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The Great Recession and its recovery:

A growth accounting analysis for selected OECD countries.

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Abstract

The Great Recession is the name given to the period of economic crisis that began at the end of 2007 in most countries, and its severity and duration was very different. In this paper we analyze that period for some of the OECD countries: Italy, Portugal, Spain, Sweden, Norway and Denmark.

The selected OECD countries can be classified into two groups: Mediterranean countries (Italy, Portugal and Spain) and Scandinavian countries (Sweden, Norway and Denmark).

We focus on the study of the growth rate of output per working-age population and on the contribution of factors of production and total factor productivity to this growth rate. The methodology used is the growth accounting analysis applied to the above mentioned countries. We study those variables that contribute most to the fall in Gross Domestic Product (GDP) per working age population and those that contribute most to its recovery for each country.

Furthermore, the results obtained not only allow us to perform an individual analysis for each country, but also to identify similarities and differences among the countries chosen.

The main conclusions of the work can be summarized as follows: while in the Mediterranean countries the recovery has been due to the labor factor, in the Scandivavian countries it is mostly explained by total factor productivity.

1- Introduction

The Great Recession, a crisis that officially began in the USA in December 2007, was the biggest economic crisis since the Great Depression (Stiglitz, 2010).

This crisis caused a negative shock to the economies of the countries affected, with consequences for some macroeconomic variables, causing, among other effects, variations in income (and consequently consumption) and changes in the labor market.

Summarizing the causes of the crisis is not an easy task, as there is a diversity of opinions. The crisis started in the real estate sector in the United States in 2007 but quickly turned into a serious global financial crisis in 2008 (Keeley, Brian and Love, Patrick, 2011).

The purpose of this paper is to analyze the economic severity of the Great Recession, as well as some years before and after it. To this end, a growth accounting exercise is performed. Growth accounting breaks down the contribution of factors, and total factor productivity, to GDP growth. This tool allows us to identify which specific factors contribute to economic growth, thus allowing us to analyze both the causes of the downturn and those that have contributed to its recovery (Bosworth and Collins, 2003).

To carry out the growth accounting exercise, we first collect the necessary aggregate data from the OECD database: GDP, gross capital formation, employment and hours worked. We divide the labor force into two components: labor-extensive (employment) and labor-intensive (average annual hours per worker).

Once all the information has been compiled, a growth accounting exercise is carried out for the 6 selected countries. For each country, a graph is made in which the growth/decrease path of output per working age population, as well as the factors of production (capital and labor) and total factor productivity (TFP) can be easily observed. The growth accounting exercise is then shown both graphically and numerically.

The remainder of the document is structured as follows. Section 2 describes the theoretical model on which the empirical approach is based. Section 3 details the data and calibration used in the paper. Section 4 outlines the growth accounting exercise. Sections 5 and 6 present and discuss the main results by country and by groups of countries. Finally, section 7 concludes.

2- Solow model

The Solow growth model is a neoclassical model built to explain economic growth and the variables that affect it in the long run. That is, it explains how production (Y_t) depends on the factors of production and total factor productivity. Therefore, the level of production of an economy is determined by the supply side, which means that it is not necessary to take into account the demand side. This is because neoclassical models assume that prices are completely flexible and, as a consequence, output is completely determined by supply. Moreover, neoclassical models assume that all factors of production are fully utilized.

Assuming that the economy is closed (there is no trade with the rest world), and there is no government, the amoung of goods produced (Y) are used for household consumption (C) and investment (I). Investment increases future production capacity. It should be taken into account that, in equilibrium, production is equal to income, so in a closed economy, saving is equal to investment.

In addition, the Solow model assumes that: 1) savings is a constant proportion of income or GDP; 2) capital depreciates at a constant rate; 3) prices are not considered, there are no markets and 4) there is no unemployment.

Solow considers a Cobb-Douglas production function that depends only on two factors of production: capital (K) and labor (L):

$$Y_t = F\,(K_t\,,\, L_t) = A_t\, K_t^{\alpha} L_t^{1-\alpha}$$

As in every neoclassical model, this production function has constant returns to scale with respect to all factors of production and, therefore, decreasing returns with respect to each of them. The growth rate of total factor productivity, A_t, is exogenous.

The only factor of production that can be endogenously accumulated is the capital factor. Ivestment increases the capital stock and depreciation reduces it. The change in the capital stock per worker (ΔK) depends on investment (I) and capital depreciation per worker (δK), that is:

$$\Delta K = \text{investment (I)} - \delta K$$

This model shows that the proportional growth path towards which the economy converges to is characterized by the fact that all aggregate variables grow at the same rate and the variables in terms per worker grow at a rate equal to technical progress (zero if there is none).

3- Aggregate data

3.1- Data collection

This section shows the aggregated data collected from the OCDE[1] database for the 6 selected countries and for the same time period, in other words, from 1970 to 2018.

This is the list of the data collected:

- Gross Domestic Product (million euros)
- Gross Capital Formation (millions of euros)
- Gross Domestic Product at constant prices (millions of euros)
    - Italy: base year 2010
    - Portugal: base year 2011
    - Spain: base year 2010
    - Sweden: base year 2015
    - Norway: base year 2005
    - Denmark: base year 2010
- Employment (in thousands of people)
- Number of hours worked
- Working age population 15-64 (in millions of people)

3.2- Data construction

With the data collected from the OECD database, investment and capital stock, both at constant prices, have been constructed for the growth accounting exercise.

To obtain the capital stock series at constant prices, the perpetual inventory method is used, according to which the capital stock of one year is equal to the undepreciated capital stock of the previous year plus the investment made in that past year, as reflected in expression (1).

$$Kt{+}1 = (1 - \delta)Kt + It \qquad (1)$$

Before computing Gross Capital Formation at constant prices, (It) ; it is also necessary to calculate the depreciation rate (δ), and the initial capital stock (K(0)).

The gross capital formation at constant prices (*It*), has been worked out from the ratio between the Gross Capital Formation at current prices and the GDP deflator.

The GDP deflator has been calculated as the division of nominal GDP to compute the real GDP.

[1] stats.oecd.org

As for the depreciation rate (δ), this has been obtained as the average value of the depreciation rates of each country, collected in the Penn World Table database, for the considered period. In the case of the selected countries the depreciation rate is around 3-4%.

Finally, to obtain the capital stock series (at constant prices) it was also necessary to obtain the initial capital stock (K(0)). To obtain a reasonable value, we used the same method used by Conesa and Kehoe (2017), which consists of calculating the value of K(1970) such that equation (2) is satisfied:

$$\frac{K_{1970}}{Y_{1970}} = \frac{1}{10} \sum_{t=1970}^{1980} \frac{Kt}{Yt} \qquad (2)$$

Equation (2) shows that the initial capital stock must be a value such that the capital-output ratio for that initial year is equal to the average of this same ratio for the following 10 years.

Following this method we get the initial capital stock, that is K_{1970}, and, consequently, applying the perpetual inventory method, the values of K_t for all periods up to 2018.

Although our analysis focuses on the time period from 1995-2018 (depending on each country), the series has been constructed since 1970. Because the depreciation rate of the capital stock is positive, the importance of the initial capital decreases as we move forward in time. This fact implies that the results of the growth accounting exercise do not depend on the choice of initial capital, since the first observations for the constructed capital series are discarded.

Along the balanced growth path, on the one hand, both average annual hours per worker and employment per working-age population remain constant; and, on the other hand, the capital stock and aggregate output grow at the same rate.

4- Growth accounting exercise

The growth accounting exercise in this work is based on the growth accounting exercise proposed by Kehoe and Prescott (2002).

As in the basic growth accounting exercise of Solow (1957), the technology of the economy can be represented by a Cobb-Douglas production function according to which the level of output depends on both capital and labor factors and total factor productivity:

$$Y_t = F\,(K_t\,,\,L_t) = A_t\;\; K_t^{\alpha} L_t^{1-\alpha} \qquad (4)$$

From this last expression (4), we can write total factor productivity as follows:

$$A_t = \frac{\mathrm{Yt}}{Kt^{\propto}\;\; Lt^{1-\propto}} \qquad (5)$$

The steps followed to rewrite the production function following Kehoe and Prescott (2002) are shown below. The idea is to isolate the variation in capital that is not determined by the increase in productivity from that which is caused by the variation in total factor productivity.

In neoclassical models, on he balanced growth path, both average annual hours per worker and employment per working-age population are constant; the capital stock and aggregate output grow at the same rate. Only when a deviation in the growth path occurs, the capital stock, employment per working-age population or average hours worked will affect output growth (yt), and thus output per working-age population.

Otherwise, all output growth will be given by factor productivity growth. In this way it is possible to isolate the effect of the factors of production from the effect of productivity on the growth rate of output per working-age population, and to quantify properly the contribution of the factors of production and of total factor productivity.

1. We divide both sides by N_t: working age population (15-64 years):

$$\frac{Yt}{Nt} = \mathrm{At}\left(\frac{kt}{Nt}\right)^{\alpha}\left(\frac{Lt}{Nt}\right)^{(1-\alpha)} \qquad (6)$$

Obtaining: $y_t = At\ (kt)^{\propto}\ (lt)^{1-\propto}$ (7)

2. We divide both sides of the expression by (y_t^{α}):

$$y_t^{1-\alpha} = \mathrm{At}\left(\frac{kt}{Nt}\right)^{\alpha}(lt)^{(1-\alpha)} \quad (8)$$

3. We raise both sides of the equation to $\frac{1}{1-\propto}$:

$$y_t = At^{\frac{1}{1-\alpha}}\left(\frac{kt}{yt}\right)^{\frac{\alpha}{(1-\alpha)}} lt \quad (9)$$

Using the latter expression (9), we can express output per working-age population (yt) as a function of total factor productivity ($\mathrm{At}^{\frac{1}{1-\propto}}$), the contribution of the capital ($(\frac{\mathrm{kt}}{\mathrm{yt}})^{\frac{\propto}{1-\propto}}$) and of the labor factor (lt).

In addition, one of the modifications done in this work, with respect to the basic growth accounting exercise, is the decomposition of the labor factor. The labor factor is decomposed, on the one hand, into extensive labor or employment per working age population, and on the other, into intensive labor or average annual hours worked per worker. Thus, the expression of the labor factor is expressed as follows:

$$L_t = E_t \times h_t \quad (10)$$

If we divide both sides by N_t (working age population), we obtain the same expression in terms per working age population:

$$\frac{\mathrm{Lt}}{\mathrm{Nt}} = \frac{\mathrm{Et}}{\mathrm{Nt}} \times h_t \quad (11)$$

That is, we obtain as a final expression:

$$l_t = \frac{Et}{Nt} \times h_t \qquad (12)$$

Where E_t is employment, and thus $\frac{Et}{Nt}$ the number of employees relative to the working-age population (extensive work), and ht the number of hours worked per worker in a year (intensive work).

The next step consists of the application of natural logarithms to the whole expression (9), to obtain the growth rates of each variable:

$$\ln y_t = \frac{1}{1-\propto} \ln A_t + \frac{\propto}{1-\propto} \ln \frac{kt}{yt} + \ln l_t \qquad (13)$$

The growth accounting exercise is calculated as follows: the difference of expression (13) between two time periods (t and t+T) and divide by T to express growth rates in annual growth rates:

$$\frac{ln\, y_{t+T} - ln\, y_t}{T} = \frac{1}{1-\propto} \left[\frac{ln\, A_{t+T} - ln\, A_t}{T} \right] + \frac{\propto}{1-\propto} \left[\frac{ln \frac{k_{t+T}}{y_{t+T}} - ln \frac{k_t}{y_t}}{T} \right] + \left[\frac{ln\, l_{t+T} - ln\, l_t}{T} \right] \qquad (14)$$

Finally, by plugging equation (12) into expression (14) we obtain the final expression in which the contribution of labor, both in extensive and intensive form, in the growth rate of production by the working age population is taken into account, that is:

$$\frac{ln\, y_{t+T} - ln\, y_t}{T} = \frac{1}{1-\propto} \left[\frac{ln\, A_{t+T} - ln\, A_t}{T} \right] + \frac{\propto}{1-\propto} \left[\frac{ln \frac{k_{t+T}}{y_{t+T}} - ln \frac{k_t}{y_t}}{T} \right] + \left[\frac{ln \frac{E_t+T}{N_t+T} - ln \frac{Et}{Nt}}{T} \right] + \left[\frac{ln\, h_{t+T} - ln\, h_t}{T} \right] \qquad (15)$$

4.1- Participation of the capital factor in total income (α)

Finally, all that remains is to establish the value of α. Since we are considering a Cobb-Douglas production function, the value of α is equal to the share of the capital factor in income; and, consequently, the value 1-α refers to the share of the labor factor.

The chosen value of α has been obtained as follows: first, we have collected the data provided in the Penn World Table[2] database on the labor share for the years to be analyzed for each country. Secondly, we have calculated the average value of such data, thus obtaining the value of 1-α. And finally, to obtain the value of α, we simply solved the following operation:

$$\alpha = 1 - labor\ share\ in\ income \qquad (16)$$

For those countries whose α value was less than 0.31 or greater than 0.4, we have considered a value of standard alpha = 1/3; this was the case for Italy, Sweden and Norway.

For the case of the remaining 3 countries, the α values are as follows: 0.3749246 (Portugal); 0.3959906 (Spain) and 0.36338 (Denmark).

4.2- Indexation

By indexing each of the variables to the same year, we are able to observe the evolution of all the variables (capital, labor and total factor productivity) in the same graph, and thus easily see the contribution of each of them to the GDP per the working age population.

All variables have been indexed by dividing the value of each variable in each year by the value of that same variable in its initial year, and multiplying it by 100.

This expression summarizes how we have indexed all variables:

$$\text{Indexed Variable} = 100 \times \frac{value}{value\ in\ the\ base\ year} \qquad (17)$$

[2] Penn World Table

5- Results by countries

In this section we present the growth accounting exercises for each country both graphically and numerically (using tables). This makes easier to analyze how each of the factors contributed to the growth of GD per working-age population in each period, that is, before to the Great Recession, in its outbreak and in its recovery.

As I have mentioned above, the results of the growth accounting exercise will be shown in two ways, starting with graphs, as it is an easy and visual way to draw not only conclusions, but also to establish the different periods/phases for each country in the selected time range (which depends for each country). These chosen periods will be considered to quantify the contribution of the different variables

In addition, remember that the labor factor has been broken down into two subcategories: intensive and extensive labor, so that it will be reflected numerically in the tables. We will be able to observe how the Great Recession has affected the labor factor, causing a reduction in extensive labor (especially an increase in unemployment), an intensive reduction (a reduction in hours worked), or affecting both.

Before showing the graphs, we explain the notation of the variables in the following tablle:

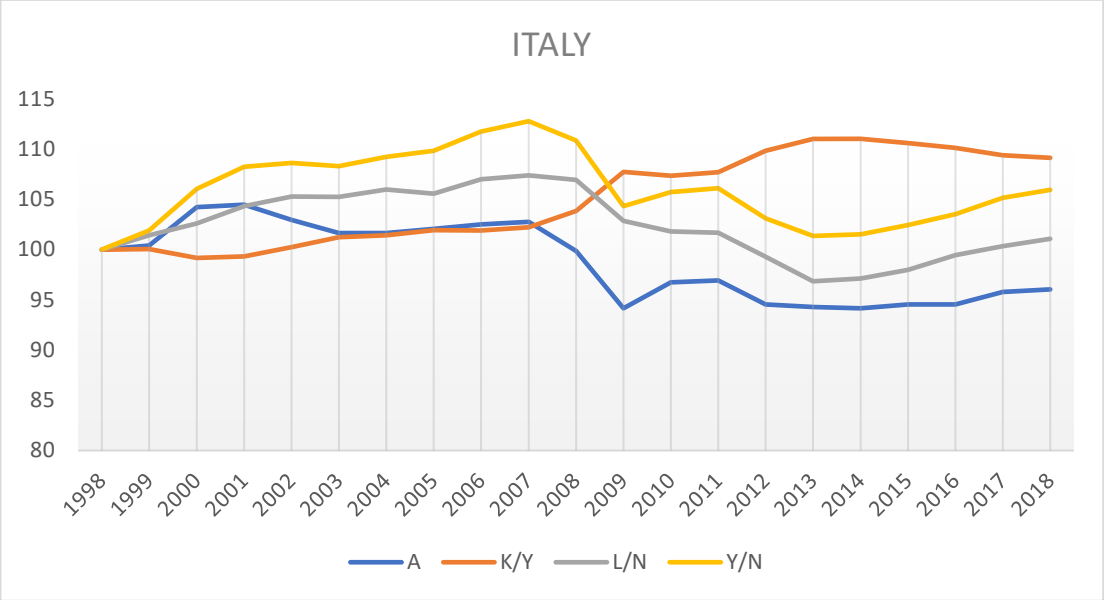
VARIABLE	DESCRIPTION
$A = (At)^{\frac{1}{1-\propto}}$	Total factor productivity
$K/Y = (\frac{kt}{yt})^{\frac{\propto}{1-\propto}}$	Capital factor intensity
Y/N	GDP per working age population
L/N	Labor by working-age population
E/N	Number of employees per person of working age (extensive work)
h	Number of hours worked in a year per worker (labor-intensive)

The graphs and growth rates by section for each of the six selected countries are shown below.

In addition, after performing the growth accounting exercise for each country and showing the data obtained by means of the corresponding graph and table, we will proceed in this section to comment on the results. To be more precise, which variables have contributed to the growth (decrease) of output per working age population (Y/N), before, during and after the Great Recession.

5.1- ITALY

- **ILLUSTRATION 1. Graph (Index 1995)**



Source: Own elaboration
Data: OECD Data

- **TABLE 1. Average annual growth rates by periods**

ITALY						
PERIODS	Yt/Nt	Contribution to Yt/Nt			Work contribution	
		At	Kt/Yt	Lt/Nt	Et/Nt	ht
1998- 2007	1,34%	0,31%	0,24%	0,79%	1,13%	-0,34%
2007- 2008	-1,71%	-2,86%	1,57%	-0,42%	0,20%	-0,62%
2008- 2009	-6,08%	-5,88%	3,70%	-3,90%	-2,15%	-1,75%
2009- 2011	0,85%	1,44%	-0,02%	-0,57%	-0,50%	-0,07%
2011- 2013	-2,29%	-1,38%	1,52%	-2,43%	-0,90%	-1,53%
2013- 2018	0,89%	0,37%	-0,34%	0,86%	0,86%	0%

Source: Own elaboration
Data: OECD Data

- **Analysis of results**

In the first period, that is from 1998 to 2007, we observe a clear continued growth of 1.34% in output per person of working population. Most of it was explained by the labor factor, and more specifically by extensive work.

It should be pointed out that in Italy the unemployment rate in the 1990s exceeded 10%, but it began to fall, reaching a value of 6.1%. It was not until 2007-2008 that it began to rise again.[3]

From 2007 onwards we can observe the consequences of the Great Recession, from which they did not manage to start recovering until 2009. In the period 2007-2008 the Italian economy fell by 1.71%, mostly explained by the fall in productivity (-2.86%), and it is thanks to the growth rate of the capital factor (1.57%) that it manages to mitigate the fall in this year. This is what normally happens, since the capital stock is predetermined by the investment of the previous period.

Over the period of 2008-2009, we observe its greatest decline with a fall of 6.08%, this is one of the biggest falls of all the countries analyzed; as we have already commented in the previous section, the fall is mainly caused by productivity, since this plummeted by 5.88%.

In addition, we observe that over the 2007-2008 period, the labor factor also contributes to the fall in output per working-age population. This is mainly because hours fall. But over the 2008-2009 period, the fall in the GDP per working-age population fall is due to both extensive (-2.15%) and intensive (-1.75%) work. The only variable showing growth is the capital factor, which grew at an anual growth rate of 3.7%.

In 2009 Italy began to recover, but growth only lasted until 2011, when it began to decline until 2013. It is from that year onwards that it experiences continued growth until 2018 (0.89%). The 2009-2011 period seems to be a period of recovery for the country, due to the fact that the output per working age population increased at annual growth rate of 0.85%.This growth rate can be explained by the increase in productivity by 1.44%, as the rest of the variables continued to decrease (albeit in small proportion).

However, this period of growth ended in 2013, where output per working age population fell by 2.29%. The cause, as in the first, was due to both productivity and the labor factor, as employment and hours worked fell by 0.9% and 1.53% respectively.

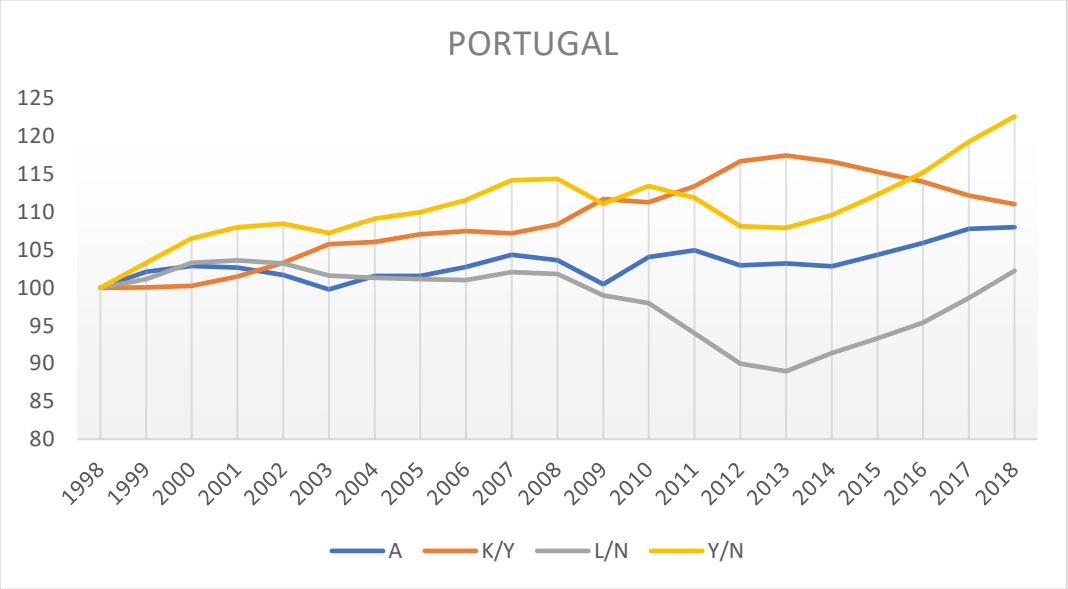
Finally, we can consider the last period, 2013-2018, as the period of recovery of the Italian economy. Output per working age population grows at 0.89% due to the increase in productivity and, above all, to the labor factor, and more specifically to the increase in employment (as hours worked remain unchanged).

Moreover, we note that the unemployment rate in Italy suffers a continuous growth since 2006, peaked in 2014, at 12.7%, and since then has been decreasing at a slow but steady pace.

[3] Data obtained from the OECD database (stats.oecd.org).

5.2- PORTUGAL

- **ILLUSTRATION 2. Graph (Index 1995)**



Source: Own elaboration
Data: OECD Data

- **TABLE 2. Average annual growth rates by periods**

PORTUGAL						
PERIODS	Yt/Nt	Contribution to Yt/Nt			Work contribution	
		At	Kt/Yt	Lt/Nt	Et/Nt	ht
1998- 2003	1,40%	-0,04%	1,12%	0,32%	0,52%	-0,20%
2003- 2007	1,57%	1,12%	0,33%	0,12%	-0,07%	0,19%
2007- 2008	1,23%	0,42%	0,42%	0,39%	0,28%	0,11%
2008- 2009	-2,92%	-3,13%	3,03%	-2,82%	-2,82%	0%
2009- 2010	2,11%	3,53%	-0,39%	-1,03%	-1,20%	0,17%
2010- 2013	-1,67%	-0,26%	1,8%	-3,21%	-2,67%	-0,54%
2013- 2018	2,56%	0,9%	-1,12%	2,78%	2,55%	0,23%

Source: Own elaboration
Data: OECD Data

- **Analysis of results**

As we can see in the graph behaviour is very similar to that of Italy. Over the 1998-2003 period, output per working age population grew at an anual growth rate of 1.4%, and in the following period, i.e. from 2003 to 2007, by 1.57%. The difference between these two periods is that during the period 1998-2003 the growth is mainly due to the

contribution of capital and in the following period the total factor productivity is what contributes most.

It is from 2007 onwards that the Portuguese economy began stop growing: in the period from 2007 to 2008 we can still observe a slight growth, namely 1.23%, caused by both productivity (0.42%) and the labor factor (0.39%).

But it is in 2008, as in most countries, when it begins to experience the effects of the crisis with a fall of 2.92%. It seems that the recovery starts in 2010, although not definitively. During this time, both productivity and labor fell in a similar proportion, and it was the capital factor that prevented Y_t/N_t from decreasing, since it grew at an anual growth rate of 3.03%. Hours worked did not change, so the entire drop is explained by the decline in employment.

As mentioned earlier, in Portugal, it seems to be a slight recovery, but it only lasted until 2010. In this period, output per working-age population increased by 2.11% due exclusively to the contribution of productivity (3.53%), since both the capital and labor factors fell at rates of 0.39% and 1.03%, respectively. Once again the fall in the labor factor was caused by extensive work (1.2%) as hours worked even increased by 0.17%.

The unemployment rate in Portugal during the 1990s did not exceed 5%, however, from 2003 it began to grow steadily, reaching 10.8% in 2010. [4]

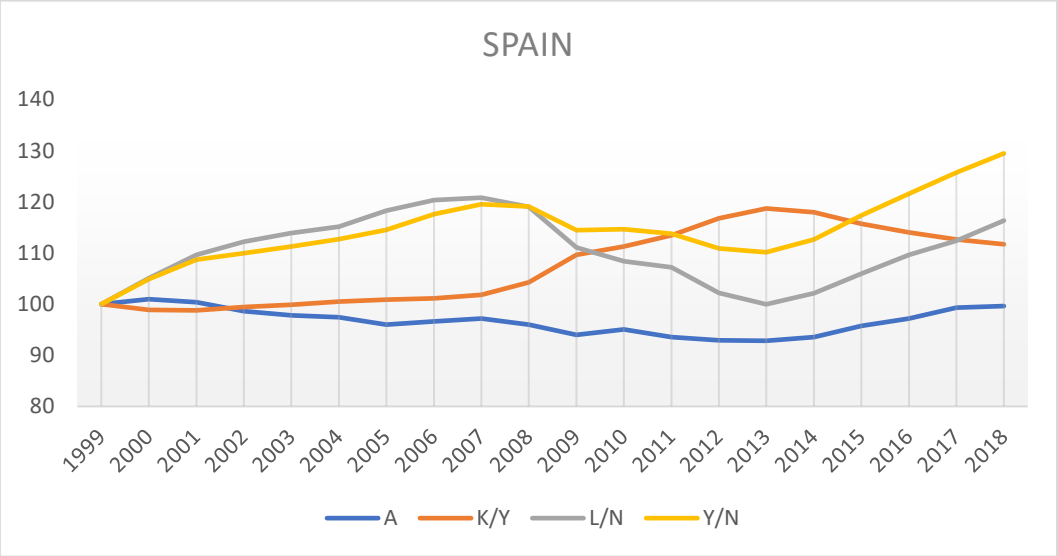
The brief recovery came to an end in 2010, with a decrease in the average annual rate of production per working age population of 1.67%; and it is not until 2013 that we observe what could be considered the definitive recovery. This drop is mainly due to the labor factor, as it fell by 3.27%, in this period the hours worked decreased by 0.54%, and therefore most of the decrease is caused by work in extensive form (2.67%). In 2013 Portugal reached its maximum unemployment rate reaching 16.2%.

Finally, from 2013 onwards, Portugal grew at an annual rate of 2.56%, it manages to increase the growth rate with results higher than at the beginning of the Great Recession. And this was due not only to productivity, which grew at a rate of 0.9%, but also to the labor factor, which changes its dynamic of decline that began in 2008 and starting to grow at 2.78%, practically entirely thanks to the increase in employment (2.55%). Since 2013, the unemployment rate has done nothing but decrease in Portugal, around 7%. Although the reduction is not so notorious as to reach the figures recorded in the 1990s (4-5%).

[4] Data obtained from the OECD database (stats.oecd.org).

5.3- SPAIN

- **ILLUSTRATION 3. Graph (Index 1999)**



Source: Own elaboration
Data: OECD Data

- **TABLE 3. Average annual growth rates by periods**

SPAIN						
PERIODS	Yt/Nt	Contribution to Yt/Nt			Work contribution	
		At	Kt/Yt	Lt/Nt	Et/Nt	ht
1999- 2007	2,23%	-0,36%	0,23%	2,36%	2,74%	-0,38%
2007- 2008	-0,35%	-1,23%	2,36%	-1,48%	-1,99%	0,51%
2008- 2009	-3,98%	-2,09%	5,01%	-6,90%	-7,23%	0,33%
2009- 2013	-0,96%	-0,30%	1,98%	-2,64%	-2,26%	-0,38%
2013- 2018	3,23%	1,41%	-1,21%	3,03%	2,92%	0,11%

Source: Own elaboration
Data: OECD Data

- **Analysis of results**

Spain, like Portugal, did not really experience the consequences of the crisis until 2008, although it began to decline in 2007. From 1999 to 2008 the Spanish economy grew at a rate of 2.13%, explained, as expected in Mediterranean countries, by the labor factor, and more specifically by extensive labor, as it grew at an anual growth rate of 2.74%.

However, the hours worked (intensive labor) even decreased.

Unemployment rates in Spain during the 1990s remained mostly constant, with small variations and never exceeding 8.5%. However, from 2003 onwards, it began to decrease slowly but steadily, reaching rates of around 5%.

As mentioned above, in 2007 we observed a slight drop in production per working-age population (-0.35%), explained in almost equal parts by both the labor factor and productivity. It is the capital factor that slows down and does not cause a greater fall thanks to its annual growth of 2.36%.

In 2008 the Spanish economy collapses completely, in other words, Spain, unlike its neighboring countries (Portugal and Italy), does not manage to grow at any time in the 6 years from 2007-2013.

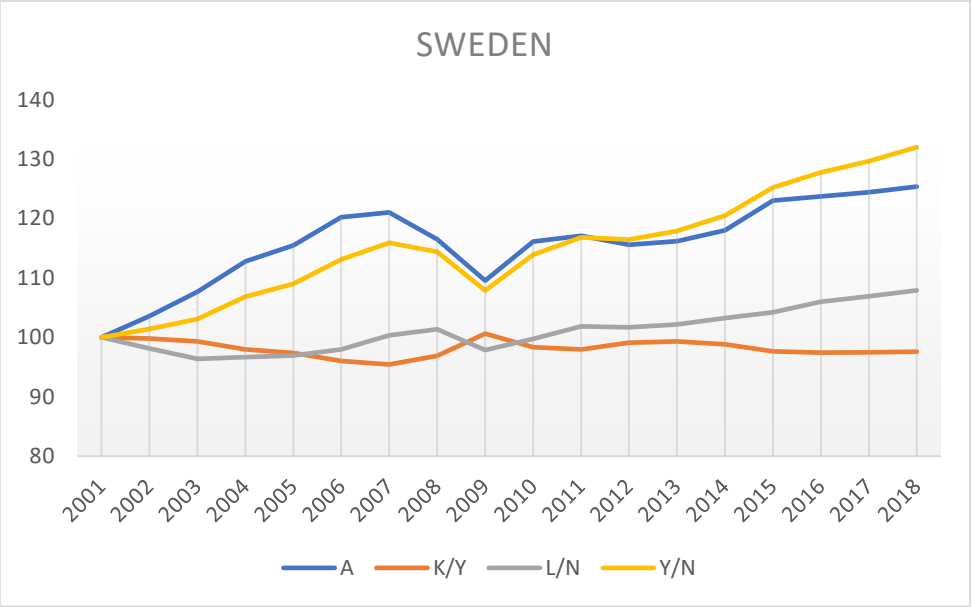
In the 2008-2009 period suffers its biggest fall with a 3.98% decline rate, mostly caused by the labor factor (-6.9%), and more specifically by the extensive factor (-7.23%); the number of hours worked hardly changed (0.33%). Productivity also contributed with a negative rate of 2.09%. In addition, the capital factor experienced its highest growth rate in this year, reaching 5%.

During the following period, 2009-2013, the economy continued to fall, although at a slower rate, -0.96%. And again, the main cause is the labor factor, although in this period intensive and extensive labor contributed, but more the extensive labor.

Finally, we observe that the recovery period for Spain, as for the two previous countries, arrives in 2013. In the 2013- 2018 period (as far as we have data) it grew at an anual growth rate of 3.23%. Once again, due to the labor factor (3.03%), and more specifically thanks to the increase in the number of employees with respect to the working age population (extensive work).

5.4- SWEDEN

- **ILLUSTRATION 4. Graph (Index 2001)**



Source: Own elaboration
Data: OECD Data

- **TABLE 4. Average annual growth rates by periods**

SWEDEN						
PERIODS	Yt/Nt	Contribution to Yt/Nt			Work contribution	
		At	Kt/Yt	Lt/Nt	Et/Nt	ht
2001- 2007	2,46%	3,19%	-0,78%	0,05%	0,07%	-0,02%
2007- 2008	-1,28%	-3,83%	1,52%	1,03%	0,42%	0,61%
2008- 2009	-5,89%	-6,17%	3,78%	-3,50%	-2,61%	-0,89%
2009- 2014	2,21%	1,5%	-0,36%	1,07%	0,99%	0,08%
2014- 2018	2,29%	1,52%	-0,33%	1,10%	1,08%	0,02%

Source: Own elaboration
Data: OECD Data

- **Analysis of results**

In the first period selected for Sweden, i.e., from 2001 to 2007, we observe a clear continued growth in output per population working age, namely 2.46%. In contrast to the three previous countries analyzed (Mediterranean countries), in which the triggering

factor for growth (decrease) was the labor factor, in the case of Sweden labor factor places a minor role.

We can see how in the Nordic countries total factor productivity gains relevance, being essential to explain such growth rates. In the case of Sweden, productivity grew at an annual growth rate of 3.19%.

In 2007 the Swedish economy began to suffer the consequences of the Great Recession with a drop of 1.28%. This is caused by productivity (-3.83%), both the capital factor and the labor factor slow down to a certain extent and do not cause a greater fall. The unemployment rate in 2007 was 6.2%.

However, in the 2008-2009 period, it experienced its largest drop, output per working age population plummeted by 5.89%. This is one of the largest falls of all the selected countries, along with Italy and Denmark, is mainly explained by the fall in total factor productivity (-6.17%). The fall in the labor force (-3.5%), due to the decline in the extensive labor force, also contributed, but to a lesser extent. The only variable that experienced positive growth was the capital factor, which increased by 3.78%.

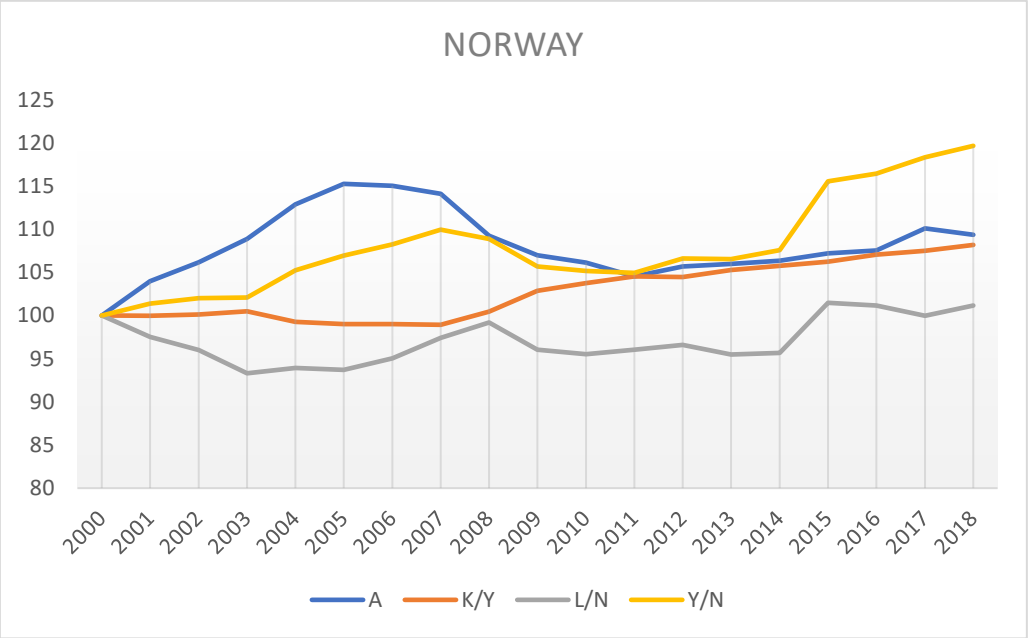
Sweden began its recovery earlier than the previous countries. In 2009 it recovers positive growth rates, and very close to those before the crisis, growing in the 2009-2014 period by 2.21%.

This growth rate of GDP per working age population is explained both by productivity (1.52%), and by the labor factor (1.07%). The growth in the labor force is explained by the increase in the number of employees relative to the working-age population (extensive labor).

Finally, from 2014 to 2018, Sweden continued to grow and again it was thanks to productivity and the labor factor.

5.5- NORWAY

- **ILLUSTRATION 5. Graph (Index 2000)**



Source: Own elaboration
Data: OECD Data

- **TABLE 5. Average annual growth rates by periods**

NORWAY						
PERIODS	Yt/Nt	Contribution to Yt/Nt			Work contribution	
		At	Kt/Yt	Lt/Nt	Et/Nt	ht
2000- 2003	0,69%	2,83%	0,16%	-2,30%	-0,74%	-1,56%
2003- 2007	1,86%	1,17%	-0,39%	1,08%	0,79%	0,29%
2007-2008	-0,99%	-4,35%	1,55%	1,81%	1,74%	0,07%
2008- 2009	-2,98%	-2,10%	2,36%	-3,24%	-1,84%	-1,40%
2009- 2011	-0,35%	-1,15%	0,80%	0%	-0,46%	0,46%
2011- 2012	1,56%	1,07%	-0,08%	0,57%	0,83%	-0,26%
2012- 2018	1,92%	0,56%	0,59%	0,77%	0,97%	-0,20%

Source: Own elaboration
Data: OECD Data

- **Analysis of results**

In the case of Norway, unlike its neighboring countries (Sweden and Denmark), total factor productivity and output per working-age population do not follow a similar path. As we observe in the graph, productivity (A_t) takes the largest role, growing at a higher

rate than output per working-age population (Y_t/N_t) in the early periods, prior to the Great Recession. However, unlike the behavior of Sweden and Denmark, GDP per working-age population and TFP do not vary in unison, which means that in the Norwegian economy this relationship is not so evident.

In the first period (2000-2003), there is an upward trend in output per working-age population, namely 0.69%. This growth is explained, as I have already mentioned, by total factor productivity (2.83%), since the labor factor even shows negative growth rates (-2.3%). Norway is the country with the lowest unemployment rates as a percentage of the labor force: in the period from 2000 to 2003, it does not even exceed 4%.

In the second period, from 2003 to 2007, output per working-age population continues to grow at a faster rate, increasing by 1.86%. Unlike the previous period, this growth is sustained by both productivity growth (1.17%) and the labor factor (1.08%), which in turn is mainly driven by extensive labor.

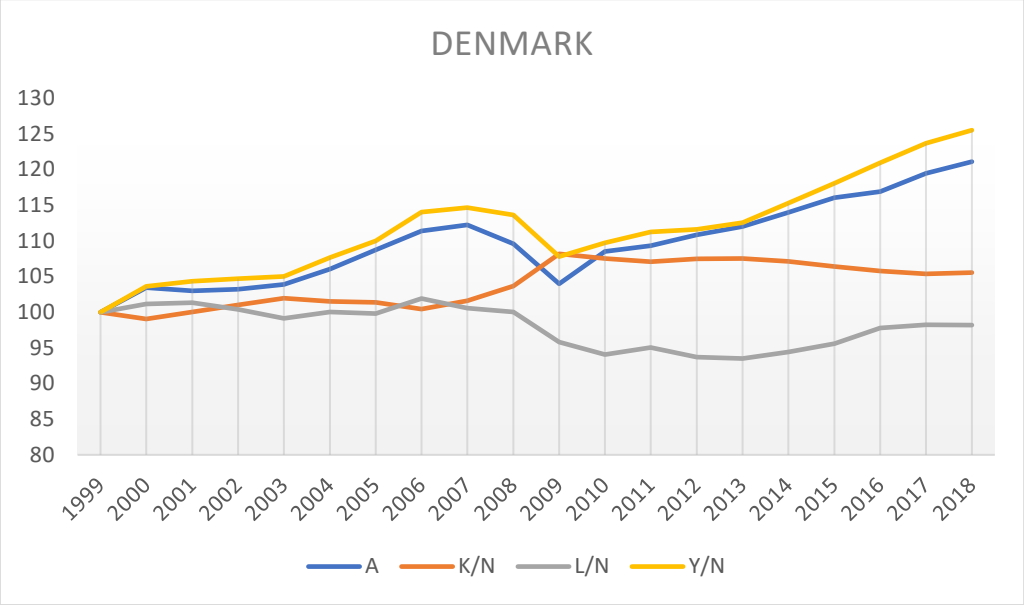
In 2007 productivity falls dramatically (-4.35%), causing production to begin to decline. The Norwegian economy experienced its worst years from 2007 onwards, and did not manage to recover from the effects of the crisis until 2011: Over the 2008-2009 period, the fall can be mainly explained by the labor factor, which decreased by 3.24% (due to both extensive and intensive labor). However, over the following years, 2009-2011, we observe that the growth rate of the labor factor does not vary, and it is productivity that explains why output per working-age population, Y_t/N_t, continues to decrease, the capital factor grows by 0.8% and slows down the negative impact. Therefore, we could define this period as a period of stagnation.

We can say that from 2011 Norway begins its recovery stage, as it recovers pre-crisis growth rates. In the period 2011-2012 the growth rate was 1.56%, mainly explained by factor productivity (1.07%), and it is due to the fall in capital factor (-0.08%) that the growth of output per working age population slows down to some extent.

From 2012 onwards (as far as we have data), we observe how the country fully recovers, reaching the maximum growth rate of output per working-age population (1.92%). It is due not only to TFP but also to both the recovery of the capital factor (0.59%) and of the the labor factor (0.77%), which in turn is almost exclusively due to extensive labor.

5.6- DENMARK

- **ILLUSTRATION 6. Graph (Index 1999)**



Source: Own elaboration
Data: OECD Data

- **TABLE 6. Average annual growth rates by periods**

DENMARK						
PERIODS	Yt/Nt	Contribution to Yt/Nt			Work contribution	
		At	Kt/Yt	Lt/Nt	Et/Nt	ht
1999- 2003	1,22%	0,95%	0,49%	-0,22%	-0,26%	0,04%
2003- 2007	2,20%	1,94%	-0,10%	0,36%	0,80%	-0,44%
2007- 2008	-0,93%	-2,42%	2,02%	-0,53%	-0,31%	-0,22%
2008- 2009	-5,28%	-5,23%	4,27%	-4,32%	-3,41%	-0,91%
2009- 2018	1,69%	1,69%	-0,27%	0,27%	0,55%	-0,28%

Source: Own elaboration
Data: OECD Data

- **Analysis of results**

From 1999 to 2003, Denmark's economy grew at an anual rate of 1.22%. This growth is mainly explained by the contribution of productivity (0.95%); and to a lesser extent, by the capital factor, which increased at an anual rate of 0.49%. In contrast, the labor factor fell (not much) and its contribution was in the opposite direction (-0.22%).

Denmark experienced some good years of growth, especially in the period 2003-2007, where output per working-age population grew at an annual rate of 2.2%, mainly caused (as expected in the Nordic countries) by total factor productivity (1.94%). In this period, both the growth rate of the labor factor and that of the capital factor changed signs with respect to the previous period, in other words, L_t/N_t grew at an anual growth rate of 0.36% and K_t/Y_t decreased by 0.1%.

In 2007 there was a deceleration in the average annual growth rate of production per working-age population, from growing at an annual growth rate of 2.2% per year to decreasing at an anual growth rate of **-**0.93%. This deceleration is explained once again by the fall in productivity (-2.42%) and the slight drop in the labor factor (-0.53%), both in terms of employment per working-age population and average annual hours worked.

In the 2008-2009 period, as in all the countries analyzed above, Denmark experiences its greatest decline. Production per working-age population, Y_t/N_t fell by 5.28%, one of the largest declines in terms of rate of decrease, with similar figures to Italy and Sweden, which in the same year suffered a decrease of 6.08% and 5.89% respectively.

In 2009 the unemployment rate as a percentage of the labor force began to grow slowly**,** but steadily and reached figures higher than in previous years (approximately 5%), around 8%.[5]

Finally, the recovery period for the country occurs from 2009 to 2018 (as far as we have data) as output per working age grows again at an anual growth rate of 1.69%, figures very similar to those prior to the crisis period. This recovery is entirely due to the recovery of productivity, which grew in the same proportion. However, we note that the labor factor did grow, but at a much lower rate, namely 0.27%, while the capital factor fell at a rate equal to that of the labor factor, but of the opposite sign.

[5] Data obtained from the OECD database (stats.oecd.org).

6- Discussion

Based on the results obtained, after performing the growth accounting exercise for each country, we observe that these countries can be classified into two categories: Mediterranean countries (Italy, Portugal and Spain) and Scandinavian countries (Sweden, Norway and Denmark).

On the one hand, we find that, in all the selected Mediterranean countries, that is, in Italy, Portugal and Spain, the growth of output per working-age population comes from the growth of the labor factor. To be more precise, it is explained by labor in an extensive way, in other words, it is due to the increase in the number of employees relative to the working-age population.

Moreover, the Mediterranean countries, unlike the Scandinavian countries, which, as we have observed both in the graphs and in the tables, are based on productivity, coincide in the stagnation of productivity. In Italy, Portugal and Spain, total factor productivity is practically constant.

Despite the slight variations in productivity over time, we sometimes observe how it helps to some extent to the growth of the working-age population, Y_t /N_t at certain points in time, these countries saw their labor market more altered, especially in terms of employment (extensive work). Which was decisive for the growth (decrease) of output per working-age population. On the opposite, in the Scandinavian countries, there are hardly any variations in the labor factor, with the contribution of the growth (decrease) of output per working-age population falling mainly on productivity.

Regarding the recovery process, it should be underlined that, in the case of the three Mediterranean countries, we can not speak of a definitive recovery until 2013, which is when the growth rate of output per working age recovers figures higher (as in Italy and Spain) or similar (as in Italy) to those obtained before the crisis. Finally, it should be pointed out that Portugal and Italy experience a slight growth, which a priori could be said to be a recovery (in the period from 2009 to 2011), but they fall again and it is not until 2013 that the real recovery of the country's output per working-age population is achieved.

On the other hand, the Scandinavian countries, in contrast to the Mediterranean countries, have recovered thanks to productivity growth. In these countries, the role of the labor factor takes a back seat; although it helps, especially in the last period (2013-2018), which can be considered the recovery, in which the average annual rate grows at a rate close to that of productivity.

On the one hand, Sweden managed to recover very quickly (2009), being the country that has managed to emerge from the Great Recession the fastest, followed by Denmark, which, in turn, recovered annual growth rates higher than those prior to the crisis. Norway, however, is recovering fast, but not as fast as the other two countries. Compared to Sweden and Denmark, Norway is arguably the country that is having the hardest time getting out of the crisis, even though it managed to do so in 2011 (before the 3 Mediterranean countries).

It is true that they all depend directly on productivity growth, but the labor market behaves differently in each country. While for Sweden and Norway both extensive and intensive labor have contributed in a similar way; in the case of Denmark we can conclude that the labor factor is mainly driven by the extensive labor.

In summary, the major difference between the Nordic and Mediterranean countries is that while the former recovered to a greater extent thanks to productivity, the latter did so thanks to the labor factor, and mainly due to extensive labor.

7- Conclusions

The purpose of the growth accounting exercise for the six selected countries is to analyze the contribution of the factors of production (capital and labor) and total factor productivity to the average annual growth rate of output per working-age population in the years before, during and after the Great Recession.

The period to be analyzed spans from 1995 to 2018, depending for each country (given the availability of existing data). The sample of selected countries can be divided into two groups, due to their geographical position: on the one hand, we have the Mediterranean countries, Italy, Portugal and Spain; and on the other hand, the Scandinavian countries, Sweden, Norway and Denmark.

As might be expected, the results obtained with respect to the Scandinavian countries have been very different from those of the Mediterranean countries, since the former base their growth on productivity and the latter on the labor factor; this is the major difference between the two groups of countries, the Mediterranean countries have a very low contribution of total factor productivity to output growth per working age population, while the Scandinavian countries have a low contribution of labor to output.

A common fact to highlight in all the countries of both groups is that the years in which the economies suffered the most were in the period from 2008 to 2009. In that period we find the biggest drop in GDP per working-age population, especially, and as already mentioned, this drop was especially significant in Italy, Sweden and Denmark.

In conclusion, this growth accounting exercise has allowed us to analyze which variables have contributed more or less to the growth rate of output per working-age population. On the one hand, as already mentioned, for the Mediterranean countries (Italy, Portugal and Spain) the labor factor has been the main driver, and more specifically extensive labor. However, on the other hand, for the Scandinavian countries, it has been total factor productivity.

Another finding is that, looking at the graphs and tables, these countries have already managed to overcome the Great Recession, as they are once again growing at rates similar to or higher than before the crisis.

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9- Appendix

Using the graphs we have made for each country, we have selected the different cycles or phases that each country goes through, which are reflected in the following tables:

ITALY	PORTUGAL	SPAIN
1998- 2007	1998- 2003	1999- 2007
2007- 2008	2003- 2007	2007- 2008
2008- 2009	2007- 2008	2008- 2009
2009- 2011	2008- 2009	2009- 2013
2011- 2013	2009- 2010	2013- 2018
2013- 2018	2010- 2013	
	2013- 2018	

Source: Own elaboration Data: OECD Data

SWEDEN	NORWAY	DENMARK
2001- 2007	2000- 2003	1999- 2003
2007- 2008	2003- 2007	2003- 2007
2008- 2009	2007-2008	2007- 2008
2009- 2014	2008- 2009	2008- 2009
2014- 2018	2009- 2011	2009- 2018
	2011- 2012	
	2012- 2018	

Source: Own elaboration Data: OECD Data

As we can see, we have selected different time intervals for each of the countries, so that each country has a unique number of periods and duration.

To select them we have based on the graphs shown in the paper, where the evolution of output per working age population (Y/N), capital (K/Y), labor (L/N) and total factor productivity (A) can be observed.

Once the different periods have been selected, we can focus to a greater extent on the period covered by the Great Recession which, as might be expected, is not identical for the six countries analyzed, despite finding similarities among them.

Finally, remark that an easy way to check that the data in the tables are correct is by using expression (14), and consequently (15); that is: we know that the growth rate of Y_t/N_t is equal to the sum of the growth rates of $(At)^{\frac{1}{1-\propto}}$, plus that of $(\frac{kt}{yt})^{\frac{\propto}{1-\propto}}$, plus that of Lt/Nt. And, furthermore, that $L_t/N_t = E_t/N_t + h_t$, so by these simple sums we can detect any errors in the calculation of the rates.