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Drivers of Economic Growth in Advanced Economies: Results from a Multisectorial- multiregional Perspective

Motores del crecimiento económico en economías avanzadas: resultados desde una perspectiva multisectorial-multirregional

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Abstract:

Since the beginning of the crisis, determinants of economic growth have returned to the forefront of economic debates. In this context, the main objective of this paper is to analyse how the global economy has evolved in the years between 1996 and 2009, focusing our analysis on developed countries, in order to determine the factors that can explain economic growth. To do that, our work analyses the main magnitudes provided by the WIOD and the associated Multiregional input-output model. First, we study the evolution of key variables such as output, value added, trade, and capital, and the structural changes observed for these variables. On the basis of this first analysis, we go deeper into the identification of drivers of income generation by way of an MRIO-SDA. The results show a significant influence of demand, whereas components associated with technological elements appear to have a less relevant development.

Keywords: Economic Growth; WIOD; SDA.

Resumen:

Desde el comienzo de la crisis los temas relacionados con los factores del crecimiento económico han vuelto a ponerse de "moda" en los entornos económicos. En este contexto, el principal objetivo es analizar la evolución de la economía global entre 1996-2009, centrándonos en las economías desarrolladas. Para ello, en nuestro trabajo analizamos las principales magnitudes proporcionadas por WIOD y el modelo multirregional asociado. Primero estudiamos la evolución de algunas variables claves como son el output, el valor añadido, el comercio o la inversión en capital. Una vez visto esto, queremos profundizar en los motores del crecimiento económico a través del MRIO-SDA. Los resultados muestran una gran influencia de la demanda mientras que los componentes más tecnológicos parecen tener una menor relevancia.

Palabras clave: Crecimiento económico; WIOD; SDA.

JEL Classification: F63.

1. Introduction[1]

If there is a recurrent topic between economists this are economic growth and their influential factors. From Solow (1956), through Kuznets (1965) o Barro (1989), to Schumpeterian theories, which have led to the new evolutionary theories, there are diverse points of view about what are the key elements that make an economy growth. There is a certain consensus in the economic literature on the factors that have produced differential growth rates between developed and developing countries. This can be seen in papers such as Szirmai (2013), who highlights the role of industrialization as an engine of growth in developing countries, and Hanushek (2013), with a focus on human capital and that demonstrate its capacity to promote economy growth.

However, the crisis that would have begun in 2007, and whose consequences are still possible to notice, has shown the differences between developed countries. Paying attention on a particular area, we can observe, for instance, how inside European Union it has been talking about the different behavior between south Europe (Spain, Portugal, Italy and Greece) and north Europe countries. In the last one Germany would highlight, which seems to be the less affected by the current economic crisis. From that moment several 'voices' has expressed their opinion about the politics that should have taken place in order to stimulate economic growth. Besides, there is a discussion about whether all countries should be considered equal and, so on, whether they should be treated in the same way. In neither of both issues it was possible to achieve an agreement.

Nevertheless, a previous step to the politics valuation is the study of the factors that have influenced economic growth in last decades and in what extent particular structural and technological factors has determined different responses and problems derived from economic crisis. Because of that, a first question to be driven is what factors makes one countries different from others. In that way, in this general context, our objective is to obtain a multiregional picture of the essential drivers of growth in developed countries.

From the end of the last century globalization has an important role in order to explain economic growth as it has influenced in the way that these es-

[1] We express our gratitude for the financial support received from ECO20013-41353-P from the Spanish Ministry of Economy and Competition, from consolidated group S10, financed by the Government of Aragon, and from the Spanish Education Ministry through the grant FPU13/00236.

sential drivers of growth behave. Because of that input-output framework seem to be an appropriate tool to get our purpose. Input-output tables, as well as their associated models (multisectiorial and multiregional models), are a useful tool to capture interrelationships between sectors. As we would like to obtain a multiregional image of economic growth it is obviously that we are going to work inside a multiregional framework. These models let us to analyse each country/region separately or in an integrated way. Multiregional model can be applied to the regions of one country (for instance, different states of USA), but also to supranational units such as UE or the global economy. A detailed explanation of multiregional models, as well as the most usual applications until now, can be found in Murray (2013).

From an empirical point of view, international databases such as GTAP, GLIO, GRAM and WIOT offer relatively detailed economic data, showing the main interrelationships between countries. Given our main focus on advanced economies, most of them in the Euro-zone, and the need for homogeneous series of data for studying long-term trends, we work with the data provided by the World Input-Output Database (WIOD). More specifically, we utilise the information on multiregional input-output tables at previous year prices. More information on the characteristics and specificities of this database can be seen in Timmer (2012).

As Timmer (2012) indicates, WIOD tables are formed by forty countries, plus 'Rest of World' (which is residual). Thirty-five sectors are considered for each country. The list of countries that are included can be found in Table 1 in the Appendix.

The rest of the paper is organized as follows. Section 2 presents a briefly literature review whereas section 3 presents the main features of the economic structure of the selected countries and their evolution over time. Section 4 develops a Structural Decomposition Analysis (SDA) on the basis of the underlying MRIO model, with the aim of quantifying the contributions of different factors to income growth. We particularly focus on the role of demand, structural change, and technological change. Section 5 closes the paper with a review of our main conclusions.

2. Literature Review

As we have mentioned previously, economists have always pay attention on economic growth and there is a huge of variety of theories around this topic (Solow (1956), Kuznets (1965), Schumpeter (1934), Nelson (1973) among others). Previously we have also shown that there is a consensus around what are the determinants for developing countries to become a developed. In that way, literature review agrees that human capital is one of the most important factors that encourage economic growth in developing countries. In that way Argüelles *et al.*. (2008) argues that, along the time, knowledge, technology, 'learning by doing' and high skill are getting more relevance in the global world

and developing countries should adapt their selves in order to be involved in the 'convergence running'. Benhabib *et al.* (1994) shows evidence of that through an econometrical regression as well as Giménez *et al.* (2015) that even propose a new indicator capturing also what we can call spillover effects.

However, as Bulman *et al.* 2017 explain, the factors that influence development in low income countries are not the same that those that affect high income ones. Even he claim that there is a step in the development of low income countries on which they become middle income and the increase of human capital, for instance, it is not relevant anymore and they have to change their politics. We can find few studies related to determinants of growth in developed economies. One of them, Lobejón *et al.* (2007) talks about the Italian experience until 21st century beginning and demonstrate the importance of demand to explain Italian economic growth. In the other hand, Luque *et al.* (2015) analyses Germany growth from 1995-2007 demonstrated the relevance that sectoral specialization has had in Germany, which focused their economy on high-technology industries. Fernández *et al.* (2010) also talk about how sectoral differences among countries can affect economic growth showing the relevance of being industry oriented or not. Others works studies convergence as Crespo *et al.* 2014, which analyse what determines convergence between European countries being capital a relevant factor.

To sum up we can see that there is not any agreement about the factors that established the differences between developed countries. As we commented before, this is even more evident from current economic crisis beginning, as Rodrīguez (2010) also argues, claiming that new paradigms have been opened. This is our purpose; understand these new paradigms through the analysis of the global world behaviour from 1996 to 2009.

3. Understanding the evolution of output and value added in advanced economies from a multisectorial-multiregional perspective

Multiregional and multisectorial databases, such as WIOD, allow us to investigate production structures, accounting for all the steps and countries involved in any production chain of any product, worldwide. In this regard, the multiregional input-output models (MRIO models) and the associated indicators are particularly suited to an examination of the structural and technological changes driving growth, as well as the changes in the role of countries in the supply chain, which also implies a change in the generation of value added. An example of one use of WIOD tables for the study of economic structure is Timmer *et al.* (2015), who centered their analysis on the automotive industry and the geographical and factorial distribution of its value added.

The main purpose of this section is to obtain a preliminary image of countries behavior before and during the first years of the crisis. In that way, we can observe what the main differences between them have been in order to be able to understand why some countries seem to be stronger than others, mainly when difficulties arisen as was the case from 2007.

In that way, in 3.1 we briefly comment on how production and value added have progressed from 1996 to 2009, in order to obtain a general idea of what has happened during this period. In 3.2, we discuss trade between countries. More specifically, following Saviotti & Frenken (2008), we address the question of whether or not these global interrelations are significant in explaining growth. We then analyze capital investment, showing its evolution while also paying attention to its location, (the importance of this was expressed by Diaz & Franjo (2014)). As we are working within a world MRIO model, we also focus on sectoral specialization and the behavior of key sectors.

3.1. Value added: Sectorial specialization

On the basis of the information provided by the WIOD tables, when we compare the world productive structure at the beginning and at the end of the period under study, we observe that, although the US is the first country in the ranking of income, both in absolute and per capita terms (see Table 2 in the Appendix), China, followed by the US, is the country with the highest level of value added (in absolute terms). However, China's situation changes when we analyze value added per capita, either in 1996 or 2009. Moreover, paying attention to the proportion of value added relative to output, we see that China does not achieve high values. The all-country ratio moves around the average percentage of 51.5% and 47.8% in 1996 and 2009, respectively, whereas the figures for China are around 37.9% and 32.2% in 1996 and 2009, respectively. This different behavior of the largest economies in the world can be partially explained by their different patterns of specialization.

In general terms, we can highlight the usual share of the services block in developed economies in 1996, even in cases such as China, Indonesia, India, Korea, Romania, Turkey and Taiwan. However, the evolution of services has not been as significant as we might expect, with the US being a good example, whose contribution to output increased around 4 percentage points between 1996 and 2009. Also, industry had even more moderate growth and, in some cases there is a decrease. This is the case of the US; in 1995 industry represented 15.5% of total output, while by 2011 it had declined to 12.25%.

The case of China is interesting. Despite being industry the block that contributes the most to value added in 1996; it is services sector that makes the highest contribution in 2009. In 2009, services contributed 43.1% to value added, whereas industry was reduced to second place at 32.8%. All this will have a certain effect on the Chinese economy in the long term, as the data appears to reflect a productive structure formed by an industry of relatively low technology.

3.2. Commercial relationships

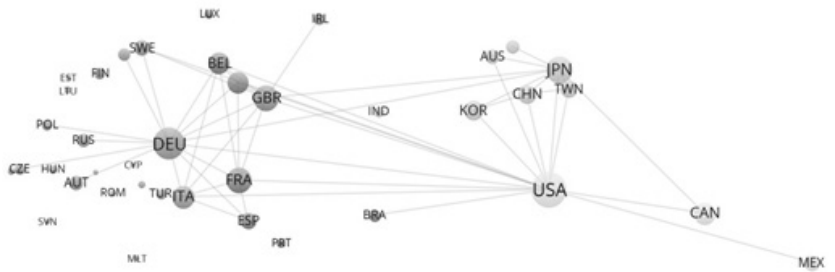
Trade is another key variable of economic growth. We show in graphs 1 and 2 the volume of trade of each country and the fifty main relationships that

are established in 1996 and in 2009, with each color indicating a different 'cluster'. In 1996, we observe five clusters. Europe is divided in three clusters; one formed by UK and Ireland, another formed by Spain, Luxemburg, Portugal, France, and Belgium, plus Brazil, and the last composed by Germany, Italy, and all north-west European countries. The other two clusters are related to Asiatic countries, plus Australia, and a group that includes the NAFTA countries. In 2009, the UK-Ireland cluster is eliminated as it combined with Spain, Portugal, France, Luxemburg, Belgium and the Netherlands. Consequently, Brazil now centered its commerce in the cluster formed by the US, Mexico, and Canada.

When we focus on the volume of commerce, we see that, in 1996, the three main countries were the US, Germany, and Japan, but by 2009, China had attained volumes of trade that were comparable with the US. It is interesting to compare the under-appreciated commerce of Asiatic countries in 1996, in comparison with the levels achieved in 2009, reflecting the commercial opening-up of these countries. We can also see that the US remains the center of global commercial relationships.

In that sense we have to comment results in net terms that are shown in Table 3 of the Appendix. It is possible to see that in 1996 the main net exporters were the US, Germany, and Japan. However, it is interesting to look at the evolution followed by each country. The US and Japan had growth rates of imports higher than those of exports but the main difference between both is that imports rose faster in the US than in Japan . The average rate of growth of exports and imports for the whole period is 3.36% and 3.78%, respectively, in Japan, and 4.37% and 5.69%, respectively, in the US.

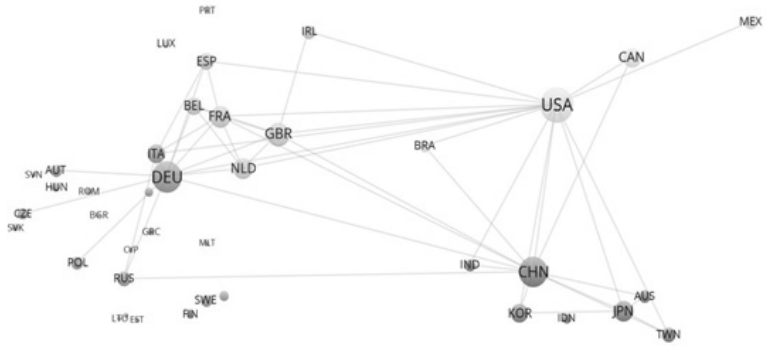
Graph 1: Graph of the fifty main relationships, 1996.[2]



Source: Own elaboration with VOSviewer.

[2] In these kinds of graphs, we represent the sum of imports and exports.

GRAPH 2: GRAPH OF THE FIFTY MAIN RELATIONSHIPS, 2009.



Source: Own elaboration with VOSviewer.

In the other hand, the main net importers in 1996 were China, Spain, and Turkey. Over the years, the exports of Turkey increased significantly, with a growth rate for the whole period of 12.17% and 19.84% between 2002 and 2009, while its rates of growth of imports grew smaller. In Spain and China, the rates of growth of exports and imports are high and similar to each other; in the case of China, we find average rates of growth for the whole period of 18.14% in the case of exports and 17.61% in the case of imports. This is surely a result of the opening-up of the Chinese economy, especially during the early years of the 21st century. For the whole economy, we see rates of growth of exports and imports, between 1996 and 2009, of 6.64% and 7.00%, respectively.[3]

To complete our image, we need to look at the sectors that are mainly involved in this process of globalization. First, we can say that global exports are largely centered on electrical and optical equipment, i.e. medium-high and high technology for most of the years under study, but we must remember that countries differ in their economic structures.

For instance, in Australia and Canada, the most important sector is Mining and Quarrying, due to the wealth of their natural resources. In fact, together with Indonesia, Mexico, and Russia (an important supplier to European countries), their exports are centralized in the energy sector (especially crude-oil resources). The weight of exports in this sector, with respect to total exports, in 2011 is 60% in Australia and 38% in Russia, approximately the same levels as they were in 1995. This appears to indicate that these resource-rich countries make full use of their 'comparative advantage'.

The case of China is surprising, with electrical and optical equipment being

[3] This percentage appears to be due to the growth of trade in the period 2002-2009, which is around 10%.

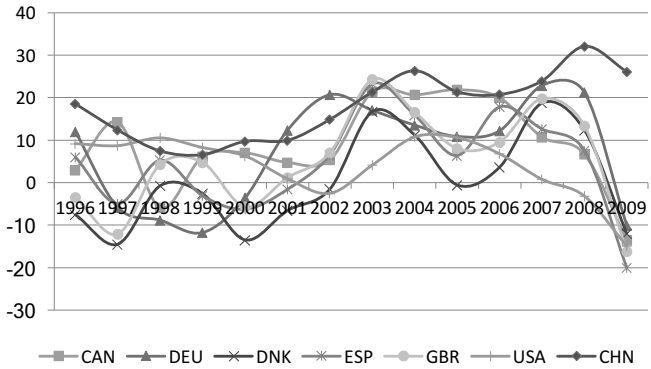
the most important sector of its exports; the rate of growth of exports in this sector is greater than in textiles, 22.12% and 12.96%, respectively. This could indicate a structural change, where technology-intensive industries are gaining in importance in the Chinese economy. Detailed data is available on request.

In terms of imports, the increasing importance of the energy sector shows the increasing demand for oil. A good example is the case of Spain, where imports in the energy sector grew significantly, with a rate of growth of 12.86% between 1996 and 2009.

3.3. Capital investment

Capital investment is an important element in improving the means of production and increasing productivity, which is a key factor in explaining growth. However, this positive effect is related to specific investments in equipment and productive structures and not for general investments as, for example, Diaz and Franjo (2014) shows for the Spanish economy. The conclusion we can get is that not only matters the amount invested but also where is invested. In this section we are going to analyze the issues through the study of gross fixed capital formation. The results obtained are presented in Graph 3 and in Table 4 in the appendix.

Graph 3: Rates of growth of fixed formation capital.



Source: Own elaboration.

China and the US are the countries with the largest capital investment, in absolute terms, as could be expected a priori. However, when we look at rates of growth of investment, we see relevant differences. As we can see in Graph 3, China achieves an average rate of 18%, and is over 25% in 2009. By contrast, the US has an average rate of 4%, declining from 2005, and becoming nega-

tive in 2009. A very similar evolution can be observed in Canada from 2003, with a negative rate in 2009. So, the question now is, could these declines have been an early indicator of the current crisis?

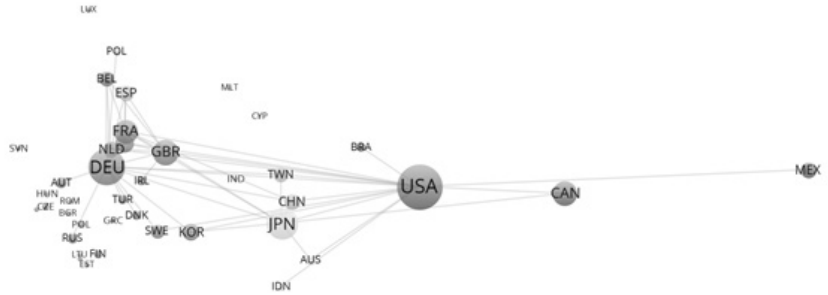
Analyzing the internal sectoral structure of gross fixed capital (see Table 4 in the Appendix) we find that, in all countries, investment in Construction is the most important. Although the construction sector probably includes more components, we use it as a way to approximate the investment in infrastructures, buildings, roads... So, exercising caution, we notice that, in most countries, investment in this sector represents more than 60% and in some countries such as Spain, Ireland, Greece, and Cyprus, investment in construction represents 70% or more of total domestic investment.

However, the main differences between countries are observed in investment destined for equipment. In Germany, the US and the BRIC countries (Brazil, Russia, India, China): investment in equipment in 2009 represents between 15% and 24% of total domestic investment. By contrast, in other countries, as in the case of Spain, this percentage is only 2.78% (in net terms). Perhaps these differences may explain different behavior during the recent crisis. Despite that, we observe a common evolution of investment in equipment, with total investment declines since 1996, in almost all economies, revealing the beginning of the crisis, as we have suggested previously. In the economies as a whole, domestic investment in equipment fell from 17% in 1996 to 15% in 2009.

In absolute terms, the countries with the largest external investments were the US and Germany in 1996, and the US, China, and Germany in 2009. But more relevant is that external equipment investment, in many countries, is above 90%, with the average values being 88.57% in 1996 and 84.82% in 2009. More detailed data related to external investment is available on request.

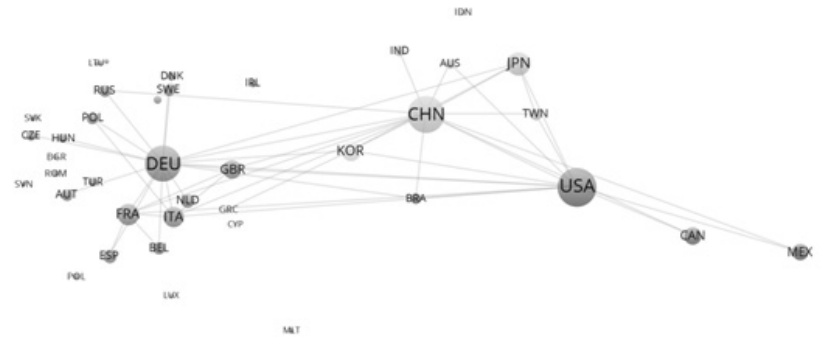
As we showed, high technology sector seems to be the favorite destination of external capital investment, so we choose it as a representative sector to study in depth the relationships established between countries (see graphs 3 and 4). First, we observe that, in 2009 there are more and newer links between countries than in 1996; in other words, there is an opening of capital investment in high and medium-high technology industry. In 1996, we see six clusters, while in 2009 we observe only four. However, in 2009, there are more capital movements between European countries, as well as between Asiatic countries. In 1996, there were six key countries; the US, Japan, Canada, Germany, the UK, and France, the three last from the same cluster. In 2009, we only have four key countries: the US, Germany, China, and Japan (followed by South Korea, France, the UK, and Italy). In the case of China, perhaps this reflects a strong process of structural change.

Graph 3: Fifty main capital relationships in High and Medium high technology industry, 1996.



Source: Own elaboration with VOSviewer.

Graph 4: Fifty main capital relationships in High and Medium high technology industry, 2009



Source: Own elaboration with VOSviewer.

4. A basic SDA for a global world

In the previous section we have identified a common pattern in the economic structures of developed countries, with the services sector generating a significant part of output in these countries. We have also seen the importance of trade and capital investment in explaining the economic features of the key developed countries (the US, Germany, Japan, and China). However, for a better understanding of growth in advanced economies we must determine whether, in fact, that growth has been due to an expansion of demand or to factors related to technology. We try to answer this question on the basis of a MRIO. On that basis, a well-known methodology is Structural Decomposition

Analysis (SDA forward) that let us clearly identify different sources of growth year by year and both for the aggregate economy and for each region, something that we cannot obtain through the use of other techniques.

4.1. METHODOLOGY

SDA aims to separate a time trend of an aggregated variable into a group of driving forces that can act as accelerators or retardants (Dietzenbacher and Los, 1998; Hoekstra and van den Bergh, 2002; Lenzen *et al.*., 2001). A basic idea that underlies the analysis is the independence of the explanatory factors involved. As we are working within an input-output frame, the starting point is the basic equation of the input-output model:

$$x = Ax + y; \quad x = (I-A)^{-1}y \tag{1}$$

where *x* reflects the output's vector, *A* is the matrix of technical coefficients, and *y* is the vector of final demand. From (1), if *c* is the vector of value-added coefficients respect to output, we can obtain the vector *v* of value added,

$$v = c'(I-A)^{-1}y = c'Ly \tag{2}$$

As we can observe in (2), if we try to do an SDA analysis of value added, we find dependency problems between *c* and $(I-A)^{-1}$, which we are going to call L, and this can imply biased results. In order to avoid this full dependence problem, we base our analysis on the SDA proposal by Dietzenbacher & Los (2000), who construct an 'intermediate' Leontief's inverse based on a matrix of technological coefficients, $\tilde{A}$, that has in each column the same distribution of coefficients as the matrix of coefficients *A*. $\tilde{A}$ can be obtained by multiplying the elements in A by scalars representing row sums, as we show

$$\text{with } s_r' = e'A_r \ (i, j = 0,1) \tag{3}$$

In that way, we can decompose value added increments in three effects

$$\Delta v = \left[\hat{c}_1 L_1 - \hat{c}_0 \tilde{L}_1\right] y_1 + \hat{c}_0 \left[\tilde{L}_1 - L_0\right] y_1 + \hat{c}_0 L_0 (\Delta y) \tag{4}$$

Note that, following 'the principle of nested or hierarchical decompositions', since we use three explanatory factors, we can obtain three more decompositions but equivalent to expression (4). They are

$$\begin{aligned} \Delta v = \left[\hat{c}_1 L_1 - \hat{c}_0 \tilde{L}_1\right] y_0 + \hat{c}_0 \left[\tilde{L}_1 - L_0\right] y_0 + \hat{c}_1 L_1 (\Delta y) = \left[\hat{c}_1 \tilde{L}_0 - \hat{c}_0 L_0\right] y_0 + \hat{c}_1 \left[L_1 - \tilde{L}_0\right] y_0 + \\ \hat{c}_1 L_1 (\Delta y) = \left[\hat{c}_1 \tilde{L}_0 - \hat{c}_0 L_0\right] y_1 + \hat{c}_1 \left[L_1 - \tilde{L}_0\right] y_1 + \hat{c}_0 L_0 (\Delta y) \end{aligned} \tag{5}$$

As a commitment solution, the average of all the decompositions is used in the analysis

$$\Delta V = FE + SE + DE$$

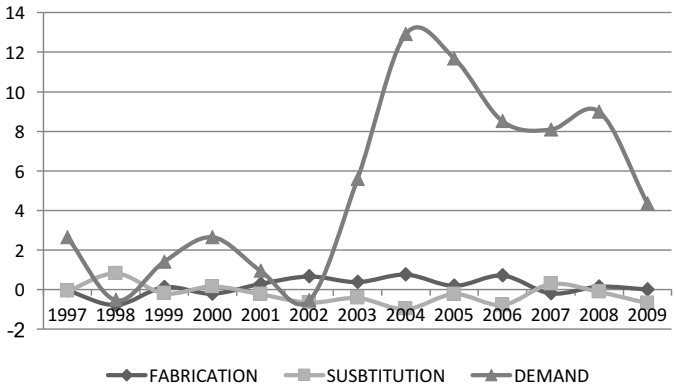
With this decomposition, value added changes can be explained on the basis of three main drivers. The first element can be called the fabrication effect (FE) and indicates the substitution between total intermediate inputs and 'value added terms'. It represents a sort of index of technological change in so far as it captures the more or less intensive use of labour, rather than technology, which is reflected in technical coefficients. The second element is called the substitution effect (SE) and reflects the effect of changes in the mix of intermediate inputs. In this regard, it is a proxy of structural change, since it captures how intermediate consumption is distributed between sectors and countries. Finally, the demand effect (DE) captures the contribution of final demand changes (all other things being constant) to income growth.

As we are working with multiregional input-output tables, we use a square matrix of final demand, created through the formation of diagonal matrices by parts. This is a block matrix (B_{ij}) where each block B_{ij} is a diagonal matrix of final demand of country i produced in j. In that way, we can take into account imports of final products of each country as part of the final demand of these countries. The analysis is carried out on a year by year basis.

4.2. Main results

Table 5 and graph 5 show the main results of our analysis. In graph 5, we can observe the evolution of the three effects from 1996 to 2009, whereas in Table 5 we show the average value of each effect as a percentage of value added of 2009. The main conclusion is obvious; the more important factor in explaining increments of value added, in almost all periods, is the change of final demand. This effect is especially significant for the period 2002-2009 (see the average values in Graph 5), achieving a maximum of 12% (with respect to the value added of the previous year) in 2004. So, the evolution followed by the demand effect is also interesting. The demand effect experienced a moderate increase between 1998 and 2000, when we observe a decrease, which may be due to the TIC crisis that occurred in those years. However, since then there has been a constant decline, although achieving values (around 4%) in 2004 that are higher than those observed at the beginning of the period analysed. This strong decline could be a signal of the crisis that would begin in 2007.

GRAPH 5: FABRICATION, SUBSTITUTION, AND DEMAND EFFECTS INGLOBAL TERMS, 1996-2009.



Source: Own elaboration.

We also notice that both fabrication and substitution effects are near zero throughout the period. Nevertheless, we must take into account that, in relative terms, these values are not so weak. In Table 1, we see that the fabrication effect is over 0.5% in a majority of the countries. However, a positive value of the fabrication effect appears to be followed, immediately, by negative values of the substitution effect. This is more evident from 2001 until 2006. However, as we have said, in almost all countries studied in the early years of the 21st century, we can observe a positive fabrication effect, which is an indicator of technological improvement.

In this way, focusing our attention on Table 5, we can get a more detailed analysis. For instance, the area with the highest values of the demand effect is Europe, probably due to their internal politics, obtaining an average value of 11.15% of 2009 value added. Asiatic countries come second, with values around 8% (a difference of 3 percentage points).

Here, we also must take into account the effect of external demand. For example, countries such as the US and Germany had an external demand effect of 0.89% and 2.61% respectively, but the domestic effect is higher. This situation is repeated through most countries, with average values of the external and domestic demand effects of 3.82% and 6.41%, respectively, suggesting a direct relationship between demand and economic growth.

With respect to the substitution and fabrication effects, we do not observe such high values as might be expected after our global analysis. The case of Denmark is interesting, since its substitution effect was -46.47% and its fabrication effect was 28.39%, reflecting the importance of its positive fabrication effect (improvements in productivity) and the negative effect of a change in the mix of intermediate inputs (increments in the input cost per unit). Note that a positive fabrication effect means that there is an increase of value-added for fixed values of input costs and final demand.

Table 1: Average Demand, fabrication and substitution effect as percentage of 2009 value added.

	Demand	External demand	Domestic demand	Substitution	Fabrication
Australia	11.05	1.55	9.50	0.36	0.34
Austria	7.18	3.52	3.66	0.14	-0.34
Belgium	7.21	3.64	3.57	-0.47	-0.10
Bulgaria	15.80	8.29	7.51	9.76	-1.63
Brazil	9.36	0.92	8.45	-0.14	0.09
Canada	9.74	2.54	7.21	0.86	0.19
China	9.70	4.91	4.79	0.72	-0.24
Cyprus	10.19	1.87	8.32	0.64	-0.35
Czech Republic	11.86	7.22	4.64	0.99	0.29
Germany	5.90	2.61	3.29	-0.71	0.19
Denmark	9.26	2.66	6.60	-46.47	28.39
Spain	9.93	2.08	7.85	0.87	-0.14
Estonia	17.36	8.65	8.71	1.76	0.68
Finland	10.69	2.92	7.77	0.64	-0.73
France	7.61	1.96	5.65	0.02	0.07
UK	7.61	2.68	4.93	-0.65	-0.07
Greece	10.36	1.74	8.62	0.25	0.20
Hungary	11.70	6.82	4.88	-0.02	0.31
Indonesia	12.46	0.99	11.48	-1.40	0.15
India	6.96	2.69	4.27	-0.15	-0.03
Ireland	12.89	8.06	4.83	3.24	-0.35
Italy	10.79	2.10	8.69	0.39	-0.21
Japan	-2.15	0.71	-2.86	-0.94	-0.27
Korea	7.66	2.51	5.15	0.07	-0.25
Lithuania	13.96	7.43	6.52	0.66	1.33
Luxemburg	8.72	8.43	0.29	4.61	-2.62
Latvia	14.76	6.38	8.39	-1.84	-0.25
Mexico	7.80	1.65	6.15	-1.16	0.21
Malta	27.35	4.24	23.12	-2.99	-0.73
Netherlands	7.76	3.58	4.17	-0.73	0.07
Poland	9.63	4.39	5.24	-0.18	0.55
Portugal	9.40	1.88	7.52	-0.10	0.04
Romania	10.32	4.70	5.62	-0.30	-1.64
Russia	11.81	3.82	7.99	3.97	0.71
Slovakia	11.62	8.00	3.62	0.85	0.67
Slovenia	10.34	4.93	5.41	-0.77	0.92
Sweden	10.93	3.51	7.42	-0.14	0.72
Turkey	12.25	2.86	9.39	1.27	-0.28
Taiwan	5.89	2.24	3.65	-2.46	0.47
USA	5.29	0.89	4.41	-0.59	0.04
Average value	10.22	3.82	6.41	-0.75	0.66
European Union	11.15	4.60	6.55	-1.13	0.94
North America	7.52	1.72	5.81	0.13	0.12
Asia and Pacific	8.40	2.47	5.93	0.16	0.07

Source: Own elaboration.

Following this argument, we can analyze which sectors make greater contributions to each effect, and to each country. From the results obtained (available on request), we can highlight the high-technology industries, and Services. We can say about demand effect that, in average terms, the services-related sectors are where we find the higher percentages. Moreover, the evolution of services is quite clear throughout the period, whereas percentages for industrial sectors are more moderate. The main exception is China, where some industrial sectors, such as Basic Metals or Other non-metallic minerals, represents around 6% of the total demand effect. However, we must note that they are sectors of low or medium-low technology. The agriculture sector, although it achieves some importance in certain countries, such as Bulgaria, Rumania, and even China, is not, in general, a significant factor. If we focus on the fabrication effect, we can say that the construction sector, at the beginning of the period, is where the effect of substitution of intermediate consumption for value added is highest, whereas at the end we find that the strongest fabrication effect is found in sectors such as Chemicals, and Rubber and Plastic products. Finally, with respect to the substitution effect, in 1997 we can find the energy sector as a key in the change of the mix of intermediate consumption, together with some parts of the services sector. However, whereas the energy sector weakens throughout the period, the services sector increases its contribution to the substitution effect (for example, Real Estate Activities). Some high-technology sectors, such as equipment, have increased their importance in the contribution to the substitution sector, achieving high values at the end of the period.

5. Conclusions

The objective of this paper has been to provide an overview of the factors that influence growth in developed countries.

We have seen that the US and China have been the major producers between 1996 and 2009. However, in per capita terms, Luxemburg appears in first position, which could be explained by its fiscal characteristics; for example, financial intermediation is the main sector in Luxemburg's economy. In spite of such anomalies, we do find a common pattern in most countries, where services are central to developed economies and industry is stable.

External specialization is also important and developed countries tend to export products related to high and medium-high technology sectors, although – not surprisingly – we see that countries rich in resources center their exports on mining and quarrying or the energy sector, using their comparative advantage.

One important variable to explain growth is capital investment, although the direction of such investment is as important as the amount. We find certain variations. The US directs almost 40% of its total to equipment, while other countries devote less than half of that proportion. We also note that capital investment, particularly by the US and Canada, has been in a decline since 2005.

So, we can observe that in fact sectoral structure, or focus, matters as some literature claimed; Luque *et al.* (2015) and/or Fernández *et al.* (2008) among

others. This is especially evident from capital investment perspective, marking one of the main differences between countries.

After the descriptive analysis, we have run a basic SDA that let us to obtain three effects; demand, fabrication, and substitution effects. Our results reflect that global economic growth has been primarily due to changes in demand, especially in the early years of the 21st century. These results are in line with those obtained by Lobejón *et al.* (2007) for the Italian economy or Chóliz-Sánchez (2006) for the Spanish one. We find also, between 2001 and 2006 positive values of fabrication effect, which we take to be a proxy for technological change. Although values are not as high as those observed for the demand effect, we see values between 0.5% and 1% in most countries. These values can be relatively important, as they indicate a period of six years with continuous increments of productivity and of technological change.

In general, thinking about the results obtained, we can conclude that there were some signs of deceleration in developed economies before 2007, when the current crisis began. These signals are especially clear from 2004 to 2009. For example, the role of industry in the majority of the economies is decreasing each year; capital investment is located in the construction sector, rather than in equipment, where technology is more important; and in capital investment we see a deceleration in important economies such as the US or some European economies (Germany or Finland, for instance). Moreover, the demand effect has decelerated since 2004, continuing to decrease until 2009, and there has been a continuous decline in the fabrication effect since 2006, reaching negative values in 2009.

This is a preliminary study, and we must carry out a more detailed analysis in the future, so that our subsequent objective is to examine how the factors studied in this paper determine different paths of growth and make an economy stronger, or weaker, especially when faced with difficult situations, such as the current, ongoing, economic crisis.

6. Bibliography

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Appendix.

Table 1: Countries in WIOD database.

European Union			North America	Asia and Pacific
Austria	Germany	Netherlands	Canada	China
Belgium	Greece	Poland	United States	India
Bulgaria	Hungary	Portugal		Japan
Cyprus	Ireland	Romania		South Korea
Czech Republic	Italy	Slovak Republic	**Latin America**	Australia
Denmark	Latvia	Slovenia	Brazil	Taiwan
Estonia	Lithuania	Spain	Mexico	Turkey
Finland	Luxembourg	Sweden		Indonesia
France	Malta	United Kingdom		Russia

Source: Timmer (ed) (2012).

Table 2: value added by country and sectorial specialization 1996-2009.

	Value added									% va/output	
	1996	2009	1996 Per capita	2009 Per capita	% Industry		% Services		Average annual rate	1996	2009
					1996	2009	1996	2009			
Australia1	366271	989511	21,403	43,188	14.58	8.51	67.82	67.40	7.94	47.13	48.40
Austria	218574	358955	26,335	40,907	19.64	18.54	66.61	69.81	3.89	53.82	47.09
Belgium	258845	440826	24,319	38,748	20.28	14.54	70.08	77.06	4.18	45.10	41.42
Bulgaria	11295	38826	1,527	5,306	21.96	17.57	52.29	61.83	9.96	41.70	36.92
Brazil	685730	1399629	4,498	7,159	18.62	15.20	66.70	67.81	5.64	53.03	49.03
Canada	555583	1435750	19,177	36,693	18.36	16.74	66.82	67.09	7.58	52.69	52.15
China	798530	4935907	703	3,726	34.80	32.84	32.86	43.13	15.04	37.86	32.22

Cyprus	8649	22096	9,842	19,257	11.80	6.84	72.46	80.35	7.48	61.15	56.60
Czech Republic	51714	185478	5,425	16,348	24.26	25.84	56.69	59.68	10.32	37.24	35.73
Germany	2315011	3098848	26,951	36,511	22.64	22.41	66.58	69.49	2.27	53.15	49.53
Denmark	161388	280715	30,104	48,296	17.12	11.45	71.45	76.30	4.35	52.58	47.71
Spain	563622	1413448	14,510	29,338	19,19	13.23	64.86	72.12	7.33	48.52	46.69
Estonia	3515	17946	2,947	12,526	20.98	14.32	61.24	70.96	13.36	42.25	44.89
Finland	118396	217576	21,775	38,709	25.40	18.61	62.19	68.97	4.79	47.48	43.41
France	1422363	2520799	23,464	36,933	14.24	10.12	72.10	79.90	4.50	51.11	49.80
UK	1078715	2323185	18,917	31,998	20.94	11.69	67.47	77.05	6.08	48.99	50.17
Greece	121252	304080	11,686	26,337	11.99	10.31	69.64	79.07	7.33	55.99	58.65
Hungary	39513	123709	3,861	10,902	21.27	25.32	62,63	62.07	9.18	41.73	41.79
Indonesia	259330	537432	1,410	2,259	29.48	22.65	40.28	38.16	5.77	51.24	50.83
India	378495	1308652	382	1,043	18.53	14.56	45.77	56.72	10.01	48.90	47.50
Ireland	65072	227443	18,221	44,341	30.16	26.77	54.97	65.58	10.10	44.05	41.86
Italy	1025840	1959788	20,020	32,183	22.23	16.58	66.42	73.17	5.11	48.13	46.23
Japan	5395550	4438621	36,634	38,566	22.59	18.60	64.57	71.73	-1.49	53.40	49.66
Korea	514934	854802	11,293	15,279	27.21	31.09	54.04	58.14	3.98	43.11	35.72
Lithuania	6331	36309	2,105	10,741	19.13	16.37	57.54	69.69	14.38	47.19	51.00
Luxemburg	19010	50920	45,104	94,747	13.69	6.46	77.24	86.60	7.87	47.10	34.15
Latvia	4488	25670	2,047	11,145	20.68	9.94	60.57	76.06	14.36	48.28	45.65
Mexico	327735	1008076	3,641	7,129	19.88	17.62	61.36	61.13	9.03	54.33	57.43
Malta	3342	7322	8,878	17,134	21.67	13.29	68.78	78.33	6.22	48.96	44.38
Netherlands	390182	758092	24,171	42,781	17.44	14.05	69.16	73.52	5.24	47.60	46.65
Poland	129585	479072	3,574	10,097	21.11	18.07	56.83	64.49	10.58	45.47	44.51
Portugal	102444	213283	10,219	19,450	18.44	13.40	65.95	74.79	5.80	46.06	47.45

Romania	36909	171720	1,556	7,273	25.57	23.61	42.38	54.69	12.55	43.79	46.34
Russia	290298	1323577	2,533	7,595	17.42	16.27	56.44	59.62	12.38	49.97	50.03
Slovakia	18877	82203	3,544	14,833	26.78	19.56	56.32	60.91	11.98	37.72	40.87
Slovenia	18425	44234	9,064	21,017	25.69	19.59	60.47	66.46	6.97	44.07	44.09
Sweden	224932	406730	27,330	37,716	22.39	16.73	66.49	71.02	4.66	47.90	46.55
Turkey	227435	622458	3,893	7,554	29.29	18.44	50.00	63.17	8.05	55.58	48.72
Taiwan	284040	387577	12,924	15,449	26.51	22.99	62.20	71.37	2.42	47.26	46.20
USA	7730078	14042923	29,123	45,638	15.50	12.25	75.77	79.38	4.70	55.07	55.25
RoW	3052198	8235597	92	178	29.43	45.79	23.76	42.18	7.93	51.06	49.05

Source: Own elaboration.

Table 3: Exports and imports for each country for years 1996, 2002, and 2009.

	1996			2009			Average rate of growth exports	Average rate of growth imports	Difference growth rates exports-imports
	Exports	Imports	Net exports	Exports	Imports	Net exports	1996-2009	1996-2009	1996-2009
Australia[4]	64036	47386	16650	167126	107586	59540	7.66	6.51	1.15
Austria	48469	45949	2520	110422	95092	15331	6.54	5.75	0.78
Belgium	105567	101254	4313	195486	186639	8847	4.85	4.82	0.04
Bulgaria	4341	4673	-332	13755	16192	-2437	9.28	10.03	-0.75
Brazil	42239	42059	180	128716	112622	16093	8.95	7.87	1.08
Canada	145594	111758	33836	262383	216324	46058	4.63	5.21	-0.58
China	78026	101706	-23680	681053	838006	-156953	18.14	17.61	0.52
Cyprus	965	2185	-1220	2818	4642	-1825	8.59	5.97	2.62
Czech Republic	17955	19427	-1472	73011	79214	-6203	11.39	11.42	-0.02
Germany	339516	279575	59941	740609	590329	150280	6.18	5.92	0.27
Denmark	32110	31452	658	79608	78459	1149	7.23	7.28	-0.05
Spain	64277	81422	-17145	165618	219102	-53484	7.55	7.91	-0.36

[4] We follow the same order as WIOD tables.

Estonia	1489	1881	-392	6714	5807	907	12.28	9.06	3.22
Finland	31391	23829	7562	61823	54705	7118	5.35	6.6	-1.25
France	192413	183380	9033	323358	352406	-29049	4.07	5.15	-1.08
UK	205614	183833	21782	384253	330311	53942	4.93	4.61	0.32
Greece	5613	16700	-11087	31479	50941	-19462	14.18	8.96	5.23
Hungary	10954	14198	-3243	52202	58152	-5950	12.76	11.46	1.31
Indonesia	42828	42634	194	102708	80558	22150	6.96	5.02	1.94
India	25445	33361	-7917	109753	190437	-80685	11.9	14.34	-2.44
Ireland	25703	30444	-4741	125824	121734	4090	13	11.25	1.74
Italy	146694	148647	-1953	245325	308582	-63257	4.03	5.78	-1.74
Japan	282406	230158	52248	433884	372595	61289	3.36	3.78	-0.42
Korea	97748	110989	-13241	275455	280803	-5348	8.3	7.4	0.89
Lithuania	2119	2728	-609	11722	11054	668	14.06	11.36	2.7
Luxemburg	16416	11885	4531	64190	55124	9066	11.06	12.53	-1.47
Latvia	1599	1589	10	6487	5848	640	11.37	10.54	0.83
Mexico	57932	66395	-8462	130384	143721	-13338	6.44	6.12	0.32
Malta	1354	1767	-413	3461	3323	137	7.49	4.98	2.51
Netherlands	129590	121033	8557	271804	253956	17848	5.86	5.87	0
Poland	20810	21779	-968	96188	103820	-7632	12.5	12.76	-0.27
Portugal	13952	23104	-9152	34312	43912	-9600	7.17	5.06	2.1
Romania	5823	8808	-2986	30331	37106	-6775	13.54	11.7	1.84
Russia	76354	29014	47341	257360	72066	185294	9.8	7.25	2.55
Slovakia	7447	8192	-745	33942	36992	-3051	12.38	12.3	0.08
Slovenia	4875	5913	-1039	14007	15298	-1292	8.46	7.59	0.87
Sweden	61409	52272	9137	120654	101242	19412	5.33	5.22	0.12
Turkey	14972	28681	-13709	66653	66937	-284	12.17	6.74	5.44
Taiwan	79343	81199	-1856	180723	142905	37819	6.54	4.44	2.09
USA	556101	492545	63556	969244	1011497	-42253	4.37	5.69	-1.33
Total	3061491	2845804	215687	7064841	6856036	208805	6.64	7	-0.35

Source: Own elaboration

Table 4 : Investment (in US millions dollars) and percentage of investment by sectors, with respect to total investment.

	Construction		Equipment		Services		Total economy	Total economy	Sum of percentages	Sum of percentages
	1996	2009	1996	2009	1996	2009	1996	2009	1996	2009
	%	%	%	%	%	%				
Australia	76.68	24.69	4.08	1.77	15.68	24.75	218,020	498724	96.44	51.21
Austria	54.63	54.49	7.51	2.9	19.13	21.53	52196	76288	81.27	78.92
Belgium	59.92	59.46	3.25	0.67	21.67	25.28	48024	91345	84.84	85.41
Bulgaria	59.46	67.69	12.28	7.81	6.99	11.86	1720	12687	78.73	87.36
Brazil	51.99	55.35	25.77	22.21	11.23	13	131368	248405	88.99	90.56
Canada	75.76	71.78	5	5.37	11.61	13.77	103524	270872	92.37	90.92
China	66.83	65.1	20.83	23.67	4.76	8.41	286826	2281480	92.42	97.18
Cyprus	84.45	76.59	0.23	1.17	9.13	13.46	1784	4721	93.81	91.22
Czech Republic	57.88	59.75	8.78	14.5	12.65	17.33	19129	41124	79.31	91.58
Germany	58.03	52.35	12.83	15.44	17.66	18.48	482108	545505	88.52	86.27
Denmark	59.99	56.83	2.42	2.43	25.74	27.4	30009	50585	88.15	86.66
Spain	68.88	67	3.99	2.78	18.37	19.46	126781	338641	91.24	89.24
Estonia	56.19	67.8	8.28	0.76	16.03	22.85	1168	3795	80.5	91.41
Finland	61	76.34	11.8	5.46	17.47	13.1	21453	43466	90.27	94.9
France	56.46	55.47	7.82	4.94	27.64	29.54	249469	478955	91.92	89.95
UK	55.12	60.6	6.38	4.31	22.24	27	190127	299961	83.74	91.91
Greece	75.73	64.3	6.07	4.33	12.82	20.19	23674	52829	94.62	88.82
Hungary	53.04	54.8	10.96	8.88	18.21	19.6	9122	24928	82.21	83.28
Indonesia	79.8	90.37	14.58	3.66	4.93	4.68	72836	167891	99.31	98.71
India	49.25	65.22	30.68	17.57	7.54	8.64	86901	413899	87.47	91.43
Ireland	78.55	83	6.52	5.8	9.91	9.64	12361	30806	94.98	98.44
Italy	53.12	52.71	16.62	13.24	19.47	21.77	225915	380142	89.21	87.72

Japan	60.01	55.55	20.48	17.26	15.32	19.15	1310592	1044200	95.81	91.96
Korea	63.43	65.4	22.13	17.64	9.95	11.78	194869	227605	95.51	94.82
Lithuania	74.73	68.98	3.28	1.89	12.09	20.22	1667	6217	90.1	91.09
Luxemburg	76.24	77.58	1.23	0.01	15.96	15.2	3842	8606	93.43	92.79
Latvia	73.67	67.44	4.24	0.51	11.65	23.17	880	5388	89.56	91.12
Mexico	69.39	72.57	10.53	5.18	9.14	8.9	63342	183369	89.06	86.65
Malta	41.56	51.16	8.77	0.21	19.16	27.74	787	1132	69.49	79.11
Netherlands	56.64	47.94	2.94	1.18	26.6	34.18	81975	137851	86.18	83.3
Poland	61.58	56.44	14.76	6.37	12.93	22.72	28750	86148	89.27	85.53
Portugal	63.87	63.37	8.82	5.84	19.07	20.88	26791	44208	91.76	90.09
Romania	59	72.02	32.25	12.8	6.84	8.9	7966	41539	98.09	93.72
Russia	74,52	68.72	10.63	14.9	7.66	15.45	71020	221237	92.81	99.07
Slovakia	61.58	69.97	9.06	6.07	14.34	14.4	6354	17493	84.98	90.44
Slovenia	62.57	69.55	12.07	1.29	13.54	18.68	4343	10900	88.18	89.52
Sweden	50.62	60.32	7.46	9.14	25.06	22.77	41002	65830	83.14	92.23
Turkey	65.01	54.2	17.6	11.6	11.65	20.13	56140	99876	94.26	85.93
Taiwan	63.92	57.13	16.66	6.22	16.48	27.39	62177	64049	97.06	90.74
USA	49.01	40.08	22.66	18	18.67	22.63	1480667	2290663	90.34	80.71
TOTAL	55	56	17	15	21	23	5,837,680	10,913,356	93	94
Average	62.7	62.5	11.3	7.6	14.9	18.7	145942	272833.9	89.23	88.8

Source: Own elaboration.