

PORTUGUESE EXPORTS AND ITS RELATIONS WITH GEOGRAPHICAL DISTANCE, GROSS DOMESTIC PRODUCT AND LINGUISTIC AFFINITY A BIPLLOT APPROACH

SANDRA CRISTINA RIBEIRO

OBSERVARE - Autonomia University of Lisbon

1150-293 Lisbon, Portugal

e-mail: sribeiro@autonomia.pt

tlm: +351917818676

ISCAD – Higher Institute of Management Sciences

ANTÓNIO DUARTE SANTOS

Autonomia University of Lisbon

1150-293 Lisbon Portugal

e-mail: ajsantos@autonomia.pt

GUILHERME CASTELA

CIEO-Research Centre for Spatial and Organizational Dynamics, University of Algarve

Campus de Gambelas, 8005-139 Faro, Portugal

e-mail: gcastela@ualg.pt

NELSON SILVA

CIEO-Research Centre for Spatial and Organizational Dynamics, University of Algarve

Campus de Gambelas, 8005-139 Faro, Portugal

e-mail: info@ntavaresdasilva.com

e-mail autor de contacto: sribeiro@autonomia.pt

Abstract

The geographical scope and the consequent reduction in transport costs, the evolution of the GDP of the destination countries, the membership to the European Union and linguistic affinity are use as support to an explanatory gravitational perspective for Portuguese exports in 2011-2015. This was done for the 61 main trading partners of Portugal's exports of goods and services over the period 2011-2015, with a multidimensional perspective, using the HJ-BIPLLOT method developed by Galindo (1986). This methodological approach identified and categorized the sample countries in latent constructs of reduced dimensionality related to the exports policy. The simultaneous factorial representation identified (a) the most relevant variables to characterize Portugal main export destination countries, (b) the changes that occurred during the period in analysis, and (c) the relations between variables, between countries, and between variables and countries. This approach showed that distance is not a main determinant for exports, and that GDP and export volumes have a slightly positive relationship. In the other hand, there were identified four clusters of countries, via two step algorithm (Chiu et al. 2001), for which Portugal had different performances, taking into account not only exports, distance, and GDP but also linguistic affinity and EU membership. This analysis showed to be useful in export problematic research, when studying multivariate data and also, by its visual nature, a potential tool for producing richer information for the academia and also for international trade policy makers.

Key Words: Exports, Geographical Distance, Linguistic Affinity, GDP, BIPLLOT

Thematic Area: E9: Quantitative Economy. Quantitative Methods for the Economy and Business

1 INTRODUCTION

In an increasingly global and networked economy, companies have a wider market at their disposal but also a number of barriers they have to overcome in order to expand their business internationally. In this era of globalization, the impact of opening economies to welfare is increasingly important.

In recent years, exports of goods and services have been the positive growth factor of the Portuguese economy, representing, in 2015, more than 40 percent of the national Gross Domestic Product (GDP).

The process of increasing economic integration that has been occurring in the last century has allowed the realization of high international trade movements. However, it should be noted that the existence of a broader market also implies the existence of certain characteristic barriers to trade between different countries. In order to increase their turnover and exchanges for the expansion of their businesses, companies have to overcome these barriers, which represent different types of costs, such as physical, motivated by the distance between countries, and the linguistic ones, motivated by the communicative needs often in multilingual contexts.

Also in Portugal, this growing integration has been felt in the recent past. In this way, the Portuguese economy has witnessed substantial changes, such as the increase of trade openness abroad and modifications in the sectorial specialization pattern towards areas more exposed to international competition. These transformations play an important role, since the export side has been the main factor of positive growth in the country and the basis of one of the most visible aspects of the structural evolution of our economy. In this context, it is emphasized the maintenance of positive growth rates of exports in an adverse external environment, in an situation of reduced external demand from some of Portugal's main trading partners, particularly those most affected by falling commodity prices.

We take it as relevant to characterize Portuguese export destination countries, on a gravimetric model perspective and in a post-crisis context, incorporating five variables considered to be the most pertinent. In this sense, we used five variables: Export Volume, Gross Domestic Product (GDP), Geographic Distance, European Union Membership and Linguistic Affinity.

The HJ-BIPLLOT method developed by Galindo (1986), developed from the classical BIPLLOT introduced by Gabriel (1971, 1981) ensures the best simultaneous representation of the effects of Gross Domestic Product (GDP), Geographic Distance, European Union Membership and Linguistic Affinity on the Portuguese export destination countries, by identifying their similarities and dissimilarities.

Traditionally, descriptive statistic allows only an analyses of the average country on an individual level. On the other hand, the HJ-BIPLLOT identifies relationships between the individuals (countries per year), between the variables and between individuals and variables allowing the identification of hidden patterns in the data, facilitating and enriching the interpretation of results.

Thus, we highlight four major objectives:

- (1) – To generate a methodological approach, with the use of the HJ-BIPLLOT method in order to achieve a richer diagnosis, for the 2011-2015 period, of the effects of Gross Domestic Product (GDP), Geographic Distance, European Union Membership and Linguistic Affinity on the 61 main trading partners of Portugal's exports of goods and services, by identifying their similarities and dissimilarities;
- (2) – To identify relationships between Exports, GDP, geographical Distance, European Union Membership and Linguistic Affinity, in the main Portuguese exports recipient countries for the period 2011-2015;
- (3) – To recognise behavioural typologies in the main Portuguese exports destination countries;
- (4) – To distinguish clusters of countries with divergences and/or convergences on their behaviour regarding Portuguese exports.

2. EXPORT PERFORMANCE

2.1. THEORETICAL FRAMEWORK

Inspired by Newton's gravity equation, the gravity model of trade is based on the idea that trade volumes between two countries depend on their sizes in relation to the distance between them. This model has been used since the 1960s, initially by Tinbergen (1962), who found that bilateral trade flows between any two countries can be explained by a law called the 'gravity equation'. Soon, works based on this model were presented by Linnemann (1966) and Leamer and Stern (1971).

This model begins by considering that exports between two countries are positively associated with the size of their economies and negatively related with factors that indicate the existence of barriers to trade, most prominently the distance between them. Therefore, the basic gravity model relates the volume of exports between two countries with the economic weight of those two countries, measured using the GDP of exporter and importer ($GDP_i GDP_j$) and the cost of trade between them, represented by the distance between them.

This model has been subsequently improved over the years and expanded to include several variables that intend to explain bilateral trade flows.

Over time, other variables were added to the basic variables considered by the model (GDP and distance), such as population, GDP per capita (Bergstrand, 1990), country size (Helpman, 1987) and set of countries (Azevedo, 2004). Binary variables that intend to represent the specific characteristics of the countries have also been added, such as cultural proximity, language (Endoh, 1999; Breuss, & Egger, 1999; Nitsch, 2000; Feenstra, 2002), cultural similarity, belonging to the same trade bloc — in the 1990s this effect was also considered as existence of preferential trade agreements (Breuss & Egger, 1999) — common borders, colonial relationship (Glick & Rose, 2002), among others.

Herrera (2013) defends that “traditionally, the multiplicative gravity model has been linearized and estimated using OLS assuming that the variance of the error is constant across observations (homoscedasticity), or using panel techniques assuming that the error is constant across countries or country-pairs.” In this complement, Santos Silva and Tenreyro (2006) argue that OLS estimation is not consistent in the presence of heteroscedasticity.

Some other authors have compared alternative estimation methods like Martín and Pham (2008), Burger et al. (2009), Westerlund and Wilhelmsson (2009) and Gervais (2015).

2.2. PORTUGUESE EXPORT REALITY

Following the recession of 2001-2002, world trade experienced a six-year high growth period. Subsequently, in 2008-2009, and as a result of the economic crisis (considered the greatest economic recession since World War II), there was a severe, rapid and synchronized breakdown between countries and sectors. As of 2010, due to the well-coordinated and successful international response, international trade resumed a pre-crisis growth trend. In the particular case of Portugal, there has been a great increase in exports and a progressive elimination of the trade deficit in the last five years, as part of a difficult economic adjustment program. Of the highest ever exports, close to EUR 75 billion, and a trade surplus of more than EUR 3 billion.

According to data published by the Bank of Portugal, the Portuguese economy closed 2016 with an external surplus equivalent to 1.8% of GDP, which is an improvement over that registered in 2015, with a 2% increase in exports. With the fifth consecutive year of external surplus, the Portuguese economy is thus able to reverse a cycle of current and capital account deficits, which occurred before the request for financial assistance in 2011.

As can be seen in the graph below (Figure 1), Portuguese trade intensified in the 1990s, which served as a major driver of the country's economic growth.

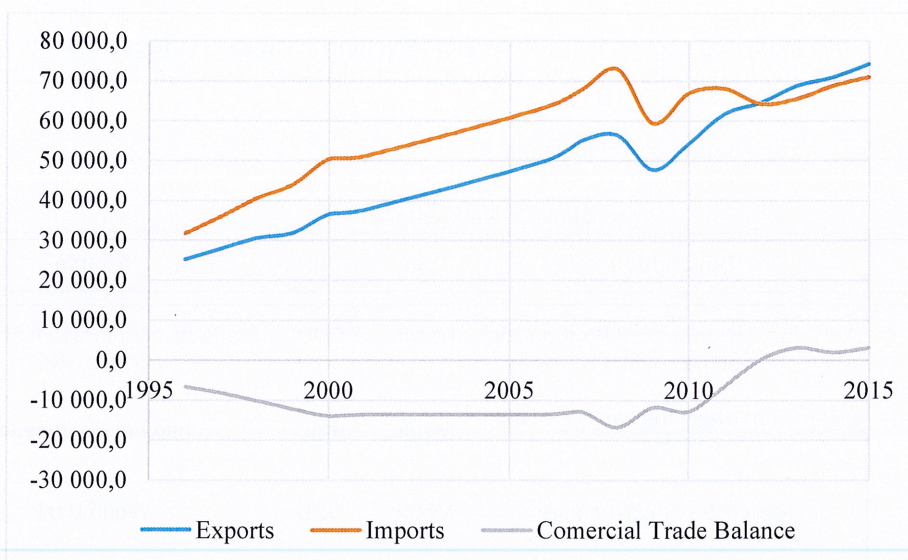


Figure 1 Portuguese Trade Balance (1996 to 2015) in EUR (10⁶€)

Source: own elaboration

Regarding the period under analysis, the evolution of trade with the rest of the world can be analysed in Table 1 below.

Table 1 Portuguese international trade in goods and services

	2011	2012	2013	2014	2015
Exports (10⁶€)	61 595	64 372	68 587	70 747	74 064
Imports (10⁶€)	68 048	64 204	65 455	68 781	70 950
Trade Balance (10⁶€)	-6 452	169	3 132	1 965	3 114

Source: own elaboration with data from INE/Pordata

The EU is the world leader regarding trade: it is not only the world's largest exporter of goods and services, but it is also the largest import market for more than 100 countries. The countries that belong to the EU are Portugal's biggest trading partner.

In the AICEP Country Sheet - Portugal, published in September 2016, it is "according to data from the Bank of Portugal, in the last five years, exports and imports of goods and services registered average annual growth rates of 4.9 % And 1.2%, respectively. In the first half of 2016, exports of goods and services fell by 1.3% year-on-year, with imports falling by 2%, with the coverage rate at 103%. The balance of trade in goods and services was positive between 2012 and the first half of 2016, reversing the negative trend previously recorded. "

3. RESERARCH METHOD

Of all components of international trade, goods are the most important, accounting for about 66 percent of total Portuguese exports of goods and services and a 29 percent share of GDP at current prices. This is why our study is based exclusively on the analysis of Portuguese exports of goods.

Based on the Current Statistics of Portuguese International Trade, published by INE, "in 2015, 22.5 thousand Portuguese companies were involved in export operations, generating a total of 49.8 billion euros in exports, an amount that represents a Nominal growth of 3.7 percent over the previous year (average annual change of 3.9 percent in the period 2011-2015)."

3.1 THE VARIABLES

The five variables used in this research are Exports, GDP, Geographic Distance, European Union membership and Linguistic Affinity, considered as the most relevant for the comparative analysis of Portuguese exports, for the period of 2011-2015.

The variables used in this study are economic (such as export volume between Portugal and a trading partner and the GDP), linguistic (linguistic affinity), and geographical (distance between Portugal and a trading partner).

These indicators datasources are presented in Table 2.

Table 2: 5 indicators

Variable	Description	Type	Units	Source
Exports	Volume of exports from Portugal for some country	Metric	EUR	Statistics on international trade in goods, INE
Geographical Distance	Distance between the capitals of both countries.	Metric	Km	http://pt.distance.to/
GDP	Real GDP of each country	Metric	USD	World Bank
EU Membership	1 when country belongs UE and 0 otherwise.	Nominal	Yes/No	EU's official site
Linguistic Affinity	1 when country has Portuguese, Spanish, or English has its official language and 0 otherwise.	Nominal	Yes/No	World Economic Forum

Source: own elaboration

Exports is presented in euros and figures taken from the INE's International Trade Statistics of goods. They were considered the main trading partners that represent more than 90% of the total exports of goods. The criterion used was to consider all the countries for which Portugal exports, in 2015, more than 30 million euros, totalling 65 countries.

The importer's GDP reflects expenditure in the country of destination capturing the effect of demand, privileging the use of unidirectional export data.

The GDP variable represents the GDP in USD of each country. It should be noted that dollar values for GDP are converted from national currencies using official one-year exchange rates. For some countries where the official exchange rate does not reflect the rate effectively applied to real currency transactions, an alternative conversion factor is used.

Given the nonexistence of GDP values, according to the source used, for Cuba and Venezuela in 2015 and for Taiwan and Gibraltar in each year these countries were withdrawn, leaving only 61 countries.

Distance is a measure of trade feasibility for it encompasses not only the geographical distance but also the transport and transaction costs between countries.

The distance variable indicates the kms that are between the two countries (for the most part the distance between the capitals of both).

Linguistic affinity is used as a possible variable that can affect the trade between countries, which overcomes the restraints of the geographical location in determining the competitive advantage of the country, especially in services that require the consumer to move to the exporting country of service (as in the tourism sector), and other factors that could affect the language and communication skills of citizens, and the ability to easily deal with different cultures.

According to Ferro & Ribeiro (2016) the variable Linguistic affinity "intends to capture the language proximity between two countries. We defined this variable taking into consideration the official language of the destination country, which had to be Portuguese, Spanish, or English. Our aim was to capture a threefold effect: with this variable we identified the countries that share a common language with Portugal but also included those that have Spanish as their official language to reflect language similarity, and those that have English as their official language to capture the effect of the most widely studied and spoken foreign language in Portugal."

Since Tinbergen (1962, p. 263) "... no attention is paid to the development of exports over time".

For example, it is now widely accepted that nominal variables should be used. Similarly panel estimations are to be preferred to cross-section estimates in most cases and fixed effects should be selected not blindly but with a view at how to best isolate developments in the variable of interest. Moreover, it is now widely accepted that distance is only an imperfect proxy for trade costs, that its effect on the extensive and intensive margin of trade differs from each other and that zero values contain information that should not be neglected.

On the supply side Porter pointed to the importance of the geographical location in determining the competitive advantage of the country, especially in services that require the consumer to move to the exporting country of service (as in the tourism sector), and other factors that could affect the language and communication skills of citizens, and the ability to easily deal with different cultures.

On the demand side, the most important reasons for increasing demand on services in the recent period could be attributed to: increases of wealth and income in some countries and the desire to improve the quality of life and increased leisure hours, urbanization and some demographic, social and technological factors, and the determinants of the demand for services of historical and social factors and the culture of communities.

The role of government regulations and its link to the industry and other related industries in the impact on the competitive advantage of the state and the industry cannot be ignored.

3.2. POPULATION AND SAMPLE

Taking into account the variables mentioned above, in this study we selected the 61 main trading partners of Portugal's exports of goods and services, for the period of 2011-2015 as our target population. This population was chosen in order to broaden and generalize the results obtained in previous studies, and also in order to overcome limitations posed previously regarding the countries being studied and the data analysis techniques used.

The sample we use comprises the 61 countries selected which represent the main trading partners of Portugal (see Appendix 1) corresponding to the latest information available and incorporates different geographical contexts: Europe, Africa, America, Asia and Oceania, and encompasses observations for the period of 2011-2015. The sample countries are presented in Table 3.

Table 3: 61 main trading partners of Portugal's exports of goods and services

Country	Code	Country	Code	Country	Code
United Arab Emirates	AE	Denmark	DK	Luxembourg	LU
Angola	AO	Algeria	DZ	Morocco	MA
Argentina	AR	Egypt	EG	Mexico	MX
Austria	AT	Spain	ES	Mozambique	MZ
Australia	AU	Finland	FI	Nigeria	NG
Belgium	BE	France	FR	Netherlands	NL
Bulgaria	BG	United Kingdom	GB	Norway	NO
Bahrain	BH	Equatorial Guinea	GQ	Peru	PE
Brazil	BR	Greece	GR	Poland	PL
Canada	CA	Guinea-Bissau	GW	Romania	RO
Congo	CG	Hong-Kong	HK	Russian Federation	RU
Switzerland	CH	Hungary	HU	Saudi Arabia	SA
Côte d'Ivoire	CI	Ireland	IE	Sweden	SE
Chile	CL	Israel	IL	Singapore	SG
China	CN	India	IN	Slovakia	SK
Colombia	CO	Italy	IT	Senegal	SN
Cape Verde	CV	Japan	JP	Sao Tome and Principe	ST
Cyprus	CY	Korea, Republic of	KR	Tunisia	TN
Czech Republic	CZ	Lebanon	LB	Turkey	TR
Germany	DE	Lithuania	LT	United States	US
				South Africa	ZA

Source: own elaboration

3.3. STATISTICAL ANALYSIS

The analysis of several aspects at once requires the storage of large volumes of data. In order to explore the data to get a better understanding of several processes, it is important to identify the salient features underlying them. The reduction in the dimensionality of the problem enables us to summarize the information captured in a large number of variables with a smaller number of latent variables. Plots which simultaneously show both the countries and the indices can be of great assistance in this respect. In this sense, BIPLLOT which simultaneously represent variables and observations, are used in this paper.

The study of relation of the produce factorial representation of export, GDP and geographical Distance with attributes of non-metric nature as EU membership and Linguistic Affinity, is of interest. For this analysis the two-step cluster is used in this paper.

3.3.1. BIPLLOT METHODS

BIPLLOT analysis is a multivariate technique proposed by Gabriel (1971) which has the main objective of performing an approximated graphical representation, with reduced dimension, of a data matrix $X_{n \times p}$. It is done in such a way that the representation allows the visualization in the same plane of the relations and interrelations between rows and columns of matrix X . According to Gabriel (1971), *"Every rank two matrix can be graphically represented by a BIPLLOT that consists of a vector for each line and a vector for each column, chosen so that each element of the matrix is exactly these vectors' internal product. If the matrix has a rank greater than two, this matrix can be represented in an approximated way, by a BIPLLOT of a matrix of rank two"*.

The original data matrix X is to be represented as the product of two matrices performed by Singular Value Decomposition of the matrix in Singular Values – SVD, which contains the row and column vectors and that constitutes the elements considered in the graphical representation.

In the BIPLLOT representation of $X_{n \times p}$, there are simultaneously two sets of vectors $a_1, a_2, \dots, a_n$ for the lines from X , representing the individuals (observations of countries for years), and $b_1, b_2, \dots, b_p$ for the columns of X , representing the variables, in such a way that the internal product $a_i^T b_j$ approximated to the x_{ij} element of the original matrix, is as good as possible.

If the rank of matrix $X_{n \times p}$ ($r = \min(n, p)$) is greater than three, the BIPLLOT representation will always be a data approximation. Nonetheless, when the rank of the $X_{n \times p}$ is two or three, the representation of the data in bifactorial or trifactorial planes is exact.

BIPLLOT methods are used as a data visualization tool essentially due to two properties: the internal product property, which originates an exact or approximated representation of the individuals in space, and the property of equality between the cosine of the angle formed by the vectors which represent two variables and the correlation coefficient between these same variables. The properties of BIPLLOT are detailed in Gabriel (1971).

As result of the BIPLLOT properties it is possible to identify:

- 1) The relations between column vectors (individuals);
- 2) The relations between line vectors (variables);
- 3) The interrelations between line vectors and column factors.

Therefore the BIPLLOT representation gives a more complete picture of the data matrix than any scatter plot. Also the identification of the relations and interrelations of individuals and variables is of value, as it facilitates multivariate analysis of data. The seminal works in BIPLLOT Methods, known as Classical BIPLLOTS, were developed by Gabriel (1971, 1981) and are designated: JK-BIPLLOT, GH-BIPLLOT and SQRT-BIPLLOT.

An HJ-BIPLLOT (Galindo, 1986) for a data matrix $X_{n \times p}$ is defined as the multivariate graphical representation by means of vectors $j_1, j_2, \dots, j_n$ for the lines (individuals) and $h_1, h_2, \dots, h_p$ for the columns of X , selected so that row and column representations can be projected in the same reference system with the same maximum quality of representation. The rows are represented by points and the columns by vectors. The advantages and properties of BIPLLOT (Gabriel, 1971) apply to the HJ-BIPLLOT developed by Galindo (1986).

3.3.2. THE TWO-STEP CLUSTER ANALYSIS

The general principle of classification used in this research is based on building a table of similarities between the series data. The Biplot coordinates are to be related with non-numerical attributes as EU membership and Linguistic Affinity. For this purpose, our study used the Two Step Cluster Analysis, developed by Chiu et al. (2001) for the analysis of large data sets which is appropriate in clustering large data sets with mixed attributes (Norusis, 2003). The method is based on a distance measure that can handle mixed type attributes to be clustered. This is derived from a probabilistic model in which the distance between two clusters is equivalent to the decrease in log-likelihood function as a result of merging (Chiu et al. 2001). The procedure consists of two steps:

- In the first step, Pre-clustering of cases, original cases are grouped into preclusters that are then used in place of the raw data in the hierarchical clustering. Based upon its similarity to existing preclusters, each successive case is added to form a new precluster, using a likelihood distance measure as the similarity criterion. Cases are assigned to the precluster that maximizes a log-likelihood function. A sequential approach is used to pre-cluster the cases. The aim is to compute a new data matrix with fewer cases for the next step. In order to reach this aim, the computed pre-clusters and their characteristics (cluster features) are used as new cases. The pre-clusters are defined as dense regions in the analyzed attribute-space.
- In the second step, clustering of cases, the preclusters are grouped using the standard agglomerative clustering algorithm, producing a range of solutions, which is then reduced to the best number of clusters on the basis of Schwarz's Bayesian inference criterion (BIC), which is known as one of the most useful and objective selection criteria, because it essentially avoids the arbitrariness in traditional clustering techniques. A model based hierarchical technique is applied. Similar to agglomerative hierarchical techniques, the (pre-) clusters are merged stepwise until all clusters are in one cluster. In contrast to agglomerative hierarchical techniques, an underlying statistical model is used.

3.4. THE METHODOLOGICAL PROCEDURE

The methodological options used in this research are presented in Table 4.

Table 4: BIPLLOT and Segmentation procedure by MultBiplot (2016) and SPSS21

Type of BIPLLOT	HJ-BIPLLOT
Transformation of the raw data	Column Standardization (z-scores)
Estimation Method	Singular Value Decomposition
Segmentation process 1	A priori groups for nominal variables
Segmentation process (SPSS)	Two step clustering for nominal variables using HJ-BIPLLOT scores

Source: own elaboration

The statistical software used for the data treatment was Multbiplot, version 16.0430 (Villardón, 2016) and SPSS 21 (IBM, 2012).

4. RESULTS

Through the application of the HJ-BIPLLOT with the MultBiplot software, we were able to attain a two-dimensional solution that captured about 91,79 % of the variability of the original data, with 55.67% of the information retained on the first axis (Table 5).

Table 5: Explanation level of Inertia

Axis	Eigenvalue	Expl. Var.	Cummulative
1	507.734	55.673	55.673
2	329.37	36.115	91.788

Source: Adapted from MultBiplot (2016) output

In Table 6, we observe the relative contributions of the 61 main trading partners of Portugal's exports of goods and services (2011-2015), distributed in two dimensions, where the most significant contributions for the construction of the factorial axes can be distinguished. In turn, Table 6 shows the factorial coordinates of the three numerical variables (Exports, GDP and Distance) that allow a projection in Euclidean space (Figure 2). So, a cloud of observations can be observed spread over the four quadrants of this factorial structure. The variables EU membership and Linguistic Affinity of nominal order are taken as supplementary and do not contribute to the construction of the factorial dimensions.

Table 6: HJ-BIPLLOT Relative Contributions from rows and columns

Axis	Main Contributors for Axis Construction	
	Countries (2011-2015)	Variables
1 (55,67%)	SE, IT, GB, FR, DE, NL, CI, PL, CG, BH, PL	Exports
2 (36,11%)	JP, RU, MX, SK, TN, CA, IN, HU, CN, KR, AU	Geographical Distance GDP

Source: Adapted from MultBiplot (2016) output

Exports has the highest influence in the construction of the first axis, while geographical distance and GDP are the main contributors for the second axis.

4.1. THE RELATION BETWEEN EXPORTS, GDP AND DISTANCE

Threw the analysis of norms of each variable we can reveal the variability of values taken in each variable. Also, the angles between the vectors representing each variable identify positive, negative or non-inexisting correlations between variables, as observed in figure 2.

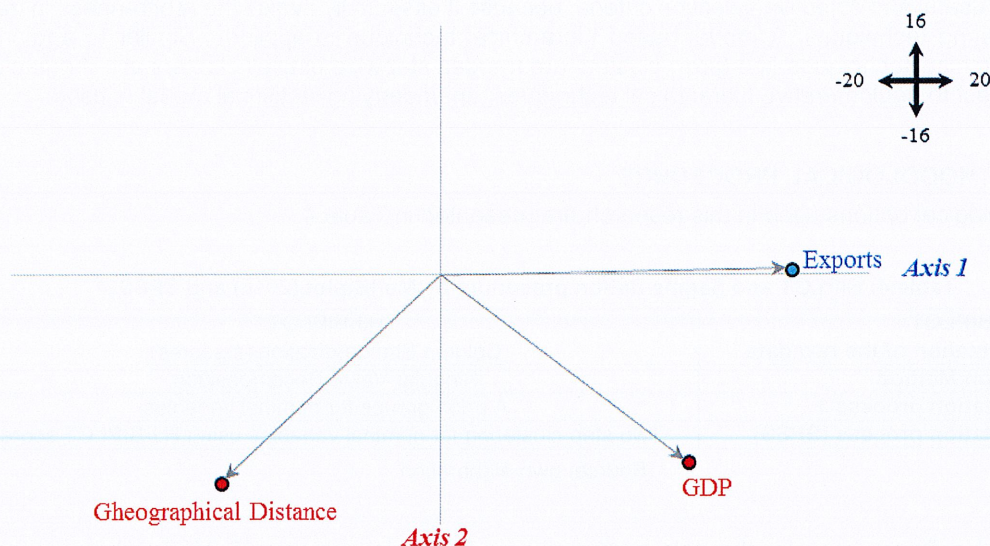


Figure 2: HJ-BIPLLOT factorial representation of plan 1-2 for the three numerical variables

Source: MultBiplot (2016) output

In Figure 2, the higher the norm of the vector, the greater the variability associated with the represented variable. For example, Distance and GDP variables show greater variability between the countries for the different years under review. Also from Figure 3 and according to the most relevant contributions, it becomes possible to interpret the correlations of the indicators between each other and associated with the two axes (using the angles which form between variables and with the two axes). Thus, the proximity (smaller the angle, higher the correlation) of Distance and GDP, both associated with axis 2 36,12 % (information retention), expresses their positive correlation. In turn, Exports, associated with axis 1 (55,67 % of information retention), are slightly positively correlated with GDP, and on the other and negatively correlated with Distance.

4.2. THE RELATION EXPORT, GDP, DISTANCE AND DESTINATION COUNTRIES

Projecting the factorial coordinates of both variables (vectors) and individuals (points) in the same Euclidean space (Figure 3) we obtain their positioning over the four quadrants of the HJ-BIPLLOT structure, the complete Biplot factorial representation which allows further interpretation.

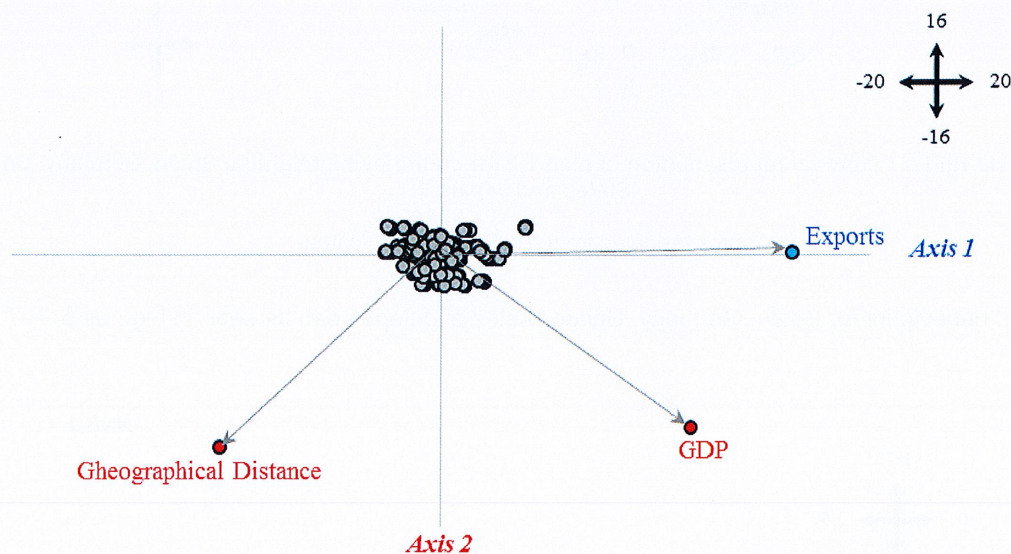


Figure 3: HJ-BIPLLOT factorial representation of plan 1-2 for countries and the three numerical variables

Source: MultBiplot (2016) output

The countries closest to the vectors are more related to the variables that these same vectors represent. Through the projection of the countries on the vectors (variables) we can identify which countries/years contributed most to the value of the variable. For example US is the main contributor for the variable GDP, which is expected taking in account it's the biggest economy of the world. For exports variable the main contributor is Spain, which also adheres to reality for it is the main export destination for Portugal. For distance, Australia is one of the main contributors, which is expectable due to its geographic location comparatively to Portugal.

Also from Figure 3 if we particularize the analysis for a given country we can evaluate its trajectory over the years regarding wider or thinner paths, direction and sign.

Taking four countries from the HJ-representation (figure 4), for a particular analysis it is possible to identify some particularities regarding Portuguese export performance.

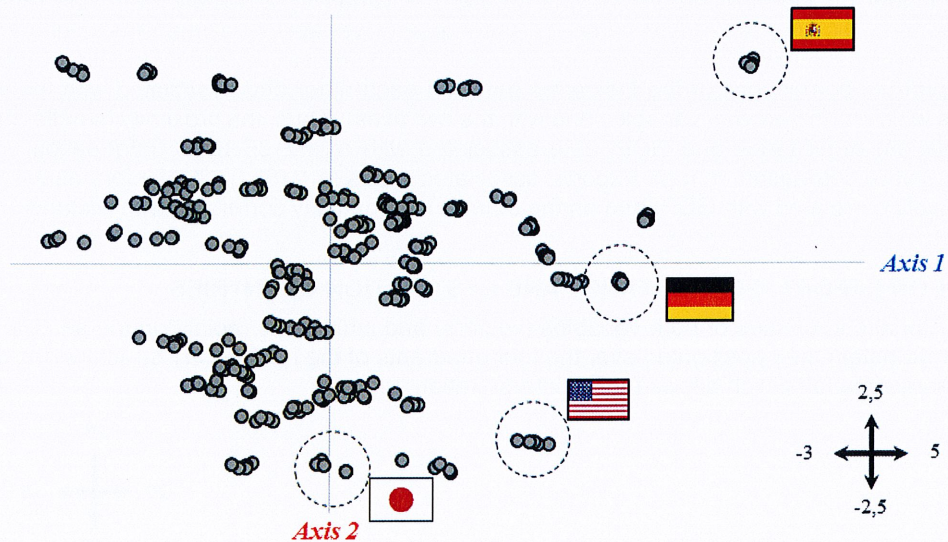


Figure 4: HJ-BIPLLOT factorial representation of plan 1-2 for countries highlighting Spain, Germany, United States and Japan.

Source: Adapted from Multiplot (2016) output

The detected behaviours for Spain, Germany, United States and Japan can be seen in Figures 5, 6, 7 and 8.

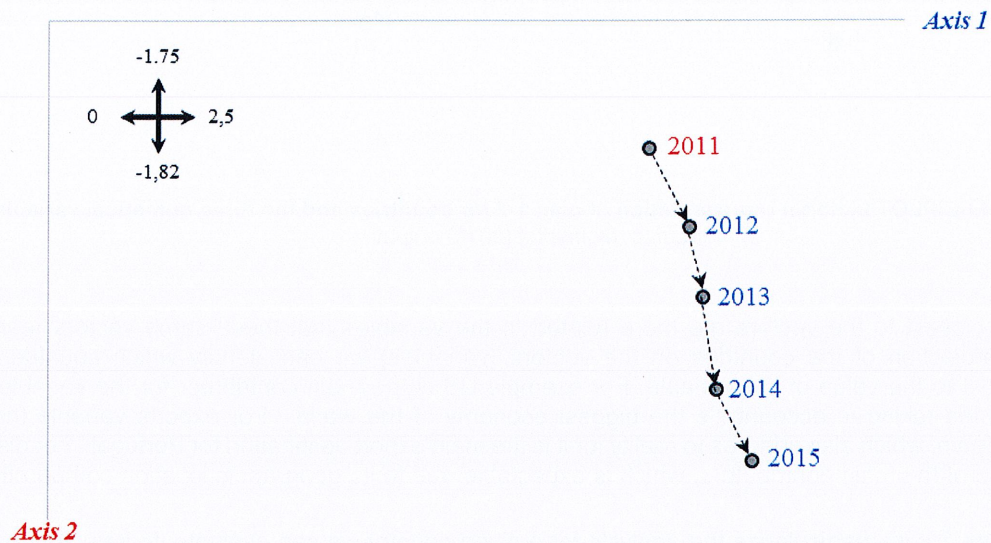


Figure 5: Interpretation of detected trajectories for the US

Source: Adapted from Multiplot (2016) output

Regarding the US, there is a stable evolution, with a downward trend over axis 2 and a positive evolution over the direction of axis 1 for the full path of 2011-2015.

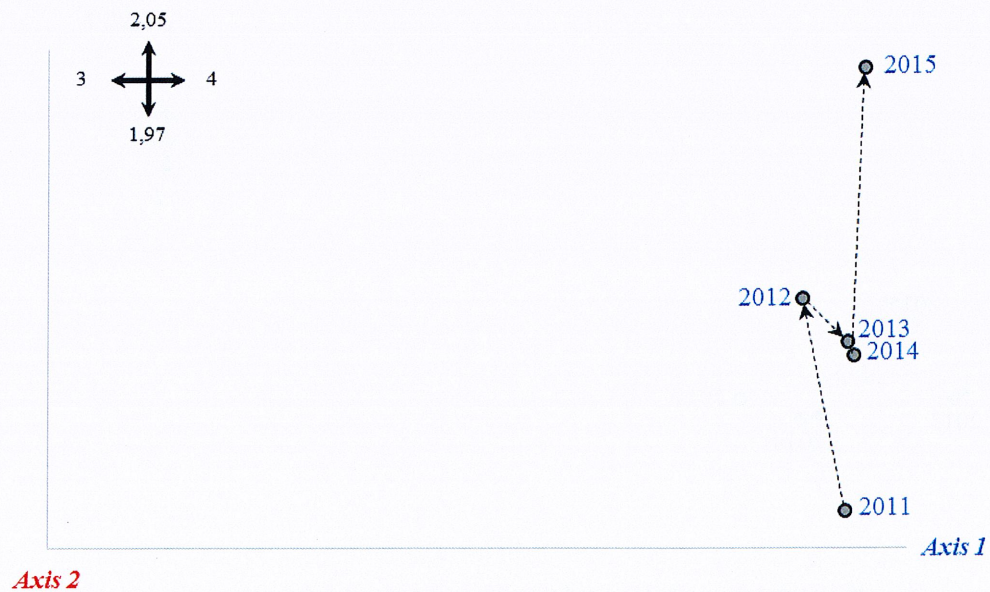


Figure 6: Interpretation of detected trajectories for Spain
Source: Adapted from Multiplot (2016) output

Thus, ES is characterized for a tendency for higher levels of direction and sign changes during its trajectory, showing greater uncertainty for the period on analysis.

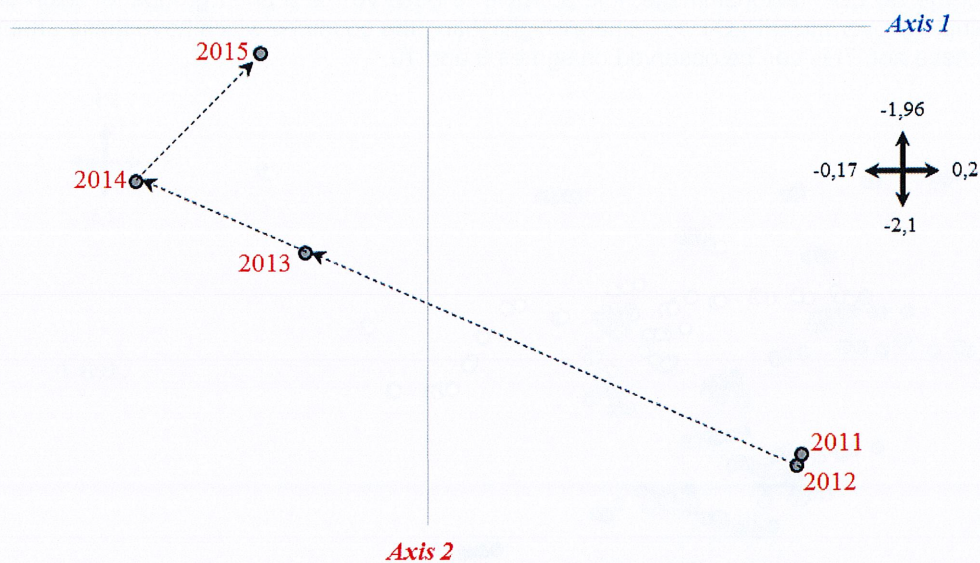


Figure 7: Interpretation of detected trajectories for Japan
Source: Adapted from Multiplot (2016) output

Regarding the JP, related to the second dimension, revealing the same center in 2011 and 2012, there is a constant evolution with a positive evolution over the direction of axis 1 for f 2011-2014 with a change of direction from 2014 to 2015.

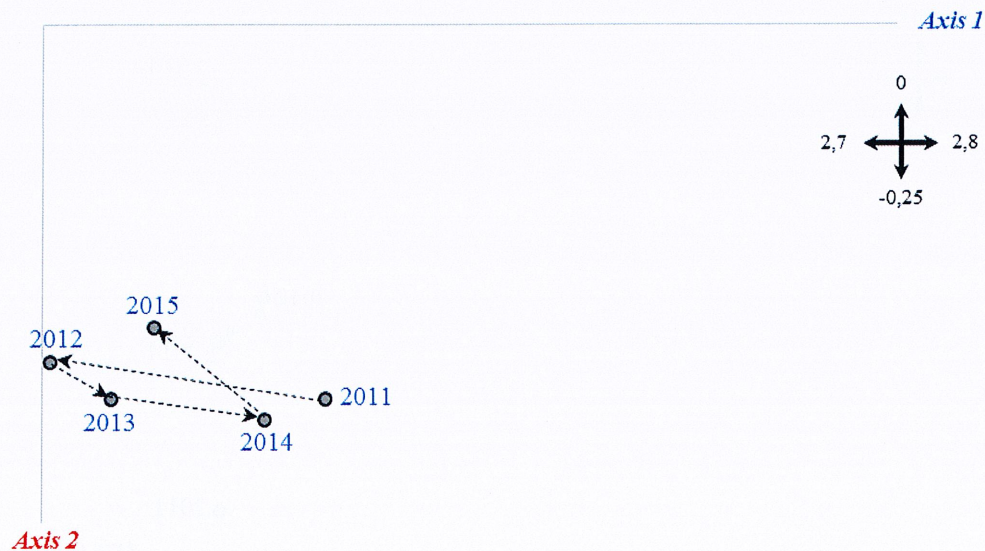


Figure 8: Interpretation of detected trajectories for Germany
Source: Adapted from Multiplot (2016) output

Thus, DE is characterized for a tendency for higher levels of direction and sign changes during its trajectory, showing two inversions for the period on analysis, with a reduction in 2011 and a setback again in 2015.

4.3. THE RELATION EU MEMBERSHIP AND LINGUISTIC AFFINITY WITH A EXPORTS, GDP AND GEOGRAPHICAL DISTANCE REALITY

Though EU membership and Linguistic affinity are of nominative nature and therefore did not contribute to the construction of the BIPLLOT factorial image, it is possible to observe the *a priori* groups for each of the two nominative variables over the BIPLLOT coordinates highlighting the countries which have these attributes and the ones who have not. This can be observed on figures 9 and 10.

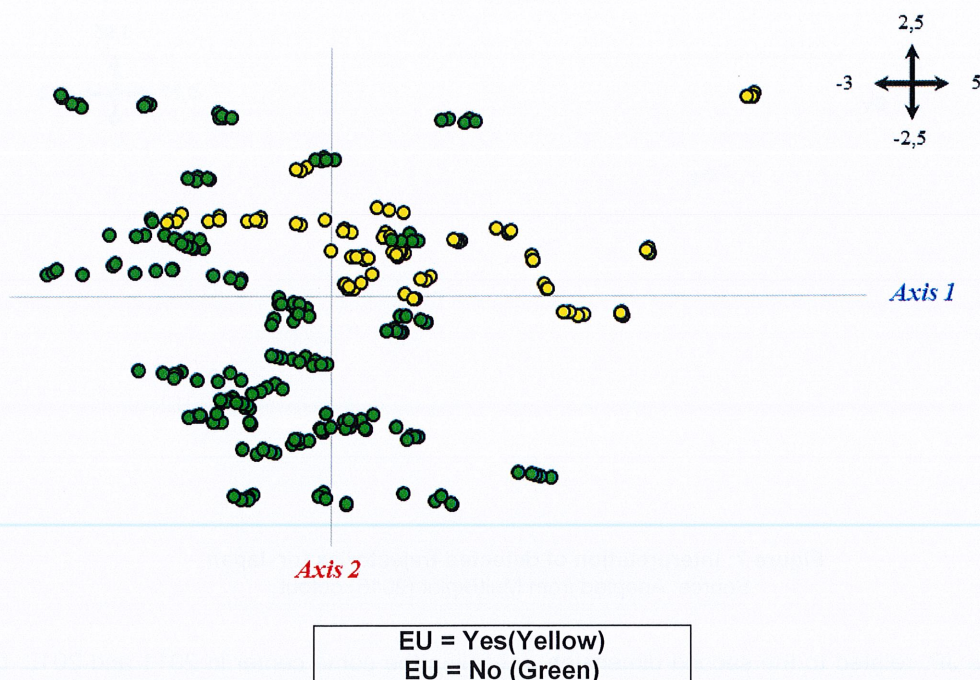


Figure 9: a priori groups for EU membership over the BIPLLOT coordinates
Source: Adapted from Multiplot (2016) output

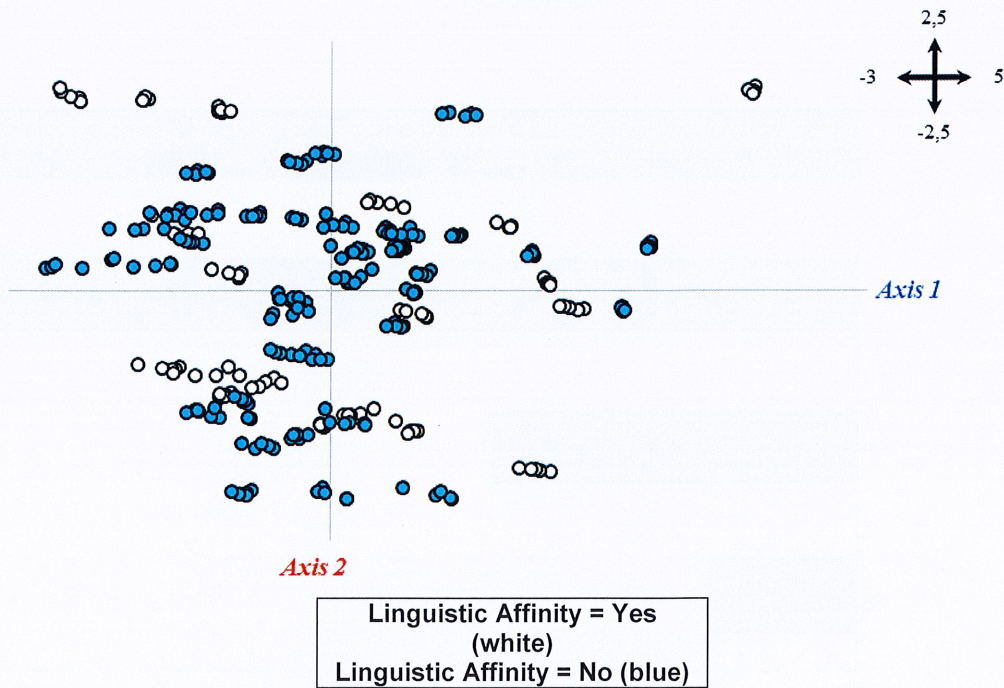
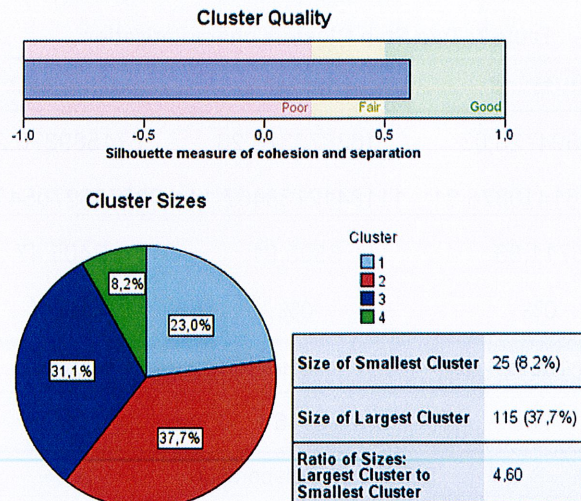


Figure 10: a priori groups for Linguistic Affinity over the BIplot coordinates
 Source: Adapted from MultBiplot (2016) output

Nonetheless, it is possible to identify the observations which are members of each *a priori* group of EU countries and of countries with linguistic affinity, it is not clear that there are well-delimited segments (cluster) and that these variables are of any importance to characterize the exports reality. To confirm a non-identified relation of these variables with the reality constructed with the HJ BIplot it is possible to use the two-step clustering algorithm to test predictor importance and segmentation of countries to groups which encompass this reality. Figure 11 illustrates this approach.



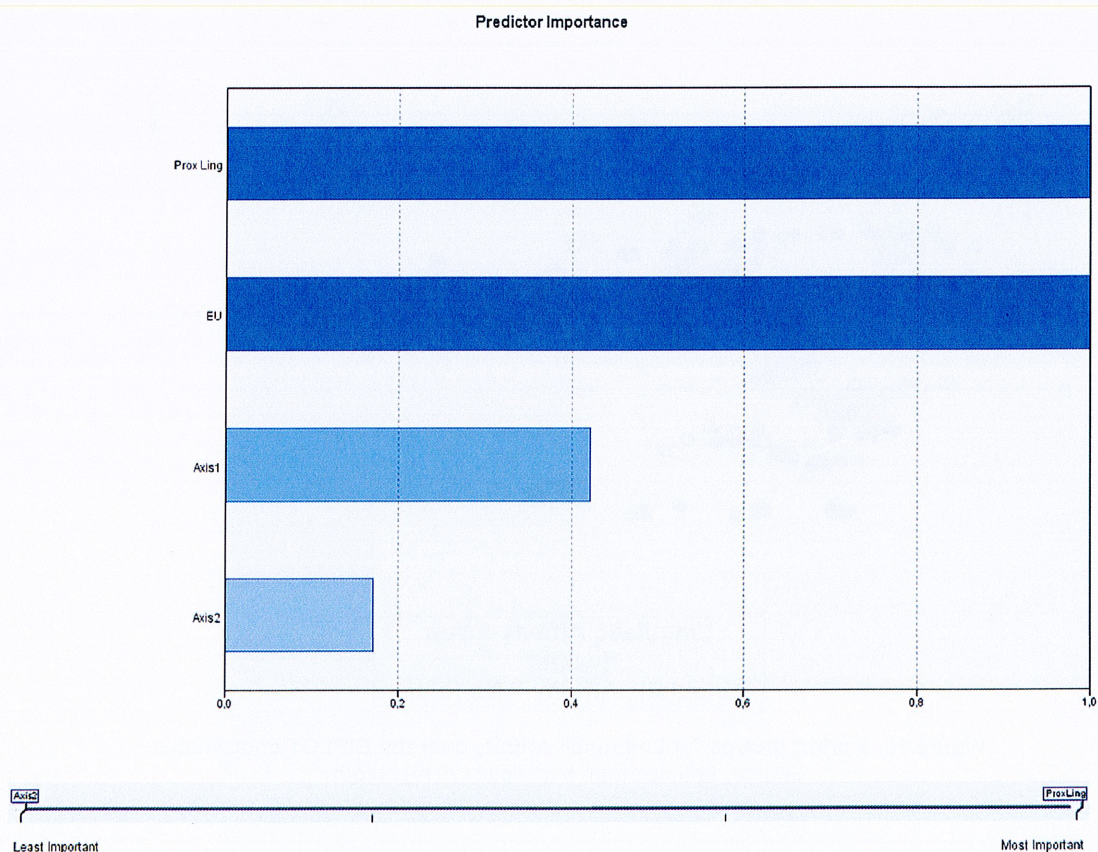


Figure 11: Two step clustering for EU membership and Linguistic Affinity over BIPLLOT coordinates

Source: Adapted from SPSS 23 output

According to the two step model EU membership and Linguistic Affinity are important predictors, and axis 2 is the least important for this analysis.

It is possible to characterize the members of the two step clusters and their values are shown on table 7.

Table 7: Two Step Clusters characterization

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Exports	489694723,03	162872376,26	871589870,27	3384114621,96
GDP	1671261410876,81	1118412738467,14	605766270543,28	1392283725302,00
Geographical distance	6711,86	6503,91	2405,47	1462,40
EU membership	0%	0%	100%	100%
Linguistic affinity	100%	0%	0%	100%
Number of members	70	115	95	25

Source: own elaboration

Cluster 1: Consisting of 70 records representing:

- Countries without an expressive volume of received Portuguese exports
- Higher GDP
- "Bigger" geographical distance
- Non-EU membership
- With linguistic affinity
- Angola, Brazil, Canada, Chile, Colombia, Cape Verde, Equatorial Guinea, Guinea-Bissau, Mexico, Mozambique, Peru, São Tome and Principe, United States and South Africa.

Cluster 2: Consisting of 115 records representing:

- Countries with less volume of received Portuguese exports
- "Bigger" geographical distance
- Non-EU membership
- Without linguistic affinity
- United Arab Emirates, Argentina, Australia, Bahrain, Congo, Côte d'Ivoire, China, ALgeria, Egypt, Hong-Kong, Israel, India, Japan, Republic of Korea, Lebanon, Morocco, Nogeria, Russian Federation, Saudi Arabia, Singapore, Senegal, Tunisia, Turkey

Cluster 3: Consisting of 95 records representing:

- Countries with an expressive volume of received Portuguese exports
- A few geographical distance
- EU membership
- Without linguistic affinity
- Austria, Bulgaria, Switzerland, Cyprus, Czeck Republic, Germany, Denmark, Finland, France, Greece, Hungary, Lithuania, Luxembourg, Netherlands, Norway, Poland, Romania, Sweden and Slovakia.

Cluster 4: Consisting of 25 records representing:

- Countries with more volume of received Portuguese exports
- Lower geographical distance
- EU membership
- With linguistic affinity
- Belgium, Spain, United Kingdon, Ireland and Italy

Through this study we conclude that the clusters of countries that were formed are notorious:

- the cluster with the most registrations includes countries with less volume of Portuguese exports reception, "bigger" geographical distance and they are non EU members and don't have linguistic affinity. Khan (2013) have already, defends that distance and dummy variable for cultural similarities showed a negative relationship towards trade volume.

- the cluster with the fewest registrations encompasses countries with more volume of received Portuguese exports, lower geographical distance, that are EU members and have linguistic affinity with Portugal. Camacho, Paulo (2013) presents in his study that the participation of Portugal in the EU and in the Community of Portuguese Language Countries (CPLP) are important for both exports and imports. Eger (2012) argued that on average, a common (official or spoken) language increases trade flows directly by 44%.

- a cluster with an expressive number of registrations includes countries with an expressive volume of exports, EU membership, so with a few geographical distance but without linguistic affinity.

- a cluster with 70 registrations includes countries without an expressive volume of exports, nom EU membership, so with a big geographical distance and without linguistic affinity. Doumbe, Eric & Belinga, Thierry (2015) when studying the bilateral trade of Cameroon, argued that, 1 percent point increase in distance leads to decrease the bilateral trade volume of Cameroon by 2.0306 percent.

5. DISCUSSION

In short, Figure 12 shows 4 behavioral typologies related to the 161 main trading partners of Portugal with regard to Exports, GDP, distance and linguistic affinity, for the period 2011-2015.

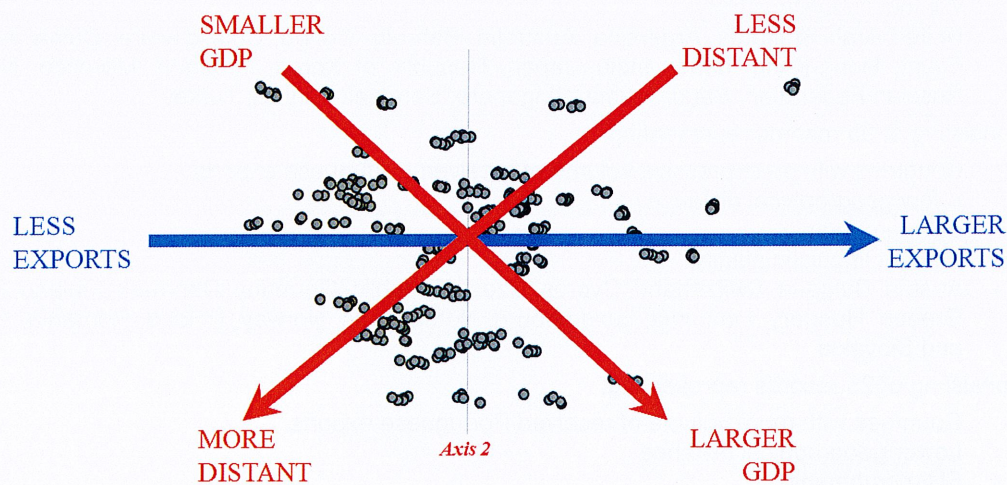


Figure 12: Behavioural Typologies
Source: Adapted from MultBiplot (2016) output

6. CONCLUSION

In the last decade, Portugal has even tried to leave the “comfort zone” of the European market and diversify exports to non-EU markets such as Angola, Brazil or Venezuela. But the collapse of purchasing power of oil-producing clients is forcing Portuguese exporters to rethink strategies and seek alternative markets. However, it should be noted that the different variables considered in the present study lead us to conclude their weight in explaining the volume of exports in Portugal.

As we have seen most Portuguese exports have as destination country an EU member state, however the reasons for this occurrence go far beyond European economic integration and the sharing of a common market. As we have been able to observe the evolution of data over the several periods, physical proximity and linguistic proximity are two relevant factors.

Thus, we conclude:

1. It was possible to analyze the Portuguese exports reality on a temporal evolution perspective.
2. There is a slightly positive relation between export and GDP, and slightly negative with distance. Nonetheless exports and GDP/Distance are different dimensions.
3. The relation export, GDP, distance and destination countries: There are four main typologies of countries. The countries with which Portugal has the highest volume of exports belong to the European Union, although they are not those that are closer geographically or have linguistic proximity. It should be noted that this group is composed of 19 countries, so the volume can be justified for this reason. The next group is made up of countries that, although not of the EU, Portugal have linguistic affinity. Next, also with a significant level of exports, is the group of countries that belong to the EU, so they are closer in geographical terms and with which there is linguistic proximity. Finally, the group of countries with which Portugal has the lowest volume of exports are those that are not from the EU, Portugal has no linguistic affinity.
4. The relation EU membership and Linguistic affinity with exports, is important to characterize the Portuguese exports reality, surpassing geographical distance and GDP of destination countries;
5. The results substantiate the previous finding of gravimetric models, and the integration of nominal variables as EU membership and Linguistic affinity on conceptual models.
6. This methodological approach showed to be useful for diagnostic and decision making, on the export analysis perspective, for its visual representation nature enabled a general characterization, the dimensions, similarities and dissimilarities between countries (clusters), the but also the analysis of the behavior of each country.
7. The need to integrate other variables, possibly it would be positive to use a two sided approach (imports and exports) and not only of goods but considering the services also

This study can be seen as a contribution to the future application of multivariate data methods in international commerce. Even from an exploratory perspective, it is a potential tool for producing richer information not only for academia but also for policy makers.

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APPENDIX 1

	2015			2014			2013			2012			2011											
	Exportações (€)	Ln Export	Ln GDP (USD)	Exportações (€)	Ln Export	Ln GDP (USD)	Exportações (€)	Ln Export	Ln GDP (USD)	Exportações (€)	Ln Export	Ln GDP (USD)	Exportações (€)	Ln Export	Ln GDP (USD)	Distância	Ln Dist	Prox Ling						
Emiratos Árabes Unidos	1 170 172 859	18 952	370 206 255 566	26 838	1 235 001 588	18 6318	401 958 066 712	26 7195	101 711 479	18 4327	388 598 502 383	26 6858	95 100 149	18 3704	373 431 994 554	26 6460	80 101 305	18 3164	348 526 072 158	26 5770	0	6067	8 10919528	0
Angola	2 099 561 151	21 465	102 639 929 545	25 354	3 177 688 336	21 8795	128 778 674 217	25 0557	3 112 687 722	21 8558	124 912 063 308	25 5059	2 988 536 867	21 8150	115 369 371 426	25 4717	2 380 054 737	21 5992	348 526 072 158	26 5770	0	6067	8 10919528	0
Argentina	90 608 813	18 322	583 168 571 071	27 062	50 877 714	17 7449	526 726 159 461	26 9956	89 533 398	18 3101	554 155 168 984	27 0407	53 054 324	17 7874	548 854 618 736	27 0312	45 219 802	17 6270	533 302 389 250	27 0022	0	102029	9 247710752	1
Áustria	283 087 700	19 461	376 590 249 628	26 655	268 656 518	19 4101	438 375 178 526	26 8063	257 004 241	18 3547	428 248 420 465	26 7830	259 944 785	19 3644	407 451 583 084	26 7332	235 858 258	19 2779	429 010 875 963	26 7847	1	2037	7 169235416	0
Austrália	1 05 147 293	18 469	1 339 140 527 498	27 623	93 445 886	18 3529	1 454 675 479 666	26 0056	60 066 747	18 3161	1 563 950 599 270	26 0782	78 905 348	18 1838	1 537 477 830 481	26 0612	72 112 186	18 0897	1 389 919 156 058	27 0603	0	18150	6 686675329	0
Bélgica	1 134 739 626	20 850	455 055 726 960	26 844	1 303 296 000	20 6882	531 761 915 065	26 9995	1 343 284 623	21 0184	520 891 780 650	26 0773	1 421 269 215	21 0748	497 884 216 569	26 9936	1 390 101 667	21 0234	526 975 674 176	26 9604	1	1583	7 36770706	1
Bulgária	75 477 785	18 145	50 169 117 547	24 639	71 545 008	18 0872	56 732 006 512	24 7166	55 342 950	17 8291	55 788 744 571	24 7443	67 208 363	18 0233	53 903 028 282	24 7105	60 730 566	17 8220	57 418 391 042	24 7736	1	2881	7 948350289	0
Canadá	30 442 769	17 231	31 729 581 064	24 161	7 211 177	15 7625	33 587 712 166	24 2316	3 618 106	15 1615	32 539 441 499	24 2057	4 252 444	15 2830	32 749 308 511	24 1491	4 719 785	15 3673	26 776 595 145	24 0828	0	9308	8 631845429	0
Birani	556 780 324	20 159	1 774 724 618 800	28 205	638 568 960	20 2747	2 417 046 523 842	26 5136	735 945 642	20 4207	2 465 773 850 935	25 5335	630 845 723	20 3338	2 490 659 440 428	26 5315	563 107 128	20 1839	2 614 573 170 732	26 5921	0	7486	8 80078688	1
Canadá	359 316 088	19 697	1 550 536 520 142	28 070	258 000 496	18 3683	1 783 775 990 895	26 2098	1 213 335 375	19 1774	1 837 443 486 716	26 2394	184 158 381	19 0313	1 824 288 757 448	26 2322	204 951 747	18 1363	1 788 703 385 548	28 2125	0	6918	8 841881699	1
Congo	48 471 204	17 654	8 553 154 506	22 870	47 224 024	17 6704	14 177 437 627	23 3748	32 168 281	17 2865	14 085 852 120	23 3684	16 678 650	16 6295	13 677 930 124	23 3300	26 783 852	17 1022	14 425 607 224	23 3923	0	5039	8 854296299	0
Costa do Marfim	458 607 312	19 944	670 789 928 510	27 232	429 323 000	19 8777	702 705 544 909	27 2782	419 109 540	19 8536	685 835 034 384	27 2524	400 850 715	19 8091	685 054 050 621	27 2231	372 247 983	19 7581	696 418 391 959	27 2891	1	1565	7 355541103	0
Chile	40 911 433	17 517	31 759 248 584	24 181	18 960 191	16 7579	34 217 083 110	24 2595	40 110 533	17 5071	31 264 187 110	24 1657	14 044 884	16 4878	27 040 582 587	24 1008	15 228 738	16 5357	25 381 616 734	23 9873	0	5532	8 613204698	0
China	833 961 704	20 548	11 007 720 584 139	30 030	839 714 326	20 5486	10 482 371 325 325	29 9807	657 484 200	20 3039	6 607 224 248 685	29 8935	777 967 664	20 4722	8 560 546 868 812	29 7782	396 586 584	19 7684	7 572 564 360 443	29 6956	0	9157	9 122273893	0
Colômbia	59 193 254	17 896	262 030 156 833	26 400	63 775 852	17 9709	378 416 020 534	26 6593	40 642 674	17 5203	380 181 851 860	26 6039	27 783 847	17 1392	399 669 700 376	26 6358	18 773 899	16 7480	335 415 156 702	26 5386	0	7640	8 841152882	1
Cabo Verde	214 522 668	18 184	1 603 239 233	21 195	214 964 268	18 1660	1 881 466 592	21 3553	201 965 234	19 1238	1 850 852 140	21 3350	215 610 578	19 1890	1 751 887 839	21 2840	263 786 091	19 3530	1 864 823 991	21 3464	0	3020	8 10392111	1
Chipe	36 883 735	17 423	19 559 842 331	23 697	26 064 665	17 0889	23 308 212 817	23 8721	30 362 018	17 2287	24 054 965 481	23 8036	24 368 199	17 0314	25 012 226 060	23 2429	26 487 184	16 5015	27 427 161 523	24 0348	1	3684	8 811745987	0
República Checa	513 005 025	19 567	185 156 559 571	25 844	519 302 844	19 5816	207 818 330 724	26 0599	355 400 679	19 4697	209 402 444 860	26 0578	327 017 035	19 6055	207 378 427 021	26 0578	264 697 184	19 5015	227 468 564 387	26 1524	0	2190	7 991656820	0
Alemanha	5 983 117 114	22 495	3 953 446 822 668	28 844	5 618 419 020	22 4493	3 979 276 587 199	26 0567	5 508 668 397	22 4496	3 752 513 021 278	26 0534	5 595 892 004	22 4493	3 543 983 909 148	26 0563	5 800 908 005	22 4493	3 767 464 553 795	26 0548	1	1961	7 576069341	0
Dinamarca	305 950 306	19 539	265 091 333 721	26 411	305 063 119	19 5300	348 119 472 128	26 5700	314 982 346	19 5660	338 927 058 064	26 5491	311 815 860	19 5579	325 012 152 410	26 5071	271 810 837	19 4208	341 488 688 333	26 5566	1	2280	7 73190271	0
Egito	565 474 510	20 153	668 838 617 797	25 840	588 071 585	20 1624	213 518 488 688	26 0870	527 403 984	20 0835	209 703 529 364	26 0690	428 170 853	19 8750	209 047 389 600	26 0656	358 009 923	19 6961	200 013 050 828	26 0216	0	2285	7 734121303	0
Espanha	103 143 180	18 452	330 778 550 717	26 525	79 738 542	18 1943	301 498 960 052	26 4230	65 519 766	17 9679	286 011 730 726	26 3793	87 370 214	18 2857	276 333 328 880	26 3449	71 130 848	18 6800	236 051 658 960	26 1871	0	3659	8 298163052	0
Finlândia	12 467 279 644	23 246	1 199 057 336 143	27 813	11 284 010 353	23 1467	1 381 542 107 736	27 8541	11 176 716 813	23 1371	1 369 261 671 179	27 8453	10 151 358 731	23 0409	1 339 948 773 437	27 8257	10 667 219 710	23 0084	1 487 024 659 838	28 0204	1	300	5 1037032415	1
Francia	6 031 727 961	22 820	2 418 835 532 882	28 514	5 659 613 493	22 4544	2 639 162 443 235	28 0745	5 496 751 571	22 4274	2 808 511 203 185	28 0637	5 351 324 888	22 4008	2 681 416 108 537	28 0714	5 026 678 987	22 3732	2 862 002 085 071	28 0627	1	1138	7 037027615	0
Reino Unido	3 558 920 248	21 525	2 888 003 269 686	28 841	2 943 891 123	21 6030	2 998 833 559 196	28 7920	2 612 562 587	21 6356	2 719 509 472 493	28 8215	2 386 033 899	21 5929	2 646 002 634 000	28 8041	2 232 339 525	21 5025	2 608 965 353 309	28 8500	0	2100	7 49692624	1
Guiné Equatorial	35 872 913	17 392	12 202 323 684	23 235	54 332 467	17 8106	21 461 969 483	23 7895	65 758 231	18 0015	21 842 597 765	23 8117	42 059 042	17 5548	22 389 627 284	23 8319	41 183 422	17 5331	21 329 395 901	23 7834	0	4601	8 43402896	1
Grécia	131 207 446	18 692	194 851 319 175	25 996	176 850 413	18 0905	236 079 774 688	26 1674	162 965 913	18 0195	239 892 011 450	26 2033	214 779 010	18 1551	245 870 668 629	26 2273	131 828 501	18 0670	267 779 921 184	26 3855	1	2576	7 653993097	0
Guiné-Bissau	73 704 177	18 115	1 056 716 803	20 778	54 055 855	17 6889	1 109 007 426	20 5267	69 787 043	18 0943	269 600 475 468	20 5624	71 523 791	18 0655	965 561 562 20 7168	20 5624	64 248 761	17 9783	1 056 467 822	20 3028	0	3144	8 053231154	1
Hong Kong	129 793 255	18 681	326 234 500 374	26 457	121 976 522	18 9193	291 228 511 369	26 5974	130 728 059	18 6868	275 658 844 765	26 3424	123 978 843	18 6556	262 629 441 499	26 2840	111 474 536	18 5929	248 951 677 677	26 2838	0	10004	9 266594073	0
Hungria	198 633 067	19 107	121 715 203 208	25 525	213 809 760	19 1811	139 264 565 101	26 3594	181 122 966	19 0147	146 600 475 468	26 3424	130 728 059	18 6868	275 658 844 765	26 3424	123 978 843	18 6556	262 629 441 499	26 2840	0	10004	9 266594073	0
Írlanda	237 427 306	19 285	283 703 217 034	26 371	189 272 319	19 0587	256 271 350 219	26 2695	154 049 743	18 8526	239 271 162 516	26 2009	136 235 013	18 7299	225 819 184 921	26 1430	127 862 452	18 6649	240 575 769 118	26 2063	1	1558	7 351158028	1
Israel	112 641 977	18 540	209 415 714 727	26 425	90 562 915	18 3216	305 769 389 066	26 4559	88 585 966	18 4105	293 514 777 889	26 4545	106 832 520	18 4549	257 641 796 640	26 2748	74 488 845	18 1262	261 374 751 953	26 2892	0	3962	8 295934945	0
Índia	78 991 338	18 184	2 055 388 546 296	26 371	65 297 347	18 3725	2 042 438 591 344	26 3453	116 801 497	18 5760	1 863 208 343 558	26 3533	94 787 584	18 3671	1 638 963 283 085	26 2848	89 345 046	18 3030	1 822 869 507 290	26 2816	0	8339	9 038658584	0
Índia	1 586 699 214	21 125	1 621 496 954 401	28 231	1 539 198 700	21 1545	2 119 814 255 579	28 3823	1 554 825 975	21 1710	2 130 401 269 673	28 3594	1 661 847 961	21 2312	2 072 823 111 961	28 3509	1 571 953 146	21 1756	2 276 150 784 757	28 4035	1	1771	7 47029638	1
Japão	146 262 656	18 801	412 257 609 615	26 040																				

