A Work Project, presented as part of requirements for the Award of a Master Degree in Economics from the NOVA – School of Business and Economics

Determinants of Portuguese Trade and specialization across the period 1995-2014

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A Project carried out on the Masters in Economics Program, under the supervision of:

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6th January, 2017

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Abstract

The purpose of this thesis is to evaluate the determinants of the Portuguese trade patterns between 1995 and 2014 and to compare the results with previous investigations. The econometric approach followed is based in dynamic panel data. This paper concludes that Portugal has comparative advantages in products relative intensive in unskilled labour and in products of economic activities with a high level of the technology proxy and with high market concentration. However, Portugal exhibits comparative disadvantages in products capital intensive while the skilled labour has a neutral impact. Since some results contradict previous literature, there were structural changes in the determinants of the Portuguese trade patterns.

Keywords: International trade, Specialization, Dynamic Panel Data, Labour Quality, Economies of Scale

I. Introduction

Over the last hundred years, the international environment has been suffering different changes. In the XX century, there were two world wars that affected many countries, including Portugal. However, "*after six postwar decades of relentless progress, in recent years world trade growth, and world trade liberalization, have both now seemingly ground to halt. Globally, trade grew twice as fast as GDP in the 25 years prior to 2007, but at a rate below GDP since late 2011*" (Feenstra et al., 2015). Before 1950, Portugal was a relatively closed economy – the openness index oscillated between 15 and 20 percent (Neves et al., 2002). As pointed out by Afonso et al. (2004), in the period 1910-1950, the Portuguese degree of openness was lower than the values presented by some European countries such as the United Kingdom, France, Germany, Italy Denmark, Sweden or Norway. Nevertheless, in the second half of the XX century, the Portuguese position changed, as one can state from figure 1 [of the Appendix], and Portugal clearly became an open economy. Moreover, during the period 1980-2000, Portugal exhibited higher values of trade relatively to Gross Domestic Product (GDP) when compared to the European Union. Many remarkable events contributed to the increasing openness to the outside and to the growth of the interactions between Portugal and its trade partners. For instance, in 1960, Portugal amongst the founders of the European Free Trade Association (EFTA), whose primary objective was to liberalize trade among its member states. However, the period of international exposition was not always positive. The oil shocks had horrific consequences, leading to an international recession which hit the Portuguese exports resulting in two strong crises in the Portuguese Balance of payments. Nonetheless, the last fifteen years of the century represented a new era for the Portuguese economy and its development. Portugal joined the European Economic Community (EEC) in 1986 and benefited from many structural transformations.

Moreover, in 1993, it was established the Single Market, which implemented among the members of the EEC the four freedoms: movement of goods, services, people and capital. During the first years as a member of the EEC, as a result of macroeconomic stability, Portugal saw the Foreign Direct Investment (FDI) rise (Mateus, 1992). This statement can be confirmed by the figure 2 [of the Appendix], where we can see the rise in FDI (in percentage of GDP) after 1986. These funds were fundamental to invest in new structures, research and human capital. Yet, the acceleration of the FDI was not equally distributed by the different sectors. In particular, the financial sector became the major beneficiary of the FDI (Mateus, 1992). In the XXI century, as we conclude from the figure 2 [of the Appendix], the FDI in Portugal (as percentage of GDP) shows an unstable behavior, reaching, in 2010, the highest value (10%) and the lowest one (-0.7%), in 2014. The recent performance represents a net outflow of investment, which is the opposite of the last 40 years.

Hence, in the last five decades, there were some events that backed up the international relations, contributed to the increasing trade openness and, consequently, caused changes in the Portuguese trade patterns (Amador et al., 2007). The trade flows, combined with the industrialization process were the most outstanding aspects of the structural changes in the Portuguese trade over the XX century (Afonso and Aguiar, 2004).

Nowadays, the degree of openness of the Portuguese economy is about 80% (source: World Bank). Therefore, the intensification of the trade and the constant process of globalization led to a permanent investigation about the details and changes in the international relations. From an individual country's perspective, it is fundamental to study the behavior and evolution of trade patterns, since they may provide guidelines for the companies and governments on where and how to invest, in order to improve the efficiency on production.

According to trade theory, there is a central theory named "*Principle of Comparative Advantages*", which was formulated by David Ricardo in 1817 in the book "*Principles of*

Political Economy and Taxation". Curiously, David Ricardo used trade flows between Portugal and England as an example to demonstrate his idea. Comparative advantage occurs when one country can produce a good or service at a lower opportunity cost than another. This principle stimulated many researchers to investigate the trade patterns of a country and it is the base for this research. Hence, the aim of this study is to identify the pattern of Portugal's comparative advantage that is defined by empirical evidence, related with the international transactions and its various determinants, as physical capital and labour.

This study is mostly empirical. However, behind all the econometric analysis, there is a strong theoretical component that supports the hypothesis and the models that provide the conclusions about the comparative advantages of Portugal in the international trade. Dynamic panel data, which embraces time-series and cross-section components, was used. The data comprises the period 1995-2014 and all the variables are disaggregated in 12 different economic activities. Firstly, one started with the simple Heckscher-Ohlin-Samuelson Model that uses as determinants of the Net Exports the stock of Capital and Labour. Afterwards, one introduced different variables, such as economies of scale and technology proxies, to incorporate new and modern theories of international trade.

This paper is organized as follows: section II reviews some related empirical studies and presents their main ideas and conclusions. Section III presents the model, the econometric approach and describes the data set and its characteristics. Section IV incorporates the estimation and the results. Lastly, Section V points out the main conclusions.

II. Literature Review

During the second half of the XX century, with the external trade proving to be a central component of Portugal's convergence process towards the most developed European countries, many researchers began to investigate the patterns and determinants of Portuguese trade.

The pattern and determinants of Portugal's net exports across the period 1972-79 were studied by Courakis and Roque (1984) who later (1992) extended the investigation into the pattern and determinants of Portugal's trade in manufactured goods across the period 1972-85. In the first study, the authors started by using an econometric model based on the Heckscher-Ohlin-Samuelson (HOS) model of international trade that suggests the existence of two factors, physical capital and labour, and not only one factor, as in the simple Ricardian model (Feenstra, 2002). The main difference between the Ricardian model and the HOS one, is that the latter "*dispenses with the notion of technological differences and instead show how factor endowments form the basis for trade"* (Feenstra, 2002, p. 4) while the first one states that technological differences across countries matter. This characteristic of the Ricardian model makes it relevant to explain the international trade nowadays. They also tested the neo-factorial and neo-technological extensions of the HOS model and concluded that Portugal had a comparative advantage in producing goods that are intensive in unskilled labour, but a comparative disadvantage in physical capital and skilled labour intensive products. These conclusions were later confirmed by the same authors in 1989. In the analysis of the manufactured goods, the relevant factors to characterize the Portuguese specialization were the skilled and unskilled labour: indeed, Portugal showed a comparative advantage in industries that were intensive in unskilled labour, losing position in products of industries skilled labour intensive. In 1989, Courakis et al. concluded that Portugal had comparative disadvantage in products from industries that show high concentration ratios, which proves "*the lack of conditions conductive to exploiting economies of scale in the years 1972 to 1979"* (Courakis et

al, 1989). The technology influences were proxied by the eight average ratio of skilled labour, expressed in percentage terms, and the results exhibit comparative advantage in products of industries that display high levels of this proxy.

Roque, Fontoura and Barros (1989) explored the patterns of the manufacturing Portuguese trade, between 1973 and 1982, applying different trade models with a panel data econometric approach. The authors tested the simple HOS model and the neo-factorial model, which introduces factors like unskilled and skilled labour, as well as the neo-technological models which try to explain the technological improvements and the technological gap by using as variables a proxy for economies of scale and a technological indicator. Finally, the authors suggested new concepts to improve the model and, to do so, they differentiated the capacity to adapt from the capacity to innovate to explain the trade patterns. In general, this research shows that the physical capital, unskilled work, human capital, economies of scale and the capacity to adapt are the factors that explain the behavior of the net exports of the Portuguese industry between 1973 and 1992. Furthermore, they draw the conclusion that Portugal had comparative advantage in the products of the industries unskilled labour intensive and disadvantage in the products of the industries physical capital or skilled labour intensive. However, if we consider two classes of human capital – skilled and semiskilled -, Portugal had comparative advantages in the products of the industries that use intensively labour with high qualifications. Hence, the labour quality affects significantly the structure of the comparative advantages in Portugal. These conclusions do not corroborate previous studies, which show comparative disadvantages in skilled labour intensive products. As previous empirical studies, this research pointed out the comparative disadvantage of Portugal in products from economic activities that show high levels of market concentration. Regarding the technology proxy, the first result shows that Portugal has a comparative advantage in products from industries with high proportion of qualified labour. Nevertheless, the authors stated that it is important to differentiate the capacity

to adapt to new technologies from the capacity to create them. Hence, they created a proxy to the capacity to innovate that represents the percentage of scientists and engineers from the USA and they concluded that this differentiation between capacity to adapt and to create is important to explain the determinants of the trade patterns. Between 1973 and 1982, Portugal was a follower in terms of technology and the Portuguese economic activities more technologically advanced were increasingly capable to adapt than the ones less sophisticated. Thus, it was normal that the coefficient related with the capacity to adapt was positive for Portugal.

The econometric approach normally used in this subject is panel data. Conversely, Bento (2004) analyzed the pattern and determinants of Portugal's trade in manufactured goods across the period 1971-98 with a time-series approach and he used the FDI as a significant variable to explain the trade patterns, since the FDI inflows were a significant part of the Portuguese GDP following the country's integration in the European Union (Source: World Bank). The results are different from the ones obtained by Courakis and Roque (1984) because they query the idea of comparative advantage on unskilled labour intensive products. The author shows that in the long-run, the net exports would increase if Portugal specialized in products of industries that are intensive in human capital (skilled labour).

In the last 30 years of the XX century, Portugal has presented comparative advantages in products unskilled labour intensive, as well as disadvantages in the physical capital and skilled labour ones. Concerning the economies of scale and the technology proxies, Portugal had comparative disadvantage in products from industries with high market concentration and comparative advantage in products from industries that show a high level of the technology proxy. The majority of different empirical studies for Portugal investigated the behavior of the net exports for the years before 1992. The scarcity of work analyzing the recent years is a source of opportunity for new studies and it is useful to compare the new tendencies with the old ones.

III. Empirical Analysis

A. Model and Econometric Approach

The investigation and conclusions of the Portuguese trade patterns will be based on the Heckscher-Ohlin Theorem, which states that *a country with balanced trade will export the commodity that uses intensively its relatively abundant factor and will import the commodity that uses intensively its relatively scarce factor* (Leamer, 1984, p.8).

In general, the empirical work related with this topic starts by testing the simple Heckscher-Ohlin-Samuelson model, which uses physical capital and labour as explanatory variables. The equation (1) translates the idea of the HOS model: the patterns of specialization depend on the endowments of the aforementioned factors of each country. Specifically, a country abundant in labour will tend to export products that use intensively labour in their production. In this sense, the dependent variable of this investigation is the net exports over the gross value added, which is named as *XNET*. The net exports are the difference between exports *(X)* and imports *(M)*, which is the Balance of Trade. In equation (1), regarding the explanatory variables, they are the logarithms of the stock of capital and of the quantity of labour, denoted by *LNK* and *LNL*, respectively. The application of logarithm transformation is explained later.

$$XNET_{i,t} = \alpha_0 + \alpha_1 XNET_{i,t-1} + \alpha_2 \mathrm{LN}K_{i,t} + \alpha_3 LNL_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $i = A, \mathrm{B}, C, D, \ldots$ and represents the 12 different economic activities, $t = 1995, \ldots, 2014$ and $\varepsilon_{i,t}$ denotes the error term.

The variable $XNET_{i,t-1}$ represents the net exports (in percentage of the Gross Value Added) of the previous period and it is a consequence of the estimation by dynamic panel data. This term is part of all the equations and is clarified at the end of this sub-section.

The traditional trade models as the Ricardian Model and the simplest version of HOS model are not sufficient to explain all the trade patterns that characterizes the world and the relations

between countries, in the sense that these models only reflect the trade of products from different industries. Currently, the volume of trade from intra-industry is growing, which brings the need about the formulation of new models that incorporate the reality of the world. As Roque et al. presented in their research (1989), there are different trade theories, as the neo-factorial and the neo-technological ones, which are extensions of the HOS model. The neo-factorial models, presented in Waehrer (1964) and Stern (1976) and Branson and Monoyios (1977), emphasize the relevance of labour quality composition (Courakis et al., 1989). The main point that distinguishes these models is the treatment of the non-homogeneity of labour force: while Waehrer introduces in his theory two different categories of labour – unskilled and skilled – Stern and Monoyios use the variable "Human Capital" as a stock, keeping the physical capital and labour as explanatory variables. For the purpose of this investigation, it was adopted the decomposition of labour in two different categories: unskilled labour *(USL)* and skilled labour *(SL)*. A natural logarithmic transformation was applied to the two previous variables, unskilled and skilled labour, which resulted in the variables *LNUSL* and *LNSL*. The logarithmic transformations of the two types of labour were used as additional explanatory variables, as it is presented in equation (2):

$$XNET_{i,t} = \alpha_0 + \alpha_1 XNET_{i,t-1} + \alpha_2 LNK_{i,t} + \alpha_3 LNUSL_{i,t} + \alpha_4 LNSL_{i,t} + \varepsilon_{i,t} \qquad (2)$$

With the decomposition of the labour, one intend to verify whether the labour quality continues to be a fundamental component to explain the trade patterns, as it was in previous investigations.

On the other hand, the neo-technological models reflect differences in the technological level. Technology is not free and the capacity to create new products, lower cost production techniques or to adapt to innovative techniques is different across countries. In this line, it was created one proxy for technology denominated by *INOV*. The explanatory variable used is the natural logarithm of this proxy, which is called *LNINOV*.

$$XNET_{i,t} = \alpha_0 + \alpha_1 XNET_{i,t-1} + \alpha_2 LNK_{i,t} + \alpha_3 LNUSL_{i,t} + \alpha_4 LNSL_{i,t} + \alpha_5 LNINOV_{i,t} + \varepsilon_{i,t} \quad (3)$$

Finally, the last variable introduced to explain the dependent variable *XNET* was the natural logarithm of the proxy for the economies of scale *(LNES).* This variable appears also in the neo-technological models and tries to explain some technological gaps across the countries. Hence, the equation (4) embodies all the previously mentioned explanatory variables, except the *LNL*.

$$XNET_{i,t} = \alpha_0 + \alpha_1 XNET_{i,t-1} + \alpha_2 LNK_{i,t} + \alpha_3 LNUSL_{i,t} + \alpha_4 LNSL_{i,t} + \alpha_5 LNINOV_{i,t} + \alpha_6 LNES_{i,t} + \varepsilon_{i,t} \quad (4)$$

One of the goals of this research is to test as many different models as possible, considering new modern theories, in order to better understand the Portuguese trade patterns. Thus, based on the HOS model, one started to estimate the equation that uses as dependent variables the logarithms of the stock of capital and quantity of labour, and gradually introducing new independent variables, following the previously mentioned process.

Finally, it is relevant to clarify the use of the logarithms of some variables instead their actual values. Regularly, there are some data that present a very skewed distribution which may lead to poor and misleading results from the regression. Having said so, it is important to run a Normality Test for all the explanatory variables, except for the lag of the dependent variable, since it derives from the econometric method of estimation. From the results of the tests displayed in table 4 [of the Appendix], one can conclude that all the variables are not normally distributed, because the null hypothesis of Normal Distribution is rejected. Hence, in order to reduce the skewness of these variables and to fit them into the model, the natural logarithm was applied, as it was previously described.

The econometric approach is supported by dynamic panel data background, which combines cross-section and time-series mechanisms. The cross section component is given by the 12 economic activities and the time-series by the considered period 1995-2014. The dynamic

approach, unlike the static one, incorporates a temporal dependency of the dependent variable, using lags of the dependent variable as a regressor. For instance, the net exports of this year can be explained by the net exports of the previous year. Although the coefficients on the lagged dependent variable might be far from the interest of this work, the introduction of lags becomes crucial to control for the dynamics of the process. Hence, one should not treat the net exports as a static variable that does not relates with its previous behavior. In this investigation, it was decided to introduce one lag of the dependent variable as explanatory variable, which is translated in all equations by the term $XNET_{i,t-1}$. One of the problems regarding the dynamic panel data models is the endogeneity bias of estimates, which results from the inclusion of the lagged dependent variable as explanatory variable. Generally, to surpass this problem, instrumental variables are used. In this project, it was used the Arellano-Bover/Blundell-Bond Generalized method of moments (GMM) estimator[1], which improves the efficiency of the estimations.

One of the objectives of this investigation is to obtain the best model to explain the Portuguese trade patterns and it is crucial to run some robustness tests, which will sustain the veracity and quality of the research and its conclusions. The robustness test is related with the proxy for the economies of scale and the results of the robustness test are presented in Section IV.

B. Data

The dependent variable is the Net Exports in terms of Gross Value Added *(XNET)*, by economic activity, and it was obtained by the following equation:

$$XNET_{i,t} = \frac{X_{i,t} - M_{i,t}}{GVA_{i,t}} \quad (5)$$

[1] The Arellano–Bover/Blundell–Bond builds a system of two equations—the level equation and the differenced one—and is also known as system GMM. "Building on the work of Arellano and Bover (1995), Blundell and Bond (1998) proposed a system estimator that uses moment conditions in which lagged differences are used as instruments for the level equation in addition to the moment conditions of lagged levels as instruments for the differenced equation." (Stata Manual, 2013)

Where *GVA* represents the Gross Value Added. The dependent variable was created using data from INE and PORDATA.

The stock of capital in percentage of Gross Value Added, which is represented by *K*, is one of the most important data in this investigation and it was not easily obtained. For the period 1995-2005, the Real Fixed Capital Stock (valued at 1995 prices) was available in the EU KLEMS database. The stock of capital, for the period 2006-2014, was computed by the following equation:

$$Stock\ of\ capital_{i,p} = Stock\ of\ capital_{i,p-1} + Net\ Capital\ Formation^{2}{}_{i,p} \qquad (6)$$

Where $p = 2006, \dots, 2014$.

Other relevant data for this project is the quantity of labour *(L)* and its decomposition into two categories, unskilled *(USL)* and skilled *(SL)* labour. From the basic HOS model, labour is introduced with no quality differentiation. Nevertheless, the increasing education and qualification of people brings about the need to differentiate the labour quality. To access the quantity of labour and to construct indicators for unskilled and skilled labour, it was used the "Number of employees, by economic activity, by the level of qualification*"* (source: Gabinete de Estudos e Planeamento*).* As it was mentioned previously, the labour was divided in two categories: unskilled and skilled labour. The data from GEP is divided in levels of education, where level 1 ("Quadros Superiores") is the most qualified labour. To create the variable unskilled labour (*USL*), it was used the number of employees with a level of qualification equal or lower to "Profissionais semi-qualificados". The skilled labour (*SL*) is composed by the employees with a level of qualification equal or higher than "Profissionais qualificados".

Nowadays, the technological component and the capacity to innovate and to adapt is a fundamental part of the companies, because the market is in constant change and the companies

[2] The Net Fixed Capital Formation is the Gross Fixed Capital Formation less the Consumption of Fixed Capital

should follow the market trends. Generally, more knowledge leads to new production techniques and procedures. The knowledge is not free and there are differences across countries, in the same industry. These differences can be translated by an indicator that represents the percentage of employees with high educational degree. Hence, to produce the proxy for the technology component (*INOV)*, it was considered the employees with a Bachelor, Master's degree and PhD as the ones with high educational level.

As mentioned previously, it is important to measure the intra-industry trade and, for that purpose, it was created the variable *Economies of scale (ES)* by using the data "Number of companies, by economic activity, by dimension of the company" (source: GEP). The indicator Economies of scale was obtained by the following formula:

$$ES_{i,t} = \frac{n_{i,t}}{N_{i,t}} \tag{7}$$

Where $n_{i,t}$ represents the number of companies of the economic activity *i*, in year *t*, with 50[3] or more employees, whereas $N_{i,t}$ represents the total companies of the economic activity *i*, in year *t*. The idea is that lower values indicate the absence of economies of scale, because they suggest a high number of small companies. This construction is supported by the Herfindahl-Hirschmann Index, which is a measure of market concentration. To support the veracity and accuracy of the results, it was performed a robustness test for the variable economies of scale, which implies the construction of a new proxy. This proxy, which is called *ESS*, shows the percentage of companies with a business volume higher than 10 000 000 euros, in each economic activity. The equation (8) uses all the explanatory variables presented in equation (4), except the logarithm of the proxy of the economies of scale (*LNES*). Instead it is used the natural logarithm of the new proxy, which is named by *LNESS*. The estimation and the results from this robustness test are also presented in section IV.

[3] Other authors use 100 or more employees, but the disaggregation of the data only allow to create this indicator using the number of companies with 50 or more employees.

$$XNET_{i,t} = \alpha_0 + \alpha_1 XNET_{i,t-1} + \alpha_2 LNK_{i,t} + \alpha_3 LNUSL_{i,t} + \alpha_4 LNSL_{i,t} + \alpha_5 LNINOV_{i,t} + \alpha_6 LNESS_{i,t} + \varepsilon_{i,t} \quad (8)$$

The data sample used comprises 12 economic activities (see table 3 in Appendix) for each of the 20 years across the period 1995-2014. The sample period was not larger because the division of the economic activities is not standardized across the time and this could lead to inconsistent results. Some aggregations of the economic activities were necessary in order to obtain a list of activities that is easy to work but without losing essential information. All the arrangements and transformations were always supported by the "*Classificação Portuguesa das Actividades Económicas (CAE)*".

IV. Estimation and Results

A. Benchmark Results

In this section, the econometric estimation was conducted, in order to find out the determinants of the Portuguese trade patterns. The econometric approach used is dynamic panel data. In table 1, the results from the estimation procedure described in section III are presented. From these results, it is possible to analyze the significance of the variables, to take some considerations regarding the determinants of the Portuguese trade patterns and to compare them with other studies.

Since Portugal is a country abundant in labour and not in capital, the first expected result, following the Heckscher-Ohlin Theorem, is that Portugal should export products that are relative intensive in labour and import products that are relative intensive in capital. In this sense, from the results of the equation (1) one can infer that Portugal has comparative advantages in products relative intensive in labour and comparative disadvantages in products relative intensive in capital. All the variables are statistically significant at a 1% significance level.

The neo-factorial models introduce differentiation of the labour quality and these models show that the treatment of all labour as homogeneous can lead to wrong conclusions. Hence, it was tested the significance of the two categories of labour, unskilled and skilled. The first conclusion is that Portugal should specialize in products from economic activities that use intensively unskilled labour in their productions. This conclusion was already verified by different authors as Courakis et al. (1984) and Roque et al. (1989). Regarding the skilled labour, the level of skilled labour has a neutral impact in the net exports, because the coefficient is not statistically significant. Nevertheless, the decomposition of the labour was relevant to take more precise conclusions regarding the skilled labour. The comparative disadvantage in products relatively intensive in capital is confirmed by the regression of equation (2).

Equation (3) introduces the variable that represents the technological component. Focusing on the significance of the variables, one finds that all of them are statistically significant, except for the variable representing the skilled labour. Once again, the variable that represents the skilled labour is not statistically significant, which confirms the neutrality of this variable in the Portuguese trade patterns. This neutrality was not verified in previous investigations made by Courakis and Roque in 1984 and 1989. The authors showed that Portugal had a comparative disadvantage in products from industries that use intensively skilled labour in their productions for the years before 1995. Hence, this is a significant change in the determinants of the Portuguese trade patterns. The comparative disadvantage in products intensive in capital continues to be a strong conclusion. Regarding the technology proxy, it is verified that there is a comparative advantage in products of economic activities that use a high proportion of employees with a Bachelor, Master's degree and/or PhD. Besides the gap when compared with other developed countries, since 1986, Portugal exhibits an evolution regarding human and financial resources allocated to scientific research and "*the fast scientific and technological development of the country continued to be a national priority"* (source: GPEARI/MCTES).

Thus, it is not so surprising that the technology level of each economic activity influences positively the net exports.

Table 1 – Estimation results

	Equations				
Explanatory variables	**(1)**	**(2)**	**(3)**	**(4)**	**(8)**
Constant	-9.916* (-7.30) [1.358]	-8.895* (-6.35) [1.40]	-3.39 (-1.56) [2.17]	-2.182 (-0.98) [2.236]	-7.473* (-2.53) [2.953]
XNET(-1)	0.731* (17.92) [0.041]	0.740* (17.84) [0.041]	0.697* (16.13) [0.043]	0.677* (15.38) [0.044]	0.654* (13.59) [0.048]
LNK	-1.823* (-4.48) [0.407]	-1.684* (-3.98) [0.423]	-1.21* (-2.75) [0.44]	-0.972* (-2.15) [0.452]	-1.29* (-2.93) [0.44]
LNL	0.947* (7.46) [0.126]	-	-	-	-
LNUSL	-	0.56* (2.56) [0.219]	0.681* (3.09) [0.22]	0.577* (2.57) [0.225]	0.576* (2.56) [0.255]
LNSL	-	0.363 (1.38) [0.263]	-0.035 (-0.12) [0.287]	-0.214 (0.69) [0.491]	0.1815 (0.59) [0.305]
LNINOV	-	-	1.139* (3.29) [0.346]	1.357* (3.77) [0.36]	0.976* (2.76) [0.354]
LNES	-	-	-	0.716* (2.02) [0.355]	-
LNESS	-	-	-	-	-0.514* (-2.03) [0.253]
Wald Chi2	2922.93	2827.52	2885.61	2931.37	2909.7

Note: the values in parenthesis denote the z-statistics and the values in square brackets are the Standard Errors (SE); *, ** and *** represents the significance of the variables at 1%, 5% or 10%, respectively.

Finally, in order to analyze the effect of the proxy for the market concentration, equation (4) was regressed. The previous conclusions, taken from the results of equation (3), prevail. Focusing on the new explanatory variable, the result is different from the mainstream literature.

For previous periods, it was shown that Portugal had comparative disadvantage in products from industries with a low level of market concentration. In this work, one can conclude that Portugal has a comparative advantage in products from industries that reveal high level of market concentration. Moreover, the coefficient is statistically significant at a 1% significance level. According to Courakis et al (1989, p. 560), "*it is envisaged that "large" countries will tend to display comparative advantage in industries with significant economies of scal*e". Hence, it is important to run a robustness test, in order to clarify the impact of the market concentration in the Portuguese trade patterns.

B. Robustness Test

The robustness test provides veracity and strength to the results of this investigation. The robustness test run in this section is related with the proxy for the economies of scale. From the results in equation (4), the proxy for the economies of scale is significant at a 1% significance level. In other investigations, the common result is that Portugal has a comparative disadvantage in products from economic activities that benefits from high level of economies of scale. Hence, it was constructed another proxy for the economies of scale named *ESS*, which represents the percentage of companies with a business volume higher than 10 000 000 euros. In the results of the equation (8), the new proxy for economies of scale is statistically significant at a 1% significance level and the conclusion is that Portugal has a comparative advantage in products of economic activities that does not benefit from high market concentration, which accords with other available background[4] for different periods of time. Hence, the relation between the level of economies of scale and the net export is ambiguous. However, from the first proxy, which is the most similar to the ones used is previous works, one can state that there was a structural change in the determinants of the Portuguese trade patterns.

[4] See Courakis (1986) and Roque (1989)

V. Conclusions

Reflecting on the main results of this investigation, firstly, one can state that, as a country abundant in labour and scarce in capital, Portugal has a comparative advantage in products relative intensive in labour and comparative disadvantage in products relative intensive in capital. Regarding the decomposition of labour, it was important to divide it in two categories, because it was more evident the positive contribution of the unskilled labour intensive products to the net exports. Concerning the skilled labour, it is verified the neutrality of this factor in the Portuguese Balance of Trade. For the variables related with the neo-technological component, the technology proxy shows that Portugal has a comparative advantage in products from economic activities which present a high proportion of employees with a Bachelors', Masters' degree and/or PhD. From European Commission data, in 2016, Portugal has 21 graduates in STEM (Science, Technology and Mathematics) for each 1000 people aged 20-29 years old ranking 7 among 28 European Countries. Furthermore, the data from Gross Domestic expenditure on R&D (source Eurostat) supports that, in 1995, Portugal presented a value close to 0.5%, which has been increasing and getting closer to the average of the EU-28. Effectively, in 2009, Portugal displayed a Gross Domestic Expenditure on R&D of 1.6% and the EU-28 of 2%. For the proxy of the economies of scale, the results are not so robust, since the two proxies used show different conclusions. However, the first proxy, which is the most similar to the proxies used in other works, translates the idea of the comparative advantage in products from economic activities that reveal high levels of market concentration, which is the opposite result of previous works for the years before 1995. Based on the aforementioned results, there is clear evidence of structural changes in the determinants of the Portuguese trade patterns from the period before 1995 to the recent period, particularly concerning the impact of the skilled labour and in the proxy for the economies of scale. For the 20 years that preceded 1995, Portugal had comparative advantage in products of economic activities relative intensive in unskilled labour

and with high levels of the technology proxy. On the other hand, Portugal showed comparative disadvantages in products relative intensive in physical capital, skilled labour and in products from economic activities that show high market concentration.

This topic is a major area for future research because Portugal is a country with strong international relations and the conclusion of these type of investigations can be a useful tool for the economic authorities to take some advice related with international trade and investment policies. However, the number of works related with this subject is relatively low given the difficulty to obtain the required data. The main setback of this investigation was the search for the data, since not all the data is published on the current databases. The results could be more accurate and correct if the data was homogeneous and without gaps. The stock of capital is an estimation and might not correspond to the real values, which is a source of noise. On the other hand, the different division of the economic activities across the periods bring about the need to transform the data and this is another source of risk and noise.

For future improvements, it would be useful the construction of a database with all the relevant data by economic activity, which would bring homogeneity and effectiveness to the results. It is fundamental to explore the dynamic component of the external demand, because most of the works related with this subject are static approaches. Since the Arellano-Bover/Blundell-Bond estimator is more appropriate for estimations with a high number of panels, it would be more efficient to use increasingly disaggregated data.

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Appendix

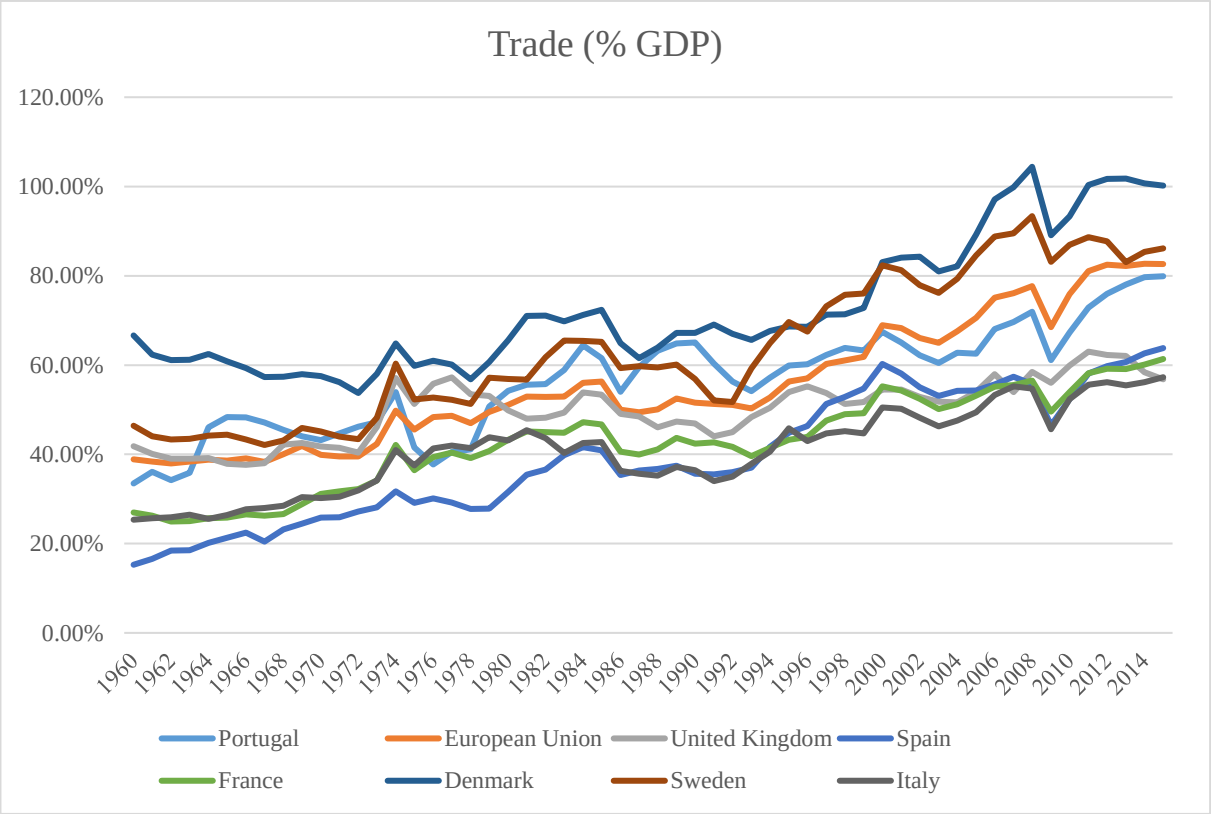

Figure 1 - Trade (% of GDP)
Source: World Bank national accounts and OECD National Accounts

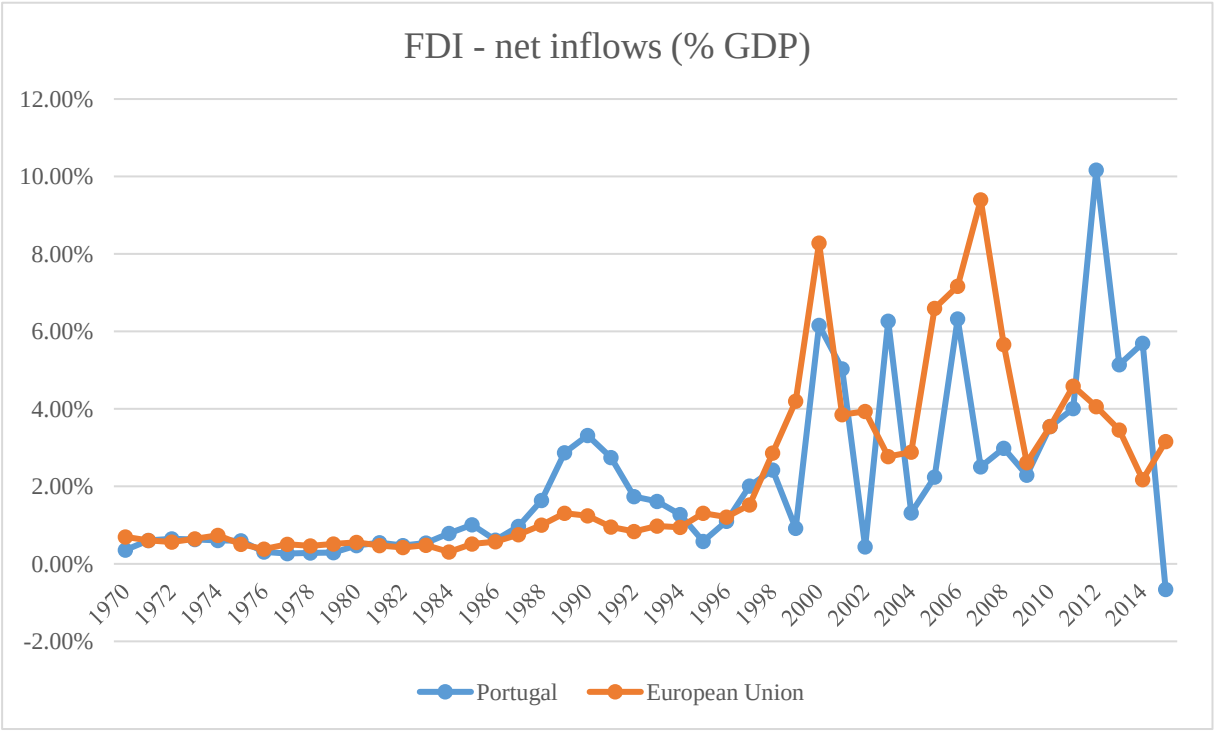

Figure 2 - Foreign Direct Investment, net inflows (% GDP) from 1970 until 2014

Source: World Bank national accounts

Table 2 - Definition, sources and characteristics of the data set

Variable	Description	Source
XNET	Net exports (% of Gross Value Added)	INE, Pordata
K	Stock of capital (% of Gross Value Added)	OECD, EU KLEMS, Pordata, INE
L	Quantity of labour	GEP[5]
USL	Unskilled labour	GEP
SL	Skilled labour	GEP
ES	Economies of Scale proxy	GEP
INOV	Technology proxy	GEP
ESS	Economies of Scale proxy (variable used for the robustness test)	GEP
LNK	Natural logarithm of the Stock of capital (% of Gross Value Added	
LNL	Natural logarithm of the quantity of labour	
LNUSL	Natural logarithm of the unskilled labour	
LNSL	Natural logarithm of the skilled labour	
LNES	Natural logarithm of the economies of scale proxy	
LNINOV	Natural logarithm of the technology proxy	
LNESS	Natural logarithm of the economies of scale proxy (used in the robustness test)	

Table 3 - Economic activities aggregation

A	Agriculture, farming of animals, hunting, forestry; Fishing
B	Mining and quarrying
C	Manufacturing
D	Production and distribution of electricity, gas and water; Water supply; sewerage, waste management and remediation activities
E	Construction
F	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
G	Hotels and restaurants
H	Transport, storage and communication
I	Financial activities
J	Real estate, renting and business activities
K	Public administration and defense; compulsory social security; Education
L	Health and social work; Other community, social and personal service activities; Activities of Households as employers of domestic staff and production activities of households for own use; International organizations and other extra-territorial institutions

[5] Note that the Gabinete de Estudos e Planemaneto (GEP) is not responsible for the results presented in this project

Table 4 - Skewness/Kurtosis tests for Normality

H0: The variable has a normal distribution		
Variable	Adj chi2	Prob>chi2
K	-	0.0000
L	39.94	0.0000
USL	68.20	0.0000
SL	19.96	0.0001
INOV	47.06	0.0000
ES	61.29	0.0000
ESS	-	0.0000

Table 5 - Level of qualification

Level	Description
1	Quadros Superiores
2	Quadros Médios
3	Encarregados, contramestres, mestres e chefes de equipa
4	Profissionais Altamente Qualificados
5	Profissionais Qualificados
6	Profissionais Semiqualificados
7	Profissionais não Qualificados
8	Praticantes e Aprendizes
9	Ignorado

Table 6 - Levels of education

Level	Description
1	Inferior ao 1º Ciclo do Ensino Básico
2	1º Ciclo do Ensino Básico
3	2º Ciclo do Ensino Básico
4	3º Ciclo do Ensino Básico
5	Ensino Secundário e Ensino Pós-Secundário
6	Bacharelato e Licenciatura
7	Mestrado
8	Doutoramento
9	Ignorada