



# **INCOME, DISTANCE AND INFRASTRUCTURE IN THE INTERNACIONAL TRADE**

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## **ABSTRACT**

This paper aims to determine which variables are more relevant when analyzing trade flows. In this case, the study will be done about Spanish exports to the world and their effects depending on the chosen variables. At first, it is analysed the importance of the GDP of the country which Spain trades with and the distance between them. These are two of the most important issues when speaking about trading, but not the only ones. Then, we are going to analyse the importance of having a good communication by testing the spoken language. In addition, we are going to focus on the development level of the country infrastructure, specially the maritime ones, because it is the kind of trade which we refer to in this paper. So, it is necessary for Spain to analyse the effect of trading with a coastal or a landlocked country.

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# **INCOME, DISTANCE AND INFRASTRUCTURE IN THE INTERNACIONAL TRADE**

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## **I. INTRODUCTION**

International trade has been always linked to humans, increasing its size and importance over the centuries. Globalization and innovation in new technologies have facilitated trade development worldwide. For example, you can not compare the time taken by the Spanish and Portuguese to navigate to the African continent in search of gold, ivory and other materials that it would take today. Moreover, other nearby countries certainly have the goods we need or even we produce them ourselves.

The world is increasingly competitive and the need arises to constantly not to get behind in technological development. If a new technological process serves to reduce the costs of a variety of products, the country that provides them will have an advantage with other countries. Now, is it sufficient that a product is cheaper in production? The answer is no, as there are many other factors that influence the cost of a product. Transport costs, which will depend on the means of transport used and the distance between the countries which make the business operation, must be added at the price of the product. For example, if Japan is able to decrease the price of any product due to its advances in technology ... is it worth for Spain buying that product to Japanese if France sells a little more expensive? Being neighboring countries, now is the time to do calculations and see from where is more advantageous importing the product. Everything depends on whether the amount you save by buying the product in Japan is greater or less than the difference in transport costs.

International trade is defined as "the exchange of goods and services between the residents of two or more countries." Therefore, it is inevitable to talk about exports (sales to other countries) or imports (purchases from other countries). Normally exports are used to measure the wealth and size of each country's economy by gross domestic product (GDP). Countries with a higher volume of exports are considered as those that have a greater economic power in the world, since this volume is closely related to the fact of having a very advanced technology.

In contrast, economies that are in a development process need to make a greater number of imports because of their limited technology prevents them from producing

everything they need to keep growing. The need for economic development not only improves the economic issues, but it may serve to provide more services to citizens and affect them in a substantial improvement in their living standards.

The infrastructure should be adequate if you want to save time and money on commercial concepts. A country with poor infrastructure will never be able to compete at the same level as others who have invested a substantial amount of money. The effects of a good infrastructure system are reducing costs and increasing the volume of trade through a higher level of efficiency and quality. According to Manheim (an automotive firm) we can do some subgroups to see what the key aspects of a good infrastructure system are. In this case, the division is made about three determinants. The location, which is the level of easy access to that port (if we refer to shipping) or, if it is a landlocked country, the road conditions up to the point of destination. Mobility, which refers to the ability of the port to receive goods and the speed with which you can download or charge, depending on whether you export or import. And, as we already mentioned above, the efficiency, which measures the relationship between total costs involved and the level of productivity.

Logistics is defined by the RAE as "the set of means and methods necessary to carry out the organization of a company, or service, especially distribution." Logistics is vital, in strategic terms, as it is responsible for issues related to business management both at customers, suppliers and their production processes. It also makes a strong emphasis on the use of new information technology and communications to improve both the internal development of the company, as the relations between companies. So what relevance does the logistics in connection with transportation?

Figure 1: Logistic process



Source: NG – Logística, transporte y distribución

Well, in the process of distribution, transportation plays a very important role because of the transport system depends that deliveries are on time, with a product whose quality and amount are proper. Good choice of means of transport, taking into account the product you are offering, the distance between importers and exporters and the level of infrastructure in both, the exporting and importing countries will be very important to reach its destination at the right time. When it is about being competitive and getting advantages over your opponents, it is important to improve the technology in order to get price reductions, but it could be more significant to be aware of the customers' welfare so that they continue buying from our firms. Therefore, the service for customers must be correct to get their attention and to be faithful to the products offered by the company in question.

We have seen throughout this section the importance of international trade, transport systems and other economic factors related to the global economy. In times of crisis, this analysis should serve as motivation for each of the individuals and companies that can improve the level of global welfare, to help developing countries to grow and have a better life, and poor countries to achieve greater development. The more countries compete at the same level, the more beneficial the outcome for individuals. The higher quality products, the better price and the happier customers. While there are some countries that dominate others and can take advantage of these situations, the rich countries will remain rich and poor countries will be getting poorer. With this level of inequality, everyone thinks more in their personal interests than in the global ones. For a rich man means nothing stop earning a minimum amount of money that would make them happy to millions of people living in poverty. Why do not? It is not known, but this is not my understanding of globalization.

At the end of 2013, a few months ago, the Spanish Maritime Institute (IME) released a report in which appeared a ranking of the most important ports in the world. Spain was positioned as the third most important country in Europe and eleventh in the world in regard to the container trade. And is that among the one hundred and twenty-five most important ports appeared five Spaniards, including the port of Valencia. In addition, the development minister Ana Pastor said that "through the Spanish ports spend nearly 60% of exports and 85% of imports, accounting for 53% of Spanish foreign trade with the European Union and 96 % with third countries."

With these data we can see the relevance has maritime trade and in particular the Spanish maritime trade. This is one of the main motivations for monitoring these events, further studies that can determine new aspects not previously had in mind when trading and that they serve as an impetus to continue to grow and have a higher degree of efficiency, both quantitative and qualitative terms.

Throughout the work will be developed a model to see how important certain characteristics in foreign trade have and their contribution to total exports. This gravity equation will be composed by a number of variables that may be important when analyzing a country is related and trade with the rest of the world. First a theoretical explanation of this gravity equation can be performed and thus assume what the results might be. Then these results can be confirmed, or may not, by an econometric analysis which will be estimated with a computer software. The estimation of this model will be based on an Ordinary Least Squares (OLS) regression to make it easier to obtain coefficients and their explanation.

Different databases will be used in the empirical application. The most important databases are the World Development Indicators (World Bank) and Market Access Database, where we have found all the information related to income and exports. Furthermore, CEPII database has been used to know the distance from Spain to the other countries. The sample considers Spanish exports around the world to have a wider vision about the effects of being located on different places in the world, being Spain the initial point.

The paper is organised as follows: Section 2 reviews the literature on transport costs, port efficiency, economic geography and infrastructure. A descriptive analysis about how the maritime trade is in recent years and the main routes to export and import around the world is shown in Section 3. Section 4 presents the gravity model and explains the variables which are going to be included in the model. In this section, it is also explained what the expected results are. In Section 5, the model will be specified and the results will be displayed with their corresponding comments. And, finally, the Section 6 summarises the study and its results.

## **II: AN APPROACH TO WORLD MARITIME TRADE**

It is known that most of the Earth's surface is covered by water, so it is not surprising that shipping is the most used in international trade. Currently it holds more than 80% of world trade and it is vital for the functioning of the global economy. Its availability, its low cost and its high level of efficiency are the main factors that make it very important when trading. In addition, shipping is the one that has a greater capacity to trade goods between two fairly distant geographical locations. Despite the protectionist tendencies of some countries, most of the international traffic is carried out in conditions of free competition.

It should also take into account the change in the socio-economic environment in recent years compared to the trend observed in previous decades. Globalization and the development of centers of low-cost production in Eastern Europe, China and India, the aging and declining labor in developed countries, the increasing costs imposed by environmental legislation and illegal use of the sea (poaching and related crimes), plus the cost of security measures to combat such phenomena, and the increase in demand for energy and food are key factors in a period of considerable change, development and challenges.

The maritime transport of goods has been developed recently, as the route through which it moves does not need repair and maintenance expenses. Moreover, the distance that the ship travels by sea gives shipping some legal autonomy from the other means of transport. Apart from the globalization of contemporary economic life, the great possibilities offered by new technologies, communications and financial flows have generated that international trade import and export has become a large-scale phenomenon, which characterizes our time with increasing economic exchanges, new business forms they take and the creation of large regional or supranational trading blocs.

The attachment of some countries trade agreements has decreased transport costs, as there are many exchanges between countries in the same geographical area and, without tariffs or taxes, it causes a welfare improvement. These serve to develop the reciprocal exchange and taking into account the special interest in promoting bilateral trade by strengthening and adequate protection from the economic stability of the respective merchant marine whose existence and development is considered essential not only for the expansion and diversification of economic relations between two



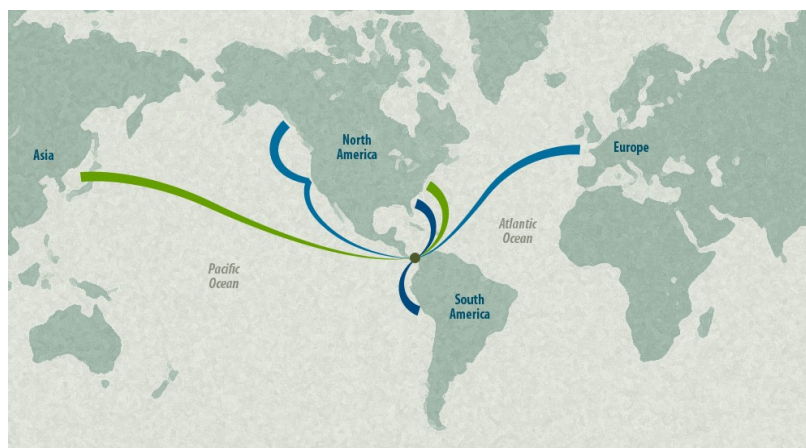
countries, but also to strengthen the foundations that enable the increase in commercial and industrial complementation.

Shipping can be divided into two groups: liner and tramp. The first one refers to the operation of ships through regular line offering a permanent service in a trade that covers usual routes, with exits and entrances to ports that make up the itinerary and scales at regular intervals and rates fixed beforehand. The second group refers to the tramp service, which consists on hiring a ship to realise a specific route. Before the trip the two enterprises usually negotiate in which port the route is going to begin and finish. Most of these services are realised in case of bulk cargo, specially, in goods as oil.

Some of the main sea routes are the Panama Canal, the Straits of Gibraltar, the Suez Canal, the English Channel and the Strait of Magellan.

The Panama Canal may be the most important because it is the only port that has terminals in two different oceans. It connects the Atlantic Ocean to the Pacific. Its main trade routes are: from the east coast of the United States to the Far East, from the U.S. east coast to the west coast of South America, and from Europe to the west coast of the United States and Canada. Since it was inaugurated on August 15, 1914 the Panama Canal revolutionized the shipping: allowed to join for the first time the Atlantic and Pacific oceans, bringing with it a significant savings, as it avoided ships skirting South America. This also meant significant savings in time and money.

Figure 2: Panama Canal in the world trade

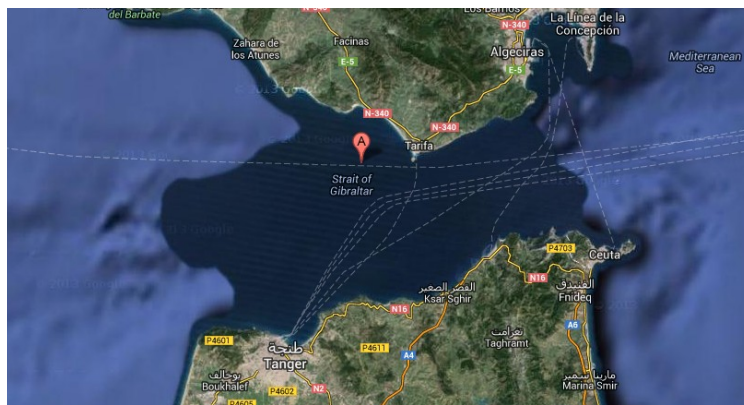


Source: Logistics Innovation and Research Center (Panama City, Panama)

For instance, a merchant ship which leaves the east coast of the United States toward Japan via the Panama Canal saves about 4,800 km, compared to the alternative of a shorter sea route. A vessel leaving from Colombia (or similar) to Europe saves about 9,000 km. But, there is a problem. Trade between Latin America, mainly Brazil, and Asia is destined to increase due to the extraction of some minerals such as coal. Although, currently the most important mineral is iron ore, which starts from Brazil to China. These journeys must be performed by the Cape of Good Hope, as the vessel size exceeds the limits of the Panama Canal and crews must choose an alternative route even if this requires a greater distance.

The strait of Gibraltar is located between the Mediterranean Sea and the Atlantic Ocean, linking the North of Africa and the South of Europe. It is located in an unbeatable location for maritime communication routes since it makes a nexus between Africa and Europe and represents about 10% of the volume of international trade in regards to shipping.

Figure 3: Strait of Gibraltar in the world trade



Source: Google Maps

The Port of Gibraltar is home to many services to maritime transport. These include ship repair, crew change, provisioning tasks and waste from ships, being especially important the report fuel. Since 1985, this activity has grown very strongly, with the five largest companies operating in this market, of which the most important is Cepsa Gibraltar Ltd., which the fuel is supplied from the Cepsa refinery Algeciras. These services can be carried out both in the port and at sea, to minimize the time for refueling and maintenance. The development and infrastructure planning is obviously greater part of Spain, as the role of the port of Algeciras makes necessarily be taken into account when developing infrastructure plans at national, regional and local level.

On the African side Tangier has a port in the bay where the city is located, but it also has recently opened a complex called Tanger-Med, further comprising port facilities. Moreover there are free trade, logistics, commercial and industrial areas, connected with a network of highways and railways to the rest of the country. This resort has been designed primarily as a platform for exchange and distribution centre.

The Suez Canal is another key point for the development of world maritime trade, separating Africa and Asia. It is an artificial waterway located in Egypt, which allows Europe and Asia to have a more direct way to trade without the need to route around Africa, which means a saving of time and money. Currently, it supports an 8% of world seaborne trade.

Figure 4: Suez Canal in the international trade



Source: [www.arkiplus.com](http://www.arkiplus.com)

One advantage of the Suez Canal is that it is situated near the places where there is oil, so that European countries send their ships through the canal to move barrels of oil from where it is extracted. It supposes a huge volume of trade. The only problem that may exist in this part of the planet are the wars that occur against the governments of neighboring countries such as Egypt, which could endanger the passage of ships and reduce trade during these periods of war. That is why the European countries, in particular Spain, France and Italy are interested in the political situation in these countries to see if their crews are at some risk as they travel to their destinations in South Asia.

### III: REVIEW OF THE LITERATURE

One of the greatest contributions to the economics of “new” international trade theory was Krugman’s paper *“Increasing returns and economic geography”*, in 1991. This model shows that in the presence of high transport costs, manufacturing companies are present in both regions, but as costs drop, an agglomeration process that will lead to the firms to concentrate production in one place is triggered from which supplying both markets in order to exploit their economies of scale. The result is that two initially identical regions evolve towards a scheme of center-periphery or north-south, where industrial production, which is subject to increasing returns via the migration of workers is concentrated in a region (center) with high productivity and income. This model emphasizes the crucial importance of trade costs but also for the structure of economic activities (Radelet and Sachs, 1998). Their paper is about *East Asian Financial Crisis* where they explain that the link between geographic location, trade and economic growth is important to explain the cost of being landlocked. The fact of being landlocked has a higher cost when purchasing products and decreases countries’ trade with foreign countries.

Limao and Venables (2001) continued adding variables that are influential on transport costs. They claimed that the quality of infrastructure (access, design...) involved a variation between 40 and 60% in transport costs. They also showed that some deterioration in the infrastructures increased transport costs by 12% and reduced trade volumes by 28%. One of their famous examples is the seagoing departure from Baltimore to two different destinations: a coastal port and a landlocked country (Durban and Lesotho).

Mico and Pérez (2001) agreed that since the mid-nineties, the transportation cost for Latin America exceeded the tariff cost (Micco and Perez 2001). The particular trade since then, higher cost of transportation (including insurance) to high value product, the growing importance of economies of scale in container transport and the resulting increase in cabotage ports (and transportation in general), and the importance of the specific characteristics of national and regional trade, are still valid today. Clark, Dollar and Mico (2004) delved into the analysis of transport costs, concluding the importance of port efficiency in reducing these costs.

David Hummels (2001) estimated the technological relation between freight rates and distance to analyze trade barriers. Their analysis concluded with the calculation of

some barriers. Therefore, Hummels used a model to isolate the channels of trade barriers that affect trade volumes. This model allowed a characterization of implicit trade costs on trade flows and its division into three components: explicit costs, the implicit ones and costs related to proxy variables.

Martinez Zarzoso and Novak Lehmann (2003) used the standard gravity equation, adding a number of variables, to determine which ones were important in bilateral trade flows. Some of them were the infrastructure of each country, income differences and exchange rate. They performed the sample with the 15 countries of the European Union, the four Mercosur countries and Chile.

Clark, Dollar and Micco (2004) focused on the determinants of shipping costs. There are many variables that influence the cost of this type of transportation: geographical factors insurance rates for the goods, the trade imbalance, the existence of economies of scale, development of container transport, port efficiency and anti-competitive practices from other countries.

Anderson and Van Wincoop (2004) studied the determinants of transport costs. They included transportation, distribution of the product to the final consumer and if the traders had a common border. They also noted that transport costs were related to the policies of each country, but there were more important variables such as infrastructure, legal regulations or language and others that were less significant such as quotas or their equivalence with the exchange rate. Finally, they also obtained results showing the importance of geographic location and the use of economies of scale.

Egger (2004) provides an analysis of outsourcing and trade in a spatial model (Hotelling). In this setting, he discusses the trade-off between transport-cost-related disadvantages and outsourcing-induced production cost advantages of a large economy. The model gives a rich picture of possible trade and welfare effects of a movement towards free trade and points to the role of national transport costs for explaining these effects.

Rozas and Sánchez (2004) notes that "the adequate availability of works infrastructure and the efficient provision of related services, allow a country to reduce the deficit, if any in the provision of certain natural resources." Their article is based on the advantages of having a system developed infrastructure. Some of the benefits are the

ability to use economies of scale, improved access to markets for goods, as well as reducing the costs associated with the consumption of services and their quality.

The globalization of trade makes shipping an important service in the global economy. So, Gordon, Wilmsmeier and Pérez (2005) analyzed the most important factors explaining the complexity of maritime transport costs in recent decades in Latin America, a region that is highly dependent on maritime trade. According to Wilmsmeier worth highlighting the importance of distance as a determinant of transport costs. Specifically, for maritime trade, he noted that the distance had a greater influence for bulk cargo to containerized cargo (a difference of 20%, 8-28%). Moreover, their analysis included the number of services between two countries to see if they could take advantage of economies of scale. For example, the fact of having twenty monthly services instead of five represents a decrease of freight and insurance about 10%.

Combes and Lafourcade (2005) investigated the role that business and social networks play in shaping trade between French regions. The intensity of bilateral networks is quantified using the financial structure and the location of French firms and bilateral migrant stocks. When it is compared to a situation in which these networks are not used, duplicated migrants bilateral trade flows, while networks of firms multiplied by four trade flows in some cases.

Martínez-Zarzoso and Suárez-Burguet (2005) analyzed the relationship between transport costs and trade. In their work they investigated the endogeneity or exogeneity of the variables in the cost of transport in their gravity equation. Their results showed higher transport costs when greater distances were crossed and when worst were buyer infrastructure. They also concluded that a greater volume of trade reduces the unit cost of transport.

One of the last items on transport policies is "*European Transport Policy (2010)*," written after the agreement between the commission of the European communities. This document is divided into four blocks: the first of all is about the imbalance between transport modes and linking up the modes of transport. The second one tries to eliminate bottlenecks by unlocking the main routes and solving the headache of funding. The third part wants to place users at the heart of transport policy, so there is unsafe roads and it is pretended to rationalize urban transport. The last one explains how to manage the globalisation of transport through enlargement changes and claims that the enlarged Europe must be more assertive on the world stage.

#### IV. ANALITICAL FRAMEWORK

Gravity equation is important to explain the trade flow between two countries. To realize the analysis we have to look up some variables which explain why two countries trade more or less with each other. Therefore, first of all, we can now set the trade flow as the dependent variable in the model. This equation was developed by a Dutch economist called Tinbergen, who designed it as follows:

$$\text{Trade} = B \cdot \frac{\text{PIBe} \cdot \text{PIBi}}{\text{distance}} \quad (1)$$

This economist related the GDP of the two countries, the exporting (GDPe) and the importing one (GDPI). Newton's law saying that "gravity is stronger between two large objects" served as an example to help to explain why. And so two countries tend to trade more with each other when they have higher incomes. The reasons that lead to this thought are the largest countries (in terms of income) export more because they produce a greater variety of products and import more because the demand is higher.

The other essential variable in gravity equations to calculate the trade flow is "distance". Distance is a significant factor, since it determines how much time they spend travelling and how much money they have to pay. The larger distance between two countries, the longer is the journey that products must perform to reach their destination. Moreover, travelling further distance also means having to pay additional costs for this service. From here, the other theory that "two countries trade more with each other when the distance between them is smaller."

Another of the variables which I am going to include in the model is "infrastructure". Limao and Venables (2001) studied, analysed and explained that the fact of not making a good investment in infrastructure. They have to be improved in order to be more efficient and to have an easier use. If they do not have, it supposes a reduction in trade flows and an increase in transport costs. I also consider that "infrastructure" will help to determine the volume of trade between two countries. Just like with "waterfront", we could have created a dummy variable with "infrastructure"; and countries would have had value 0 when the infrastructures were not advanced and value 1 when yes they were. But infrastructure can be "proxied" by the LPI coefficient, which measures the quality of infrastructure evaluated by over 5,000 countries and over 1,000 freight services.

Over the years different economists have been working with this equation for a more exhaustive analysis. Depending on what you want to explain you can add some variables or other to the model. It is clear that if someone uses more variables, he or she will be able to know more exactly what are the reasons of a higher or a lower trade flow. The three variables we have used so far have been taken by their values, or in logs or not, but they have a specific value has been quantified. But there are other variables that can not be measured not in kilometers or euros ... and their features may be relevant to explain the model or the result of other variable factors. This kind of variables are qualitative, ie, they will explain if a country has some characteristic or not. These variables are known as "dummy" and only take values 0 or 1. When they take the value 0 is as if they were not in the model, since the country does not have that feature and there is nothing to explain. In contrast, if they take the value 1 is because the country has something that can affect positively or negatively on the development of the model. The greater or lesser relevance of these variables depends on the acquired coefficient and their significance in the model. For example, if we wanted to know the sex of a person could establish a dummy variable with value 0 If he is male and 1 if she is a woman.

As this work is focused on maritime trade, one of the dummy variables used is "waterfront". This variable will attempt to explain the relevance of being a landlocked country, so it will be assigned a value of 0 in the case that the country has no access to the sea and a value of 1 when the country does. Some countries such as Kazakhstan and Turkmenistan have access to the Caspian Sea, but I have considered that are not coastal countries because they can only navigate to its neighbours. This is because it is a closed area and other transportation are required to trade around the world. So they will have value 0 in the analysis. We could sense, with a rational thought that countries that are not landlocked have increased trade due to the facilities which it involves.

The last variable I am going to add in this model is "language". I think it is important and relevant that two countries speak the same language, as it can greatly facilitate the communications between them. So, creating a dummy variable "language", we will give value 0 when two countries do not speak the same language and value 1 when they share it. So after the theoretical explanation of the model and each of the variables that will be part of it, the model is as follows:



$$\ln(\text{trade}) = \beta_0 + \beta_1 \cdot \ln(\text{GDPI}) + \beta_2 \cdot \ln(\text{distance}) + \beta_3 \cdot \text{LPI} + \beta_4 \cdot \text{language} + \beta_5 \cdot \text{waterfront} \quad (2)$$

The analysis is going to be made taking Spain as a reference, so the trade flows will be estimated with Spain exports made in other countries corresponding to a specific year. The GDP of the exporting country will always be to Spain, as it is the country about which we are working, while the GDP of the importing country will depend on who trades with. The distance will always be taken from Spain to other countries, always choosing the same starting point.

The dummy variable "language" will have value 1 for all countries which are Spanish speaking and value 0 for those who speak a different language. In the case of "infrastructure" and "waterfront" do not matter who is the reference country, since the data do not vary in this regard.

#### *Data and Sources*

As I have already mentioned in the introduction, the main source of data and statistics has been the World Bank. Indicators have been used to perform subsequent econometric analysis and to see what the differences between the major world powers are. As we have repeated throughout this paper the size of the economy is measured by gross domestic product (GDP), so thanks to it we can see which countries dominate the economic and business outlook. As this database has been made worldwide, the data are recorded in dollars. Like all other data used for the analysis come from the database of Foreign Trade in Spain are measured in euros. So, in order to analyze the data correctly, a change of currency had to be made (from dollars to euros) so that everything was in the same unit.

The database used to measure the distance between Spain and other countries has been CEPII. In addition, this database has also served to know that countries are landlocked and which are surrounded by land. Although forming part of the same database it is distinguished between "dist\_cepil" and "geo\_cepil". The first one measures the distance in kilometers between two countries, usually between the capitals, but it may also be the case that the centers of gravity are the main points.

In any case, we have been provided some data that will be helpful for the analysis of the econometric model. The second one, "geo\_cepil" is far more complete and could make good use of the information provided. First, thanks to the variable "landlocked" we have learned that are coastal countries and those that are not. Moreover, this database also included a review of the official language of each country, so we can gather all the countries that have Spanish as their primary language.

As we have advanced slightly earlier, export data have been obtained from the database of Foreign Trade Spanish, since Spain is the point of reference of this document and the flow of trade is measured through exports. These data come from surveys of exporters and importers from all countries, to properly count and divide it by country and sector. Here, to simplify the analysis, it has been decided do it by countries as a job sectors would be more complex and extensive.

World Development Indicators, which is the database of the World Bank, have also given us the values of the variable "LPI". The World Bank collects this data every two years, but it should be remembered that it is not based on actual data structure, as it is about the opinion of each of the interviewees. The final value is the average that give the interviewees, which are those that have done some service to the country. It is obvious that the interviews are not random, since it is made to staff responsible for logistics systems. The main features that are rated are: the quality of infrastructure for all types of transport, customs efficiency, compliance with delivery times and the quality and competence of logistics services.

## **V: EMPIRICAL ANALYSIS**

As we have seen in the previous section, the gravity equation is going to explain what are the reasons why there is a greater trade flow (measured as exports to each country performed in 2008 and 2012) between Spain and the rest of the world. To do this, we will have a series of variables that appear to be relevant to this analysis: income (measured by GDP) of the importing country and the exporting country, in this case Spain; the distance that separates Spain from each of the countries included in the sample; quality of infrastructure of each country; their official language; and finally, if they are landlocked or not.

The following sample includes 160 countries which are going to be analyzed in the model with their respective data. Three of the variables ("exports", "GDP" and "distance") are taken using logarithms to avoid the spread of the data and ease of interpretation, since a model with logarithms expresses the elasticity between two variables (dependent and independent). Another variable, LPI, is added to the model without dummy, nor measured in logarithms, but is a normal variable. In the case of the other variables, as it has been already explained above, these dummy variables with values between 0 and 1, depending whether they satisfy the premises established or not.

For the econometric analysis we have obtained data from 2008 and 2012. The period 2012 has been chosen because it is the most current data that exists in the variables we wanted to use in the model, since 2013 were not available for all. In addition, the 2008 period was chosen because a comparison between two years wanted to be made, with some years of range, to see what has been the evolution of each of the variables included in the model. Moreover, in this period we also had all the data available that we needed to complete the model, as for other years were not available.

The omission of so much data in so many years makes it very difficult to organize the data to have a panel structure, so an individualized and simpler analysis is going to be made. First, we will work with those data obtained for 2008 and see what the results are: what each variable coefficients gets, their significance and if they are consistent with theory. Moreover, it will be performed the same process with the data for 2012.

In turn, it will be shown which variation has been produced in term of coefficients and significance.

After entering data (2008) in the software (Gretl) we have carried out the regression Ordinary Least Squares (OLS). The results have been as follows:

Table 1: OLS estimation for the year 2008

```

Modelo 1: estimaciones MCO
utilizando las 160 observaciones 1-160
Variable dependiente: l_EXPORTS
Desviaciones típicas robustas ante heterocedasticidad, variante HC1
Omitidas debido a colinealidad exacta: l_SPAIN_GDP

```

VARIABLE	COEFICIENTE	DESV.TÍP.	ESTAD T	VALOR P
const	14,0884	2,91082	4,840	<0,00001 ***
l_GDP	0,346887	0,0867321	4,000	0,00010 ***
l_DISTANCE	-1,02595	0,273557	-3,750	0,00025 ***
LPI	1,54296	0,266242	5,795	<0,00001 ***
LANGUAGE	1,49579	0,292844	5,108	<0,00001 ***
WATERFRONT	0,808851	0,316789	2,553	0,01164 **

Source: Gretl

First of all, before we start talking about the coefficients of each variable, we have to see if the variables conform to the theoretical explanation. I mean, let's see if they are positive or negative and, if they are different from the theory, find the reasons why they have changed.

The negative coefficient of "l\_distancia" is a highlight, since the other coefficients are positive. This result is not surprising, as it is expected that trade flows decrease when there is more distance between two countries. The value of the coefficient is -1.02595 which means that trade flows will be reduced by 1.02% to an increase of 1% in the distance.

In the case of the other variable measured by logarithms "l\_PIB" the coefficient is positive. The result confirms what we expected after explaining the theory, since two countries tend to have a greater number of exchanges the greater the size of its economy, and this is measured by GDP. Therefore, we can say that with the increase of 1% of GDP, trade flows increase by 0.34%.

The variable "LPI", which measures the quality of infrastructure related to transport and trade, is rated from 1 (low quality) to 5 (high quality). This is a fairly reliable measure because many people and companies have worked to make it available and to have a reference of what the infrastructure systems that each country owns. That is why it has been considered to this variable was better than creating a dummy variable called "infrastructure" and it was determined only by being good (value 1) or bad (value 0).

Its coefficient is 1.54296 so, being a log-level model, is multiplied by 100 in order to compare the volume of exports. In this case, an increase of 154% by increasing by one unit LPI occur.

It is time to analyse the effects produced by dummy variables. These variables do not include logarithms, so they will explain what is the rate of growth or decrease of all the variables. Firstly, we are going to analyse the effect of trading with a country whose official language is Spanish. The variable "language", valued with 1 for countries that have Spanish as an official language, is positive with a coefficient of 1.49579. This means that if the country with which Spain trades, speaks Spanish, trade flows will increase by 306%. This percentage goes to apply the following mathematical operation:  $[\exp(1.49579) - 1] * 100$ .

Finally, based on the model used, the results are about countries which are landlocked. After the studies carried out, we can confirm that "waterfront" positively affected (with the highest ratio of all) the flow of trade. Its value is 0.8088, so that countries are landlocked enjoy a 119% increase in trade flows for countries that are surrounded by land.

The results are as we expected after making the theoretical contribution. Furthermore, we observe that all variables almost have the three asterisk marker (\*\*\*), which means that its significance is high. The only one which do not have three asterisk marker is "waterfront", but it has two. With this we can assert that the inclusion of these variables in the model and therefore all these factors in real life, are crucial for the analysis of the flow of global trade.

After analyzing the 2008 data will perform the same process with the same regression by Ordinary Least Squares (OLS) to obtain the estimations on 2012 data Let's see the results:

Table 2: OLS estimation for the year 2012

```

Modelo 1: estimaciones MCO
utilizando las 160 observaciones 1-160
Variable dependiente: l_EXPORTS
Desviaciones típicas robustas ante heterocedasticidad, variante HC1
Omitidas debido a colinealidad exacta: l_SPAIN_GDP

```

VARIABLE	COEFICIENTE	DESV.TÍP.	ESTAD T	VALOR P
const	5,93659	2,04632	2,901	0,00426 ***
l_GDP	0,822171	0,0595480	13,807	<0,00001 ***
l_DISTANCE	-1,12397	0,223956	-5,019	<0,00001 ***
LPI	0,425206	0,202085	2,104	0,03699 **
LANGUAGE	1,22275	0,200255	6,106	<0,00001 ***
WATERFRONT	1,15759	0,201295	5,751	<0,00001 ***

Source: Gretl

As in the Table 1, the OLS regression model has eliminated the variable "Spain\_GDP" because of exact collinearity. This is sensible because Spain has the same GDP in 2012 compared to other countries and, therefore, its value does not vary across this variable. So, to avoid further problems, is omitted from the model because it does not meet the standards prewritten.

Regarding the sign of the variables is as expected: the distance negatively affects trade flows and other variables affect positively. As to coefficients of each of the variables observe some differences. So let's do an individual analysis to determine its variation and which has been the possible cause.

We first note a higher coefficient of the variable "GDP", indicating that their influence on the flow of trade has grown. Instead of assuming an increase of 0.34% now represents an increase of 0.82%. Why? One reason may be the growth of developing economies, starting to trade more, its economy is growing and increasing GDP. So now developed countries also conduct more trade with these countries and not with those who do not follow an increasing development.

The variable "distance" also has a higher coefficient, so now are reduced by greater exports few more miles between two countries. Discovered and applied technological innovations in developed countries makes practically all varieties of the same product could be produced in different countries. This means that buyers can purchase the same product to closer countries to avoid further expense. So the number of exports in the period 2012 has been reduced if there was a greater distances between countries. The advanced technology is the key to the coefficient of this variable.

The LPI variable shows a severe decrease in the estimated coefficient for 2008. Rising one unit LPI increases in trade flows by 42% in 2012, while in 2008 the increase was to 143%. One possible reason is that in 2008 the countries with good quality infrastructure traded much between them, while now there are new horizons, new countries which are beginning to have some importance on the world stage and its infrastructure are not well designed at all. The developing economies are trading with the "big" countries, but they have not taken adequate logistics systems yet, so the importance of the LPI to trade has declined.

The variable "language" also has changes, becoming less important. This variable is defined with value 1 if countries speak the same language (in this case, Spanish) and 0 if one or both do not speak Spanish. As the world has a high level of globalization and integration is usually set as a base language, so companies working internationally should have qualified staff to speak several languages. In this case the most used language worldwide is English, in which companies can communicate anywhere in the world. That is why the importance of speaking Spanish with the country that you trade is not as important, because people learn new languages to establish business relations with more countries.

Instead, the variable "waterfront" has a greater importance in 2012 than in 2008. This is due to the growing demand for products that are shipped by sea, as the commercial transportation is the most used in the world. Every year a large number of vessels are used to transport products, so countries with coast are favored and take advantage to export and import more products.

## **VI: CONCLUSIONS**

International trade, especially maritime, is gaining strength every day. Continuing improvements in logistics systems and technological advances in production processes "force" that maritime transport is the main means of distribution of goods and services between countries. Its ability to move large volumes of goods from one point of origin to another destination is its main feature. It is also shown that the total cost is lower than if the air or ground transportation was used.

Another important feature is the care of the environment. In recent years we have tried to maintain the sustainability of the planet, so it was necessary to reduce pollution levels. And the shipping has the lowest levels of contamination; ie freight vessel uses a smaller amount of fuel compared to an airplane or a truck, for instance.

Therefore, it is undeniable the importance of maritime commerce today. The study has been carried from various points of view, in order to address a larger amount of data and analyze more efficiently the econometric model based on a gravity equation. From an economic perspective takes into account income levels (measured by GDP) and trade flows taken as the total amount of exports.

Geographic factors are also taken into account because their relevance is significant, as it has been demonstrated in the estimations of the model. Both the distance between two geographical points as the location of each country are important when you have a larger or smaller amount of foreign trade. The distance obviously has been obtained through the measurement between two geographic points (in this case, between Spain and each of the countries included in the study). While the importance of the location of countries is defined by the landlocked, having a greater importance that countries surrounded by land.

Increasing globalization has made the infrastructure and logistics systems pass to the foreground being key in international trade. To analyze the effect of infrastructure is taken as reference the Logistics Performance Index (LPI), which measures the quality of infrastructure through surveys to thousands of professionals in many countries. The importance of this factor lies in the greater port efficiency when loading and unloading ships. Also for a classification within the port and subsequent set-point so that you can distribute to the exact point of destination. In addition, logistics systems include dealing



with clients and other companies, so a substantial improvement of these systems can attract more people and get more benefits.

After performing the econometric estimation and analyzing the results it has been concluded that all these factors are essential for the proper development of international trade and its continued growth. Each of the variables is important, the level of communication between two countries (analyzed in this study through the Spanish trade with Spanish-speaking countries) and infrastructures, income levels and geographic location. The only negative, as supposed, is the distance, but face of this phenomenon can not make any improvement.

Other factors are also relevant but its complexity when analyzing has done that we can not include them in the model. Some of the most determining factors are the policies that each country imposes, and that may change frequently. For example, the change of power in a government can do to change these policies by ideology or because the new president believes appropriate to implement other policies to be more competitive or for the economy to grow rapidly. Obviously, this factor can not be measured. As happens with constant technological innovations. We could do a study on which countries are more advanced technologically and surely would have much significance when relating them to trade flows, but it is also complex to give a quantitative value.

The cost of transport (both in terms of time and value) would be very interesting to analyze variable, but the limitation of time and space makes it impossible to observe it with the attention it deserves. These variables require further study to see bilateral trade between countries. Moreover, as we have remarked at this work, it focuses on maritime commerce and their respective variables. So the study of the transport cost would fall short by not using road transport, which is used to transport the goods to the final consumer. Once the ships reach the port, road transport becomes essential for the distribution of the product and, therefore, the analysis would be too spread without considering important variables.

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## VII. APPENDICES

### A. GDP structure around the world

GDP is an essential element for analyzing the international trade, as it serves to explain why a greater number of trade is developed between some determined countries. In the next picture we can see the size of each country represented by a red dot. The higher the red dot, the greater the weight of the country's economy. It is clear the United States is who ranks first, followed by China and some countries in Western Europe. It can be seen that the contribution of the South American countries is very low, since these are developing countries. Moreover we have the African continent, which also has very low rates due to the underdevelopment of most of its countries due to lack of, above all, technological innovations.



Figure A1: GDP distribution between 2009 and 2012 (countries)

Source: World Bank Indicators

## B. Growth rates of GDP

It is also important to see what is the rate of GDP growth for all countries of the world and which are the ones with the greatest weight in the economy. In the map below we can see that the areas of greatest growth are located in Asia and Africa (green areas), while in the rest of the world the growth is very low (between 1 and 4%) or even negative for some countries. Afghanistan, Mongolia, Chad, Ethiopia and Niger are the countries that have achieved the highest growth in 2013, while Sudan and Iran have obtained the highest negative rates. The eurozone countries are the most affected and their growth rates are negative or are slightly above 0%.

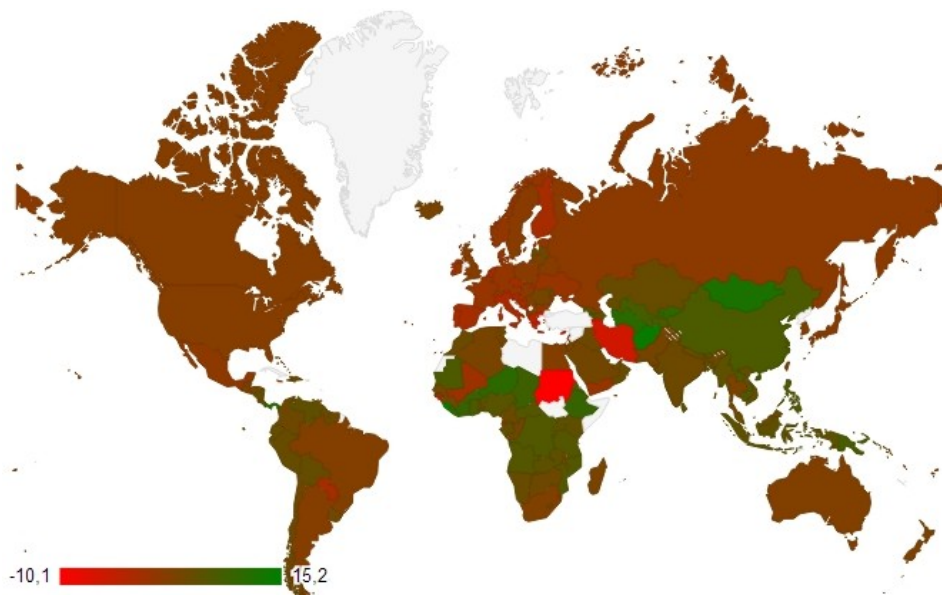


Figure B1: GDP evolution around the World (2013)

Source: [www.datosmacro.com](http://www.datosmacro.com)

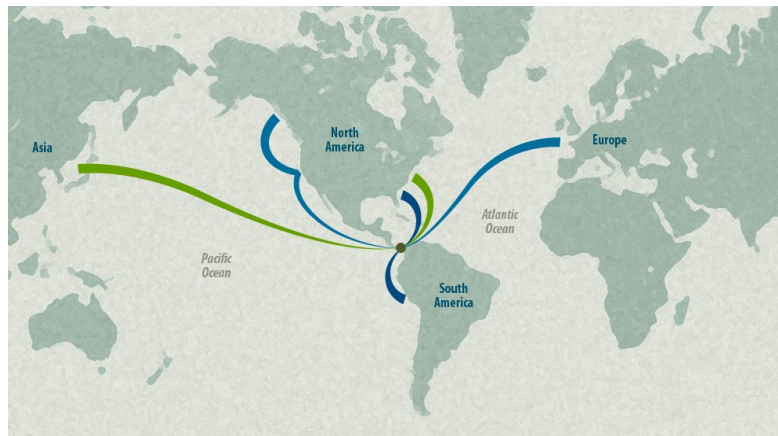
C. Figures

*C1. Logistics process:*



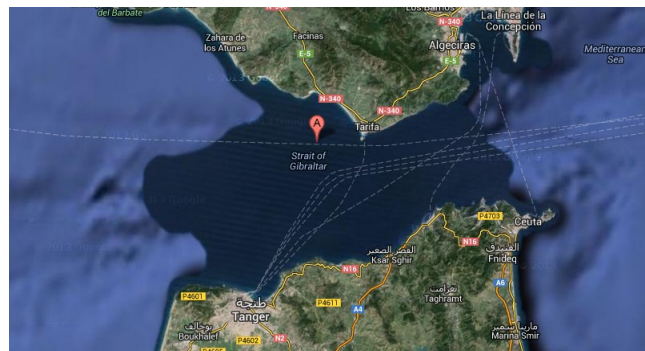
Source: NG – Logística, transporte y distribución

*C2. Panama Canal in the World Trade:*



Source: Logistics Innovation and Research Center (Panama City, Panama)

*C3. Strait of Gibraltar in the World Trade:*



Source: Google Maps

C4. Suez Canal in the International Trade:



Source: www.arkiplus.com

D. Tables

D1. Estimation for the year 2008

Modelo 1: estimaciones MCO  
 utilizando las 160 observaciones 1-160  
 Variable dependiente: l\_EXPORTS  
 Desviaciones típicas robustas ante heterocedasticidad, variante HC1  
 Omitidas debido a colinealidad exacta: l\_SPAIN\_GDP

VARIABLE	COEFICIENTE	DESV.TÍP.	ESTAD T	VALOR P
const	14,0884	2,91082	4,840	<0,00001 ***
l_GDP	0,346887	0,0867321	4,000	0,00010 ***
l_DISTANCE	-1,02595	0,273557	-3,750	0,00025 ***
LPI	1,54296	0,266242	5,795	<0,00001 ***
LANGUAGE	1,49579	0,292844	5,108	<0,00001 ***
WATERFRONT	0,808851	0,316789	2,553	0,01164 **

Source: Gretl

## D2. Estimation for the year 2012

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Modelo 1: estimaciones MCO
utilizando las 160 observaciones 1-160
Variable dependiente: l_EXPORTS
Desviaciones típicas robustas ante heterocedasticidad, variante HC1
Omitidas debido a colinealidad exacta: l_SPAIN_GDP

VARIABLE          COEFICIENTE          DESV.TÍP.          ESTAD T          VALOR P
const              5,93659              2,04632            2,901            0,00426 ***
l_GDP              0,822171             0,0595480          13,807           <0,00001 ***
l_DISTANCE         -1,12397             0,223956           -5,019           <0,00001 ***
LPI                0,425206             0,202085            2,104            0,03699 **
LANGUAGE           1,22275              0,200255            6,106           <0,00001 ***
WATERFRONT         1,15759              0,201295            5,751           <0,00001 ***
  
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Source: Gretl

## E. Extra tables

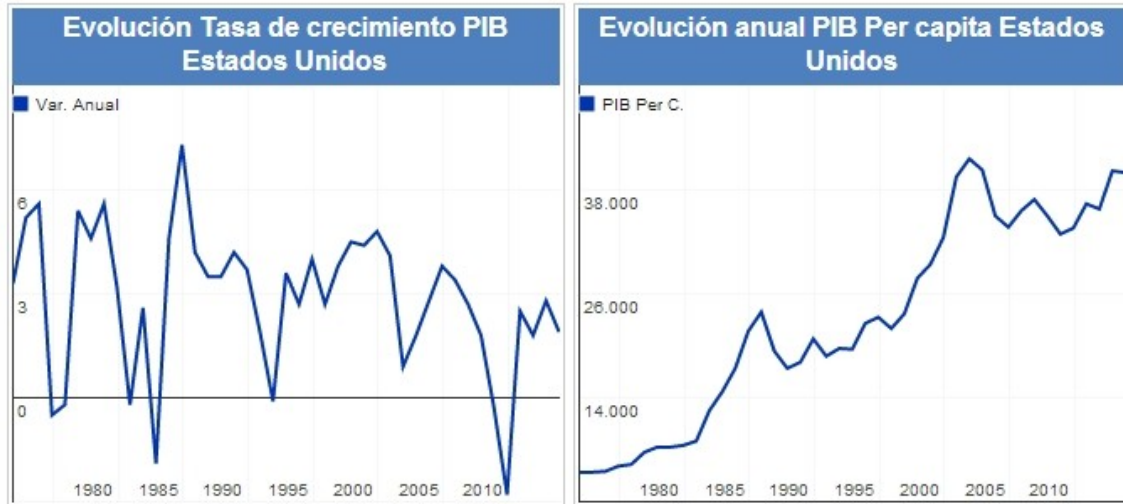
E1. Summary of the functional forms in which logarithms are involved. This information has been needed to analyse the effect which produces each coefficient in the OLS regression.

Modelo	Variable dependiente	Variable independiente	Interpretación de $\beta_1$
Nivel-nivel	$y$	$x$	$y = \beta_1 x$
Nivel-log	$y$	$\log(x)$	$y = (\beta_1/100)\% x$
Log-nivel	$\log(y)$	$x$	$\% y = (100 \beta_1) x$
Log-log	$\log(y)$	$\log(x)$	$\% y = \beta_1 \% x$

Source: "Introducción a la econometría: Un enfoque moderno", J.M. Wooldridge



E2. *GDP evolution in the USA.* This table, as the following ones, has served to obtain information about the GDP evolution in terms of growth rate and its distribution among de population.



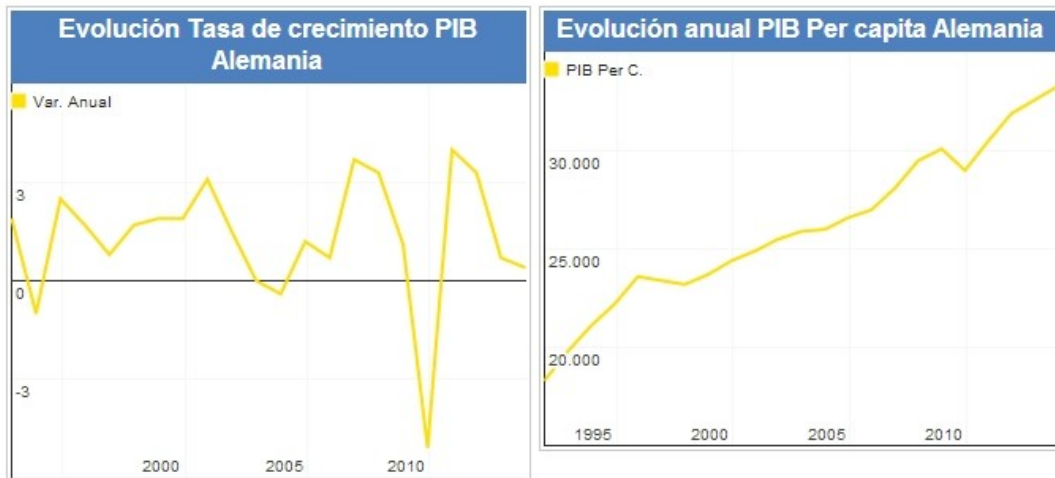
Source: [www.datosmacro.com](http://www.datosmacro.com)

E3. *GDP evolution in China.* As I have just said above, this table has been very useful to know what the trend of China's GDP was.



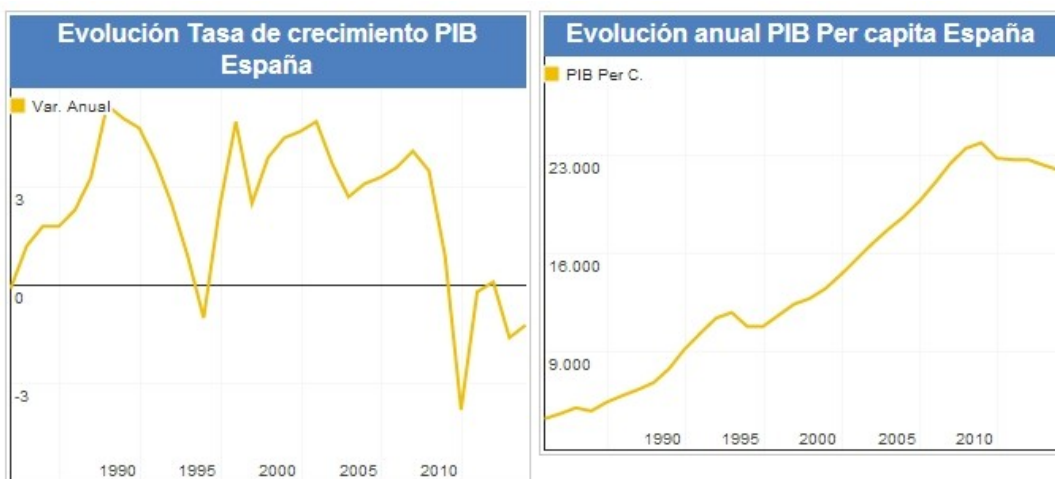
Source: [www.datosmacro.com](http://www.datosmacro.com)

#### E4. GDP evolution in Germany



Source: [www.datosmacro.com](http://www.datosmacro.com)

#### E4. GDP evolution in Spain



Source: [www.datosmacro.com](http://www.datosmacro.com)

Thanks to these tables I have been able to explain some of the causes which are significant when we talk about international trade. The United States, China and Germany, despite being the three main engines of the world economy, have had a different growth in recent years both in the evolution of GDP per capita and growth rates of GDP. Spain has been an interesting case because it has more or less followed the German trend, but suffering two falls of great consideration. So analyzing the most important countries in terms of economy and international trade and Spain, in which we have focused on, we have explained some conclusions and what we expect to happen in the future.