

Tradable Goods and Exports: Possible Scenarios

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Abstract. Portuguese exports have been suffering the past years from a great instability and variability, and being able to improve their performance is a key factor for Portugal's economic growth and competitiveness on markets as well as for most economies. The methodology for this study consists in performing several multiple regressions (using SPSS software) on a number of ratio variables for a database of over ten thousand observations, with data ranging from 2000 to 2010 for countries of the European Union, Portugal's main trading partners (only considering countries with reliable available data). Using multiple regressions, this work aims at assessing variables to see if there are good predictors of the variable that represents the share of exports in gross domestic product (referred to as the dependent variable). Results show that imports, the human development index and the balance of trade show the highest correlations with the dependent variable in a positive way (an increase in one of those variables resulting in an increase in the dependent variable). Other variables display some predictability but results suggest that they are not statistically significant and are disregarded. Uncovering predictors one sees that multiple regressions merely suggest forecasting and predictability but no causal relations, and this just leaves the possibility to make assumptions on what the future values of the dependent variable might be based on its current values and those of all other variables involved. Results indicate that the performance of exports is somehow similar to that of other economic indicators. This information combined with a further investigation involving the concepts of machine learning techniques could help predict future values of exports for Portugal for years to come and

allow the country to better prepare itself for all external threats and also improve its performance in all markets.

Keywords: Exports, Correlations, Errors, Residuals, Predictors, Forecasting

1. Introduction

1.1 Economic context

Since the end of the Second World War and beginning of the 1970s the service sector has become the dominant economic activity in developed economies and, at the same time, the part of both agriculture and manufacturing have diminished [1]. This new drift is often accompanied by complex economic transformations starting with a "blurring distinction between manufactured goods and services" [1], which market the changing of markets and the creation of a global world through a higher demand for services and cooperative relationships amid nations.

With the process of globalization, which allowed for "the integration of economic activities past borders through markets" [2], and was embraced by most of the world's countries, the trade of intermediate goods improved faster than that of final goods [3], eventually boosting the degree of interdependence amongst national production systems. This situation saw countries in the fear of possible threats of external shocks to strike them harder than afore, as revealed by the current crisis. All these aspects lead what is called today the process of "deindustrialization" in developed economies [4]. This somewhat "tertiarisation" of the economy is coupled with an increasing competitiveness found in developing economies' exports and a different international division of labour in the manufacturing sector [1].

The main purpose of this study is to analyse what may be the drivers of exports and how they influence their performance, investigating potential correlations amongst exports and a number of factors in order to help suggest new and better ways to export goods and ultimately improve a country's balance of trade and overall economy.

Countries all over the world have all, to some extent, experienced difficulties exporting their goods and services. Knowing what to export, how to export and how to promote exports are key

aspects of a country's economic policy decisions. Exports are an important factor to improve growth and welfare, particularly in small medium open economies such as Portugal [5]. This paper reflects a study of the economic situation of Portugal, Europe's most western country. Suffering from low gross domestic product and low productivity growth for over a decade prior to the actual crisis [6], Portugal has accumulated a high external debt, reflecting on high household, corporate and fiscal debts and was left to ask for financial assistance in 2011. Inadequate policy decisions as well as a record track of historical resolution lead the country to its present state. Trying to understand how to improve a country's exports is a contribution to investigate Portugal's situation, for it to strengthen its economy to overcome the economical crisis and regain "credibility" in international markets

The remainder of this paper is organized as follows. Section 2 provides an overview of Portugal's current situation and the motivation for this work, accompanied by the related work on the subject of export drivers. Section 3 describes the methodology used in this study. Section 4 presents the results and all outputs obtained. Finally Section 5 concludes the work.

1.2 Portugal

In globalization, the economic environment changes fast [7], therefore it becomes important to study how a country can adapt its national market policies to effectively be a player in the global market. The idea of a more cooperative world came with the creation of numerous international organisations with a turning point being the Bretton Woods Conference in 1944 [8]. Serving as a way to finance the rebuilding of Europe after the destruction caused by the war, this conference had in mind preventing any further economic depressions and saw the creation of, for instance, the International Monetary Fund, the General Agreement on Tariffs and Trade and the Bank of Reconstruction and Development [9]. With the European Union's establishment in 1993, Europe set the pace to strengthen its commercial bonds and political power making it nowadays the largest economy in the world¹ as well as the

largest exporter and importer of goods and services².

Economies are more tertiary than before and Portugal is no different. Employment rates in manufacturing have decreased in most developed economies the past years compared to the overall employment, mostly in developed economies like the United States and in Europe.

Portugal being at the crossroads of Europe, America and Africa, has for that reason nourished over the years diplomatic and political relationships worldwide. Its economy is a reflection of several important moments in history. Starting well in 1494 with the "division of the World" in two [10], Portugal appeared to have lost its way and got caught up in wars and disputes for independence. More recently the country also followed its European neighbours in having colonies, particularly in Africa, and then became a republic in 1910. Followed a military coup in 1926 and a dictatorship for 48 years, Portugal is nowadays a country much more prone to external trade alliances, more exposed and accessible in terms of trade, all part of the globalization process within a few decades.

Portugal's investment policies diversified over the years, mainly due to European funding, after its entry into the European Union in 1986, but all investments made came at the cost of debts. The third Eurozone country to require a bailout, Portugal struggles now with a deep recession, its exports having lost market share [6], especially labour-intensive-goods markets where Eastern European and Asian competition is fierce. The Portuguese private consumption and investments are still decreasing and, at the same time, unemployment rates continue to reach critical levels (15% in June of 2012 alone). Improving Portugal 's export performance might help it rebuilt itself from the recession, improve its economic performance and be an active player in the global economy and that is the main motivation for this work. Prior to be able to establish potential solutions to improve a

² Central Intelligence Agency. (2007). The Rank Order of Exports. The World Fact book. Retrieved 21/08/07, from <https://www.cia.gov/library/publications/the---world---factbook/index.html.z>

¹ IMF-<http://www.imf.org/external/index.htm>

country's economic performance in any way, one must know what drives it.

2. Related Work

It is difficult to establish trends in economics given all variables involved and given the way changes occur rapidly and unpredictably. Today's new economic policy decision might need to be reviewed tomorrow. A great number of studies underline the importance of exports drivers, and drivers of economic growth.

To analyse the link between exports and economic growth, one can use different frameworks, namely the *Framework of Feder* [11] comparing export and non-export sector with individual production functions and underlining the existence of an externality effect in the non-export sector resulting from the export sector. Results using this framework suggest that there is a correlation between exports and economic growth, particularly in middle-income economies where some economic stability has previously been reached prior to intensifying exports. Also exports appear to evolve better in more diversified markets, and countries exporting a large share of their output tend to grow faster than others [11][12]. Export growth appears to have a stimulating influence across the whole economy generally in the form of technological spillovers or other externalities

Geography and transport cost likewise display some impact on the performance of exports in some economies [13]. Relative location affects specialization patterns and location and transport intensity can be joined with factor abundance and factor intensity in determining trade flows [14]. Globalization changed the terms of trade and usually improves welfare of regions further away from economic centres in situation when the welfare of closer regions is diminished. Countries closer to economic centres will tend to specialize in transport-intensive activities as opposed to countries further away, which can either be import substituting or in severe cases become autarkic [14]. Also differences amongst countries in terms of exports and economic growth relate to differences in productivity levels across industries or even differences in relative factor endowments across countries [15]. In terms of transport costs, isolation can as well sometimes make it impossible for remote developing countries to ever succeed in promoting manufactured exports [16],

which in term has a severe impact on firm's competitiveness in international markets.

Commonly multinational corporations who want to sell to foreign markets decide between exporting from their home country and establishing a foreign production in the host country [17]. Foreign direct investments can sometimes substitute for exports when there are sufficient costs to external transactions, such as exporting or licensing. Using product level time series data one can see that, within product lines, the firm's choice between exports and foreign production is done, to some extent, as an "either/or" decision, underlining the fact it is probably better to have some combination of both to cope with any potential externality [17].

Exports performances are often correlated with gross domestic product and appear to have a positive impact on economic growth, once the country reaches a certain level of economic development nonetheless [18].

The idea of "exports drivers" is also often associated with the concepts of causality and correlation and the use of mathematical and statistical frameworks. Correlation relates to the idea of relationships involving dependence and do not imply causality [19]. Empirical research in macroeconomics is largely based on times series to test for economic theories and forecasting. Using cointegration, causality and error-correction models one can analyse the relationship between export growth and economic growth [20] or exports, imports and economic growth [21]. In both cases, there is, first evidence of a long-run relationship between real exports and real gross domestic product for most countries analysed and second, a two-way causal relationship between income-export growth and income-import growth. Other variables are also evaluated for correlations with exports, namely patent rights [22]. One finds that exports depend on patent rights but their degree of dependence varies with other factors, predominantly the degree of imitation. Also political decisions, regarding protectionist measures can affect exports performance [24]. Openness to foreign markets is a turning point of economic growth due to the positive externalities it provides to a country, for instance, firms tend to enjoy several benefits in a thriving export sector, namely efficient resource allocation, economies of scale or a increase in technological innovation

stimulated by the competition in foreign markets [23][24].

Exports tend to promote growth as well as productivity [25]; countries that export their goods appear to be more productive than those who do not export at all, due in part to technology transfers. Tariffs and price have an influence on export's growth. In some cases, using restrictive set of tariffs, non-tariffs barriers and special licences to control all incoming foreign investments, can make countries succeed better as exporters [26].

Ultimately exports performances tend to have "some" influence on productivity and economic growth, however they are not the only drivers of economic success. This study tries to establish new export drivers that might help improve Portugal's economic situation. The following section describes the methodology and data used in this work.

3. Data and Methodology

Determining potential degrees of correlation between exports and a number of variables are this work's main goal, which involves multiple regressions, statistical and mathematical concepts.

3.1 Time series variables

Looking at Portugal's main export and import partners and at those countries main partners as

well, one sees that these are mostly the following: Spain, Germany, France, Italy, the Netherlands, the United Kingdom, Belgium and the United States of America. This study does not consider Angola (Portugal fourth exporting destination) and China (import origin for several countries), which showed a lack of reliable data available for analysis. Portugal's main economic partners are a reflection of its past years decisions, and the country's entry into the European Union made it clear that, with similar economic patterns, government policies and business conditions, prior and after entering the Union, the amount of trade amongst nations tends to follow an interconnected trend. From this conclusion this study uses data from all eight countries referred previously and from Portugal to create a strong database of several economic and other types of variables.

Variables are also chosen given the type of model used and the number of observations found. Using multiple linear regressions, one decides to use twelve variables, which make for a database of over 10000 observations over a period of 2000 to 2010 for time series data (sequence of data points measured at successive time instants spread out at identical time intervals (for the purpose of this work, the time interval is set to one year)). The higher the number of variables involved, the higher the possibility to uncover strong correlations for more than one variable. Table 1 displays all variables involved in this study in terms of their unit of measure and designations.

| Variables | Symbol | Unit of measure * |
|-----------------------------|--------|--|
| Exports | EXP | Millions of USA dollars |
| Imports | IMP | Millions of USA dollars |
| Gross domestic product | GDP | Millions of USA dollars |
| Labour productivity | LP | Millions of USA dollars per hours worked |
| Knowledge productivity | KP | No unit |
| Corruption perception index | CPI | No unit |
| Human development index | HDI | No unit |
| Balance of trade | B | Millions of USA dollars |
| Road freight total | RF | Million of Ton-km |
| Language similarity | LS | No unit |

*When in millions of USA dollars, all variables are at constant prices (2000 base year).

Table 1 Summary of all variables studied in this work

This work involves linear regressions performed using quantitative variables measured on a continuous scale and ratio basis. To better assess correlations amongst variables, considering one equation with all variables being more complex, one uses several multiple regressions for different "bundles" of variables

to better understand all possibly uncovered correlations. Given this work revolves around the idea of trade (amongst two countries mostly, as *bilateral trade*), variables are used in terms of "pairs" of countries are expressed in example equation 1 below.

Equation 1: $Y_{ij} = EXP_i/GDP_i = \beta_0 + \beta_1 (IMP_i/GDP_i) + \beta_2 (GDP_i/GDP_j) + \beta_3 (LP_i/LP_j) + \varepsilon$; $i, j = \text{countries}$

Equation 1 reads as follows: For the country i , the ratio EXP over GDP equals the sum of the following terms: β_0 (the intercept) + β_1 (the coefficient that reflects the relative importance of (IMP_i/GDP_i)) multiplied by the ratio of IMP of country i over the GDP of country i , plus β_2 (the coefficient that reflects the relative importance of (GDP_i/GDP_j)) multiplied by the ratio of GDP of country i over the GDP of country j , plus β_3 (the coefficient that reflects the relative importance of (LP_i/LP_j)) multiplied

by the ratio of LP of country i over the LP of country j , plus an error term (ε).

3.2 Regression Equations

Countries can engage in trade in both ways, and therefore the inverse equation (where one has “ Y_{ji} ” and not “ Y_{ij} ”), also provides different results and is considered as part of this analysis. There are in total 30 pairs of countries analysed in this work and by creating ratios, one creates new variables that add different information. The final regression equations that composed this study are as such:

Equation 2: $EXP_i/GDP_i = \beta_0 + \beta_1 (IMP_i/GDP_i) + \beta_2 (GDP_i/GDP_j) + \beta_3 (LP_i/LP_j) + \beta_4 (KPI/KP_j) + \beta_5 (CPI_i/CPI_j) + \beta_6 (HDI_i/HDI_j) + \beta_7 (LS_{ij}) + \varepsilon$;

Equation 3: $EXP_i/GDP_i = \beta_0 + \beta_1 (IMP_i/GDP_i) + \varepsilon$;

Equation 4: $EXP_i/GDP_i = \beta_0 + \beta_1 (GDP_i/GDP_j) + \varepsilon$;

Equation 5: $EXP_i/GDP_i = \beta_0 + \beta_1 (LP_i/LP_j) + \varepsilon$;

Equation 6: $EXP_i/GDP_i = \beta_0 + \beta_1 (KPI/KP_j) + \varepsilon$;

Equation 7: $EXP_i/GDP_i = \beta_0 + \beta_1 (CPI_i/CPI_j) + \varepsilon$;

Equation 8: $EXP_i/GDP_i = \beta_0 + \beta_1 (HDI_i/HDI_j) + \varepsilon$;

Equation 9: $EXP_i/GDP_i = \beta_0 + \beta_1 (Bi/GDP_i) + \varepsilon$;

Equation 10: $EXP_{i,j} = \beta_0 + \beta_1 GDP_{i,j} + \beta_2 IMP_{i,j} + \varepsilon$;

Equation 11: $EXP_i/GDP_i = \beta_0 + \beta_1 (LP_i/LP_j) + \beta_2 (KPI/KP_j) + \beta_3 (CPI_i/CPI_j) + \beta_4 (HDI_i/HDI_j) + \beta_5 (Bi/GDP_i) + \beta_6 (Ri/R_j) + \varepsilon$;

Equation 12: $EXP_i/GDP_i = \beta_0 + \beta_1 (Pi/P_j) + \beta_2 (SFP_i/P_i) + \varepsilon$;

Equation 13: $EXP_i/GDP_i = \beta_0 + \beta_1 (Pi/P_j) + \varepsilon$; $EXP_i/GDP_i = \beta_0 + \beta_1 (SFP_i/SFP_j) + \varepsilon$; $EXP_i/GDP_i = \beta_0 + \beta_1 (SFP_i/P_i) + \varepsilon$; where i, j : countries.

These equations are examined from 2000 to 2005 (in what is referred to as the *training*) using a statistical method, which is also accompanied by an attempt to validate results prior to establishing conclusions (the *validation set* analyses the data from 2006 to 2010). Regression equations show similar variables on both sides of the equation, a situation that might cause some multicollinearity in the results, which is tested in this work alongside other relevant statistical concepts to provide robust and statistically significant results in order to be able to establish conclusions and suggest the export drivers.

4. Output

Multiple regressions were performed using a statistical software, SPSS (“Statistical software for the Social Sciences”), widely used for statistical analysis in econometrics, which

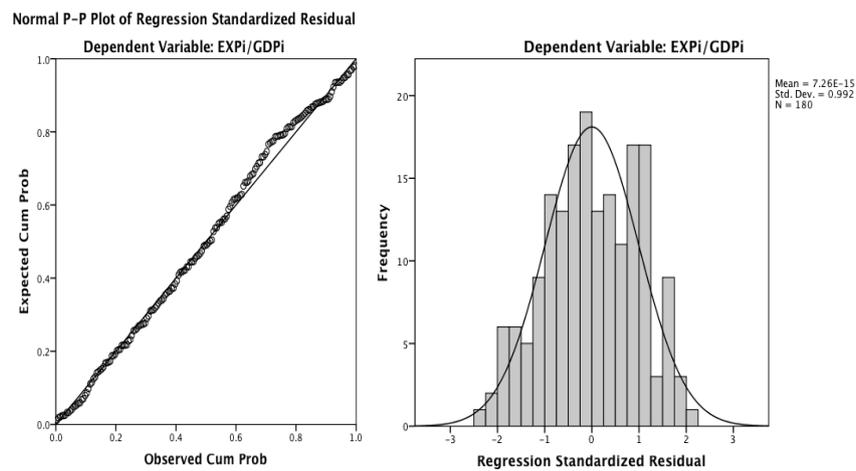
allowed to test correlations to predict, knowing the scores of some variables, the score of another variable. The *stepwise method* (which selects a subset of variables entirely by statistical criteria, considered the most parsimonious model in SPSS) is used to perform all regressions.

Equations 2 to 13 are assessed following several steps using SPSS. Multiple regressions involve many specific terms and assess several independent variables (on the right side of all equations) and one dependent variable, representing the share of exports in gross domestic product “ EXP_i/GDP_i ”.

As an example, Equation 2 displays 7 independent variables and 180 observations. The standard deviations for all variables are quite low denoting a low variability in the data sample. The model obtained from the regressions suggests that only “ IMP_i/GDP_i , LP_i/LP_j and LS_{ij} ” are considered relevant

contributors to the model, which shows an R of 0.948, a very strong value. Also the R square suggest that 89.6% of the variance in the outcome is accounted for by the three predictor variables. The standard error of the estimate is well below 0.005 (0.03), indicating an accurate model, a idea of how much the observed Y-values differ from the values on the regression line, which shows that the model appears to fit the data and therefore the prediction is good. ANOVA tests are also used to test the statistical significance of the model at each step, denoting

that it is in fact significant. Equation 2 is as follows: “ $EXP_i/GDP_i = -0.106 + 1.2 IMP_i/GDP_i + 0.06 LP_i/LP_j2 - 0.017 LS_{ij}$ ”. All beta coefficients are statistically significant and positive in value, the tolerance value shows that merely a little over 10% of the variance in each independent variable is not unique. Graphically the normal probability plot in Figure 1 and the histogram of standardized residuals help “strengthen” the results, showing residuals normally distributed.



Source: SPSS

Figure 1 Residuals’ Normal Probability Plot and Histogram of the standardized residuals

Apart from equations 4 to 13, this work also performed several individual linear regressions, trying to compare the dependent variables with all independent variables. Equations 3 to 9 are individual linear regressions performed on each independent variable to assess its predictability towards the validation set. Performing all individual and general multiple regressions, one finds that the most relevant contributions relate to the variables “ IMP_i/GDP_i ,” “ B_i/GDP_i ” and “ HDI_i/HDI_j ” in the *training set*, then validated in the *validation set*. From all equations and all tests and analysis performed several conclusions were drawn as to what might be the best “export drivers”.

5. Conclusions

Fluctuations in exports will induce uncertainties in any economy, and that is why finding what drives them is a way to improve exports. The major conceptual limitations of all regression

techniques are that one only uncovers relationships, but can never be certain about the underlying causal mechanism, therefore causal explanations are merely suggested but never confirmed.

The main findings of this study are summarized in Table 2, which presents the only equations that were considered and that might display potentially variables that can serve as export drivers. All other equations, such as general equation 2, for instance, were not considered due to lack of reliability, great variability among the data and no respect of linear regression assumptions, namely the normality of the error distribution.

| Dependent Variable | Independent Variables | | | | |
|--|--|--------|----------------|-------------------|----------------------------|
| | Name | Beta | Predictor Sign | <i>p</i> | Std. Error of the Estimate |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | IMP _{<i>t</i>} /GDP _{<i>t</i>} | 1.2 | + | <i>P</i> < 0.001 | 0.03 |
| | LP _{<i>t</i>} /LP _{<i>t</i>} | 0.062 | + | <i>P</i> < 0.001 | |
| | LS _{<i>it</i>} | 0.017 | - | <i>P</i> = 0.009 | |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | IMP _{<i>t</i>} /GDP _{<i>t</i>} | 1.179 | + | <i>P</i> < 0.0001 | 0.04 |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | B _{<i>t</i>} /GDP _{<i>t</i>} | 1.5 | + | <i>P</i> < 0.0001 | 0.06 |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | B _{<i>t</i>} /GDP _{<i>t</i>} | 1.7 | + | <i>P</i> < 0.001 | 0.083 |
| | CPI _{<i>t</i>} /CPI _{<i>t</i>} | 0.084 | + | <i>P</i> < 0.001 | |
| | RF _{<i>t</i>} /RF _{<i>t</i>} | 0.005 | - | <i>P</i> = 0.001 | |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | SFP _{<i>t</i>} /P _{<i>t</i>} | 0.0873 | + | <i>P</i> < 0.001 | 0.031 |
| | P _{<i>t</i>} /P _{<i>t</i>} | 0.07 | + | <i>P</i> < 0.001 | |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | IMP _{<i>t</i>} /GDP _{<i>t</i>} | 1.27 | + | <i>P</i> < 0.001 | 0.047 |
| | HDI _{<i>t</i>} /HDI _{<i>t</i>} | 1.4 | + | <i>P</i> < 0.001 | |
| | LS _{<i>it</i>} | 0.047 | - | <i>P</i> < 0.001 | |
| | LP _{<i>t</i>} /LP _{<i>t</i>} | 0.0136 | - | <i>P</i> < 0.001 | |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | CPI _{<i>t</i>} /CPI _{<i>t</i>} | 0.187 | + | <i>P</i> < 0.001 | 0.118 |
| | B _{<i>t</i>} /GDP _{<i>t</i>} | 0.458 | + | <i>P</i> < 0.001 | |
| | HDI _{<i>t</i>} /HDI _{<i>t</i>} | 1.34 | + | <i>P</i> < 0.001 | |
| | RF _{<i>t</i>} /RF _{<i>t</i>} | 0.009 | - | <i>P</i> = 0.002 | |
| EXP _{<i>t</i>} /GDP _{<i>t</i>} | P _{<i>t</i>} /P _{<i>t</i>} | 0.2 | + | <i>P</i> = 0.002 | 0.12 |

Table 3 Summary of the main relevant findings

Table 3 shows the summary of the main findings relevant obtained from the *training set* and the *validation set* (the grey part of the table being the *training set* and the blue is the *validation set*). The variable that first showed a positive correlation with the dependent variable is “IMP_{*t*}/GDP_{*t*}”. An increase in a country’s share of imports on gross domestic product appears to lead to an increase in a country’s exports share on gross domestic product. This situation is further confirmed by performing a simple linear regression between the dependent variable “EXP_{*t*}/GDP_{*t*}” and the variable “IMP_{*t*}/GDP_{*t*}” in this case the correlation is of the same value (beta coefficients initially of 1.2 for the *training set* and now 1.179 for the *validation set*). This situation points out the fact that imports might serve as export drivers, and this is coherent with the results previously found in literature. The correlation amongst export and imports being positive (+) for both the *training* and *validation* sets, and statistical significant (*p* < 0.001), the variable “IMP_{*t*}/GDP_{*t*}” is a good predictor of the dependent variable.

The share of the balance of trade on gross domestic product (“B_{*t*}/GDP_{*t*}”) for one country also appeared as a good predictor of the dependent variable, when assessed in a simple linear regression. A beta coefficient of 1.5 (in the *training set*) suggest that the higher the

share of the balance in gross domestic product, the higher the share of the exports in gross domestic product. An increase in “B” either results from an increase in exports or a decrease in imports. In this situation however, one looks only at the situation in which the balance increasing makes exports increase, therefore one can assume that the variable “B_{*t*}/GDP_{*t*}” appears to be as well as good predictor of the dependent variable. This situation is confirmed again in the third general equation from the *training set*, where the beta coefficients for the variable is of 1.7 with *P* < 0.001 and in the *validation set* (beta ≈ 0.5). Linear regressions cannot explain causal relations, only prediction, therefore in this case, one can just say that, the higher the balance of trade share on gross domestic product the higher the share of exports in gross domestic product.

The third variable to show a strong correlation with the dependent variable is related to the human development indexes “HDI_{*t*}/HDI_{*t*}” (beta = 1.34 and 1.4 in the *validation set*), however this variable did not show any relevant correlation in the *training set* for the period of 2000 to 2005. The data being sampled correctly, this might be an indication that over time, the importance of that variable varied, nowadays accounting more than before. An increase in the country of origin (exporter) of the human

development index and a decrease of the HDI in the country of destination (importer) results in an increase of the share of exports in gross domestic product. This situation is quite logical, taking for example Portugal as the exporter, it may seem normal that all exports of goods coming from Portugal will be easily imported by a country with a lesser human development index, like Angola for example, one of Portugal's main export destinations. On the contrary Angola does not export much to Portugal or any other European country for that matter that shows a stronger HDI. This is merely an assumption, the regression equation only provides predictors no causal relationships but this situation is nonetheless interesting and the variable " HDI_i/HDI_j " is considered a potential export driver.

The variable related to labour productivities " LP_i/LP_j " also showed a correlation with the dependent variable, but a low positive (0.062 beta coefficient) in the *training set* and a low negative in the *validation set* (-0.0136-beta coefficient) both with a strong statistical significance ($P < 0.001$). This situation would indicate that an increase in the labour productivity of the exporting country and a decrease of the labour productivity in the importing country would result in a increase in the share of exports in gross domestic product as is defined in the equation obtained in the *training set*. Several other literatures on the subject of productivity show that there is evidence of causality from productivity to exporting [27]. Ultimately exporting is associated with the "reallocation of resources from less efficient to more efficient plants". The results for the *validation set* however display a reverse result, even though with a very small coefficient (-0.0136). This situation leads to the assumption that the labour productivity ratio, although a good predictor of the dependent variable from the period of 2000 to 2005, seems less relevant from 2006 to 2010. For the countries involved in this study, most are part of the European Union and benefit from trade arrangement that make their exports more appealing to one another, not needing to be highly competitive and have high labour productivities to be exporting, however these are only assumptions, no real causal relationship can be drawn from these results, even though

they are all statistically significant. For that matter, the variable " LP_i/LP_j " is not considered a good export driver.

The variable " LS_{ij} " was designed for this work, and it appears that the higher the value of this variable the lower that of the dependent variable (the beta coefficients are of -0.017 and -0.047 respectively for the *training* and *validation sets*). This situation suggest that the similarities between two countries in terms of their respective languages, do not seem to be related to the dependent variable, that is, the more similar the languages, the lower the share of exports in gross domestic product of the country exporting its goods. The fact that the value of the beta coefficients slightly increase in negativity, could be an indication that with time, the languages similarities between countries are less and less relevant when engaging in trade, that is, countries do not need to speak the same language to necessarily better trade their goods with other countries. This variable is therefore not a very good predictor of the dependent variable.

The corruption perception index ratio between two countries, appears to relate to the dependent variable, in a way that, the higher the CPI for the country exporting and the lower the CPI for the importing country, the higher the share of exports in gross domestic product (the beta coefficients for both the *training* and *validation sets* are as follows: 0.084 and 0.187). This result would suggest that a country with a higher level of corruption if engaging in trade with a country with a lower level of corruption will see its exports share in gross domestic product increase. This does not necessarily mean that the exports are increasing, that is, the gross domestic product could be decreasing. Given that the GDP is equal to the sum of the consumption, investment, government spending and net exports, one could say that all these components could be diminishing as well. An increase in the variable representing the ratio of CPIs between two countries will result in an increase in the dependent variable, either the higher the exports or the lower the GDP denominator, and in that case, this can be due to a decrease in consumption, investment, government spending or even net exports (in the case when only net export diminish, imports must be the ones increasing, given that an

increase in exports will translate itself in the nominator and denominator so results in the dependent variable will remain the same). This work displays is that the variable “ CPI_i/CPI_j ” is a predictor of the dependent variable, but a very poor one, its variance accounting for small portion of the variance in the dependent variable.

When assessing the potential correlation amongst the dependent variable and the variable “ RF_i/RF_j ”, that is the ratio between the amounts of road freight transport in ton-km between two countries, one can see that the relationship is negative (-0.005 and -0.009). This situation suggests that the smaller the amount of RF in the exporting country and the higher the same amount in the importing country, the higher will the ratio “ EXP_i/GDP_i ” turn out to be. This situation can insinuate that the country exporting does not require a huge amount of road freight as long as the country it exports to does have a good RF transport already in place. For countries like Portugal, even though behind in the amount of road freight in ton-km per year, it did not stop it from engaging in trade with Spain or other countries further away. Nonetheless the beta coefficient is quite low and therefore the impact of the independent variable is considered weak and does not make for a good predictor of the dependent variable.

Finally for the demographic variables involved in this study, both “ SFP_i/P_i ” and “ P_i/P_j ”, one can see that in both cases they have a weak impact on the dependent variable (with respectively beta coefficient of 0.083 and 0.07 in the *training set*). The variable related to population “ P_i/P_j ” exhibits a beta coefficient of 0.2 in the *validation set*. This situation suggests that the higher the population of the country of origin and the lower that of the country of destination, the higher the ratio of exports on gross domestic product.

Ultimately, exports are a critical point for any country’s economic growth. One can even refer to the “export-led-growth” theory for instance. In this study however one tries to evaluate the potential correlations amongst several variables and a dependent variable, representing the amount of exports on gross domestic product and the results conclude that most variable show some correlation with the dependent variable, 90% of the times positive but for three variable

negative. Nevertheless the correlations help suggest predictions and forecasting for future values but needs to be assessed differently to establish a real causal relationship amongst variables.

In summary, it can be stated that of the eleven independent variables analyzed, only three shows beta coefficients above 1.0 for variables: “ IMP_i/GDP_i ”, “ HDI_i/HDI_j ” and “ B_i/GDP_i ”, which represent the share of imports in gross domestic product, the ratio of human development index in country i over the human development index in country j and the ratio of the balance of trade of country i over the gross domestic product of country i . These variables can in fact be consider as good drivers of the dependent variable, that is, the ratio of exports on gross domestic product (EXP_i/GDP_i). Between these three predictors, the first (“ IMP_i/GDP_i ”) is by far the most influential. This fact most probably has the economic meaning, that the factual knowledge of the market where to export is the main export driver. In conclusion this study allowed establishing correlations amongst several variables and finding which have the highest impact on the dependent variables and might serve as a “driver” of this variable.

In continuing this study ideally introducing machine learning techniques one will be able in the future, to learn from current data and “know” what are the future values of exports going to be given certain circumstances and, therefore make better decisions based on those results to improve Portugal’s economic performance for years to come.

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