UNIVERSITY OF ECONOMICS, PRAGUE

FACULTY OF INTERNATIONAL RELATIONS

M. A. ECONOMICS OF GLOBALIZATION AND EUROPEAN INTEGRATION

2012/2013

AN EMPIRICAL ANALYSIS OF TRADE EFFECTS OF THE EUROPEAN MONETARY UNION

(MASTER DISSERTATION)

September 2013

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Declaration of Authorship

I hereby declare that I compiled this dissertation independently, using only resources and literature listed.

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Prague, September 30th, 2013

Acknowledgements

At this place, I would like to take the opportunity to express my gratitude and appreciation to my supervisor professor Geoffrey Pugh for his helpful comments and suggestions, and especially guidance on my way through research world.

I also want to thank to doc. Ing. Anna Klosová, CSc., our coordinator, for her valuable personal involvement and support during the whole M.A. EGEI program.

Abstract

This master dissertation deals with broadly discussed topic – are there really some trade enhancing effects for countries that have adopted the euro?

This thesis provides an estimate of the effect of the European Monetary Union on trade, taking into account panel data of 37 economies during sample period 1995 – 2012. The sample consists of 27 European Union members and 10 non-EU OECD countries.

After applying gravity model of trade and controlling for gravity-model-specific influences, the effect of the euro on trade obtained from the results of the estimation is positive and statistically significant 9 per cent.

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1. Introduction

Monetary union represents an advanced level of an economic integration. Creating a monetary union means withdrawing national currencies and giving up monetary policies, which brings both costs and benefits to the participating countries. Commonly identified cost is the mentioned loss of independent monetary policy. Commonly identified benefit is a possible increase in international trade. According to theoretical foundations, monetary union enhances international trade by lowering transactional costs, eliminating exchange rate uncertainty, increasing market transparency and stimulating competition.

European monetary union (EMU) has been launched in 1st January 1999 as the last stage of the plan to introduce the common currency of the European Union (EU). All the member states of the EU automatically participate in the EMU, but the final stage, adopting the euro, requires certain procedure to be taken. Since 1999, the euro area has expanded having 17 member countries in 2013.

Launching of the euro was supported by considerable potential benefits to citizens, businesses and economic growth that the single currency should bring to the member countries. Among the potential benefits, increase in trade ranks very high.

Since the launch of the euro in 1999, an important question comes to mind. What effect does the common currency bring? Is it trade-fostering? Does it bring welfare gains? This issue becomes more important as the EU enlarges. Potential increase in trade becomes the main incentive for new member countries to join the EU. Although adopting the euro is an essential necessity for most of the EU countries, the timing of starting the procedure of adopting euro hinges, besides economic readiness, upon benefits and costs of joining the monetary union as well. What effect has the EMU brought so far is the empirical question that is the subject of this thesis.

The purpose of this thesis is to analyze the effects of the euro on trade in the EMU. The empirical analysis will be realized by gravity model of trade, allowing us to capture the effect of the single currency euro on trade, controlling for other potential influences important in the

case of the EMU, such as membership in the EU, pre-existing trade ties or distance between the trading partners. Nowadays, in 2013, 15 years after launching the euro there should be sufficient data to make a clear statement.

There have been numerous studies published, examining the impact of adopting the euro. Most of the studies are based on Rose (2000), where the effect of post-war currency unions is estimated. Rose (2000) came to the conclusion that countries participating in currency union can increase trade by 300 per cent. The relevance of applying these results to the European case is, however, questionable, mainly because Rose included small and poor countries to his sample, what is right not the appropriate characteristic of the EU countries. Most researchers, including studies of Bun and Klassen (2002), Micco, Stein and Ordonez (2003) and De Nardis and Vicarelli (2003), agreed that the euro has brought a positive effect. What they cannot find agreement about is, however, the magnitude of the effect.

The remainder of this thesis is organized as follows. Next section, Section 2, presents the most important literature and studies that have been published regarding the impact of the euro on trade. Actual figures, recent development in euro area trade with different groups of countries are reviewed in Section 3 to provide a broader insight into the topic. Section 4 introduces data and it sets up the gravity model. Estimated results are presented in Section 5, followed by the conclusions in Section 6.

2. Literature review

Paper of Rose (2000) is considered to be a core study regarding measuring impact of a common currency on trade. In his paper, Rose used gravity model to show that two countries with the same currency trade more than countries that do not share the same currency. This study uses 33903 bilateral trade observations in 5 included years (1970, 1975, 1980, 1985, and 1990) and 186 geographical units. In his dataset, Rose has 330 observations for the case when two countries trade and use the same currency. Rose came to the conclusion that countries using common currency increased their trade about more than 300 per cent. What is important here is the fact that the countries observed are mostly small and poor unlike the EU countries, so it is difficult to apply his results right on the case of the EU.

Glick and Rose (2001) examined whether leaving a currency union reduce international trade. They estimated effects of currency union on trade using time series and cross-sectional variation. Their data set included annual panel data from 217 countries from 1948 to 1997. During this period, number of country pairs created any many country pairs dissolved currency union, so the authors could compare trade before and after. This study came to economically large and statistically significant results: bilateral trade doubles or halves as a country pair creates or dissolves a currency union, ceteris paribus.

Bun and Klassen (2002) examined effect of introducing the common currency on intra-EMU exports using dynamic fixed effects panel data model. They found two ways of the euro effect to take shape – the first one is real exchange rate volatility that captures nominal exchange rate fixing and convergence of inflation. The second way is the EMU dummy that includes other changes such as perfect credibility of nominal exchange rate fix, transaction cost reduction and integration of the capital market. Bun and Klassen found out that the real exchange rate volatility has statistically insignificant effect on intra-EMU exports. The reason can be seen in preexisting ties – the volatility had already been low before the common currency was introduced. On the contrary, this paper estimated positive, trade-enhancing cumulative effect of the EMU dummy on trade, reaching 3.9 per cent in 1999, 6.9 per cent in 2000, 9.6 per cent in 2001 and 37.8 per cent in the long run. However, substantial standard error was measured, reaching 13.4 per cent for the long-run estimates.

De Nardis and Vicarelli (2003) used dynamic panel data approach in their study. They considered 11 European countries joining the euro area (Luxembourg and Belgium were put together) as exporters, and 32 countries as importers, counting with those 11 European and 21 other countries. The estimation period was between 1980 and 2000. The authors performed two kinds of short-run estimation. In the first one, they calculated the variation in EMU trade with respect to the intra-EMU trade before adopting the euro and to the EMU trade with countries not using the euro. In this case, the euro impact on the EMU trade represents an 8.9 per cent rise. In the second estimation they calculated the same kind of effect and controlled for potential bias caused by endogeneity of the currency union. In this case, the effect, representing 9.7 per cent rise, did not change significantly. This paper also outlines the fact that EMU is a special case of the currency union, because it has been going through a long-standing process of integration that could already have effects on trade.

The study of Micco, Stein and Ordonez (2003) (MSO) included country-pair fixed effect to make a better possibility to observe euro effects over time. The country pair includes all time invariant variables (e.g. language, distance). This approach should help to isolate the pre-EMU ties between the pair and also leave out cross-sectional variation. The authors used log of total merchandise trade between pairs of countries as the dependent variable. The estimation itself works with two samples of nations. The first sample comprises 22 developed countries. The second one contains EU 15 with Belgium and Luxembourg aggregated. The observations subsume years 1992 – 2002.

The MSO study came to the conclusion that the impact of the euro is important, but smaller than for example the results of Rose. The impact of the EMU on bilateral trade was estimated as high as 4-10 per cent when compared to trade of all other country pairs, and 8-16 per cent when compared to the trade among the non-EMU countries. What is interesting is that if the model excludes the pair dummy, the results are comparable to the results of the impact of membership of the EU itself. The study also points out to the possibility of reverse causality – shortly said to the fact that unusually high trade flows led to adopting of the euro. This can be removed right by including pair dummies.

MSO also thinks about timing regarding effects of adopting the euro. The authors highlight the fact that there are many channels through which the effects may appear and that some of them need time to get visible. Interesting point is also the observation that the effect increased already in 1999 but the real jump was observed in 1998. This can be explained by the admitting of 11 countries to the future euro zone and further steps taken to deeper integration.

Paper of Gomes et al. (2006) tests and replicates findings of MSO (2003). The authors made several changes to the MSO analysis – firstly, they added three more years of data, secondly, they extended the sample data back to the past to 1980 and thirdly, add more control for trends that influence trade integration. Their findings show that if they go back to the 1980, the most significant increase occurred in mid 1980, in authors´ opinion as a result of trade liberalization in the EU. They also controlled for trade trends among the EMU and non-EMU countries and based on this they claim that there is no impact of the euro. On the contrary, the authors found out that by extending the sample to 1980, there is statistically significant trade effect of formation of the EU and its forerunners.

Gomes et al. (2006) firstly replicated the fixed-effect results of MSO. Estimates of MSO suggested that the euro zone trade around 4 – 5.5 per cent more compared to the group of the other countries from the sample. As already mentioned, the authors added three more years to the analysis. The impact of the additional years in the analysis increased the estimated effect of intra-EMU trade by approximately 50 per cent. , resulting in 7 – 8.2 per cent increase in trade. Gomes et al. (2006) also repeated the analysis using EU15 only, what resulted in increase of the estimated impact of the euro on trade, exactly from 6 – 7.5 per cent in period 1992-2002 to 9.6 – 11 per cent in period 1992-2005.

The authors also dealt with MSO 2002 trade estimates that proved to be inaccurate and found out disconcerting fact: the variables that were supposed to represent the effects contributing to increase in trade liberalization, are rarely statistically significantly positive. This fact made the authors doubt about the ability of the specification of the gravity model to discriminate between effects of the economic integration and monetary union.

Extending the sample to 1980-2005, the estimated trade effects of the euro increased in developed countries as well as in EU15 sample, 15 – 17 per cent for the former, 20 – 23 per cent for the latter. It also turned out that the effect of the euro on intra-EMU trade began already in 1986 and 1988 for developed countries sample and EU15 sample respectively. Also, free trade agreement and the EU dummies proved to be statistically significantly

positive. This result shows that the important factor of increasing trade was the removal of trade barriers to trade and the euro adoption is considered rather as secondary factor.

Bringing findings of MSO and Gomes et al. together, Gomes et al. (2006, p. 19-20) summarizes that "countries that adopted euro did so realizing that their trade with other EMU countries was likely to increase as a result of their ongoing efforts to promote economic (and political) integration and that a common currency would serve to enhance further this integration. In contrast, the three non-joiners did not have the same incentives or the same outlook and thus viewed the price of joining the EMU as being high to pay", which is also consistent with "two-track" hypothesis of the European integration for EMU and non-EMU members.

Berger and Nitsch (2007) see trade effects of the euro in historical perspective and highlight the fact that it is bad to isolate creation of monetary union and point out that it is necessary to look at the trade integration process back to the past. Their dataset consists of 22 industrial countries observed from 1948 to 2003.

The study found out that trade among European countries had increased gradually and if the authors control for this trade intensifying, there is no additional euro effect on trade. Authors set up the model in the same way as for example Rose (2000) or MSO (2003). To specify the intensity of trade after creation of the EMU, country-pair fixed effect was added. As MSO and others, the authors used regression specification with a detailed set of country-pair fixed effects, estimated by ordinary least square estimator (OLS) as the preferred specification.

The study also reports standard pooled OLS results on the cross-sectional set-up of the preferred specification. For robustness check Berger and Nitsch use Poisson pseudo-maximum likelihood (PPML) estimator, using trade in levels as dependent variable. As the first stage of estimation, the authors replicate MSO results and extend the sample period by one year, to 2003. The results are as follows: the effect of the common currency on trade was 36 per cent for 22 industrial countries and 44 per cent for the EU15 sample. The fixed effects estimator claims that the trade increased to 15 per cent, compared to 4 per cent, as found out MSO.

Study of Flam and Nordström (2003) estimates unlike others, only effects on exports from euro zone countries instead of bilateral trade. They do so in order to separate effects of the euro on exports from euro zone to non-euro zone countries and exports from non-euro zone countries to euro zone countries.

Besides estimating aggregate trade level, authors also focus on different sectors in order to see whether the effect take shape in certain sectors, whereas in others does not. They estimated a standard gravity model, using country-pair dummies. Panel counts with 20 OECD countries during period 1989-2002. The results show that the effect of the euro is clearly increasing. If we compare period 1998-2002 and 1989-1997, the level of aggregate trade within euro zone increased approximately by 15 per cent, whereas the level of trade with non-euro zone countries raised by 8 per cent.

Regarding the sector estimates, authors estimated effects of one-digit SITC sector exports, where they identified clear pattern, accurately, significant euro effect were recognized in sectors producing relatively differentiated and processed goods, such as beverages and tobacco (SITC 1), chemical products and pharmaceuticals (SITC 5) and manufacturing products (SITC 6-8).

Finally, the study estimates trade effects of adopting the euro for the United Kingdom, Denmark and Sweden. Calculations were based on aggregate trade estimates. The results are as follows – in first years in euro zone these countries would reach on average 8 per cent higher trade level and in the fifth year they could reach 10 per cent increase.

Paper de Nardis, De Santis, Vicarelli (2007) provides an updated estimate of trade effects of adopting the euro. Dataset comprises 23 OECD countries during the period 1988-2004. The study considers 13 exporting European countries and 23 importing industrialized countries. Effect of adopting of the single currency is estimated approximately as 4 per cent and 17 per cent in the long run.

To sum up, this literature review mostly reflects studies that focus on the EMU case that are supposed to clarify the impact of adopting euro. Compared to common currency effect considered by Rose (2000) or Glick and Rose (2001) the EMU case is more limited. All the estimates on the EMU case are conducted on developed countries samples where some of which are further restricted to the EMU countries. Length of the sample period differed across the studies and it is obvious that this is not neutral, because the results and significance can

vary considerably according to the period, or length of the period chosen. Most of the papers that were included into this literature review conclude that euro had brought positive effects. The percentage results range from 4 to 38 per cent when talking about results for the EMU itself, depending on length of the period chosen. In one case the author found no effect. This big variance of the results shows considerable sensitivity of the model to what we include and control for and on the contrary what we omit.

As a conclusion of this section a summary table is presented. In the methodology column, “FE” stands for fixed effects, “GMM” for generalized method for moments estimator and “OLS” for ordinary least squares. In quantitative findings “SR” stands for short run and “LR” for long run.

Study	Sample	Methodology	Quantitative findings
Rose (2000)	186 countries	gravity model	when using common currency 300%
Glick & Rose (2001)	217 IMF country codes (territories)	FE	when creating CU 90%
Bun & Klassen (2002)	19 developed countries	dynamic FE, GMM lagged dependent variable	intra area EMU effect 4 % first year 38 % LR
De Nardis & Vicarelli (2003)	11 EU countries, 21 others	GMM, lagged dependent variable country group FE	pure euro adoption effect 8.9 % SR, 16% LR when corrected for endogeneity 9.7 % SR, 18.7 % LR
MSO (2003)	22 developed countries	OLS FE GMM	intra area effect 8-16%
Flam & Nordström (2003)	14 EU countries	FE	intra area effect aggregate 15 %
Gomes et al. (2006)	22 developed countries	FE	euro area 7-8.2 % EU15 6-11%
Berger & Nitsch (2007)	22 industrial countries	FE, time trend included	no effect
de Nardis, De Santis, Vicarelli (2007)	23 OECD countries	GMM	4% SR 17% LR

Table 1: Literature review summary

3. Quantitative descriptive evidence

Before we proceed to specification of the gravity model, we can have a look at some data. This section provides descriptive evidence of trade flows of the EMU in period 1995-2012. We can have a look at three graphs where trade flows of the EMU are demonstrated.

3.1. EMU Intra Trade Flows

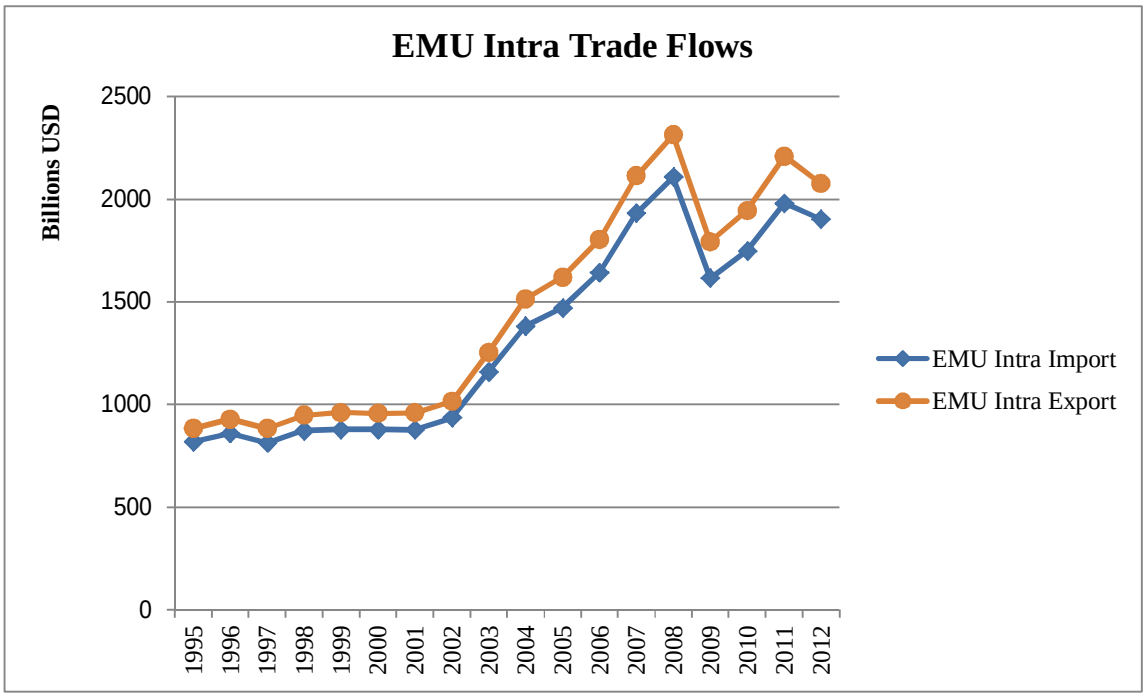

Figure 1: EMU Intra Trade Flows

Data source: UNCTAD STAT

The first graph demonstrates trade flows among the EMU members. As it is obvious from the graph, from the beginning of the observational period, year 1995, to 2002, we do not observe any significant or rapid growth of trade flows. Starting in 2002, the trade flows skyrocketed and continued to grow up to 2007. The sharp increase was followed by a slight fall between 2007 and 2008. Since 2009 the numbers climbed up to the pre-fall level, but again, in 2012 the trade flows experienced a mild fall again.

The observations from the graph suggest that the year of adopting the common currency for cashless operations in 1999 has had no significant effects on intra EMU trade. What we can, however, see on the graph is a considerable increase of trade flows among the EMU members starting in 2002, the year when banknotes and coins went into circulation. One would

probably anticipate some positive effects here within the group of the EMU countries, as they might have got an incentive to trade more with each other thanks to the single currency.

3.2. EMU Trade Flows from/to the EU

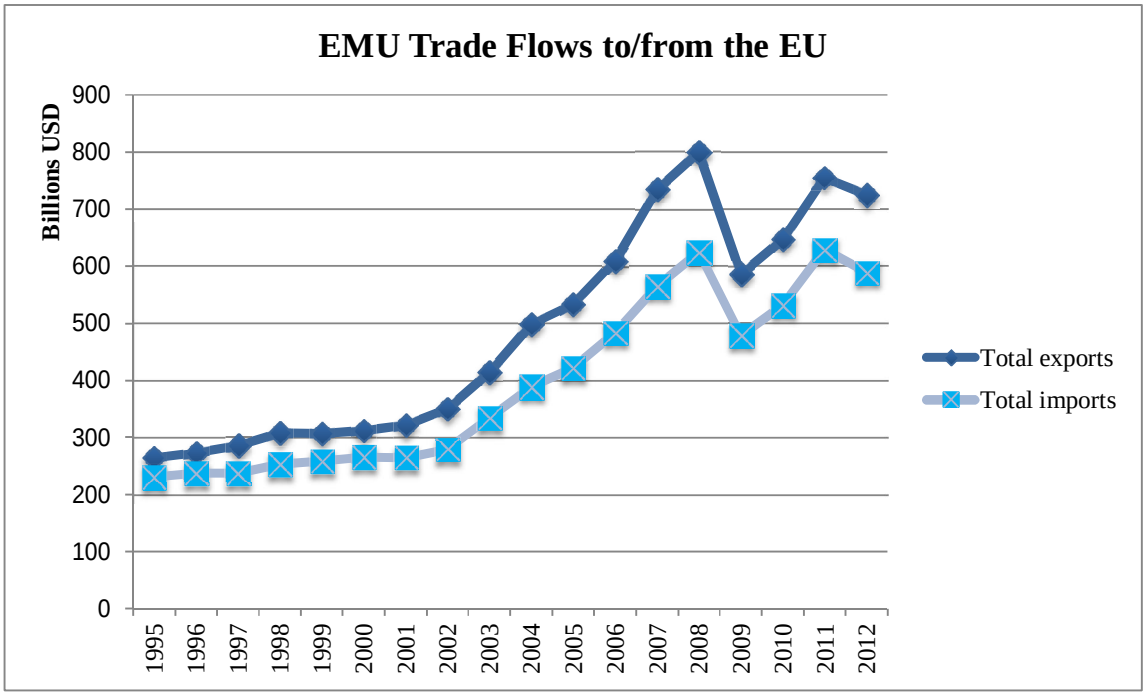

Figure 2: EMU Trade Flows to/from the EMU

Data source: UNCTAD STAT

The second graph shows the performance of the EMU in relation to the non-EMU members that belong to the EU. We can observe that the volume of trade flows from the EMU countries (total exports) exceeds the volume of trade flows to the EMU (total imports). In fact, we can see a similar pattern as in the previous graph – rather very mild growth up to 2002, take-off starting in 2002 and quite a sudden fall between 2007 and 2008, where the trade flows reached the level of 2006. A recovery and growth followed up to 2011, when the trade flows decreased again between 2011 and 2012.

We can see that the path of the figure almost copies that one in the figure for intra EMU trade. That means negligible growth in 1999 and significant growth between 2002 and 2007. In this case-trade flows between the EMU and the non-EMU part of the European Union- one would not probably expect any substantive changes in these flows as there was de facto no reason for change in trade behavior between these two country groups.

3.3. EMU Trade Flows from/to 10 non-EU OECD Countries

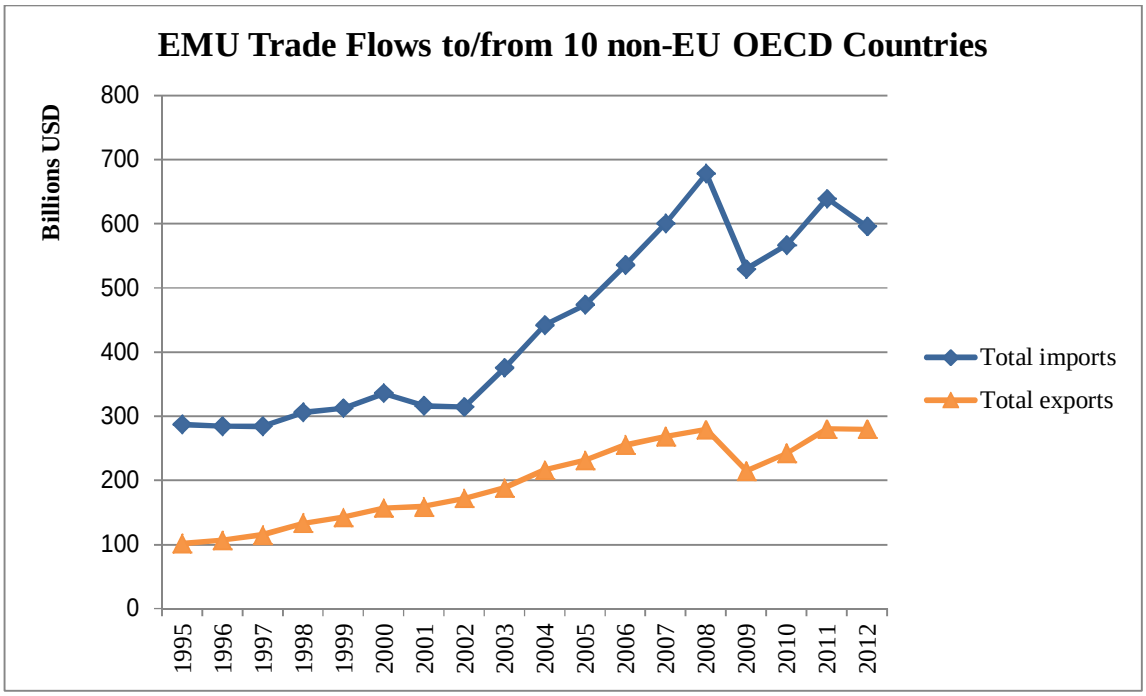

Figure 3: EMU Trade Flows from/to 10 non-EU OECD countries

Data source: UNCTAD STAT

The third figure demonstrates the development of the trade flows of the EMU countries and 10 chosen non-EU OECD countries. From the figure it is obvious that the development of total exports to OECD countries between years 1995 and 2007 can be presented as typical gradual increase. We do not observe any deviations, whether positive or negative from gradual growth around years of adopting the euro by the EMU countries. After a mild drop between 2007 and 2008, the values are growing again and do not even drop between 2011 and 2012 as it happened in previous cases, but rather remain on the same level. Regarding total imports from OECD countries, the story is slight different: after fluctuating around more or less the same value from 1995 to 2002, we can notice that the total imports soared to reach its peak in 2007, and to fall a bit between 2007 and 2008. Here we can observe a similar scenario as in previous graphs – rise up to 2011 and fall between 2011 and 2012. Again, in the case of total imports we can observe a significant increase beginning in 2002.

If we have a look at the figures themselves, there is some evidence of increased trading activity since 2002 in all trade flows of the EMU. Therefore, it could seem at glance that there is definitely the EMU effect operating. What we should do is to put all the three figures in the broader context. Similar pattern actually exists only in five out of six trade flows – intra EMU

exports and imports, both trade flows from and to the non-EMU EU and EMU imports from OECD countries. In all these five flows we can observe a sharp rise beginning in 2002. Can this really cohere with euro adoption? Or is it something else? All these five flows actually take place in the EU, they somehow hinge upon the EU's income. Perhaps is it more about income rather than EMU effect? This rise was followed by a fall between 2007 and 2008 explained by great recession.

Exports to OECD countries performed slightly differently. There is no apparent "breaking point" in 2002 as it is obvious in previous cases. There is also one more interesting development and common feature of the five mentioned flows – drop between 2011 and 2012. Again, exports of the EMU to OECD did not follow this way. Did the debt crisis that hit Europe around these years have an influence and caused an import drop of the EU (and so the EMU countries as well) that we observe? This indicates that this evidence is just informational. As suggested above, there are definitely other factors influencing trade that we should control for. In this case, we need econometric analysis. The gravity model of trade provides more complete analysis and will be discussed in the next section.

4. Gravity model

4.1. Model specification

Empirical part of this thesis is based on the gravity model. Since its introduction in 1966, the model has been widely successful in bilateral trade flows predictions. The principle of the model is similar to Newton's law of gravitational attraction between two objects. Most of the papers recently rely on standard gravity equation. This equation is a product of size variables, usually national income and geographical distance. Hence,

$$T_{ij} = C \frac{GDP_i GDP_j}{D_{ij}}$$

The trade flows between two countries (T_{ij}), where i and j are index countries, are determined by:

-their national incomes (GDP_i and GDP_j) divided by

-the distance between them (D_{ij})

-the result is multiplied by a constant term C.

Adding an error term and taking natural logs, trade flows can be estimated as:

$$lnT_{ij} = C + lnGDP_i + lnGDP_j - lnD_{ij} + \varepsilon_{ij}$$

This basic gravity equation is usually extended with other explanatory variables. Selecting variables to the gravity model is a question of researcher's interest. This thesis is interested in effects of the European Monetary Union on trade, in other words, in effects that were generated by adopting the euro. The specification of the gravity model of this thesis takes following form:

$$lnT_{ijt} = \alpha_0 + \beta_1 lnGDP_{ijt} + \beta_2 lnGDPpercap_{ijt} + \beta_3 FTA_{ijt} + \beta_4 EU_{ijt} + \beta_5 EMU_{ijt} +$$

$$\beta_6 lnDistance_{ij} + \beta_7 Border_{ij} + \beta_8 ComTer_{ij} + \beta_9 Island_{ij} + \beta_{10} Language_{ij} + \varepsilon_{ijt}$$

4.2. Variable description

In this specification, the natural logarithm of the value of bilateral trade flows between countries i and j, $\mathbf{lnT_{ijt}}$, is the dependent variable. Choice of the dependent variable is an important issue. Baldwin and Taglioni (2007) provide a broad discussion about averaging of the bilateral trade flows. They consider taking logs of the averages instead of averaging the logs as researcher's "silver medal mistake" that can seriously bias the result. With reference to Baldwin and Taglioni (2007), average of the natural logarithm of four trade flows between country i and j is used in this thesis as dependent variable.

The natural logarithm of the difference of GDP per capita of countries i and j, $\mathbf{lnGDPpercap_{ijt}}$, value of sum of GDPs of countries i and j, $\mathbf{lnGDP_{ijt}}$, and natural logarithm of bilateral distance ($\mathbf{lnDistance_{ij}}$), are the explanatory variables. Dummy variables included in the specification are: dummy variable for free trade agreement ($\mathbf{FTA_{ijt}}$), membership in the European Union ($\mathbf{EU_{ijt}}$), membership in the European Monetary Union ($\mathbf{EMU_{ijt}}$), common state border ($\mathbf{Border_{ij}}$), recent membership in a common country or territory ($\mathbf{ComTer_{ij}}$), island location of the country ($\mathbf{Island_{ij}}$) and common official language ($\mathbf{Language_{ij}}$).

We expect that bilateral trade flows are positively influenced by the "mass"- **sum of the GDPs** of the two countries – the higher the GDP the higher the trade flows. The **euro area membership** is also expected to stimulate bilateral trade flows. If we refer to recent literature, adopting of the euro is expected to have had positive impact on trade of the euro area. The **EU membership** represents an advanced phase or level of economic integration and there is an assumption that countries should have benefited from trade integration process. In this regression, dummy variables such as **free trade agreement** (FTA), **common official language**, recent **membership in a common country or territory** and **common border** are included. All these dummies proxy for a proximity of two countries and somehow "favor these fellow countries". If the FTA dummy takes value of one it means that in certain year the two countries were engaged in FTA and so probably they are (were) similar economically, which is a good basis for mutual trade. Common official language should be an advantage as the trade transactions might get easier. Recent membership in a common country or territory is again a proxy for historically close relationships and higher probability of trade. Common border means geographical neighborhood, which again makes trade more feasible.

We expect that bilateral trade flows are negatively influenced by **distance**. In a standard gravity model distance is a proxy for transportation costs. Geographical conditions such as **island** location of the country might make mutual trade more complex. From its characteristics, it is probably more costly to trade with an island than with a landlocked territory. Also **difference in GDP per capita** is supposed to have negative coefficient – the bigger the difference, the less are the two countries expected to trade.

The main goal of this thesis is to see the effects of the euro on trade. Therefore, we need to control for these other influences that can affect trade flows in the model.

So the notation is as follows:

Variable	Description
T_{ijt}	trade flows – exports and imports – between countries i and j at time t, i≠j
α_0	intercept
$GDPpercap_{ijt}$	difference in GDP per capita of country i and j
GDP_{ijt}	value of sum of GDPs of country i and j
FTA_{ijt}	dummy variable that takes value of one if countries i and j have concluded free trade agreement by time t and zero otherwise
EU_{ijt}	dummy variable that takes value of one if countries i and j are members of the EU by time t and zero otherwise
EMU_{ijt}	dummy variable that takes value of one if countries i and j have adopted the euro by time t and zero otherwise
$Distance_{ij}$	bilateral distance between capital cities of countries i and j expressed in kilometers
$Border_{ij}$	dummy variable that takes value of one if countries i and j share a common state border and zero otherwise
$ComTer_{ij}$	dummy variable that takes value of one if countries i and j have been members of the same country or territory since 1900 and zero otherwise
$Island_{ij}$	dummy variable that takes value of one if at least one country i or j or both is an island and zero otherwise
$Language_{ij}$	dummy variable that takes value of one if countries i and j share a common official language and zero otherwise
ε_{ijt}	disturbance term

Table 2: Variable description

4.3. Data description

The panel consists of 37 countries during sample period 1995-2012. 27 countries represent members of the European Union and 10 countries are representatives of non-EU OECD countries – Australia, Canada, Japan, Republic of Korea, Mexico, New Zealand, Norway, Switzerland, Turkey and United States. Croatia being the 28th member of the EU since 1st July 2013 is not included to the sample. The total number of country pairs is C = (37, 2) = 666. Hence, the cross-section dimension of the panel dataset is N=666 and time-series dimension T=18. This yields, NT=11989 observations. Distributions (histograms) of all the float variables are presented in Appendix.

4.3.1. Bilateral trade flows

Bilateral trade flows data were collected from OECD STAN Bilateral Trade Data Library and United Nations Conference on Trade and Development (UNCTAD) STAT. Data are measured in thousands US dollars. The major part of data was collected from OECD STAN Bilateral Trade Data Library. However, there were some values missing. These missing values were filled in with data obtained from UNCTAD STAT. Data from both databases were examined and can be considered as comparable. Imports were recorded as "Cost, insurance, freight" (CIF), exports as "Free on board" (FOB).

4.3.2. GDP and GDP per capita

Data on GDP and GDP per capita is obtained from World Development Indicators, collection of data of World Bank. At World Bank, GDP is calculated without making deductions for depreciation of fabricated assets or for degradation of natural resources. GDP is measured in current US dollars and the figures are converted from domestic currencies using official exchange rates of every year. For a few countries where the official exchange rate does not reflect the rate effectively, World Bank uses alternative conversion factor.

GDP per capita is gross domestic product divided by midyear population. It is measured in current US dollars.

4.3.3. Geographical data

Bilateral distance between capital cities was calculated with assistance of the online World Atlas and is measured in kilometers. Information whether countries share common state border or either of them is an island was verified at World Atlas webpage and data about common official language and common past history within the same country or territory was acquired at online encyclopedia Info Please.

4.3.4 EU, EMU and FTA

Actual data about EU and EMU membership were confirmed at the official webpage of the European Union. There are currently 28 member states of the EU, as Croatia joined the EU in July 2013. As already mentioned, this thesis does not take this into consideration and deals only with 27 members of the EU. The euro area consists currently of 17 countries – Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. Both, current member states of the EU as well as the euro area are illustrated on Figures 4 and 5 below. World Trade Organization (WTO) Regional Trade Agreements Information System provided information about bilateral free trade agreements.

All the variables and corresponding data sources are listed in Table 3 below.

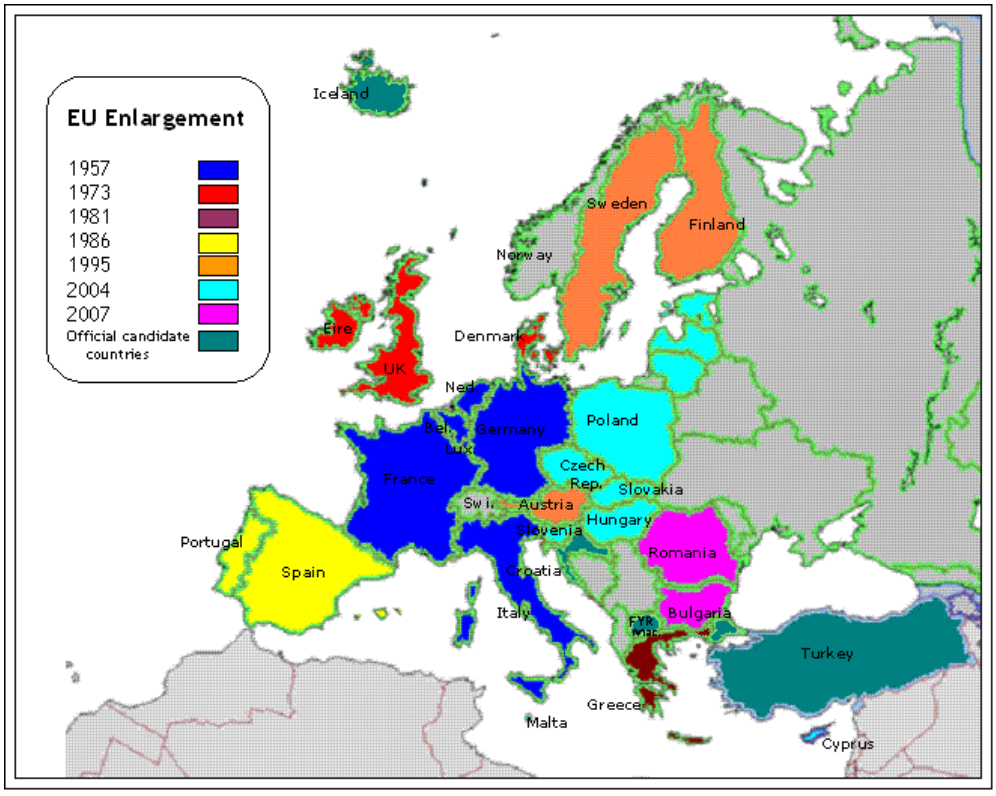

Figure 4: EU Enlargement Process

Data source: http://www.civitas.org.uk/eufacts/enlargementmap.html

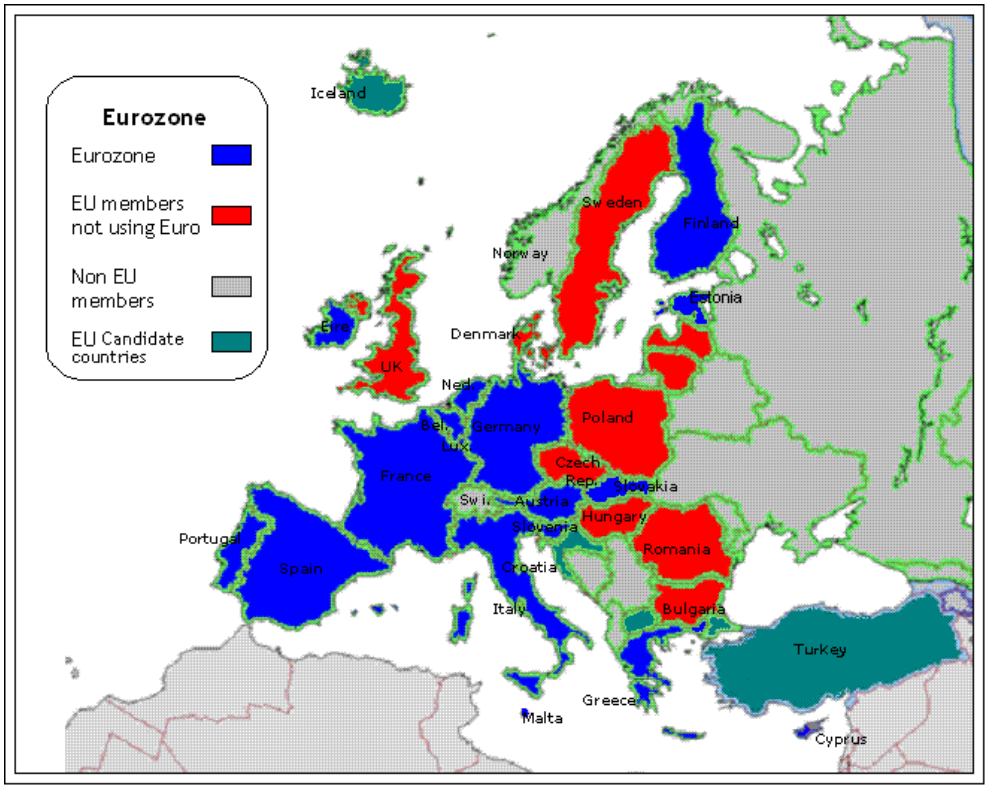

Figure 5: Euro Area Nowadays

Data source: http://www.civitas.org.uk/eufacts/eurozonemap.html

Variable	Source
Bilateral trade flows	OECD STAN Bilateral Trade Data Library http://stats.oecd.org/Index.aspx?QueryId=32186 UNCTAD Stat http://unctadstat.unctad.org/TableViewer/tableView.aspx
GDP (current USD)	World Bank Indicators http://data.worldbank.org/indicator/NY.GDP.MKTP.CD
GDP per capita (current USD)	World Bank Indicators http://data.worldbank.org/indicator/NY.GDP.PCAP.CD
Distance	World Atlas http://www.worldatlas.com/
Free Trade Agreement	WTO Regional Trade Agreements Information System http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx
EU membership	European Union http://europa.eu/about-eu/countries/index_en.htm
EMU membership	European Union http://ec.europa.eu/economy_finance/euro/adoption/euro_area/
Common Border	World Atlas http://www.worldatlas.com/
Common Country	Info Please http://www.infoplease.com/
Common Language	Info Please http://www.infoplease.com/
Island	World Atlas http://www.worldatlas.com/

Table 3: Variables and data sources

5. Results

I started the analysis with pooled ordinary least squares (OLS) regression. This model implicitly assumes that the coefficients are the same for all the variables. We suppose that each variable has time-invariant, but unique effect on the dependent variable - trade flows. Those unique effects to each variable are subsumed in error term ε_{ijt}. The estimated equation takes following form:

$$lnT_{ijt}=\alpha_0+\beta_1 lnGDP_{ijt}+\beta_2 lnGDPpercap_{ijt}+\beta_3 FTA_{ijt}+\beta_4 EU_{ijt}+\beta_5 EMU_{ijt}+$$

$$\beta_6 lnDistance_{ij}+\beta_7 Border_{ij}+\beta_8 ComTer_{ij}+\beta_9 Island_{ij}+\beta_{10} Language_{ij}+\varepsilon_{ijt}$$

Variables are usually autocorrelated in panel data. That means correlated within an entity, here pair, over time. In this estimation, autocorrelation and heteroskedasticity was found. Therefore, in case of presence of heteroskedasticity and autocorrelation it is necessary to use standard robust errors.

In the analysis, all the tests are performed on 5 per cent significance level. Before analyzing the outcomes of the model, we should focus on several tests implying significance of the model. One of them is F-test, especially its p-value. We set hypothesis H_0: $\beta_0=\beta_1=\beta$, meaning that all the coefficients in the equation are the same. We can decline $H_{0,}$ because p-value of the F-test is lower than our significance level. In other words, we say that coefficients in our equation are not the same and so the model makes sense and is therefore significant. We should also consider coefficient of determination, R-squared. This coefficient measures how well is variability in the dependent variable explained by the data used.

Magnitude of EMU variable proposed by the model is 14.7 per cent, calculated as [exp (0.136773) -1]*100, but is not statistically significant. Effect of EU is 2.9 per cent, but also turns out to be statistically insignificant. The rest of the variables seem to have the expected effect. Island location of just one country in a pair results in negative effect on trade coming up to 32.6 per cent. Bilateral distance between capital cities is statistically significant and as expected, proved negative impact on trade flows. This model also confirms negative relationship between trade flows and difference in GDP per capita. Positive effect was detected by sum of the GDPs. FTA was proved to have positive effect on bilateral trade, 123 per cent. For past membership in common state or territory and common state border there were also highly positive effects found- 143 and 96 per cent respectively.

The coefficient of determination, R-squared comes out as 0.667765. That means that variability in trade flows is explained by the model in 66.78 per cent.

	coefficient	std. error	t-ratio	p-value	
const	-19.7749	1.09182	-18.11	2.57e-072	***
Island	-0.282384	0.136139	-2.074	0.0381	**
border	0.672533	0.257922	2.608	0.0091	***
language	-0.473501	0.338635	-1.398	0.1621	
comter	1.42809	0.324187	4.405	1.07e-05	***
EU	0.0290025	0.168099	0.1725	0.8630	
EMU	0.136773	0.114787	1.192	0.2335	
FTA	0.799777	0.153253	5.219	1.83e-07	***
distance_ln	-0.786365	0.0653214	-12.04	3.53e-033	***
GDPsum_ln	1.41996	0.0415162	34.20	2.74e-244	***
GDPpercap_ln_ab	-0.138392	0.0434785	-3.183	0.0015	***

Table 4: OLS estimation

The results of pooled OLS seem to be in accordance with theory. However, it is not practical to rely just on one model. Therefore, we can continue estimating by implementing fixed effects or random effects model. According to Mundlak (1978), a fixed effects approach would be appropriate if it is supposed that some or all explanatory variables are correlated with the error term, while a random effects approach would be appropriate if all explanatory variables are assumed not to be correlated with the error-term.

As a next step, Hausman test was involved to evaluate which model better corresponds with the data. More specifically, in this case Hausman test was introduced to differentiate between fixed effects and random effects model. Random effects is preferred under the null hypothesis H_0 due to higher efficiency, while under the alternative hypothesis H_1 fixed effects is consistent and so preferred.

	H_0 true	H_1 true
Random effects	Efficient Consistent	Inconsistent
Fixed effects	Inefficient Consistent	Consistent

Table 5: Setting hypotheses to Hausman test

```
Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(5) = 67.9218
  with p-value = 2.77231e-013
```

Table 6: Hausman test

In our case, p-value of Hausman test is lower than 5 per cent significance level, so we reject H_0. It means we will perform fixed effects model.

Fixed effects regression is a method for controlling for omitted variables, when these omitted variables vary across entities (pairs) but remain unchanged over time. Omitted variable bias is captured at the expense of dropping out time-invariant variables such as common border, bilateral distance etc. that might have proved its own contribution to the model. The reason why dummy variables are excluded from the model is that the country-pair individual effect captures all unobservable factors related to trade resistance. Because they are collinear with the country-pair individual effects, estimation of coefficients on bilateral distance and other dummy variables is not possible. Therefore, we have to adjust our gravity equation. We have to omit variables for island, border, language, common territory and distance, as they are time invariant and would have been dropped out of the model. The adjusted gravity equation takes following form:

$$lnT_{ijt}=\alpha_{ij}+\beta_1 lnGDP_{ijt}+\beta_2 lnGDPpercap_{ijt}+\beta_3 FTA_{ijt}+\beta_4 EU_{ijt}+\beta_5 EMU_{ijt}+\varepsilon_{ijt}$$

EU, EMU and FTA variables should represent effects of ongoing trade liberalization. It is interesting that only two of three these variables are statistically significant. The EU variable was intended to capture trade effects of the EU Single Market that is different from (but complementary to) the euro effect. This model implies the EU effect to be negative (2.9 per cent) and statistically insignificant. The effect of EMU on trade flows is estimated to be approximately 9 per cent and statistically significant. If we compare this finding with descriptive evidence included in Section 3, where the figures clearly showed that the intra-EMU trade has been increasing with several exceptions during crisis year during the whole sample period, it indicates that there are probably effects that are more significant and trade-enhancing than adopting common currency. For example, elimination of trade barriers such as tariffs and quotas, representing by FTA variable in this model, seems to enhance trade by 76.7 per cent. One would reasonably expect that the effect of EU and FTA on trade, both basically

eliminating trade barriers, would turn out to be similar. It is therefore surprising that EU effect is negative and statistically insignificant, whereas the effect of FTA is highly positive and statistically significant. The estimate further implies that effect of sum of GDPs is statistically significant and highly positive. This is consistent with existing literature findings. On the other hand, difference in GDP per capita is not statistically significant.

With R-squared 0.96379, the model explains the data extremely well.

	coefficient	std. error	t-ratio	p-value	
const	-35.4244	1.75024	-20.24	1.92e-089	***
EU	-0.0261123	0.0716677	-0.3644	0.7156	
EMU	0.0872705	0.0375441	2.324	0.0201	**
FTA	0.569425	0.0633737	8.985	3.01e-019	***
GDPsum_ln	1.75341	0.0653497	26.83	1.31e-153	***
GDPpercap_ln_ab	0.0200066	0.0202332	0.9888	0.3228	

Table 7: Fixed effects estimation

We have performed two estimations – OLS and fixed effects. The matter is what results is more suitable to account for. The decision originates from the nature of both of the tests.

If we simply rely on OLS estimation, our results can be misrepresented by endogeneity bias. It is caused by the fact that we do not account for unobservable factor when performing OLS. Also, OLS model supposes that trade levels are the same for all the pairs which is not realistic. Therefore, we take OLS model as helpful tool for describing patterns of trade but as it does not capture time-series variation in trade, it is not rational to rely on this when measuring trade effects of the euro.

On the other hand, fixed effects model enables different coefficients (and so levels of trade) between different pairs. Therefore, we will use results of fixed effects estimation as our final results.

6. Concluding remarks

To summarize, this dissertation was compiled to describe, discuss and estimate effects of the euro on trade.

Firstly, review of recent literature on topics relating to currency unions or monetary unions and its relationship to trade creation was framed. Doing this, many different outcomes and many various methods of estimating the result were discovered. This work enabled me to acquire basic knowledge of the field and find out possibilities for future estimations.

Secondly, I did some job in descriptive statistics, gathering data that already focused mainly on the euro area trade. Thanks to this, an overview of trade patterns of the euro area with different groups such as 10 chosen OECD countries, non-EMU EU countries or just intra-euro area trade was obtained.

The third step was collection of the data. As a dataset, 37 countries were chosen, 27 of which are members of the European Union and 10 are non-EU OECD countries: Australia, Canada, Japan, Republic of Korea, Mexico, New Zealand, Norway, Switzerland, Turkey and United States. Data collected were extensively examined for potential correlations or collinearity. Also distribution of float variables was tested, making sure that these are normally distributed. Histograms are attached in Appendix of this thesis.

Finally, after dataset was ready to use, we could proceed to estimation. Gravity equation was estimated. After, I performed two models – pooled OLS regression and fixed effect model. I chose the second model after conducting Hausman test that suggested preferring fixed effects to random effects estimation. From the matter of the fact, I decided to rely on results of fixed effects model rather than OLS, because of nature, assumptions and implications of both of the tests that are already mentioned above.

After controlling for influences of economic size, memberships in different potentially trade-creating blocs or agreements and related geographical variables, the estimation results suggest that there is positive and statistically significant effect of the euro on trade, being 9 per cent. This relatively small result corresponds with that of De Nardis, S., Vicarelli, C., (2003). European trade relationships have always been relatively strong and have even been reinforced thanks to several policy introductions such as European Monetary System, Single Market or European Monetary Union, of which the last mentioned one has probably had only minor effect.

References

Baldwin, R. and Taglioni, D. (2006). "Gravity for Dummies and Dummies for Gravity Equation," NBER Working Paper No. 12516.

Berger, H. and Nitsch, V. (2007). "Zooming Out: The Trade Effect of the Euro in Historical Perspective", Journal of International Money and Finance, Vol. 25, No. 8, p. 1244-1260

Bun, M. and Klaassen, F. (2002). "Has the Euro Increased Trade?", Available at SSRN: http://ssrn.com/abstract=338602 on February 28th, 2013.

De Nardis, S., Vicarelli, C., (2003). "The Impact of the EMU on Trade Flows", Springer, Review of World Economics / Weltwirtschaftliches Archiv, Vol. 139, No. 4, p. 625-649

De Nardis, S., De Santis, R., Vicarelli, C., (2008). "The Euro's Effects on Trade in a Dynamics Setting", The European Journal For Comparative Economics, Vol. 5, No. 1, p. 73-85

Flam, H. and Nordström, H. (2003). "Trade Volume Effects of the Euro: Aggregate and Sector Estimates", Seminar Papers No. 746, Institute for International Economic Studies.

Glick, R. and Rose, A. (2001). "Does a Currency Union Affect Trade? The Time Series Evidence", European Economic Review 46-6, 1125-1151.

Gomes, T., Graham, Ch., Helliwell, J., Kano, T., Murray, J. and Schembri, L. (2006). "The Euro and Trade: Is there a Positive Effect?", Available at: http://www2.dse.unibo.it/soegw/paper/GomGraHelKanoMurrayS.pdf on February 28th, 2013.

Micco, A., Stein, E. and Ordonez, G. (2003). "The Currency Union Effect on Trade: Early Evidence from EMU", Economic Policy, Vol. 19, No. 37, p. 316-356.

Mundlak, Y. 1978. "On the Pooling of Time Series and Cross Section Data," Econometrica, 46(1), p. 69-85.

Rose, A. (2000). "One Money, One Market: Estimating the Effect of Common Currencies on Trade", NBER Working Paper No. w7432.

Appendix

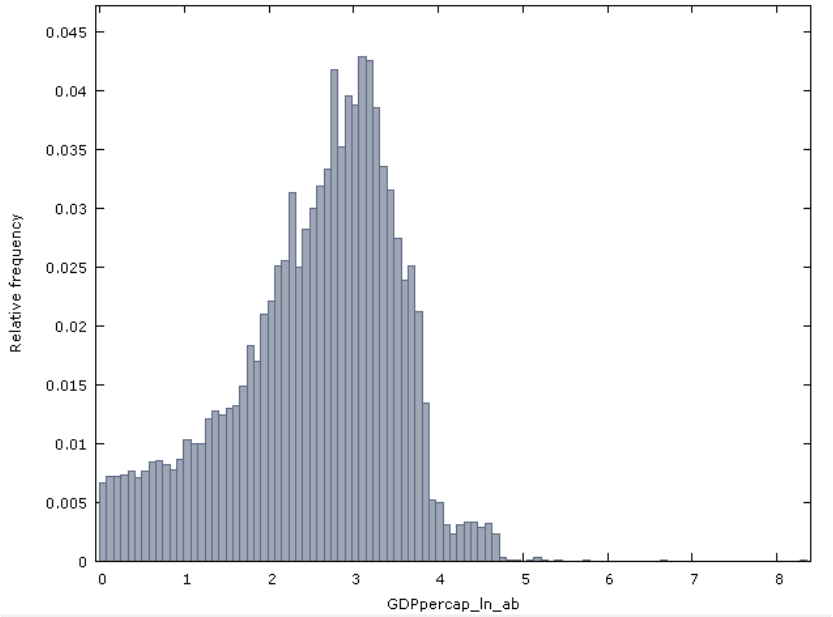

Figure 6: Difference in GDP per capita – variable distribution

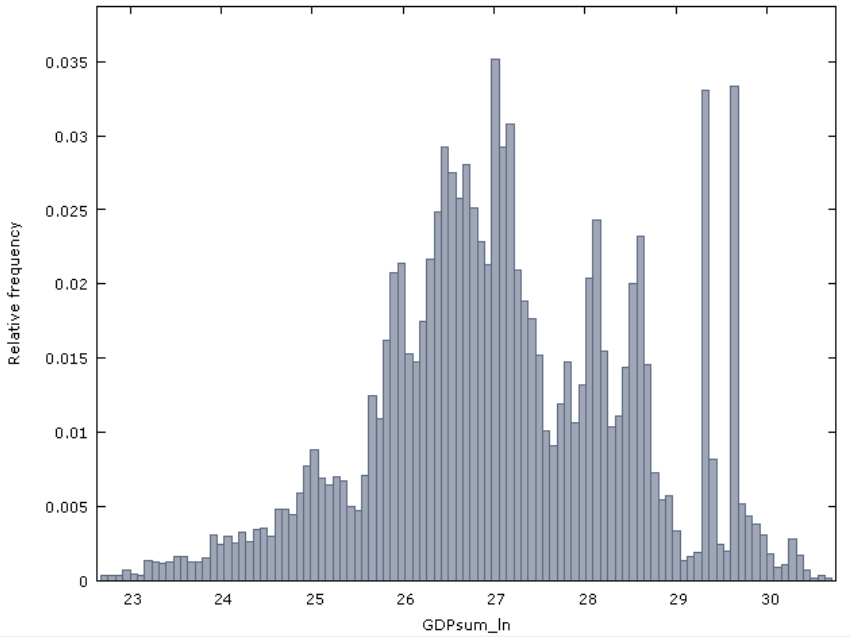

Figure 7: Sum of GDPs – variable distribution

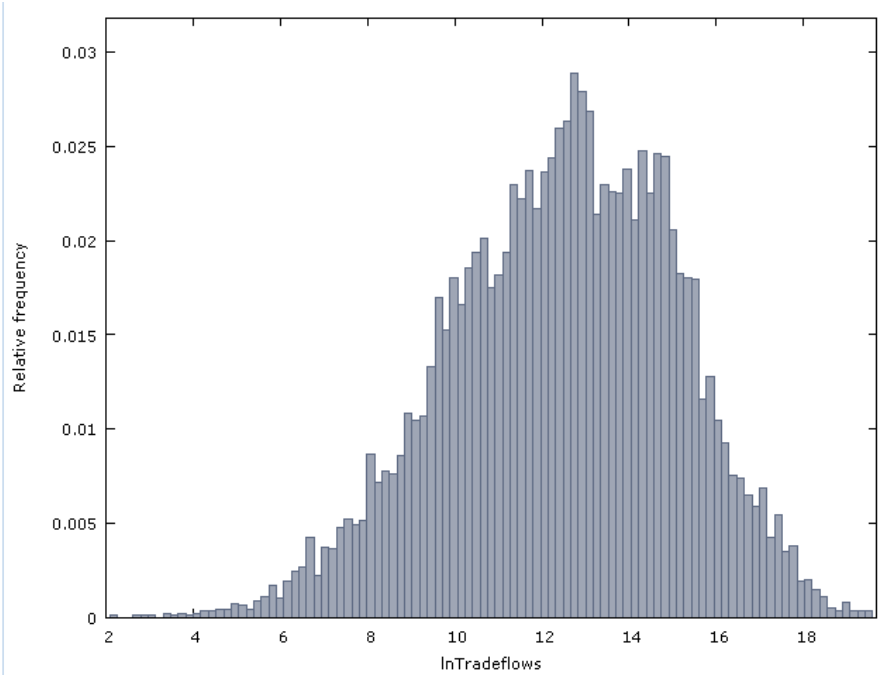

Figure 8: Bilateral trade flows – variable distribution