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Portugal's Integration in World Trade: A Gravity Model

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paulo.c.g.camacho@gmail.com.

Portugal's Integration in World Trade: A Gravity Model

Abstract

The aim of this study is to evaluate the integration of Portugal in terms of international trade in a world where trade barriers have been blurred. More specifically, the aim is to identify and quantify the factors that benefit or harm the Portuguese international trade. For this purpose it was used the standard gravity model methodology. This paper presents a summary of the literature on international trade theory, stylized facts of Portuguese international trade and literature regarding the gravity model of international trade. The Portuguese exports and imports were analyzed by using the standard gravity model methodology. In order to do so, two different standard gravity models were employed: one applied to exports and another to imports. Both models consider the following variables: GDP, GDP per capita, Distance, Common Border, Common Language, Landlocked, European Union (EU) and Eurozone (EZ). The results suggest that the participation of Portugal in the EU and in the Community of Portuguese Language Countries (CPLP) are important for both exports and imports. However, the results do not allow us to say that the participation of Portugal in the EZ has resulted in advantages for Portuguese exports destined for the EZ countries.

Keywords: Portugal; International Trade; Gravity Model.

JEL classifications: F1; F14.

1. INTRODUCTION

The economic and political scenario of Portugal has changed remarkably over the last decades. Portugal is a member of the European Economic Community (EEC) since 1986 and of the Eurozone (EZ) since its inception in 1999. On other hand, several barriers to international trade have disappeared as result of various agreements established by the World Trade Organization (WTO). These facts led to a huge rise of the Portuguese economic integration.

Portugal´s membership in Eurozone has led to costs that were underestimated, as loss of international competitiveness. Portugal's entry in the EZ occurred with a real effective exchange rate above its equilibrium value (Leão and Palacio-Vera, 2011:9). At the same time, Portugal faced an increase of direct competition from China and from countries of Central and Eastern Europe. These two factors contributed to a loss of share of Portuguese exports in its major markets.

On the other hand, the Portugal participation in the EZ allowed a public and private sector indebtedness at lower interest rates. These lower rates allowed boosting demand, as result capital and current account of Portugal has revealed successive deficits in last decade. The first decade of Portugal in the EZ is marked by a persistent divergence in terms of growth and inflation comparatively to other member countries. However, these interest rates started to rise after the 2008 financial crisis. In 2011, the financial markets were demanding high interest rates and Portugal had a large deficit account, thus creating an unsustainable situation to Portuguese economy. Hence, in 7 April 2011 Portugal requested financial assistance from the EU, the euro area Member States and the International Monetary Fund (IMF).

This context reveals the importance of understanding the Portuguese international trade, as international trade plays an important role to rebalance the capital and current account of Portugal. In this study it will be used a gravity model as a way of assessing the impact of several factors over Portuguese International Trade. For this purpose were specified two gravity equations, one for Portuguese imports and another one for Portuguese exports. The dataset applied in this study covered 178 countries from all the world, enabling a global view of Portuguese international trade dynamics and how it is affected by the following variables: distance, GDP, GDP *per capita*, Common Border, Common Language, Landlocked Countries, EU and EZ. It was also included time-fixed effects capturing any other time varying events. The obtained results highlighted the importance of Portuguese language to the Portuguese international trade while the EZ membership has not provided advantages for Portuguese exports to other EZ member countries.

The remainder of the paper is structured as follows. Section 2 presents stylized facts on Portuguese International Trade. Section 3 introduces the gravity model, its structure and examples of its application. Section 4 presents the specification of gravity equations in order to analyze Portuguese

imports and exports, the used data and the methodology. Section 5 presents the empirical results. Finally, Section 6 concludes the study.

2. STYLIZED FACTS ON PORTUGUESE INTERNATIONAL TRADE

2.1. International Trade and Deficit

The Portuguese economy has been showing an increasing integration into international trade. However, this integration did not solve the problem of successive deficits in the balance of goods.

Portugal is a member of EZ for more than 10 years. Nowadays, it is clear that the costs of this membership were underestimated, as stated by Leão and Palacio-Vera (2011); De Grauwe (2009) and Blanchard (2007). Indeed, the behavior of Portuguese economy since its entry into EZ has been disappointing (Figure 1). De Grauwe (2009:10) points out that Portugal has lost a significant amount of price and wage competitiveness since 1998 comparatively to several EZ countries. This was due to the evolution of the real effective exchange rate (based on unit labor costs).

Portugal has been recording successive deficits in its Balance of Payments since 1996 (Figure 2). These numbers express the need for external net borrowing of Portuguese economy. The deficits recorded in Current and Capital Account are mainly due to Current Account performance, since Capital Account has recorded surpluses over all those years. The Current Account recorded large deficits since 1996 until 2011, as regarded in Figure 3. The poor performance of Current Account is largely because of trade deficit in goods.

2.2. Trade Openness and Export Intensity

The importance of foreign trade to an economy can be expressed in terms of the degree of its Trade Openness (TO). This indicator measures the share of trade with foreign countries in goods and services in GDP. The Portuguese Trade Openness increased remarkably over the last 40 years (Figure 4). Nowadays, Portugal shows a TO slightly below the EU average but above the one that recorded by Spain and Greece.

Most of economies have experienced a TO rise. This rising is due to several factors, including the progressive international trade liberalization, reduced transport and communication costs, a higher demand for variety of goods and services and the role of vertical specialization activities (Banco de Portugal, 2009).

The Portuguese TO increased at a faster pace since Portugal is a member of the EEC. As a member of the EEC, Portugal benefited from EEC funds that were applied in the improvement and construction of transport infrastructures, while trade barriers were reduced.

Analyzing the rate of coverage of imports by exports it is clear that the imports contributed more than the exports to the rise of Portuguese TO. Portugal presents an Export Intensity (EI), defined as the ratio between exports and GDP, clearly below the EU27 and the EZ average (Figure 5).

2.3. Portuguese Exports and Imports

Between 1993 and 2011, EU´s member countries were clearly the main destinations/origins of Portuguese exports and imports, corresponding to an average of 16.42% and 24.96% of GDP, respectively (Figure 6 and Figure 7). On the other side, in terms of GDP, the non-EU countries were the destination of 4.40% in exports and the import´s source of 7.58%. Modest figures compared to the weight of the EU. Therefore, the EU is clearly the largest trading partner of Portugal.

The member countries of OPEC, EFTA and PALOP were the destination of 0.45%, 0.52% and 0.82% of exports on average in terms of GDP, respectively. With regards to imports, the OPEC´s countries contributed with 1.68%; PALOP´s countries contributed with 0.13% and EFTA´s countries represents 0.78%.

The Portuguese exports to PALOP´s countries have shown a remarkably evolution. In 1993, these countries were the target of only 0.51% of Portuguese exports, while in 2011 these countries were the target of 1.71%. The OPEP´s countries recorded an evolution even more remarkable. The Portuguese exports to these countries have risen of a mere 0.16% to 1.87%.

From 1993 until 2011, the Portuguese imports were always larger than the exports. In 2011, the Portuguese exports reached its largest value for the period 1993-2011: 24.75% of the GDP. Nevertheless the imports share was 33.76%.

The Portugal EZ´s membership has not contributed to an exports' rise as these have been stagnant in the period 1999-2010. Meanwhile, the Portuguese imports decreased in the period 2000-2003 and rose from 2003 until 2008. In this year the imports have fallen sharply due to the global financial crisis. Nevertheless, it returned to a growth trend from 2009 until 2011.

2.4. Net Exports

The evolution of net exports by type of good, categorized according to Combined Nomenclature-CN8 are shown in Figures 9, 10 and 11. These figures reveal that the majority of product categories show a negative trend since 1993.

The categories which present larger negative values of net exports are:

- Machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles (category 16);
- Vehicles, aircraft, vessels and associated transport equipment (category 17);
- Mineral Products (category 5);
- Base metals and articles of base metal (category 15);
- Products of the chemical or allied industries (category 6).

On the other hand, the categories which contributed to positive net exports are:

- Wood and articles of wood; wood charcoal; cork and articles of cork; manufactures of straw, of esparto or of other plaiting materials; basket ware and wickerwork (category 9);
- Textiles and textile articles (category 11);
- Footwear, headgear, umbrellas, sun umbrellas, walking sticks, seat-sticks, whips, riding-crops and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair (category 12);
- Articles of stone, plaster, cement, asbestos, mica or similar materials; ceramic products; glass and glassware (category 13).

It is important to underline that only these four categories show positive net exports values from 1993 until 2011.

These figures show the Portuguese economy fragilities in industries where innovation and technological development play an important role. Another important point revealed by these figures is Portugal´s excessive dependence of imported fuels.

The Portuguese economy presents a better performance when exporting products included in categories where technological development isn´t so determining. Therefore the Portuguese industries present high levels of quality in these categories, like "Wood and articles of wood" or "Articles of stone".

Amaral (2006:5) stated that the net revenues of Portuguese export´s sector only allow 2/3 of the Portuguese imports funding.

2.5. Revealed Comparative Advantage

The Balassa Index (BI) is a widely used Revealed Comparative Advantage (RCA) measure. The BI reveals that a specific country has a comparative advantage in a sector if BI is greater than 1. If the BI is lesser to 1, this country has a comparative disadvantage in that sector.

The Table 1 records the evolution of BI for different sectors, from 1967 to 2004.

Table 1: Relative export specialization of the Portuguese economy, Balassa Index

(Banco de Portugal, 2009:296)

	1967-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04
High-technology products	0.4	0.7	0.7	0.6	0.4	0.3	0.3	0.4
Aircraft and spacecraft	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.3
Pharmaceuticals	0.9	0.9	0.7	0.7	0.5	0.3	0.3	0.4
Office, accounting and computing machinery	0.2	0.7	0.6	0.6	0.2	0.1	0.1	0.3
Radio, TV and communications equipment	0.6	1.2	1.1	1.0	0.6	0.6	0.6	0.6
Medical, precision and optical instruments	0.1	0.3	0.4	0.3	0.2	0.2	0.3	0.3
Medium-high-technology products	0.3	0.4	0.4	0.4	0.5	0.6	0.8	0.9
Other electrical machinery and apparatus	0.5	0.8	0.7	0.5	0.8	1.3	1.5	1.2
Motor vehicles, trailers and semi-trailers	0.0	0.0	0.1	0.3	0.5	0.6	1.2	1.3
Chemicals excl. pharmaceuticals	0.6	0.7	0.6	0.7	0.6	0.5	0.4	0.5
Railroad equipment and other transport equip.	0.5	0.7	0.4	0.4	0.3	0.4	0.8	0.7
Other machinery and equipment	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.6
Medium-low-technology products	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.9
Coke, refined petroleum prod. and nuclear fuel	0.3	0.5	0.3	0.7	0.6	0.9	0.7	0.6
Rubber and plastics products	0.7	0.6	0.3	0.3	0.5	0.6	0.8	1.1
Other non-metallic mineral products	1.8	1.6	1.5	1.7	2.2	2.7	2.6	2.6
Building and repairing of ships and boats	0.1	0.4	0.7	0.5	0.8	0.5	0.4	0.3
Basic metals	0.2	0.1	0.3	0.2	0.2	0.2	0.2	0.5
Fabricated metal products, excl. machinery	0.9	0.9	0.8	0.9	0.8	0.9	1.0	1.3
Low-technology products	2.5	2.4	2.6	2.5	2.5	2.4	2.1	2.0
Other manufacturing and recycling	2.2	1.8	0.8	0.9	0.6	0.7	0.7	0.9
Wood, pulp, paper and printed products	2.2	2.5	3.3	3.1	2.8	2.2	2.1	2.3
Food products, beverages and tobacco	2.1	1.6	1.6	1.2	1.0	0.9	0.9	1.1
Textiles, textile products, leather and footwear	3.3	3.5	3.9	4.0	4.4	4.3	3.7	3.1

Looking at Table 1 we can see that the majority of products where Portugal has a comparative advantage are included in the category "Low-tech products". On the other hand, in the period 2000-2004, Portugal didn´t have a single comparative advantage in the sectors included in the category "High-tech products".

Portugal has some products in categories "Medium low-tech products" and "Medium high-tech products" which reveal comparative advantages, nonetheless these categories, as an all, show comparative disadvantages. Nevertheless, the majority of products included in these categories are showing a rising trend in recent years.

Banco de Portugal (2009: 295) considers that is not unexpected the fact Portugal has a greater number of RCA in low-tech products, since the physical capital per worker is still low, in spite of the rising occurred in last decades.

2.6. Market Shares

The exports quota (including intra-EU exports) has recorded a falling trend over the last decade, while the export quota (excluding intra-EU exports) has recorded a steady behavior. In 2011 the

Portuguese exports to EU27 were 74.1% of total exports; this number reveals the importance of EU27 for Portuguese exports (Figure 8).

Between 2000 and 2008, Portuguese exports to EU15 suffered a fall in Textile, Clothing and Footwear categories due to the "Uruguay Round" agreement, as it allowed China to raise its EU15´s quota at the expense of several European southern countries, including Portugal. Furthermore, Portugal´s exports quota to EU15 recorded a sharp decline in products included in medium an high tech categories due to East European countries. These countries have benefited from a combination of low salaries and high skilled workforces (Banco de Portugal, 2010: 144-5), thus capturing significant shares of Foreign Direct Investment (FDI), which were previously headed towards Southern Europe, including Portugal (Leão e Palacio-Vera, 2011: 12). Nevertheless, in 2011, the Portuguese exports increased its market share. These market share´s increases were considerable for both EU27´s market and outside EU27´s market. The Portuguese exports market shares increased in the USA, Brazil, Angola and China (Banco de Portugal, 2012: 26).

The EU27´s market share in Portuguese imports has been experiencing a sharp decline since 2009, as Portugal´s domestic demand has been falling (Figure 8). The market share of EU27's non-members countries in Portuguese imports is falling as well, but its extent is smaller than the recorded by EU27.

3. THE GRAVITY MODEL OF TRADE

The gravity model was proposed by Linder (1961), Tinbergen (1962) and Linnemann (1966). This model has become one of the most commonly used to analyze international trade. A number of studies, which used different modeling assumptions, have provided theoretical foundations for the gravity model of trade; see for instance Anderson (1979), Anderson and van Wincoop (2003), Bergstrand (1985), Chaney (2008), and Eaton and Kortum (2002).

Nowadays, the gravity model is regarded as a useful and reliable tool to be applied in international trade studies. For instance: it has been applied to analyze how trade will change in countries which establish free trade agreements or became members of a monetary union.

3.1 Studies

Since gravity models have high explanatory capabilities, they have been widely applied in several studies concerning international trade issues. The following examples illustrate the range of this sort of models. Rose (2004) applied a standard "gravity" model of bilateral merchandise trade and a large panel data set covering over a fifty year period and 175 countries to estimate the effect on

international trade of multilateral trade agreements. Bussière *et al* (2005) analyzed the trade integration of the Central and Eastern European countries (CEECs) with the euro area, using as benchmark an enhanced gravity model estimated for a large sample of bilateral trade flows across 61 countries since 1980. Felipe and Kumar (2010) used a gravity model to examine the relationship between bilateral trade flows and trade facilitation. They also estimated the gains in trade derived from improvements in trade facilitation for the Central Asian countries. The employed gravity model covered 140 countries. Finally, De Grauwe *et al* (2012) employed the standard gravity model to identify the quality of governance of China's African trade partners. The data set covered 53 African countries for the period 1996-2009.

3.2 Studies about Portuguese International Trade

Several authors have studied the Portuguese International Trade applying the standard gravity model. The following studies are an illustrative list of works carried out. Africano and Magalhães (2005) investigated the relation between the stock of foreign direct investment (FDI) and the geographical pattern of trade flows in the Portuguese economy. The gravity model was applied to bilateral trade between Portugal and OECD countries plus Brazil from 1998 to 2000. The conclusions of these studies pointed out that the stock of inward FDI is positively related to trade, suggesting the existence of complementary between those two. This effect is stronger on exports than on imports resulting in a positive impact on trade balance. It was also found that the stock of outward FDI has no significant relation either with Portuguese exports or imports. Finally, FDI helps to explain the above "normal" exports to the EU and the below "normal" imports from Candidate Countries. Fonseca *et al* (2010) analyzed the empirical relationship between Portuguese outward FDI and trade, applying a panel data analysis within a framework of gravity equations for exports and imports, with a sample composed by EU-15, U.S.A., Brazil, Angola, Japan and China, for the period 1996-2007. They stated that the empirical evidence for Portugal is consistent with a substitution hypothesis between direct investment abroad and trade, and hence detected a negative trade balance effect with the majority of countries in the used sample, excepting Angola and Spain. Faustino and Leitão (2008) tested the relation between immigration and Portuguese bilateral trade. This study was based on a gravity model, the dataset covered the trade between Portugal and each European partner-country (EU-15) for the period 1995-2003. The results achieved show that the stock of immigrants has a positive effect on Portuguese exports, on imports and on bilateral intra industry trade. They came with another important finding: when immigrants to Portugal come from a Latin partner-country, the effects on trade are stronger than in the case of immigrants from non-Latin countries. Leitão et al (2010) analyzed the link between trade and migration flows using a gravity model for the period 1995-2007. The sample included European Union countries and

Portuguese speaking countries (PALOPS). This study found evidence that immigration has a positive influence in bilateral trade and observed the importance of Portugal's economic integration in EU.

3.3 Gravity Equation

Gravity models define bilateral trade as a function of two key variables: the economical size of the two countries engaged in trade and the distance between them. This model postulates that the trade between any two countries is positively associated with the size of the countries involved and depends negatively on the distance between them. The gravity equation can be expressed as follows:

$$T_{ij} = A \times Y_i \times \frac{Y_j}{D_{ij}} \quad (1)$$

Where:
A: constant term
T_{ij}: value of trade between country *i* and country *j*.
Y_i: country *i´*s GDP
Y_j: country *j´*s GDP
Dij: distance between country *i* and country *j*

Head (2003) states that: "gravity equation can be thought of as a kind of short-hand representation of supply and demand forces. If country *i* is the origin, then *Yi* represents the total amount it is willing to supply to all customers. Meanwhile *Yj* represents the total amount destination *j* demands. Distance acts as a sort of tax "wedge," imposing trade costs, and resulting in lower equilibrium trade flows."

3.4 GDP and Distance

The GDP is a vital variable in the gravity model. Krugman *et al* (2011) states: "Large economies tend to spend large amounts on imports because they have large incomes. They also tend to attract large shares of others countries' spending because they produce a wide range of products. So, other things equal, the trade between any two economies is larger, the larger is either economy."
Several studies have confirmed the importance of distance in trade. Leamer (2006:37) pointed out that the distance effect on international commerce is "possibly the only important finding that has fully withstood the scrutiny of time and the onslaught of economic technique". More recently, Disdier and Head (2008) showed that distance effects decreased slightly between 1870 and 1950 and then began to rise. Hummels (2001) and Deardorff (2003) stated that the influence of time in

commerce is increasing. Berthelon and Freund (2004) concluded that changes in industrial structure have not implied any change in terms of the distance effect.

Head (2003, 6-8) has presented six of the major explanations given by the economists for the distance effect in trade:

- Distance is a proxy for transport costs. Shipping costs (freight charges and marine insurance) can go a long way towards explaining why distance matters.
- Distance indicates the time elapsed during shipment. For perishable goods the probability of surviving intact is a decreasing function of time in transit. Perishability may be interpreted quite broadly to include the following risks: Damage or loss of the good due to weather or mishandling; Decomposition and spoiling of organic materials; Loss of the market (the intended purchaser becomes unwilling or unable to make payment).
- Synchronization costs. When factories combine multiple inputs in the production process, they need those inputs to arrive in time or bottlenecks emerge. One possibility is to use warehouses to keep inventories of each input but this approach suffers from various drawbacks (land costs, technological obsolescence, fashion changes, and low pressures for quality control). Sourcing inputs from nearby lowers synchronization costs.
- Communication costs. Distance "proxies for the possibilities of personal contact between managers, customers, and so on; that much business depends on the ability to exchange more information, of a less formal kind, than can be sent over a wire."
- Transaction costs. Distance may also be correlated with the costs of searching for trading opportunities and the establishment of trust between potential trading partners.
- "Cultural distance." It may also be that greater geographic distances are correlated with larger cultural differences. Cultural differences can impede trade in many ways such as inhibiting communication, generating misunderstandings, clashes in negotiation styles, etc.

3.5 Augmented Gravity Model

The gravity model can explain accurately much of the international trade with just two variables: countries GDP and their distances. Nevertheless, there is a huge amount of variation in international trade that cannot be explained with such gravity model. Thus, economists tend to use a more comprehensive gravity model, adding few other variables with less theoretical justification. Usually because past experience has shown that they work. See for instance, Frankel (1997) and Rose (2004). Some of the explanatory variables most used by economists are the following:

- **GDP *per capita***: it is a variable widely used in the gravity models. This variable is almost mandatory. Its use is justified, since the goods consumed in a specific country vary with its GDP per capita. When the GDP per capita of a specific country increases, the demand for foreign goods,

classified as superior goods, tends to increase as well. Further, countries with a higher GDP per capita tend to be developed countries, where the development had been led by innovation or invention of new products, which afterwards were exported to other countries. On other hand, more developed countries are more likely to have advanced transport infrastructures, which facilitate international trade. These countries have a larger probability of having reduced tariffs (Head, 2003:9).

- **Common Language**: the evidence points out that a pair of countries which share a common language tend to trade twice to three times as much as pairs that don´t (Head, 2003:10). Indeed, countries sharing the same language probably have lower transaction costs to trade and tend to historically have more established trade ties, possibly also related to colonial history (Bussière and Schnatz, 2006: 13). For instance: the common language shared between Spain and its former colonies in Latin America could explain the relatively high levels of trade between them (Bussière et al, 2005: 14).
- **Common Border**: crossing borders often involves the payment of fees and others transaction costs. Hence, when countries share a common border transaction costs can be reduced, stimulating a higher bilateral trade (Bussière and Schnatz, 2006: 13).
- **Free Trade Agreement**: These agreements have the goal of stimulating the trade between the constituent countries. On average, FTAs seem to raise trade by around 50% (Head, 2003:10).
- **Monetary Agreement**: Frankel and Rose (2000) stated that belonging to a currency union promotes the trade between its members.
- **Landlocked Countries**: The maritime transport plays an important role in the world trade. The lack of a coastline increases the time and cost of transportation as well as the dependence on the quality of the infrastructure network of the neighboring countries. Indeed, if a country is landlocked, it has a larger dependence on infrastructure beyond one's own borders. Nevertheless, the explanatory variables used in gravity models are very diverse. The selection of a particular set of explanatory variables is made according to the purposes of the study. See for instance: Frankel (1997), Rose (2004), and De Grauwe et al (2012).

4. SPECIFICATION

In this paper are applied two log-linear version of Equation (1), including the selected explanatory variables identified above. It is applied a gravity equation to Portuguese exports (2) and another to Portuguese imports (3). In both gravity equations, *i* designates Portugal. These equations include 178 countries, which are or were Portuguese trade partners. A full list of the countries is included in Appendix. It was analyzed the time period comprised between 1993 and 2011.

The Equation 2 was applied to Portuguese Exports and is expressed as follows:

$$ln(X_{i,j,t}) = \beta_0 + \beta_1 ln(D_{i,j}) + \beta_2 ln(Y_{i,t}Y_{j,t}) + \beta_3 ln(Y_{i,t}Y_{j,t}/Pop_{i,t}\,Pop_{j,t}) + \beta_4 CommonBorder_{i,j} + \beta_5 CommonLanguage_{i,j} + \beta_6\, Landlocked_{i,j} + \beta_7\, EU_{i,j,t} + \beta_8\, EZ_{i,j,t} + \sum_t \phi_t T_t + \varepsilon_{i,j,t}$$

(2)

$X_{i,j,t}$: Exports of goods from Portugal to country *j*, in year *t*

$D_{i,j}$: Physical distance between Portugal and country *j*

$Y_{i,t}$: Portuguese real GDP in year *t*

$Y_{j,t}$: Country *j´*s real GDP in year *t*

$Pop_{i,t}$: Portuguese population in year *t*

$Pop_{j,t}$: Country *j´*s population in year *t*

$CommonBorder_{i,j}$: Binary dummy variable which is unity if Portugal shares a common border with country *j* and zero otherwise.

$CommonLanguage_{i,j}$: Binary dummy variable which is unity if Portugal shares a common official language with country *j* and zero otherwise.

$Landlocked_{i,j}$: Binary dummy variable which is unity if country *j* is landlocked and zero otherwise.

$EU_{i,j,t}$: Binary dummy variable which is unity if Portugal and country *j* are both members of European Union in year *t*, and zero otherwise.

$EZ_{i,j,t}$: Binary dummy variable which is unity if Portugal and country *j* are both members of Euro Area in year *t*, and zero otherwise.

T_t: Time fixed effects that takes the value 1 at time t and 0 otherwise

$\varepsilon_{i,j,t}$: Error term

β and ϕ: Coefficients

The Equation 3 was applied to Portuguese Imports and is expressed as follows:

$$ln(M_{i,j,t}) = \beta_0 + \beta_1 ln(D_{i,j}) + \beta_2 ln(Y_{i,t}Y_{j,t}) + \beta_3 ln(Y_{i,t}Y_{j,t}/Pop_{i,t}\,Pop_{j,t}) + \beta_4 CommonBorder_{i,j} + \beta_5 CommonLanguage_{i,j} + \beta_6\, Landlocked_{i,j} + \beta_7\, EU_{i,j,t} + \beta_8\, EZ_{i,j,t} + \sum_t \phi_t T_t + \varepsilon_{i,j,t}$$

(3)

$M_{i,j,t}$: Imports of goods from Portugal to country *j*, in year *t*

$D_{i,j}$: Physical distance between Portugal and country *j*

$Y_{i,t}$: Portuguese real GDP in year *t*

$Y_{j,t}$: Country *j´*s real GDP in year *t*

$Pop_{i,t}$: Portuguese population in year *t*

$Pop_{j,t}$: Country *j´*s population in year *t*

$CommonBorder_{i,j}$: Binary dummy variable which is unity if Portugal shares a common border with country *j* and zero otherwise.

$CommonLanguage_{i,j}$: Binary dummy variable which is unity if Portugal shares a common official language with country *j* and zero otherwise.

$Landlocked_{i,j}$: Binary dummy variable which is unity if country *j* is landlocked and zero otherwise.

$EU_{i,j,t}$: Binary dummy variable which is unity if Portugal and country *j* are both members of European Union in year *t*, and zero otherwise.

$EZ_{i,j,t}$: Binary dummy variable which is unity if Portugal and country *j* are both members of Euro Area in year *t*, and zero otherwise.

T_t: Time fixed effects that takes the value 1 at time t and 0 otherwise

$\varepsilon_{i,j,t}$: Error term

β and ϕ: Coefficients

In Equation 2, as in Equation 3, it is expected that the coefficients β_2, β_4, β_5, β_7, and β_8 show a positive sign while coefficients β_1, and β_6 are expected to be negative.

4.1 Data

As stated above, both gravity equations were applied to trade between Portugal and 178 countries over the time period 1993-2010. A list of the countries is included in Appendix.

Data on GDP and GDP *per capita* were obtained from the *World Bank* database. These values are in constant prices of 2005 dollar.

The figures for exports and imports of Portugal between its trading partners were both obtained from databases maintained by *Statistics Portugal* (*Instituto Nacional de Estatística*). Data for Portuguese exports were obtained from the following database: "*Exportações (€) de bens por Local de destino e Actividade económica (CAE Rev. 2.1); Anual - INE, Estatísticas do Comércio Internacional de bens*". Data for Portuguese imports were obtained from the following database: "*Importações (€) de bens por Local de origem e Actividade económica (CAE Rev. 2.1); Anual - INE, Estatísticas do Comércio Internacional de bens*". Both imports and exports figures are denominated in euros. To convert them to US Dollars it was used a *Euro/USdollar* exchange rate series provided by *Eurostat*. Then it was used the US CPI series (2005=100) from the *U.S. Bureau of Labor Statistics* database to convert the trade data in real terms.

Data on distance, common language, and landlocked were taken from the CEPII (*Centre d'Etudes Prospectives et d'Informations Internationales*) database: *GeoDist* (Mayer and Zignago, 2011).
The year of entry in EU of the member countries came from EU´s official site. The year of entry in EZ of its member countries came from ECB´s official site.

4.2 Methodology

The gravity equations were estimated applying Ordinary Least Squares (OLS) and robust standard error that was used to account for possible heteroscedasticity and autocorrelation in the residuals. Also, both gravity equations were estimated with the panel data approach, using the random effects method (RE).
The two estimation methodologies were applied in order to check the quality of the results.

5. RESULTS

5.1 Exports

The results obtained for Exports Gravity Equation are reported in Table 1. The first column indicates OLS results, while the second column indicates RE results. Most of the results obtained through OLS methodology are consistent with those obtained using Random Effects methodology.

Table 1: Export Gravity Equation Results

	Estimation Methodology	
VARIABLES	**OLS**	**Random Effects**
Distance	-1.375191***	-1.485526***
	(0.050188)	(0.141542)
Real GDP	0.860581***	0.853672***
	(0.015929)	(0.043275)
Real GDP*percapita*	0.341984***	0.402659***
	(0.029333)	(0.071331)
Common Border	-0.315473***	-0.078293
	(0.105203)	(1.185592)
Common Language	4.63303***	4.815973***
	(0.171577)	(0.421308)
Landlocked	-0.948518***	-1.001272***
	(0.083007)	(0.224045)
EU	1.198245***	0.729114***
	(0.079932)	(0.1337)
EZ	0.028064	-0.154869
	(0.073535)	(0.145036)
R-squared	0.780198	0.777849

Note: Robust standard errors (OLS) and standard errors (RE) in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

The majority of coefficients of the gravity model for trade present the expected signs in both methodologies. However, there are two coefficients that must be analyzed more carefully: *CommonBorder* and *Eurozone*.

The p-value obtained for *CommonBorder* factor through the RE methodology asserts that one cannot reject the hypothesis of this coefficient to be equal to zero, while the p-value obtained through OLS methodology states the opposite. However, the insignificant values of the obtained coefficients for these factors in both methodologies allow the conclusion that this factor has a neutral impact on trade.

The *Eurozone* factor shows opposite signs in each methodology. However, p-values obtained in both methodologies are larger than 5%, indicating that one cannot reject the hypothesis that the factor cannot be zero. Hence, it can be stated that this factor has a neutral impact on trade.

5.2 Imports

The results obtained for Imports Gravity Equation are reported in Table 2. The first column indicates OLS results, while the second column indicates RE results. Most of the results obtained through OLS methodology are consistent with those obtained using RE methodology.

Table 2: Imports Gravity Equation Results

	Estimation Methodology	
VARIABLES	**OLS**	**Random Effects**
Distance	-0.956772***	-1.092887***
	(0.064424)	(0.209698)
Real GDP	1.129889***	1.184749***
	(0.02406)	(0.065041)
Real GDP*percapita*	-0.032824	0.174079**
	(0.042829)	(0.104789)
Common Border	0.325152**	0.059236
	(0.133157)	(1.739099)
Common Language	2.308182***	2.815009***
	(0.146117)	(0.617892)
Landlocked	-0.284639**	-0.277289
	(0.120525)	(0.329161)
EU	0.990408***	0.729828***
	(0.101662)	(0.188349)
EZ	0.55115***	0.308298
	(0.088462)	(0.205199)
R-squared	0.607404	0.596980

Note: Robust standard errors (OLS) and standard errors (RE) in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

The majority of coefficients of the gravity model for trade present the expected signs in both methodologies. However, there is a coefficient that must be analyzed more carefully: *GDPperCapita*.

The results obtained through both methodologies are consistent with each other in terms of signs, with the exception of the signs for the *GDPperCapita* factor which are discordant. However, both p-values indicate that the hypothesis of this coefficient to be equal to zero cannot be rejected.

6. CONCLUSIONS AND FUTURE DEVELOPMENTS

The results show that traditional variables of gravity model present the expected behavior in both equations. Distance has a negative impact over Portuguese exports and imports, while GDP has a positive impact.

The GDP *per capita* has a positive impact over exports; its impact over imports is not significant. Thus, Portugal has products that are demanded by developed countries, while its imports are not so affected by the level of development of the origin country. Nevertheless, country's GDP has a larger impact in Portuguese exports than their GDP *per capita*.

Both equations state the value of the sea to Portuguese trade. If a country is landlocked, it will have a negative impact in Portuguese exports. Furthermore, Portugal will tend to import less from a landlocked country.

The obtained results suggest that Portugal´s EU membership resulted in advantages to Portuguese exports to other EU member countries. On the other hand, they suggest that imports from EU countries were also benefited.

The Portuguese language is an important factor in trade between Portugal and CPLP countries. This factor benefits the Portuguese exports to these countries and the Portuguese imports from them. Indeed, this is the most evident result in both gravity equations.

The results concerning Portugal´s EZ membership indicate that this factor has not rendered benefits for Portuguese exports for the other member countries, nor to the Portuguese imports from that Zone.

Finally, future developments of this work should include variables representing oil producing countries, FDI, Portuguese emigration and Portuguese immigration. These variables will be useful for better understanding bilateral trade between Portugal and countries of CPLP. Actually, several studies of Portuguese international trade in the context of gravitational models attest their impact. The importance of these variables arises from the following facts: (i) past and present Portuguese FDI investments in those countries and vice versa; (ii) certain CPLP countries are now key oil producers, particularly Angola and Brazil; (iii) there is an increase of Portuguese citizens living in those countries; (iv) Portugal has large immigrant communities from CPLP countries.

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ANNEX

Figures and Tables

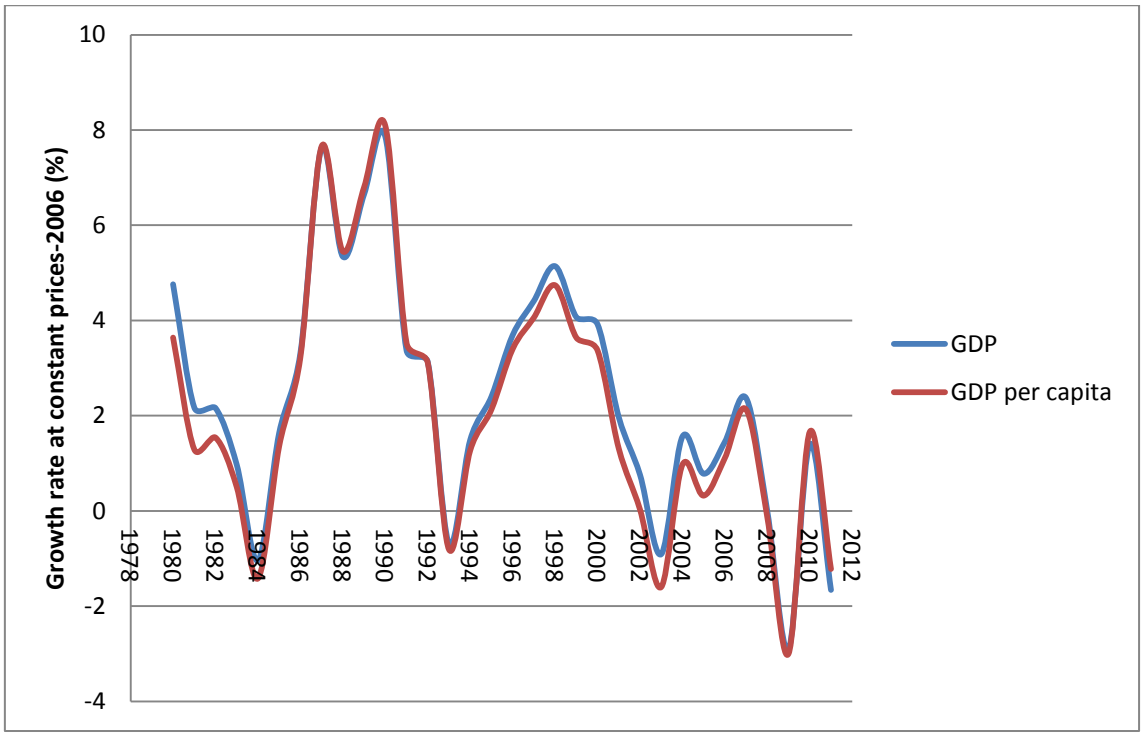

Figure 1: GDP and GDP *per capita* growth rates at constant prices-2006 (Source: INE).

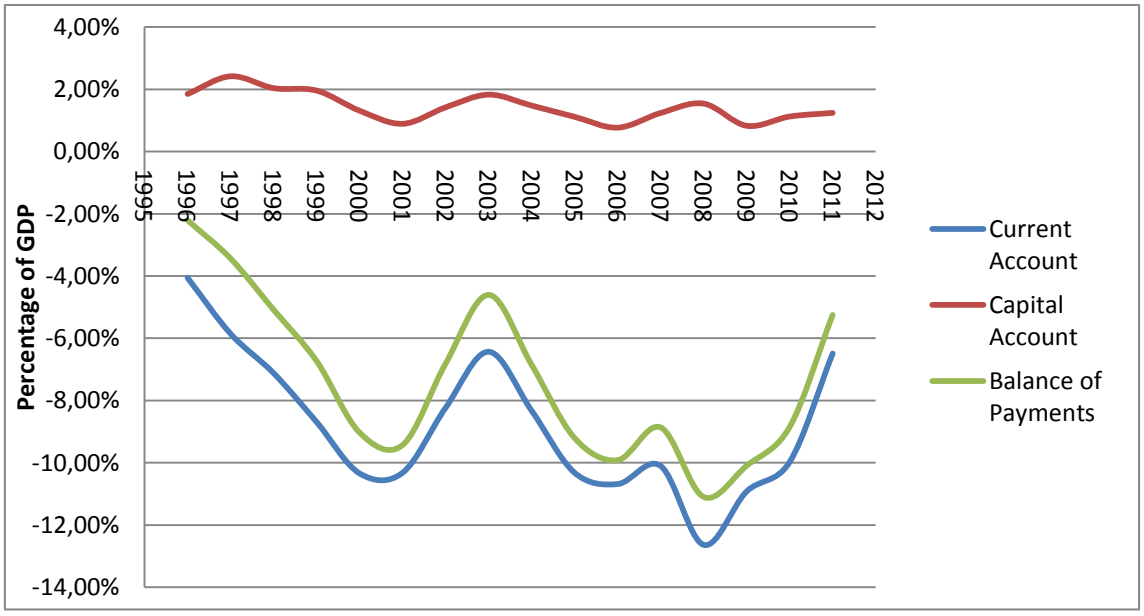

Figure 2: Current and Capital Account (Source: Banco de Portugal).

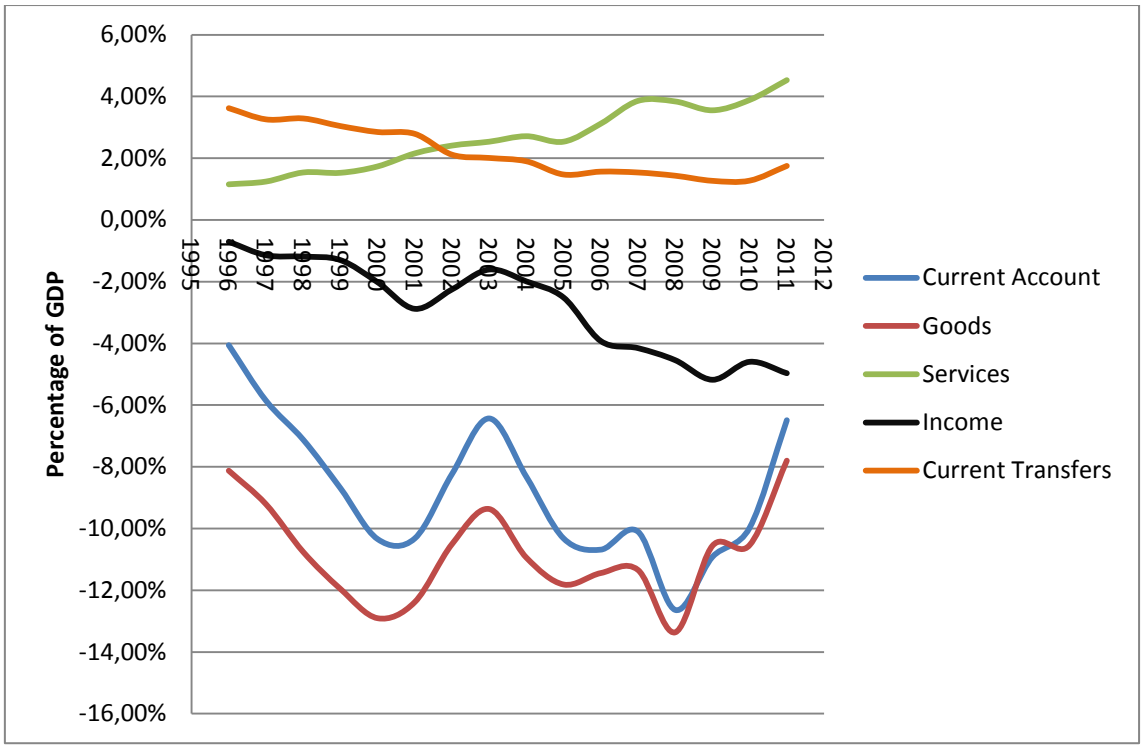

Figure 3: Current Account Components (Source: Banco de Portugal).

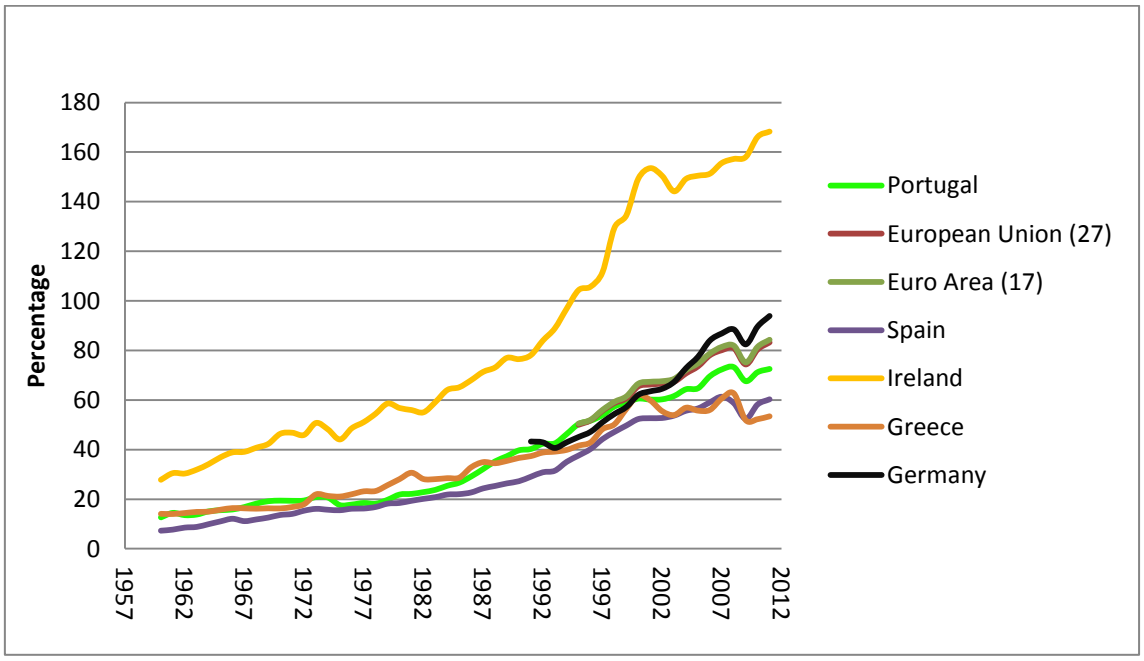

Figure 4: Trade Openness (author´s calculations based on data from AMECO).

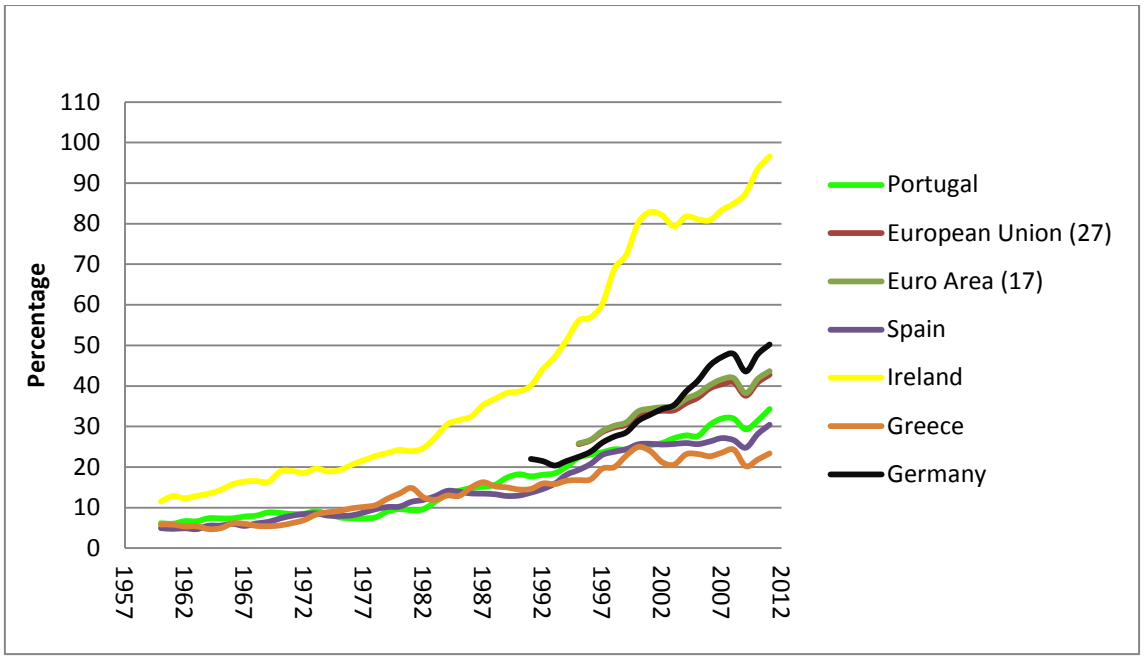

Figure 5: Export Intensity (author´s calculations based on data from AMECO).

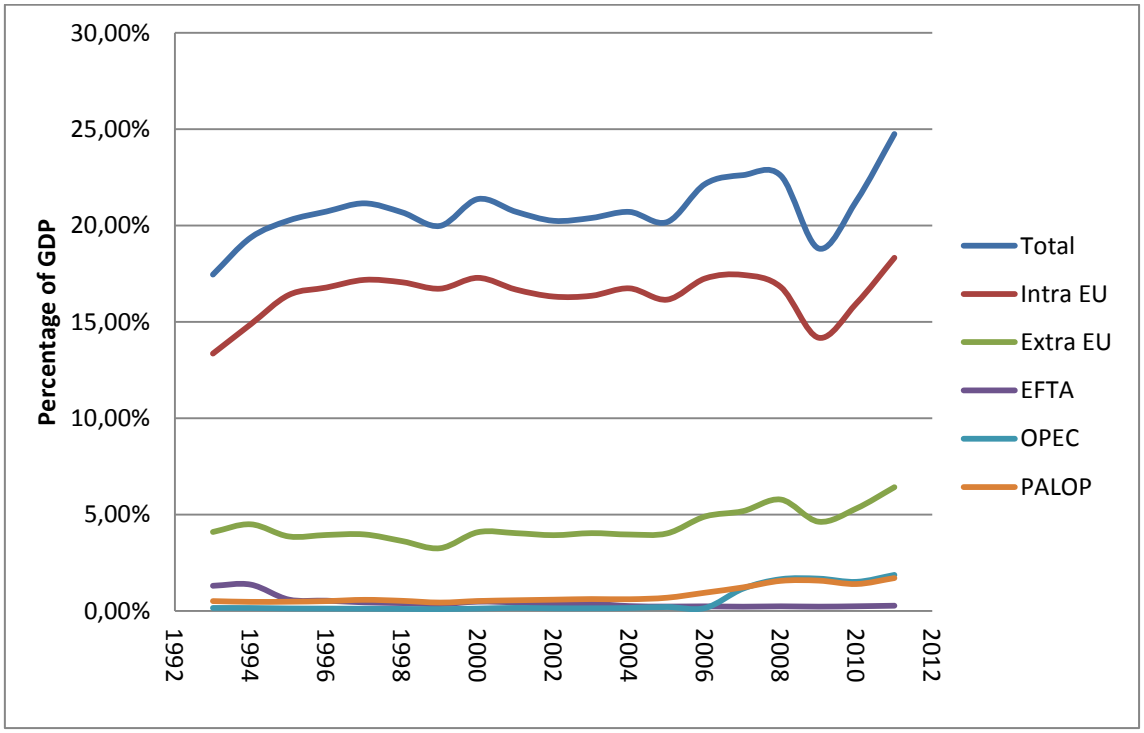

Figure 6: Exports as percentage of Portugal´s GDP (Sources: INE and AMECO).

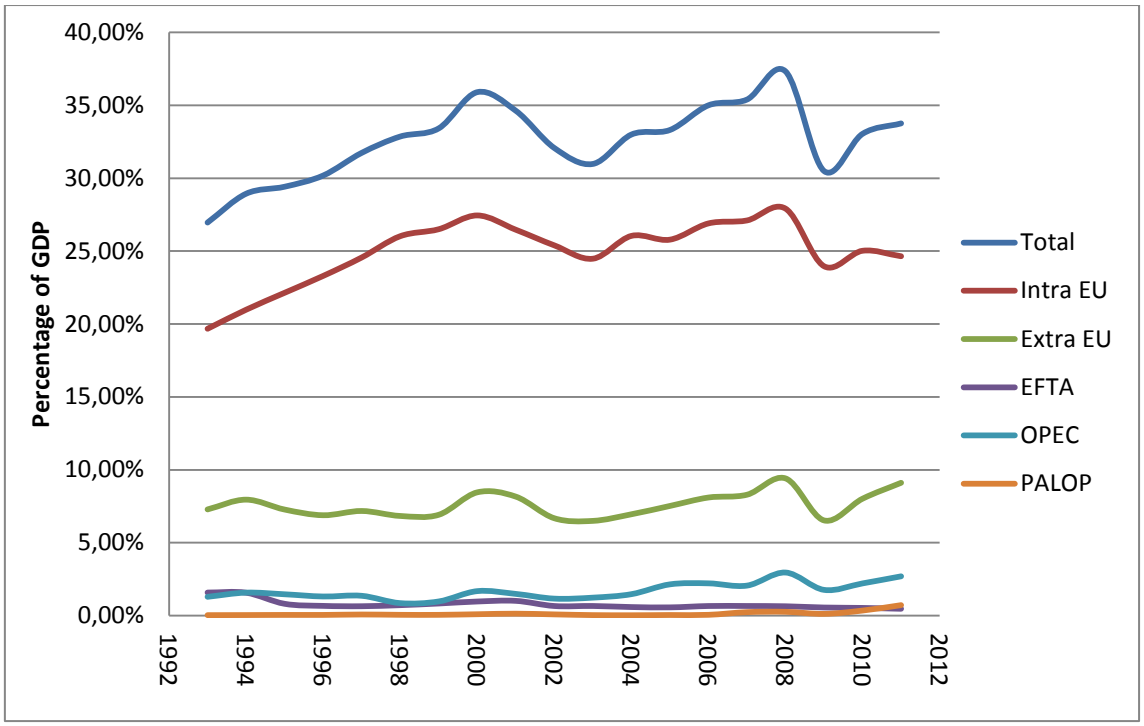

Figure 7: Imports as percentage of Portugal´s GDP (Sources: INE and AMECO).

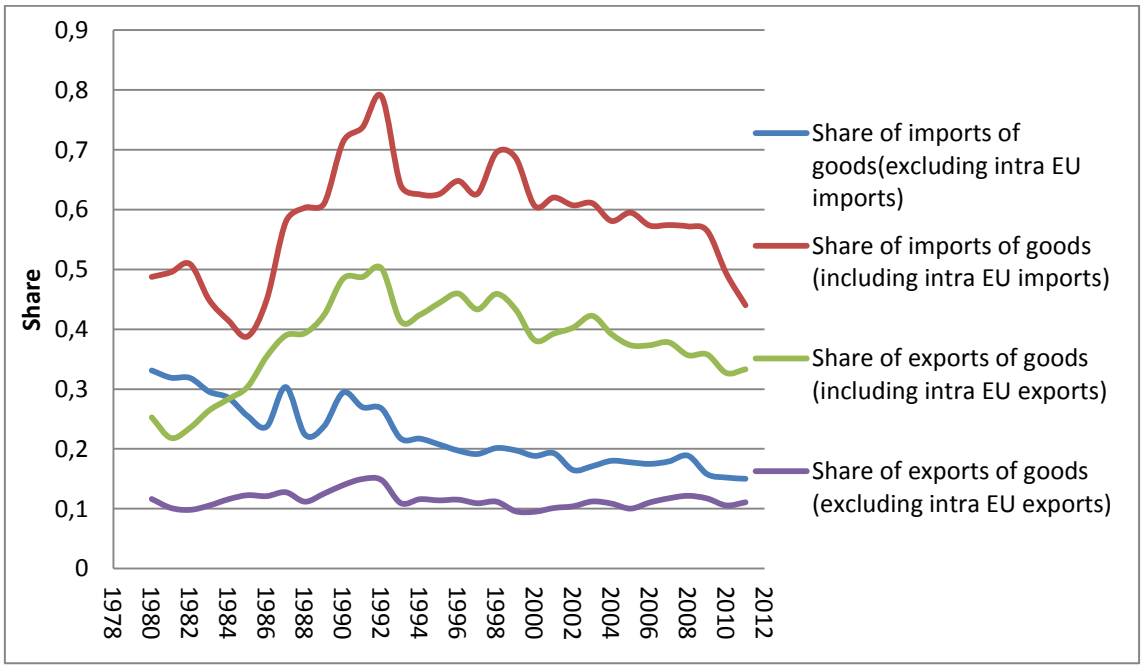

Figure 8: Share of imports of goods in world imports and Share of exports of goods in world exports (Source: AMECO).

Codes used in Figures 9, 10 and 11	Type of goods (Combined nomenclature - CN8)
1	Live animals; animal products
2	Vegetable products
3	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes
4	Prepared foodstuffs; beverages, spirits and vinegar; tobacco and manufactured tobacco substitutes
5	Mineral products
6	Products of the chemical or allied industries
7	Plastics and articles thereof; rubber and articles thereof
8	Raw hides and skins, leather, furskins and articles thereof; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silkworm gut)
9	Wood and articles of wood; wood charcoal; cork and articles of cork; manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork
10	Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard; paper and paperboard and articles thereof
11	Textiles and textile articles
12	Footwear, headgear, umbrellas, sun umbrellas, walking sticks, seat-sticks, whips, riding-crops and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair
13	Articles of stone, plaster, cement, asbestos, mica or similar materials; ceramic products; glass and glassware
14	Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin
15	Base metals and articles of base metal
16	Machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
17	Vehicles, aircraft, vessels and associated transport equipment
18	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; clocks and watches; musical instruments; parts and accessories thereof
19	Arms and ammunition; parts and accessories thereof
20	Miscellaneous manufactured articles
21	Works of art, collectors´ pieces and antiques

Table 3: Codes for "Type of goods" used in Figures 9,10 and 11.

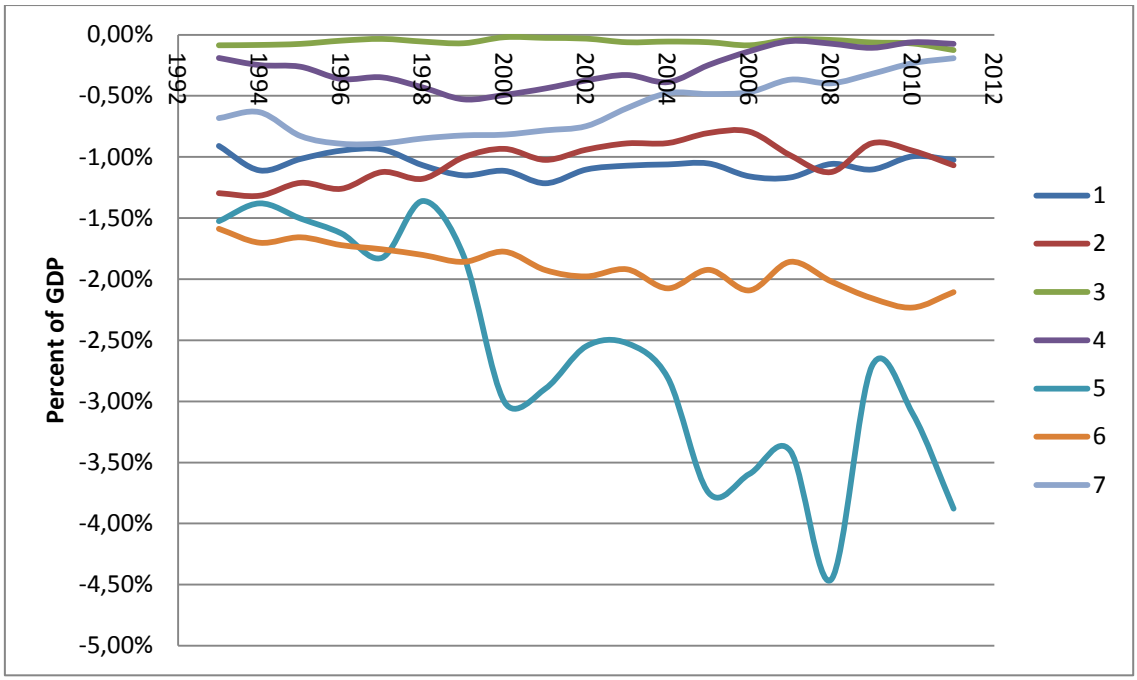

Figure 9: Net Exports by type of good (author´s calculations based on data from INE).

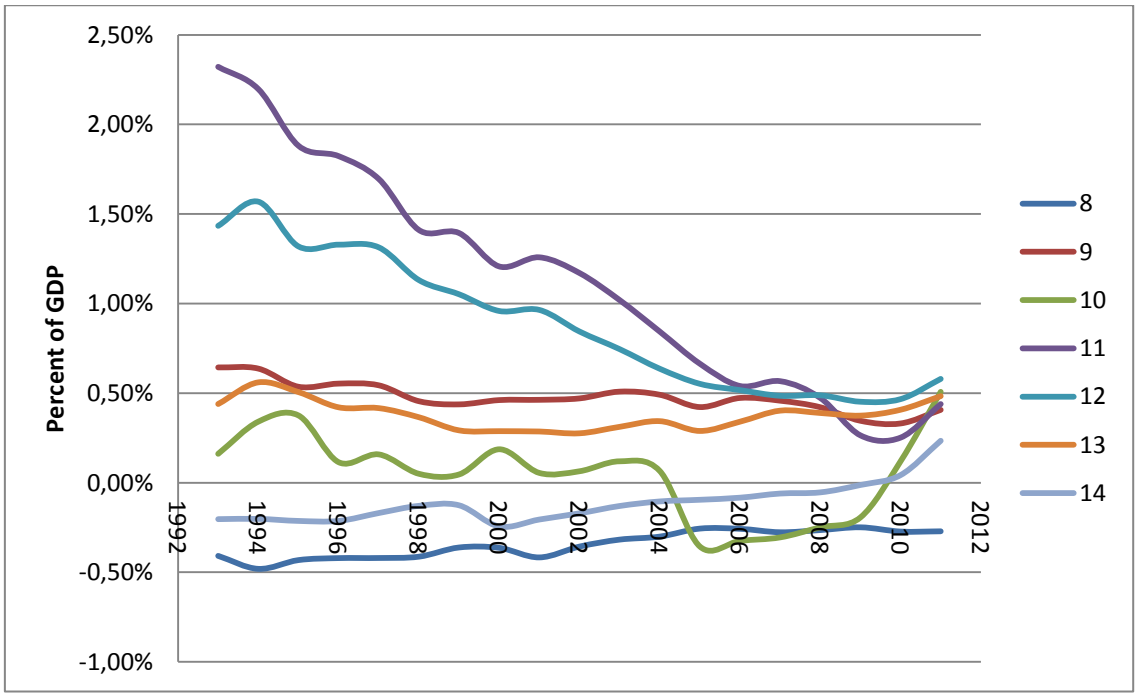

Figure 10: Net Exports by type of good (author´s calculations based on data from INE).

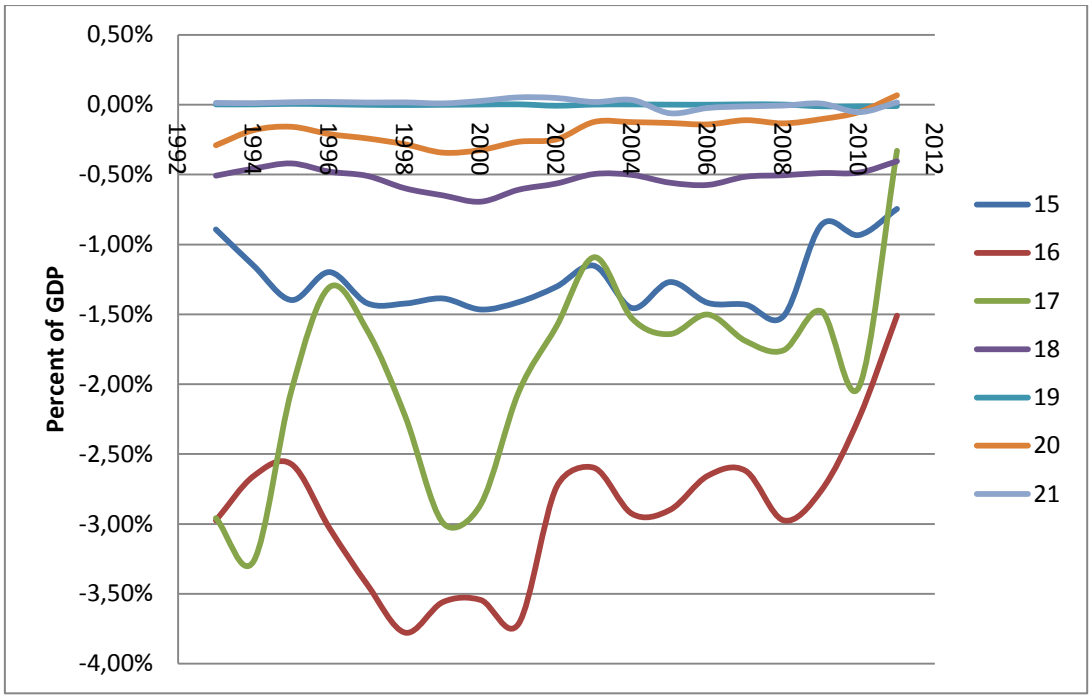

Figure 11: Net Exports by type of good (author´s calculations based on data from INE).

List of Countries

Afghanistan	Congo	India
Albania	Costa Rica	Indonesia
Algeria	Côte d'Ivoire	Iran
Angola	Croatia	Iraq
Antigua and Barbuda	Cyprus	Ireland
Argentina	Czech Republic	Israel
Armenia	Democratic Republic of the Congo	Italy
Australia	Denmark	Jamaica
Austria	Djibouti	Japan
Azerbaijan	Dominica	Jordan
Bahamas	Dominican Republic	Kazakstan
Bahrain	East Timor	Kenya
Bangladesh	Ecuador	Korea
Barbados	Egypt	Kuwait
Belarus	El Salvador	Kyrgyzstan
Belgium and Luxembourg	Equatorial Guinea	Lao People's Democratic Republic
Belize	Eritrea	Latvia
Benin	Estonia	Lebanon
Bhutan	Ethiopia	Lesotho
Bolivia	Fiji	Liberia
Bosnia and Herzegovina	Finland	Libyan Arab Jamahiriya
Botswana	France	Lithuania
Brazil	Gabon	Luxembourg
Brunei Darussalam	Gambia	Macau (Aomen)
Bulgaria	Georgia	Macedonia (the former Yugoslav Rep. of)
Burkina Faso	Germany	Madagascar
Burma	Ghana	Malawi
Burundi	Greece	Malaysia
Cambodia	Grenada	Maldives
Cameroon	Guatemala	Mali
Canada	Guinea	Malta
Cape Verde	Guinea-Bissau	Mauritania
Central African Republic	Guyana	Mauritius
Chad	Haiti	Mexico
Chile	Honduras	Moldova, Rep.of
China	Hong Kong	Mongolia
Colombia	Hungary	Morocco
Comoros	Iceland	Mozambique

Namibia	Suriname
Nepal	Swaziland
Netherlands	Sweden
New Zealand	Switzerland
Nicaragua	Syrian Arab Republic
Niger	Tajikistan
Nigeria	Tanzania, United Rep. of
Norway	Thailand
Oman	Togo
Pakistan	Tonga
Palau	Trinidad and Tobago
Panama	Tunisia
Papua New Guinea	Turkey
Paraguay	Turkmenistan
Peru	Uganda
Philippines	Ukraine
Poland	United Arab Emirates
Qatar	United Kingdom
Romania	United States of America
Russian Federation	Uruguay
Rwanda	Uzbekistan
Saint Kitts and Nevis	Vanuatu
Saint Lucia	Venezuela
Saint Vincent and the Grenadines	Viet Nam
Samoa	Yemen
Sao Tome and Principe	Zambia
Saudi Arabia	
Senegal	
Seychelles	
Sierra Leone	
Singapore	
Slovakia	
Slovenia	
Solomon Islands	
South Africa	
Spain	
Sri Lanka	
Sudan	

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