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THE IMPACT OF THE GDP GROWTH RATE ON THE EURO ZONE'S UNEMPLOYMENT RATE

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INDEX

1. INTRODUCTION AND PURPOSE

The purpose of this study is to analyze, inside the Okun's Law framework, the effect the growth of production has on the unemployment rate on each country of the Eurozone. Additionally, the reasons why this effect can be different between countries will be analyzed.

The Okun's Law is a well known empirically inverse relationship between the unemployment rate and production growth rate variables of a given country.

This concept was defined in 1962 by the american economist Arthur Okun. In this study, Okun did notice a strong linear relationship between the GDP growth rate and the unemployment rate from 1947 to 1960 for the United States, which is still relevant in financial and macroeconomic fields.

Regarding to the definition of Okun's Law, the mentioned relationship between GDP, unemployment rate and their own percentage variations must be necessarely negative (*Ceteris Paribus*).

Essentially, economies in a position of growth and expansion with a steady active population have to increase the number of workers in order to increase its production levels, hence the unemployment growth rate would decrease. Conversely, at recession times, the amount of workers would decrease.

Even though it does not define a strictly theorical relationship between variables owing to its formulation, is mainly based on statistics estimations between data. The term "Law" has been applied due to it is an empirically relationship which has been achieved for most developed economies, only with variations in the value of the coefficients.

The study is going to be set by four parts. The first part will be related with the historical facts about the origin of the Okun's Law as well as its first statements

and the evolution of this theory. The second part will talk about its empirical application for this research, whilst the third part is going to be about the study of every country in this research and it will be comprised by an econometric interpretation and macroeconomic interpretation. Lastly, in the fourth part the results will be discussed.

1.1 THE THEORICAL MODEL

Since the Okun's first formulation until today, many versions about the Okun's Law have emerged, being the main difference the way of calculating the variations in the unemployment rate and GDP growth rate.

Blanchard (1998) reformulated the original Okun's Law into the "version in difference" [1.1.1] where he would include the growth rate of the GDP, which maintains the unemployment rate steady.

$$U_t - U_{t-1} = -\beta\left[g_{yt} - \bar{g}_y\right] \quad [1.1.1]$$

Where:

- U: Represents the unemployment rate.
- g_{yt}: The growth of production.
- $\bar{g}_y$: Represents the normal growth rate. It indicates de variation of the GDP so as the unemployment rate remains steady .
- β: Okun's coefficient; indicates the effect that produces a greater increase in production than $\bar{g}_y$ in the variation of the unemployment rate.

The expression [1.1.1] means that, in order to obtain the unemployment rate modified, it would be needed a variation in production in a different rate rather than its normal growth because, otherwise if $g_{yt} = \bar{g}_y$, the unemployment rate would remain steady.

So, the interpretation might be shown as follows:

If $g_{yt} > \bar{g}_y$, then $g_{yt} - \bar{g}_y > 0$, therefore $U_t - U_{t-1} < 0$. The unemployment rate would decrease.

If $g_{yt} = \bar{g}_y$, then $g_{yt} - \bar{g}_y = 0$, therefore $U_t - U_{t-1} = 0$. The unemployment rate would remain steady.

If $g_{yt} < \bar{g}_y$, then $g_{yt} - \bar{g}_y < 0$, therefore $U_t - U_{t-1} > 0$. The unemployment rate would increase.

1.2 THE ECONOMETRIC MODEL

Through economic model [1.1.1] we can obtain the econometric model [1.2.1] taking into account the following steps:

1. $U_t - U_{t-1} = -\beta\left[g_{yt} - \bar{g}_y\right]$

2. $-\beta = \beta_2$

3. $\beta \bar{g}_y = \beta_1$

4. $U_t - U_{t-1} = \Delta U_t$

5. $\Delta U_t = \beta_1 + \beta_2 g_{yt} + \varepsilon_t$ [1.2.1]

Where:

- ΔU_t: Represents the variation of the unemployment rate.
- g_{yt}: Represents the growth of the GDP.
- ε_t: Error term, which is supposed to be a white noise.

- Then, the way to estimate the normal growth rate could be through the following formulation:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

The economic interpretation of the parameters of model [1.2.1] would be the following, considering that g_{yt} and ΔU_t are expressed in percentage.

- β_1: is the constant of the model. It shows the average of the variation of the unemployment rate in percentage, which is independent to the rest of explanatory variables.

- β_2: If the growth rate of the GDP increases by one percentage point (p.p), the variation of the unemployment rate will decrease, on average, in β_2 percentage points and viceverse. It is the coefficient that measures the impact of the GDP growth rate on the unemployment rate.

1.3 OKUN'S β COEFFICIENT

The β coefficient in Okun's Law [1.1.1] indicates how the variation of the unemployment rate is affected by deviations of output growth from its normal level. For instance, a β coefficient with value of 0.4 indicates that, if the output growth is 1 p.p. above the normal growth rate, the variation of the unemployment rate would decrease, on average, by 0.4 p.p., *ceteris paribus*.

The β coefficient varies depending on how firms adjust their employment in response to fluctuations in production. This adjustment of employment depends on turn on such factors as the internal organisation of companies and the legal and social framework on hiring and firing.

As these legal and social frameworks should be different amongst countries, we could expect a different β coefficient amongst countries and, as Blanchard *et al.* (2012) has suggested, it does indeed.

2.EMPIRICAL APPLICATION

2.1 DATA AND VARIABLES

In order to estimate the regression model [1.2.1], a recompilation of certain data has been required. This data were obtain through Eurostat data base.

Eurostat is a statistic office from the European Comission which recopilates and elaborates data regarding to the European Union and keeps the flow of the statistics methods of the member countries inside.

The obtained data from the Eurostat data base was the "growth of real GDP" and the "unemployment rate", where, both of them were seasonally and calendar adjusted in order to do away with seasonality problems due to the fact that we use quarterly data. Both variables have been gathered for some countries of the European Union where there already are available data.

The sample size of the time series consists of about 66 and 86 observations depending on each given country.

To be able to estimate and validate the model, the Gretl software has been used. Gretl is a software that is used to perform econometric analysis.

Once the data have been collected, we label the variables of the model such as, for instance:

U_Euroarea: which represents the variation of the unemployment rate of the country; in this case, the Euro Area.

GDP_Euroarea: which represents the "quarter-on-quarter" real GDP growth rate of the given country; in this case, the Euro Area.

It is remarkable that, as the time series could be influenced by the crisis of 2008, some specific dummy variables has been created for some countries in order to test whether Okun's Law relationship has presented estructural changes in that period.

3. STUDY OF THE COUNTRIES

In order to accomplish this survey, GDP growth rate and unemployment rate variation data have been gathered for the following countries: Euro Area (as a whole), Belgium, Germany, Estonia, Ireland, Spain, France, Italy, Cyprus, Lithuania, Luxembourg, Malta, Austria, Portugal, Slovenia and, Finland.

This survey is about how the Okun's β coefficient changes for these different countries and what have been the main reasons to explain so. In order to do so, this section is going to be divided in two parts or steps.

In the first part, the β coefficient is going to be explained from a econometric point of view to see how changes in the GDP affect the unemployment variation.

In the second part, the β coefficient is going to be explained from a macroeconomical view, analyzing the reasons why each unemployment variation

has responded in a different way to changes in the GDP, that is to say, we explain the reasons this coefficient differs from one country to another.

3.1 ECONOMETRIC INTERPRETATION OKUN'S β COEFFICIENT

In order to do so, all the contrasts have been estimated by ordinary least squares, using robust standard errors obtained by using Newey-West estimation of the covariance matrix of regression, in order to overcome, in case of either heteroscedasticity or autocorrelation.

Moreover, the Ramsey's RESET test has been applied for all the models to contrast whether or not any relevant variables were omitted, with an established level of significance of 1% for all the tests.

Hereunder, an econometrical interpretation is going to be shown for the following countries, with special mention to the Okun's coefficient, β_2.

1-EURO AREA:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1999:2-2017:2

Table[3.1.1]

EURO AREA	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,454753	0,0973359	1,38e-05***	0,753706
GDP	-0,360527	0,0317813	1,33E-17***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.0103			

β_1= 0,454753 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,360527 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,360527 p.p., and viceverse.

From the estimations of the regession coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, the Euro area will need to grow above $\frac{0,45}{0,36} = 1,25\%$, in order the unemployment rate reduces.

2-IRELAND:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1998:1-2017:2

In this case, the crisis has had a significant effect on the estimation. The following dummy variable takes a value of 0 from first quarter in 1998 to fourth quarter in 2009 and, a value of 1 for the rest of the years.

Dummy = 0 1998:1-2009:4

Dummy = 1 2010:1-2017:2

Table[3.1.2]

IRELAND Q2010:1	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	1,84115	0,491894	0,0004***	0,602127
GDP	-0,337045	0,0659249	2,41e-06***	
DUMMY	-1,96055	0,6632	0,0042***	
DUMMY.GDP	0,250807	0,0672736	0,0004***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.114			

[1]

[1] From now on, β_3 stands for differential constant and β_4 stands for differential slope.

β_1= 1,84115 Before the first quarter of 2010. It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,337045 Before the first quarter of 2010. If the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,337045 p.p., and viceverse.

β_3= -1,96055 After the first quarter of 2010. On average, the variation of the unemployment rate is -0,1194 % [(1,84115 +(-1,96055)] when the rest of the explanatory variables do not change.

β_4= 0,250807 After the first quarter of 2010. If the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrase, on average, 0,086238 p.p. (-0,337045 + 0,250807), and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

Before 2010:1

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Ireland will need to be above $\frac{1,84}{0,33} = 5,5\%$ in order the unemployment rate reduces.

After 2010:1

$$\bar{g}_y = \frac{\widehat{\beta_1+\beta_3}}{-\widehat{\beta_2}+\beta_4} = 0\%$$

Because:

$$\beta_1 + \beta_3 = 0$$

When we test H_0: $\beta_1 + \beta_3 = 0$ we do not reject this null hypotesis, therefore in 2010 any growth of the GDP affects on the unemployment rate variation.[2]

3-BELGIUM:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:1

Table[3.1.3]

BELGIUM	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,344766	0,134673	0,0123**	0,256327
GDP	-0,246719	0,0638991	0,0002***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0,697			

β_1= 0,344766 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,246719 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,246719 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

[2] Please check the appendix for additional table (2)

Then, Belgium will need to grow above $\frac{0,34}{0,24} = 1,41\%$, in order the unemployment rate reduces.

4-GERMANY:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

In this case, the crisis has had a significant effect on the estimation. The following dummy variable takes value of 1 during 2009 and value of 0 for the rest of the years.

Dummy = 0 1996:1-2008:4 - 2010:1-2017:2

Dummy = 1 2009:1-2009:4

Table[3.1.4]

GERMANY Q2009:1-4	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,341399	0,201029	0,0932*	0,399594
GDP	-0,322347	0,0694073	1,27E-05***	
DUMMY.GDP	0,338773	0,0936276	0,0005***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.0717			

β_1 = 0,341399 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2 = -0,322347 Before the first quarter of 2009. If the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average 0,322347 p.p., and viceverse.

β_4= 0,338773 After the last quarter of 2009. If the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will increase, on average, 0,016426 p.p. (-0,322347 + 0,338773), and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

Before 2009:1

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Germany will need to be above $\frac{0,34}{0,32} = 1,06\%$ in order the unemployment rate reduces.

After 2009:4

When we test H_0: $\beta_2 + \beta_4 = 0$ we do not reject this null hypotesis, therefore in 2009 there is no effect of the growth of the GDP on the unemployment variation rate[3] and the Okun's Law is not fulfilled.

5-ESTONIA:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 2001:1-2017:2

[3] Please check the appendix for additional table (1)

Table[3.1.5]

ESTONIA	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,910405	0,460932	0,0526*	0,649795
GDP	-0,38277	0,0570647	6,05e-09***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.0137			

β_1 = 0,910405 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2 = -0,38277 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,38277 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Estonia will need to grow above $\frac{0,91}{0,38} = 2,4\%$, in order the unemployment rate reduces.

6-SPAIN:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

Table[3.1.6]

SPAIN	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	1,62294	0,424068	0,0002***	0,718974
GDP	-0,795272	0,113156	5,13e-10***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.0194			

β_1= 1,62294 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,795272 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,795272 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Spain will need to grow above $\frac{1,62}{0,79} = 2,05\%$, in order the unemployment rate reduces.

7-FRANCE:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

Table[3.1.7]

FRANCE	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,394684	0,113674	0,0008***	0,458793
GDP	-0,274742	0,0511847	6,95e-07***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.608			

β_1= 0,394684 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate in percentage, which is independent to the rest of explanatory variables.

β_2= -0,274742 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,274742 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, France will need to grow above $\frac{0,39}{0,27} = 1,44\%$, in order the unemployment rate reduces.

8-ITALY:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

In this case, the crisis has had a significant effect on the estimation. The following dummy variable takes value of 0 from first quarter in 1996 to third quarter in 2011 and, a value of 1 for the rest of the years.

Dummy = 0 1996:1-2011:3

Dummy = 1 2011:4-2017:2

Table[3.1.8]

ITALY Q2011:4	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	-0,0453136	0,101304	0,6558	0,69985
GDP	-0,163633	0,0270199	4,03e-08***	
DUMMY	0,406141	0,159668	0,0128**	
DUMMY.GDP	-0,490808	0,0622088	1,16e-11***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.654			

β_1 = -0,0453136 Before the fourth quarter of 2011. It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of the explanatory variables.

β_2 = -0,163633 Before the fourth quarter of 2011. If the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,163633 p.p., and viceverse.

β_3 = 0,406141 After the fourth quarter of 2011. On average, the variation of the unemployment rate is 0,406141 % (-0,0453136 +0,406141) when the rest of the explicative variables do not change.

β_4 = -0,490808 After the fourth quarter of 2011. If the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrase, on average, 0,654441 p.p. [(-0,163633) + (-0,490808)], and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

Before 2011:4

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}} = 0\%$$

Because:

$$\widehat{\beta_1} = 0$$

When we test $H_0: \beta_1 = 0$, we do not reject the null hypotesis.[4] Then, we could assume its value is equal to 0. Therefore before 2011:4, any growth of the GDP affects on the unemployment rate variation.

After 2011:4

$$\bar{g}_y = \frac{0{,}4061}{-\widehat{\beta_2}+\beta_4} = 0{,}406141\%$$

Then, Italy will need to be above $\bar{g}_y = \frac{0{,}4061}{-\widehat{\beta_2}+\beta_4} = 0{,}406141\%$ in order the unemployment rate reduces.

9-CYPRUS:

Dependent variable = Unemployment rate variation
Explicative variabe = GDP growth rate
Sample period = 2001:1-2017:2

In this case, the crisis has had a significant effect on the estimation. The following dummy variable takes value of 0 from first quarter in 2001 to second quarter in 2013 and, a value of 1 for the rest of the years.

[4] Please check the appendix for additional table (3)

Dummy = 0 2001:1-2013:2

Dummy = 1 2013:3-2017:2

Table[3.1.9]

CYPRUS Q2013:3	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	1,67284	0,190575	1,57e-12***	0,765734
GDP	-0,479407	0,0424129	8,47e-17***	
DUMMY	-1,82792	0,384097	1,18e-05***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.602			

β_1= 1,67284 Before the third quarter of 2013. It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,479407 Means that, if the GDP growth rate increases by 1 p.p, the variation of the unemployment rate will decrease, on average, 0,479407 p.p., and viceverse.

β_3= -1,82792 After the third quarter of 2013. On average, the variation of the unemployment rate is -0,15508 % [(1,67284 +(-1,82792)] when the rest of the explanatory variables do not change.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

Before 2013:3

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Cyprus will need to be above $\frac{1,67}{0,47} = 3.55\%$ in order the unemployment rate reduces.

After 2013:3

$$\bar{g}_y = \frac{\widehat{\beta_1+\beta_3}}{\widehat{-\beta_2}} = 0\%$$

Because:

$$\beta_1 + \beta_3 = 0$$

When we test H_0: $\beta_1 + \beta_3 = 0$ we do not reject this null hypotesis, therefore, from 2013:3, any growth of the GDP affects on the unemployment rate variation.[5]

10-LITHUANIA:

Dependent variable = Unemployment rate variation
Explanatory variable = GDP growth rate
Sample period = 1999:1-2017:2

In this case, the crisis has had a significant effect on the estimation. The following dummy variable takes value of 0 from first quarter in 1999 to first quarter in 2010 and, a value of 1 for the rest of the years.

Dummy = 0 1999:1-2010:1
Dummy = 1 2010:2-2017:2

[5] Please check the appendix for additional table (4)

Table[3.1.10]

LITHUANIA Q2010:2	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	1,93516	0,327843	1,12e-07***	0,686666
GDP	-0,415731	0,029524	3,07e-22***	
DUMMY	-1,57836	0,536768	0,0044***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.164			

β_1= 1,93516 Before the second quarter of 2010. It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,415731 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,415731 p.p., and viceverse.

β_3= -1,57836 After the second quarter of 2010. On average, the variation of the unemployment rat is 0,3568 % [(1,93516 +(-1,57836)] when the rest of the explicative variables do not change.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

Before 2010:2

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Lithuania will need to be above $\frac{1,93}{0,41} = 4,7\%$ in order the unemployment rate reduces.

After 2010:2:

$$\bar{g}_y = \frac{\widehat{\beta_1+\beta_3}}{\widehat{-\beta_2}} = 0\%$$

Because:

$$\beta_1 + \beta_3 = 0$$

When we test $H_0: \beta_1 + \beta_3 = 0$ we do not reject this null hypotesis, therefore between 2010 and 2017 any growth of the GDP affects on the unemployment variation rate.[6]

11-LUXEMBOURG:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

Table[3.1.11]

LUXEMBOURG	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,358535	0,113224	0,0021***	0,147139
GDP	-0,0579969	0,0134455	4,36e-05***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.886			

β_1= 0,358535 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,0579969 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,0579969 p.p., and viceverse.

6 Please check the Appendix for additional table (5)

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Luxembourg will need to grow above $\frac{0,35}{0,05} = 7\%$, in order the unemployment rate reduces.

12-MALTA:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 2001:1-2017:2

Table[3.1.12]

MALTA	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,165707	0,176197	0,3505	0,156846
GDP	-0,0966888	0,0304021	0,0023***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.188			

β_1= 0,165707 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,0966888 Means that, if the GDP growth rate increases by 1 p.p, the variation of the unemployment rate will decrease, on average, 0,0966888 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Malta will need to grow above $\frac{0,16}{0,09} = 1,77\%$, in order the unemployment rate reduces.

13-AUSTRIA:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1997:1-2017:2

Table[3.1.13]

AUSTRIA	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,371585	0,09327	0,0001***	0,337153
GDP	-0,178707	0,0306041	1,08e-07***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.726			

β_1= 0,371585 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,178707 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,178707 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Austria will need to grow above $\frac{0,37}{0,17} = 2.17\%$, in order the unemployment rate reduces.

14-PORTUGAL:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

Table[3.1.14]

PORTUGAL	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,548833	0,208468	0,0101**	0,429259
GDP	-0,359884	0,0506704	3,67e-10***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.0614			

β_1= 0,548833 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,359884 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,359884 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Portugal will need to grow above $\frac{0,54}{0,36} = 1,5\%$, in order the unemployment rate reduces.

15-SLOVENIA:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1997:1-2017:2

Table[3.1.15]

SLOVENIA	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,464501	0,164345	0,0059***	0,408968
GDP	-0,167952	0,0331175	2,50e-06***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.402			

β_1= 0,464501 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,167952 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,167952 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Slovenia will need to grow above $\frac{0,46}{0,16} = 2,87\%$, in order the unemployment rate reduces.

16-FINLAND:

Dependent variable = Unemployment rate variation

Explanatory variable = GDP growth rate

Sample period = 1996:1-2017:2

Table[3.1.16]

FINLAND	COEFFICIENT	STD. ERROR	P-VALUE	R^2
CONSTANT	0,119933	0,0905309	0,1888	0,670359
GDP	-0,190682	0,0253032	5,11e-11***	
RAMSEY'S RESET	P-VALUE			
SQUARES & CUBES	0.0789			

β_1=0,119933 It is the constant or the intercept term of the model, shows the average of the variation of the unemployment rate (in percentage), which is independent to the rest of explanatory variables.

β_2= -0,190682 Means that, if the GDP growth rate increases by 1 p.p., the variation of the unemployment rate will decrease, on average, 0,190682 p.p., and viceverse.

From the estimations of the regression coefficients, an estimation of the normal production is obtained:

$$\bar{g}_y = \frac{\widehat{\beta_1}}{-\widehat{\beta_2}}$$

Then, Finland will need to grow above $\frac{0,12}{0,19} = 0,63\%$, in order the unemployment rate reduces.

3.2 MACROECONOMIC INTERPRETATION

This part is related with the reasons why the Okun's β coefficient may differs from one country to another. For this part, a data table has been created in order to organize the β coefficient in a descending order as a sum up to ease the results.

This data table [3.2] below shows the estimation of the Okun's β coefficient based. On the one hand, we can see how Spain is the country with the greatest β value of -0,795272 followed by Cyprus and Lithuania, with values of -0,479407 and -0,415731 respectively. On the other hand Italy, Malta and Luxembourg have the Okun's coefficient with the least values, being these of -0,163633 -0,0966888 and -0,0579969 respectively.

To continue, we are going to try to analyze the results obtained, from a macroeconomic point of view.

Table [3.2]

			Constant: Unemployment's rate		Explicative Variable: GDP		D.D		D.D*GDP		
COUNTRY	T	Period	β^1	P-Value	β^2	P-Value	β^3	P-Value	β^4	P-Value	R^2
SPAIN	86	1996:1-2017:2	1,62294	0,0002***	-0,795272	5,13e-10***					0,718974
CYPRUS	66	2001:1-2017:2	1,67284	1,57e-12***	-0,479407	8,47e-17***	-1,82792	1,18e-05***			0,765734
LITHUANIA	74	1999:1-2017:2	1,93516	1,12e-07***	-0,415731	3,07e-22***	-1,57836	0,0044***			0,686666
ESTONIA	66	2001:1-2017:2	0,910405	0,0526*	-0,38277	6,05e-09***					0,649795
EURO AREA	73	1999:2-2017:2	0,454753	1,38e-05***	-0,360527	1,33e-17***					0,753706
PORTUGAL	86	1996:1-2017:2	0,548833	0,0101**	-0,359884	3,67e-10***					0,429259
IRELAND	78	1998:1-2017:2	1,84115	0,0004***	-0,337045	2,41e-06***	-1,96055	0,0042***	0,250807	0,0004***	0,602127
GERMANY	86	1996:1-2017:2	0,341399	0,0932*	-0,322347	1,27e-05***			0,338773	0,0005***	0,399594
FRANCE	86	1996:1-2017:2	0,394684	0,0008***	-0,274742	6,95e-07***					0,458793
BELGIUM	85	1996:1-2017:1	0,344766	0,0123**	-0,246719	0,0002***					0,256327
FINLAND	86	1996:1-2017:2	0,119933	0,1888	-0,190682	5,11e-11***					0,670359
AUSTRIA	82	1997:1-2017:2	0,371585	0,0001***	-0,178707	1,08e-07***					0,337153
SLOVENIA	82	1997:1-2017:2	0,464501	0,0059***	-0,167952	2,50e-06***					0,408968
ITALY	86	1996:1-2017:2	-0,0453136	0,6558	-0,163633	4,03e-08***	0,406141	0,0128**	-0,490808	1,16e-11***	0,69985
MALTA	82	2001:1-2017:2	0,165707	0,3505	-0,0966888	0,0023***					0,156846
LUXEMBOURG	86	1996:1-2017:2	0,358535	0,0021***	-0,0579969	4,36e-05***					0,147139

Source: Own elaboration from Gretl

Many authors consider that, the reasons for these differences in the Okun's β coefficient amongst countries could be explained by external variables.

These variables could be the following:

- Employment Protection
- Temporality
- Wage and labour Flexibility
- Productivity

3.2.1 EMPLOYMENT PROTECTION (E.P.)

According to Blanchard (1998), one of the reasons that explain why the Okun's β coefficient can increase or decrease in many different ways is because the legal and social constrains on hiring and firing.

This estatement is related with the level of employment protection legislation that countries have. In the same way Barone (2001) defines protection legislation as "It is refered to the entire set of regulations that place some limits to the faculties of firms to hire and fire workers. In particular, favouring the disadvantaged groups in society, determining:

1. Conditions for the use of temporary or fixed-term contracts.
2. Imposing training requirements on the firm,
3. Affecting hiring and firing policies.
4. Severance payments."

In order to analyze the E.P for each country, first, it is required to know that there exist two types of indicators: the ILO EPlex indicators, which belongs to the International Labour Office, and the OECD EP legislation indicators, which belongs to the Organisation for Economic Co-operation and Development.

“The OECD EP legislation indicators are based on legal provisions, but also, to a certain extent, on estimations of the EP legislation practise, such as delays before notice can start, or estimated months of compensation for unfair dismissal.

The ILO EPlex can be considered as largely comparable to the OECD composite indicator of strictness of employment protection for regular employment, the ILO EPlex indicator also has the following distinct features:

- The set of quantitative ILO EPlex indicators is aligned with the fundamental principles and rights at work.

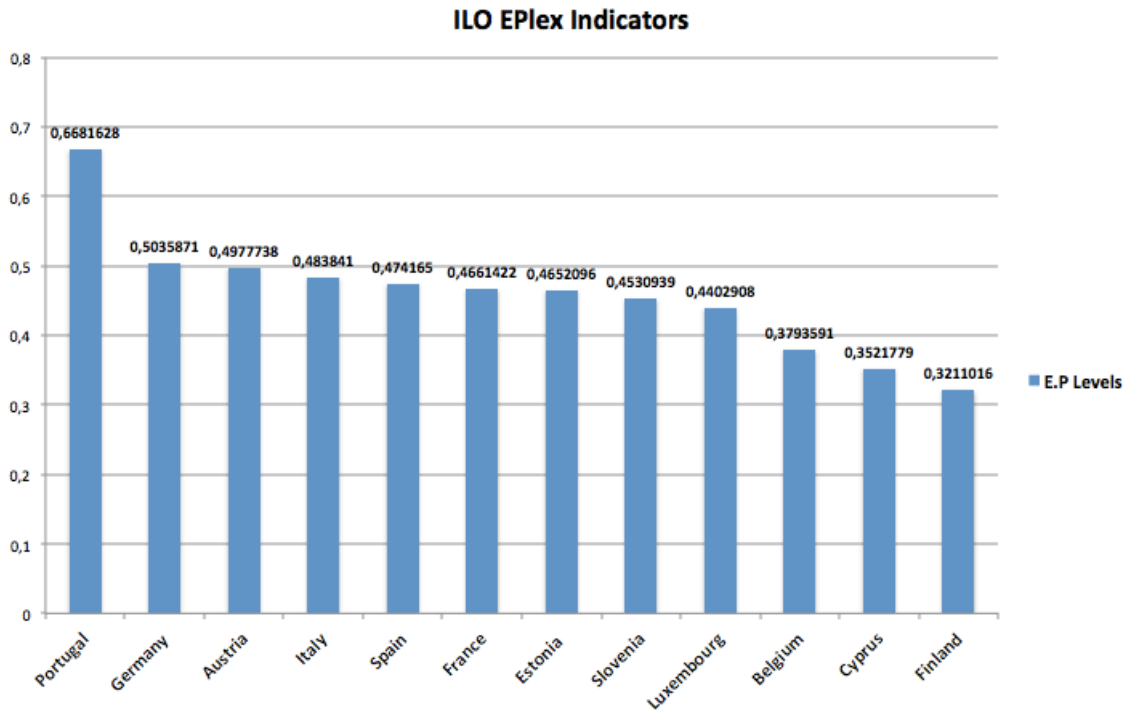
- The ILO EPlex indicators are based on laws and, where relevant, on national collective agreements.

- Assigning numeric values to coding of the legal data strives to minimize value judgements in interpreting the laws.

- Indicators are based on exhaustive components describing EPL aspects in the area of individual dissmissals to the fullest extent posible.”
  (ILO EP Legislation, 2015. pg 60).

For these reasons, ILO EPlex indicators have been elected to accomplish the Figure [3.2.1]:

Figure [3.2.1]



Source: Own elaboration from International Labour Organization data (2015).

Ultimately, all the resulting indicators are distributed on 0-1 scale. Lower values of EPLex indicators represent lower level of *jure* employment protection in a given country and a given year, while higher values of EPLex indicators represent higher level of de jure employment protection" (ILO EP Legislation, 2015. pg 60).

On the one hand, Diaz de Guzman *et al.* (2015) estimates that, during the crisis period, the OECD countries with the least employment protection levels suffered a higher increase in the Okun's β coefficient, unlikely OECD countries with higher employment protection levels. Balakrishnan *et al.* (2010) also defends that, those countries where the Okun's β coefficient has increased over the years due to they have lower employment protection are those with higher industrialization.

On the other hand, according to Nickell (1997) the strictness in the employment protection over the unemployment rate is not significant; this could explain why Portugal has the highest employment protection legislation despite its Okun's β coefficient is on the average levels. Also, Nickell and Layard (1999) did not find

evidence on the relationship between higher labor market legislation and high unemployment rate. Moreover, Bassani and Duval (2009) found out that the relationship between the unemployment rate and employment protection is not conclusive.

In conclusion, although some authors consider an inverse relationship between the employment protection and the Okun's β coefficient, it might not be as significant as expected since there are more factors that the ILO EPLex and OECD indicators do not include and, indeed, quoting Skedinger (2010), "No robust relationship between aggregate employment, or unemployment rate, and employment protection persists."

From the ILO EPlex indicators we have obtained, we cannot clearly see an inverse relationship between the employment protection and the Okun's β coefficient as it is, for instance, the case of Spain and Italy that, having the same employment protection level, Spain has the highest Okun's β coefficient whilst, Italy has one of the lowest Okun's β coefficient value.

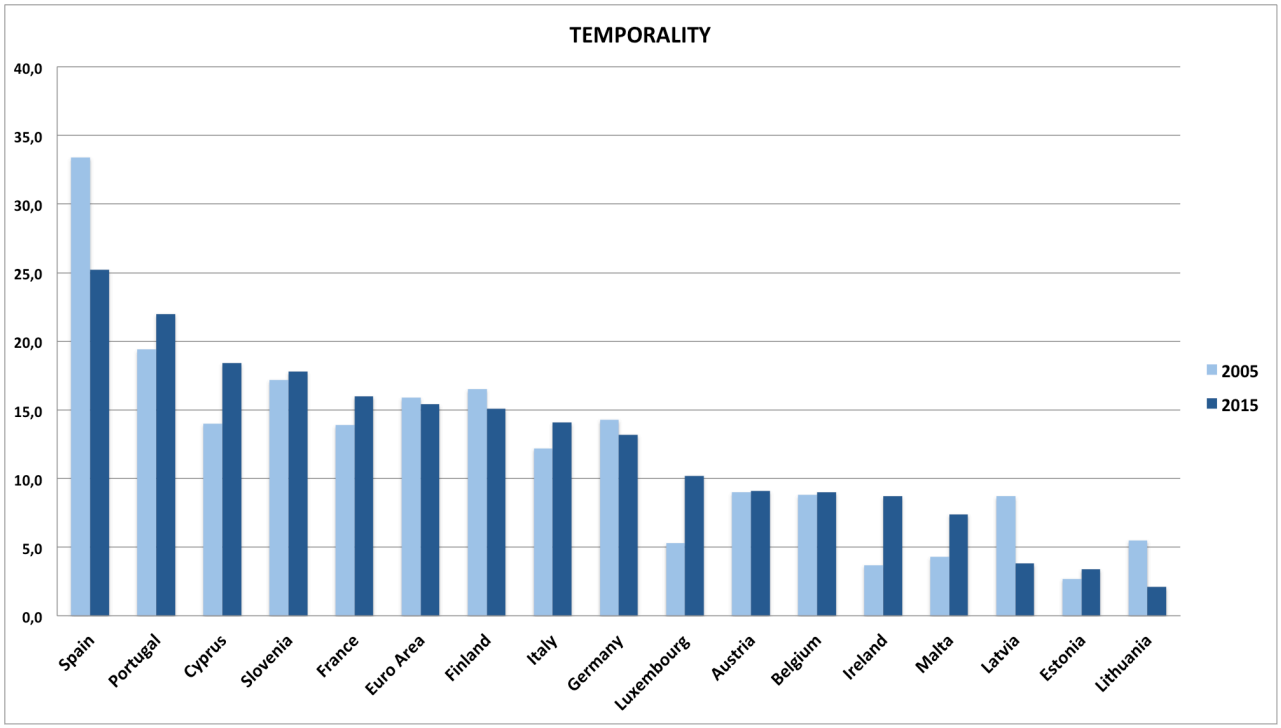
3.2.2 TEMPORALITY

Another variable that may incur in the value of the Okun's β coefficient is the temporality rate.

The temporality rate studies the number of temporary contracts over the totality of contracts of a given country. In other terms, a higher rate of temporary jobs does not mean these are briefly jobs, but it does mean that there exist a lot of temporary contracts over the total contracts of a country. A labour legislation with low levels in employment protection reduces the costs of dismissal, which leads into an increase in the Okun's Coefficient. In the same way, temporality might increase the Okun's Coefficient since temporary jobs have a lower legislation and, indeed, a lower cost of dismissal.

In order to achive a view of the temporality rates across the countries that are being studied for this research Figure [3.2.2.] has been elaborated with data obtained from Eurostat.

Figure [3.2.2]



Source: Own elaboration from Eurostat data.

According to Balakrishnan *et al.* (2010) the Okun's β coefficient has increased over the last twenty years due to labour legislations with low levels of employment protection and, on the other hand, due to an increase in temporality rates.

Generally, we can observe that, the higher levels of the Okun's β coefficient for Spain and Cyprus of -0,79 and -0,49 , respectively, could be plausible since, as we have seen lately, Spain and Cyprus have the greatest temporary rates among other countries and, as the IMF estates, the higher the temporality rate is, the lower the employment protection legislation could be and therefore, a higher Okun's β coefficient could be possible.

3.2.3 WAGE AND LABOUR FLEXIBILITY

During a recession period, firms tend to adjust their costs in order to keep the firm running by reducing working hours, decreasing wages or firing employees, depending on which solution is more beneficial, also known as wage and labour flexibility. The OECD (1986) states that the Labour Flexibility is the capacity firms have to adapt themselves to a brand new, economical, social and technological circumnstances.

On the one hand, according to Lee (2000), Cazes, Verick and al-Hussami (2012) and, Balakrishnan, Das and Kannan (2010) have related the Okun's β coefficient with the labour flexibility, in a sense that, along with technological changes and a better training for employees, it can also have an impact in the growth of the GDP and reduct the unemployment rate. Abbritti and Weber (2010) state that, strictness in the wages has, as an effect, a higher volatility on the unemployment rate, that is to say, a higher temporality rate means a strong strictness on wages and a high volatility in the unemployment rate. Moreover, Blanchflower and Freeman (1994) concluded that flexing the labour markets seemed an adecuated strategy to reduce the unemployment rate.

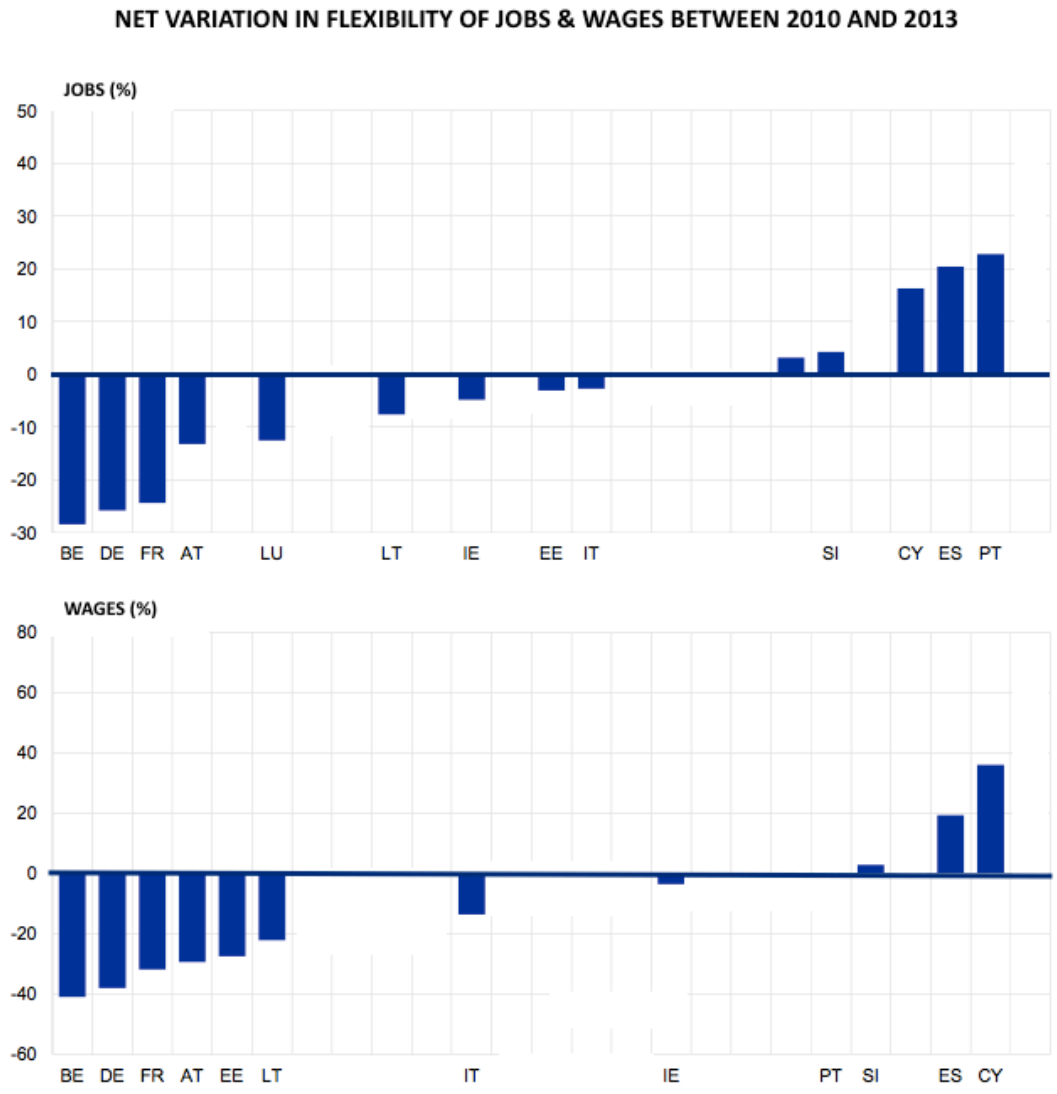
On the other hand, Diaz de Guzman *et al.* (2015) explain that in 2008, during the crisis period, those countries with more flexible labour markets, such as Spain or Ireland, suffered a greater increase in the Okun's coefficient, so some other authors showed skeptical to Blanchflower and Freeman statement. Moreover, Cazes *et al.* (2012) state that, during the financial crisis (2007-2010) those countries with more flexible labour markets such as Canada, Spain or United States, were tend to have a greater variation of the Okun's β coefficient, whereas countries with more employment protection such as, Germany, Italy or Japan did not.

To conclude, according to Villena (2015) those countries which adjusted themselves to the labour market through wages such as Germany or Luxembourg instead of dismissals such as Spain, Greece or Cyprus, experienced a reduction in

the unemployment rate and therefore, a reduction in the Okun's β coefficient, in spite of the crisis period.

In order to give values to all these estatements, two graphs have been gathered from the Wage Dynamics Network of the European Central Bank, related with wage and labour flexibility, Figure [3.2.3].

Figure [3.2.3]



[7]Source: Wage Dynamics Network.

[7] (BE), (DE), (FR), (AT), (LT), (LU), (IT), (IE), (EE), (PT), (SI), (ES) and (CY) stands for Belgium, Germany, France, Austria, Lithuania, Luxembourg, Italy, Ireland, Estonia, Portugal, Slovenia, Spain and Cyprus respectively.

Figure [3.2.3] shows the differences between the percentage of firms that affirm to have adjusted with more facility either jobs or wages against changes in economic situation over the percentage of firms that affirm to have experienced a more difficult adjustment. Positive numbers stand for the ease in the adjustment whilst negative numbers stand for the difficulty in the adjustment.

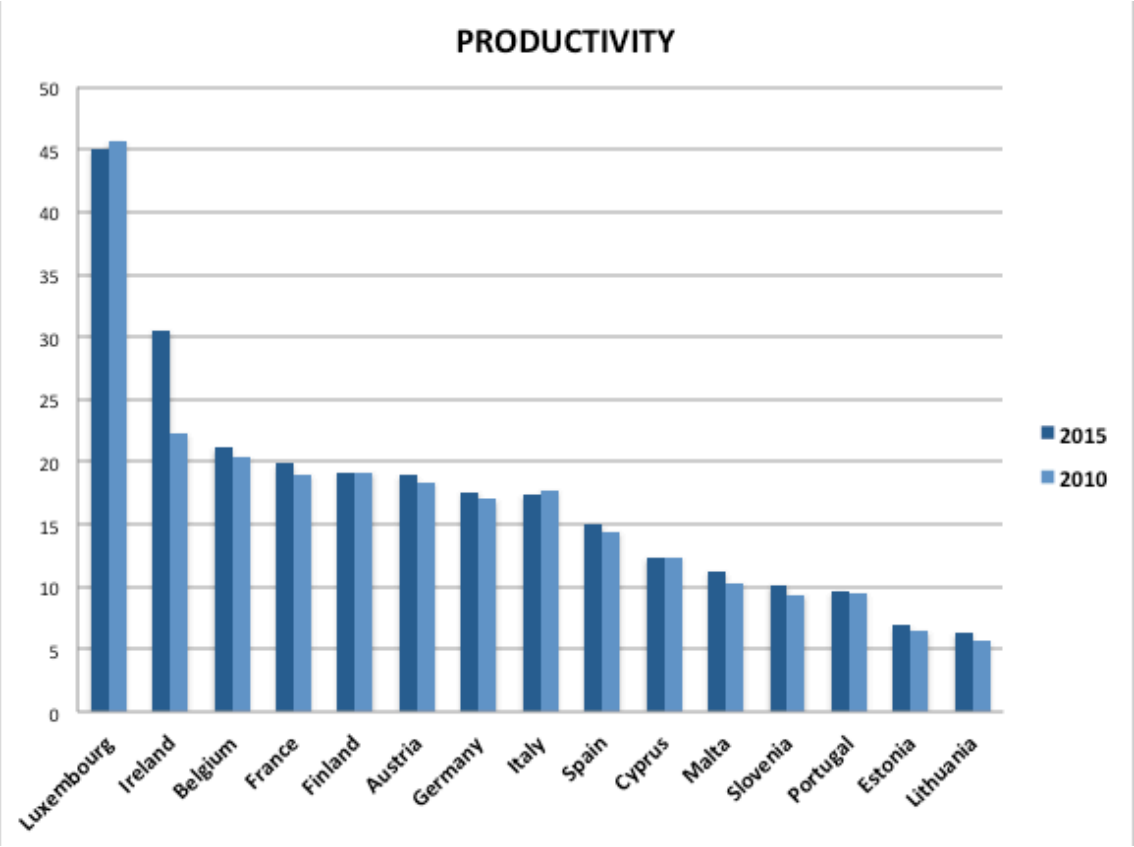
As we see from the results in Figure [3.2.3], there exists more difficulty to adjust either jobs or wages in countries like Belgium, Germany, France, Austria, Estonia, Lithuania, Italy and Luxembourg, whilst, Slovenia, Spain, Portugal and Cyprus have positive levels to ease the adjustment of jobs and wages during economic situations, which could explain some of the reasons for high values in the Okun's β coefficient in countries like Spain, Cyprus and Portugal.

3.2.3 PRODUCTIVITY

Ultimately, there is another variable that might cause an effect on the β coefficient, this variable is known as productivity. The productivity could be defined as the quantity of goods and services that are produced by worker.

A graph that gives values of the total productivity for all the countries in this research has been obtained from Eurostat to see if, indeed, there might exist a relationship between the productivity and the β coefficient.

Figure [3.2.4]



Source: Own elaboration from Eurostat data.

According to Villaverde and Maza (2009), when the productivity in a given country increases, the requirements for the employment decreases, hence, there is less employment but more steady; changes in productivity have greater effects on the Okun's β coefficient.

Moreover, regarding to Villena (2015), those countries where the productivity has decreased during expansive periods, they have increased the Okun's coefficient.
In this way, we could explain the high values of the Okun's β coefficients for Spain, Cyprus, Estonia and Lithuania, where the productivity levels for these countries are not even above the average level, with a special mention to Portugal since the results in its productivity rate could explain its β coefficient despite it has the highest employment protection legislation of all of the countries in this research and, on the other hand, Luxembourg, with the lowest β value, thanks to the highest level of productivity.

4. CONCLUSION

The Okun's Law is an empirically inverse relationship between the unemployment rate and production growth rate variables of a given country, that is to say, it is the effect which the growth of production has on the unemployment rate on a country.

In this study, we have seen that, indeed, there exists this effect for each country we have analyzed. The countries where the GDP growth rate have a higher effect on the unemployment rate are Spain, Cyprus, Lithuania, Estonia, Portugal, and Ireland, whilst, the countries where the GDP growth rate has a lower effect on the unemployment rate are Germany, France, Belgium, Finland, Austria, Slovenia, Italy, Malta, and Luxembourg.

Once this empirical analysis was made, in this study we have concluded that there exist external factors that may have incur on the differences of the Okun's β coefficient for the countries within the Euro zone during the last years such us, the employment protection legislation, the temporality rate, the wage and labour flexibility and the productivity of a country.

Taking into account some of the estatements mentioned before for some authors, the results we obtain for the Okun's β coefficient could be plausible. For instance, the β coefficient that we have obtained for countries such as Spain, Cyprus or Lithuania could be explained thanks to the high temporality rates they had for that period, as Balakrishnan, R., Das, M. y Kannan, P. (2010) estated, and also, due to its facility to adjust either jobs or wages during economic situations, according to Abbritti and Weber (2010), or owing to its low productivity rate as Villena (2015) mentioned. We have also seen how other external factors such employment protection could, or could not have an inverse relationship with the Okun's β coefficient, which is, for instance, the case of Spain, and Italy that, having the same levels of employment protection, Spain has the highest Okun's β coefficient whilst, Italy has one of the lowest Okun's β coefficient.

Moreover, we have seen how could exist a relationship amongst these variables such as temporality and employment protection since, the higher the temporality rate is, the lower the employment protection is due to temporary jobs have lower

employment protection legislation and therefore a lower costs of dismissals, which leads us to the same conclusion, an increase in the Okun's β coefficient, and viceverse.

A case that gets a special attention, is related with Malta and Luxembourg, where the Okun's Law is fulfilled but, with a practicaly nule Okun's β coefficient and a really low R^2, which leads to a lax relationship between the GDP growth rate and the variation of the unemployment rate.

This result could be as a consecuence that, these countries, are offshore territories, where both, natural person and legal person obtain financial benefits such as "tax haven" or "banking secrecy laws" regarding to their economic activity. The fact that, in these countries, there is nule relationship between their tax residence and the place where the activity is exploded, may originate the growth of the GDP does not affect on the labour market, hence, on the variation of the unemployment rate.

5. APPENDIX

Additional table (1): Germany, test $\beta_2 + \beta_3 = 0$

```
Restriction:
 b[GDP_Germanyuntil1990former] + b[D2009GDPgermany] = 0

Test statistic: Robust F(1, 83) = 0.225186, with p-value = 0.636362

Restricted estimates:

                            coefficient  std. error  t-ratio  p-value
  ---------------------------------------------------------------------
  const                       0.331784   0.0950540    3.490   0.0008   ***
  GDP_Germanyuntil1990former -0.319115   0.0427396   -7.466   7.01e-11 ***
  D2009GDPgermany             0.319115   0.0427396    7.466   7.01e-11 ***

  Standard error of the regression = 0.585394
```

Additional table (2): Ireland, test $\beta_1 + \beta_3 = 0$

```
Restriction:
 b[const] + b[D20101] = 0

Test statistic: Robust F(1, 74) = 0.0498412, with p-value = 0.823955

Restricted estimates:

                   coefficient   std. error   t-ratio   p-value
  ------------------------------------------------------------------
  const               1.84115     0.242420     7.595    7.02e-11 ***
  GDP_Ireland        -0.337045    0.0348860   -9.661    8.30e-15 ***
  D20101             -1.84115     0.242420    -7.595    7.02e-11 ***
  D2010GDPireland     0.243570    0.0407537    5.977    7.14e-08 ***

  Standard error of the regression = 1.18788
```

Additional table (3): Italy, test $\beta_1 + \beta_2 = 0$

```
Restriction:
 b[const] + b[GDP_Italy] = 0

Test statistic: Robust F(1, 82) = 3.96124, with p-value = 0.0498912

Restricted estimates:

                  coefficient   std. error   t-ratio   p-value
  ------------------------------------------------------------
  const             0.159155    0.0290809     5.473    4.60e-07 ***
  GDP_Italy        -0.159155    0.0290809    -5.473    4.60e-07 ***
  D20114            0.201673    0.112013      1.800    0.0754   *
  D20114GDPitaly   -0.495287    0.0726347    -6.819    1.37e-09 ***

  Standard error of the regression = 0.50645
```

Additional table (4): Cyprus, test $\beta_1 + \beta_3 = 0$

```
Restriction:
 b[const] + b[D2013] = 0

Test statistic: Robust F(1, 63) = 0.245369, with p-value = 0.622079

Restricted estimates:

               coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------
  const          1.67704     0.141904      11.82    9.73e-18 ***
  GDP_Cyprus    -0.481560    0.0349571    -13.78    8.20e-21 ***
  D2013         -1.67704     0.141904     -11.82    9.73e-18 ***

  Standard error of the regression = 0.880062
```

Additional table (5): Lithuania, test $\beta_1 + \beta_3 = 0$

```
Restriction:
 b[const] + b[D20102] = 0

Test statistic: Robust F(1, 71) = 0.513283, with p-value = 0.476071

Restricted estimates:

                  coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------
  const             1.87810     0.280993       6.684   4.21e-09 ***
  GDP_Lithuania    -0.402095    0.0321942    -12.49    1.07e-19 ***
  D20102           -1.87810     0.280993      -6.684   4.21e-09 ***

  Standard error of the regression = 1.65421
```

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