctuations or the Russian import embargo of 2014. All in all, the use of country-pair-product fixed effects and time fixed effects will reduce the problem of omitted variables and provide more reliable estimates of the gravity model (WTO 2012, p. 109 and Westerlund and Wilhelmsson 2011, p. 4).

## 6. Results

### 6.1 Regression Results

In order to answer the research question, three models have been specified. The first is a fixed effects model where the zero values are left out of the sample. The second is a fixed effects model where a small constant (+1) has been added to the import values before taking the logarithms. The third is a poisson fixed effects model. All models are controlling for differences across individuals (partner-reporter-product) by including country-pair-product fixed effects, and differences across months by including time dummy variables. Moreover, all models are controlling for heteroscedasticity by using robust standard errors. The models are run using either  $\delta_i^*T$  or  $\delta_i^*R$  as the independent variable. The results are presented below.

Table 2: Estimates from the three models using  $\delta_i^*T$  as the independent variable.

<b>Estimator:</b>	<b>OLS</b>	<b>OLS</b>	<b>Poisson</b>
<b>Dep. variable:</b>	<b>ln (m<sub>ijt</sub>)</b>	<b>ln (m<sub>ijt</sub>+1)</b>	<b>m<sub>ijt</sub></b>
<b><math>\beta</math></b>	0.041	0.286*	<b>0.140*</b>
<b>P-value</b>	0.717	0.092	<b>0.053</b>
<b>Standard errors</b>	0.114	0.169	0.072
<b>R<sup>2</sup></b>	0.004	0.005	-
<b>No. of individuals</b>	354	420	354
<b>No. of observations</b>	9 294	15 120	12 744

Table 3: Estimates from the three models using  $\delta_i^*R$  as the independent variable.

<b>Estimator</b>	<b>OLS</b>	<b>OLS</b>	<b>Poisson</b>
<b>Dep. variable:</b>	<b>ln (m<sub>ijt</sub>)</b>	<b>ln (m<sub>ijt</sub>+1)</b>	<b>m<sub>ijt</sub></b>
<b><math>\beta</math></b>	0.005	0.032	<b>0.022**</b>
<b>P-value</b>	0.709	0.118	<b>0.012</b>
<b>Standard errors</b>	0.014	0.021	0.009
<b>R<sup>2</sup></b>	0.004	0.004	-
<b>No. of individuals</b>	354	420	354
<b>No. of observations</b>	9 294	15 120	12 744

Note: The subscripts (\*\*\*) (\*\* and \*) denote significance at the 0.01, 0.05 and 0.10 levels, respectively.

In both tables, the first two columns show the OLS estimates using the logarithm of imports and the logarithm of imports (+1) as the dependent variable. As was explained in section 5.2, these two models cannot be expected to produce very reliable results. In particular, Westerlund and Wilhelmsson (2011, p. 3) and Silva and Tenreyro (2006, p. 650) have found that when the data is transformed in any way (by truncating the sample or adding a small constant), it generates a bias that persists despite the use of country-pair fixed effects and robust standard errors. Indeed, this gains support from the regression outputs. It can be observed that the value of  $R^2$  is very low, only 0.004 and 0.005, respectively. This means that as little as 0.4 or 0.5 per cent of the variation in the import value can be explained by the fact that the quotas have been abolished and that the exporter is competitive (Dougherty 2011, p. 104). Moreover, it can be observed that the p-values are rather high, ranging from 0.092 to 0.717. This means that it is not possible to reject the null hypothesis, saying that there is no relationship between the reform and trade, even when accepting a high level of uncertainty.

Turning then to the third column of the two tables, it presents the results from applying the gravity model directly in its multiplicative form, using the poisson fixed effects estimator. As was mentioned in section 5.2, Westerlund and Wilhelmsson (2011, p. 3) have found this model to perform very well with only a small bias. Therefore, the results from the poisson fixed effects estimator are probably reliable in this case. This will be further verified in section 6.2 through a robustness analysis. As far as the results are concerned, it can be observed that the p-values are 0.053 for the model using  $\delta_i * T$  as the independent variable, and 0.012 for the model using  $\delta_i * R$  as the independent variable. This means that the aggregate effect is significant almost at the 0.05 significance level, while the monthly effect is significant almost as the 0.01 level. In terms of statistics, this is a good result and suggests that the abolishment of milk quotas has had an effect on intra-Union trade after all. Turning then to the coefficients, they are 0.140 for the aggregate effect and 0.022 for the monthly effect. This should be understood as the extra effect for competitive countries relative to non-competitive countries. Thus, the results from the poisson fixed effects estimator suggest that after the quotas have been abolished, the exports of competitive countries have increased by 14 per cent more in total or 2.2 per cent more per month, than those of the non-competitive countries. Indeed, this is line with the expectations and can be explained by the fact that after the removal of quotas, the competitive Member States have been able to increase their production and exports of dairy products as compared to the non-competitive Member States.

## 6.2 Robustness

In order to check the robustness and reliability of the poisson fixed effects estimator, data on importer and exporter GDP will be added to the model. Given that the gravity model is applied directly in its multiplicative form, the data will not be logarithmized before used. The results are presented below. As can be seen from the tables, the estimates for the two variables remain largely the same: the aggregate effect increases slightly to 14.5 per cent while the monthly effect increases slightly to 2.3 per cent. The p-value for the aggregate effect is 0.029, while the p-value for the monthly effect is 0.005, thus suggesting a higher degree of certainty. This confirms the view that the poisson fixed effects estimator is indeed reliable in this case.

Table 4: Estimates from the poisson fixed effects estimator using  $\delta_i^*T$  or  $\delta_i^*R$  as the independent variable.

<b>Estimator:</b>	<b>Poisson</b>	<b>Poisson</b>
<b>Independent variable:</b>	<b>(<math>\delta_i^*T</math>)</b>	<b>(<math>\delta_i^*R</math>)</b>
<b><math>\beta</math></b>	<b>0.145**</b>	<b>0.023***</b>
<b>P-value</b>	<b>0.029</b>	<b>0.005</b>
<b>Standard errors</b>	<b>0.067</b>	<b>0.008</b>
<b>GDP importer</b>	0.025**	0.025**
<b>P-value</b>	0.012	0.011
<b>Standard errors</b>	0.010	0.010
<b>GDP exporter</b>	0.007	0.006
<b>P-value</b>	0.434	0.550
<b>Standard errors</b>	0.010	0.010
<b>No. of individuals</b>	354	354
<b>No. of observations</b>	12 744	12 744

Note: The subscripts (\*\*\*) (\*\* and \*) denote significance at the 0.01, 0.05 and 0.10 levels, respectively.

## 7. Conclusion

The purpose of this paper was to assess the intra-Union trade effects of the EU milk quota reform, using the gravity model of trade. In particular, the aim was to find out whether competitive Member States had started to export more dairy products as compared to the non-competitive Member States following the reform. According to the theoretical models and the empirical studies set out in the paper, such an effect could be expected for the following reason. When markets are liberalized, production will tend to move to those countries that are the most efficient in producing a good. When these countries start to produce and export more products, other less competitive countries will start to produce less and import more. This, in turn, will lead to higher trade flows and a redistribution of production between countries.

In order to answer the research question, the paper used monthly import data for the EU-15 countries between 1 April 2013 and 31 March 2016. Because of the large number of zero trade values, the gravity model was applied directly in its multiplicative form, using the poisson fixed effects estimator. The results from this model showed a statistically significant relationship between the milk quota reform and trade. According to the estimation outputs, the exports of competitive countries had increased by 14.5 per cent more in total or 2.3 per cent more per month than those of the non-competitive countries. The results were significant at the 0.10 and 0.05 significance levels, respectively. When including importer and exporter GDP in the regressions, the results were significant at the 0.05 and 0.01 levels, respectively.

In terms of policy formulation, this is an important result as it suggests that the EU milk quota reform may have great implications for the location of dairy production in the future. However, although the results are in line with the hypothesis, it is important to point out a few things. *First*, the sample period used in this paper was relatively short: only a total of 36 months. For future studies, one might want to extend the time period backwards and forwards. In particular, it would be interesting to see how bilateral trade flows are affected in a couple of years' time following the reform. *Second*, this study covered only two products: raw milk and milk powder. However, milk can be transformed into a wide range of other products, such as butter and cheese. In order to get a better picture of the reallocation of production resources, it would therefore be valuable to include such secondary products in the analysis.

## 8. References

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