THE LABOUR MARKET AND UNEMPLOYMENT IN EUROPE 15

The current economic and financial crisis has had a negative effect all over the world. Nonetheless, this effect has not been the same one in all countries as some countries were more affected than others. This paper analyses the variations that the unemployment rate suffered in the countries that form the European Union 15. Apart from trying to explain how this rate fluctuates throughout a determined timeframe and observe if it converges back to its initial natural unemployment rate of if the so called hysteresis is produced.

In order to be able to perform a correct analysis of these variations we carried out a study of temporal series through the application of unit roots tests and stationarity test. Moreover, we noticed how the rigidities of the labour market affect the convergence of the unemployment rate.

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1. INTRODUCTION

Nowadays Europe, like the rest of the world, finds itself immersed in an economic and financial crisis. This vast economic crisis began in 2007 and had a negative effect on the unemployment rate, affecting unequally countries that form the European Union and its duration.

This paper intends to explain how the unemployment rate varies over a determined period of time and if this rate converges to its initial natural unemployment rate or if, on the contrary, the so called hysteresis occurs. In other words, the main purpose is to analyse if the positive or negative effect in the economy will affect equally different unemployment rates of the countries that form European Union 15 and if these rates tend to return to their natural unemployment rate (NAIRU) or if, on the contrary, there is a permanent change and the unemployment rate does not return to its initial value. These permanent changes of the unemployment rate can be a result of the market rigidity, due to the fact that they block the free fluctuation of the economy. Like this, we will realise an empirical analysis on how the unemployment rate behaves in the countries that form the European Union 15 and we will observe the differences between them and also which countries display higher market rigidity. The timeframe that we took into observation is between January 2006 and November 2014.

Similarly, throughout the project covers different approached from several economists that based their research on the numerous alterations that affected the unemployment rate, on the nominal and real rigidities and also on the relationship between wages and the adjustment of the temporary workers. Regarding the analysis of the variations of the unemployment rate we will apply unitary roots contrasts to several trimestral time series like Augmented Dickey-Fuller and Ng and Perron, stationarity contrasts like the KPSS and finally, regarding the analysis of the unit roots and the structural changes of the sample we will apply the Lee-Strazicich test. These contrasts are really important in order to verify if the unemployment rate tends to return to its initial natural

unemployment rate after the shock that the economy suffered or if, on the contrary, these shocks have determined permanent changes.

The following project will embody in its first part a theoretical analysis on how the unemployment rate varies, that is, in order to proceed into the study of the unemployment rate we have to take into account three stages; the first of them analyses how the natural unemployment rate varies (U*), then the second stage considers the structural unemployment and lastly at the third stage we will take into consideration the so called Hysteresis and its effect on the unemployment rate. Secondly, we will present some ideas that the economists bring such as Bertola et al (2010), Blanchard, O (2005), Charles R. Bean., or Michele Belot and Jan Van Ours (2011). Thirdly, we will explain in a theoretical way the unit roots tests that Dickey and Fuller (1979) and Ng and Perron (1995) propose, a stationarity tests presented by Kwiatkowski et al., (1991) and the one proposed by Lee and Strazicich (2003) on structural changes and unit roots. Subsequently, we are going to carry out a graphical analysis of the timeframes of each country and fourthly we are going to explain if there is any correlation between the errors of the several samples and in this way determine if we encounter unit roots in the temporal series of the project. In the fourth part of the project the reader can find the results that were obtained when several named tests were applied before the fifteen temporal series. In this epigraph we can see if the temporal series are stationary or not and if they include unit roots and we will even analyse if there are any structural changes for the samples that could lead us to erroneous conclusion for any of the applied tests. Lastly, in conclusion we are going to express a personal opinion on the results that were obtained and we will talk about different applied policies in countries belonging to UE15 that stop the market from being flexible and determine a low fluctuation of the unemployment rate. Moreover we will give a solution to this type of problems, we taking into account those measures implemented in some countries from European Union 15 that achieved a higher labour market flexibility.

2. THE LABOUR MARKET IN EUROPE: A SURVEY OF THE LITERATURE

Each change in the unemployment equilibrium rate has a crucial consequence because of a series of reasons. On the one hand, the concerns connected to the short-run focus on the slowdown of the economic growth, due to the fact that it is possible to reduce what is known as the cyclical unemployment, but at the same time this fact is not so relevant, as the short term unemployment is not one of the critical problems that raise concern among the countries of the European Union. Nonetheless there is a lot of interest and uneasiness in controlling the long term unemployment.

That is why it is essential to know that the unemployment rate breaks down into cyclical and structural unemployment. The equilibrium rate is affected by the institutional characteristics and wage rigidities of the labour market, and, above all, it depends on the long-run.

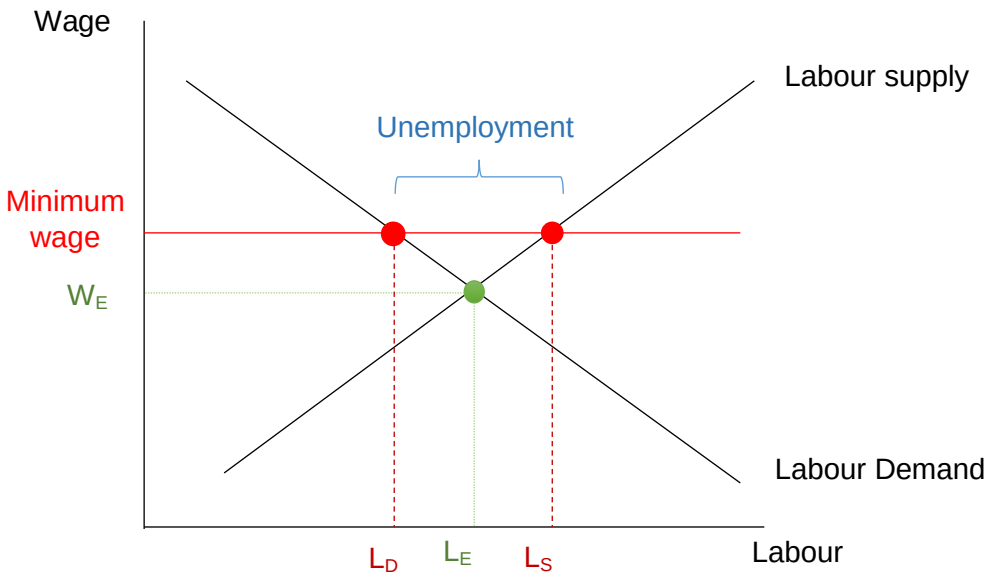
The study of the unemployment rate is analysed in three stages. The first of them is the study of how the natural unemployment rate (U*) varies, also known as the Non-Accelerating Inflation Rate of Unemployment (NAIRU). According to Henao and Rojas (1998), this rate is known as the type of unemployment rate that stabilises inflation when the salaries and the prices vary, in other words, countries expect inflation to remain constant from one year to the other and for that reason decisions regarding prices and salaries are made regarding that expected inflation. If the expected inflation rate rose, the inflation rate would tend to accelerate and, on the contrary decelerate; however, if the expected inflation rate remained the same from one year to the next then the inflation rate would remain stable.

We must take into consideration that the unemployment is directly and immediately linked to the inflation and because of that the NAIRU rate varies according to the inflation. For instance, the European unemployment is linked to a constant inflation since 2000 and for this reason the NAIRU rate is higher and it can only be lowered through the implementation of a sequence of reforms of the labour market.

The second stage related to the research of how the unemployment rate varies is by studying the structural unemployment. This is a consequence of the mismatch between labour supply and demand. Taking into account the Standing´s definition on structural unemployment (1983), a worker is structurally unemployed when there are new

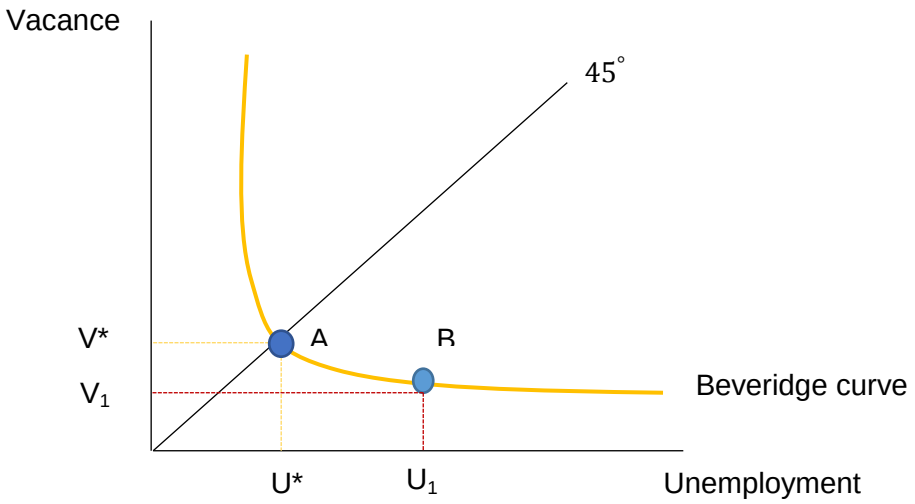
available job positions in the labour market, but this person does not fulfil the conditions to apply for this job; this happens because there has been a change in the profile of the new available job in companies and that this worker or the unemployed people do not achieve the company´s requested features. As a result, the mismatch between the supply and demand can have severe consequences on the creation of new jobs or, because of this discrepancy, the unemployed people can reach a stage in which they lose their skills before they apply for another job. We have to take into account in the study of the structural unemployment the fact that this type of unemployment follows a long-term tendency.

Graphic 1: Labour Supply and Labour Demand



Source: Compiled by the author of this paper.

Graphic 2. The Beveridge curve diagram



Source: Compiled by the author of this paper.

In the Graphic 1 there is an illustration of the relation between the labour supply and demand in the case of a minimum wage; we can notice that the labour supply is superior to the demand and this situation generates a raise in the economic unemployment. The unemployment is non-existent when the labour supply and demand interact and the demand is equal to the supply. Those countries belonging to the Europe 15 in which the effect of the economic recession has been higher and in which the destruction of the employment has been more pronounced, the discrepancy between the supply and the demand has been more noticeable than in those in which the destruction of the employment has been lower. For this same reason, there are big differences between the current situations of the diverse countries that form the EU-15.

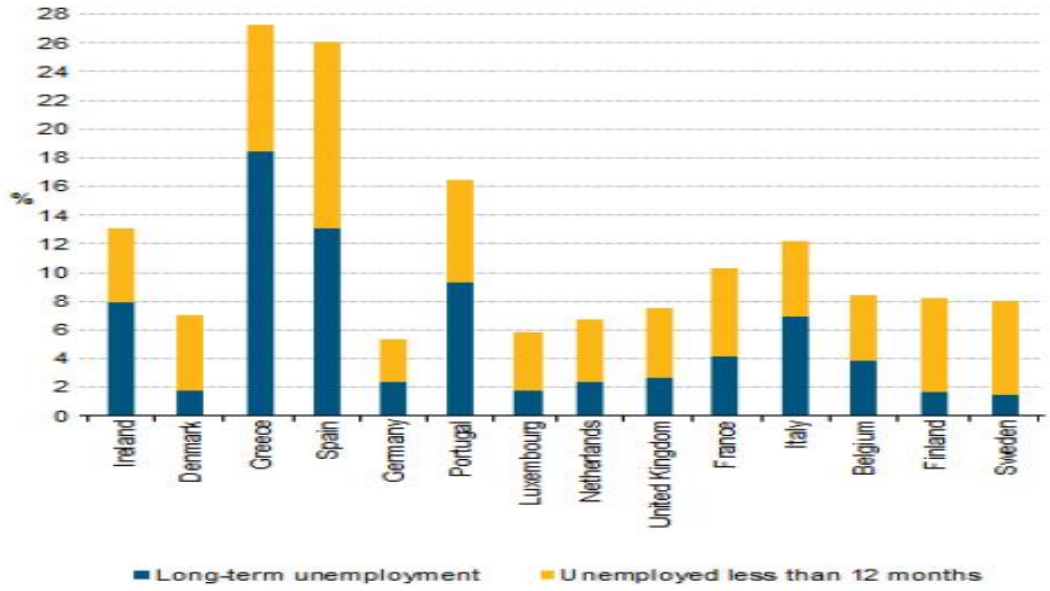
Graphic 2 represents the Beveridge curve diagram, which studies how the unemployment rate varies depending on the vacancies rate that is encountered in the labour market. The A point symbolises the equilibrium where the unemployment rate and the vacancies rate coincide, that is, at this point there are no now job offers. However, the B point symbolises a recession in which the number of jobs offered by companies is lower and as a consequence the unemployment rate increases. During recession times, real wages and unemployment increase, and on the contrary, vacancies decrease and as a result the Beveridge curves downward.

On the other hand, if we focus on the case of Europe, the widest type of unemployment that we find here is the structural one; because of this, countries apply numerous

structural reforms that aim to fight against this type of unemployment. For instance, in 2007, the EU-15 countries that registered the highest unemployment rate were Spain, Germany and France, and their rates were between 30% and 40%. These rates were worrying, due to the fact that people´s motivation to find a new job was affected and this ended in an abandonment of the labour market. As a result, the performance of the market was highly deteriorated and the unemployment tendency rose. Nowadays we still encounter this situation in several countries and for this reason, to avoid the stationarity at this high degree of unemployment, many people move to other countries and search for jobs there. It is important to realise that not all the population is affected by unemployment in the same way. For example, the unemployment rate is higher in areas with low levels of education and in the case of young people.

It is true that after the beginning of the recession in 2007 there was an increase in the destruction of the employment in numerous countries and most of the people affected by unemployment were the ones with lower levels of studies and qualifications, the ones that were young and people that had temporary contracts and working agreements.

Figure 1: Unemployment rate in 2013 according to duration.



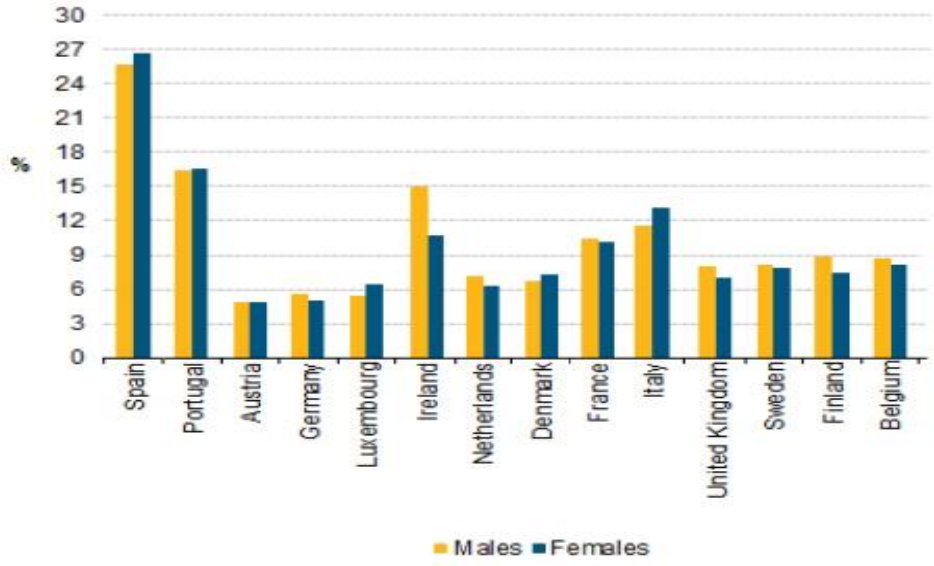
Source: Eurostat. 2013 Data

Figure 1 shows the unemployment rate for 2013 according to length of the contract. It is obvious that the *long-term unemployment* is higher for countries like Greece and

Spain and moreover that the *unemployment less than 12 months* that there was in these countries was also higher. On the contrary, countries like Germany, Sweden and Denmark register a lower *long-term unemployment* and in Germany the *unemployment less than 12 months* was very low.

Besides, in Spain, in spite of the high unemployment rate, the employment destruction was superior to other countries, reaching very high levels in the case of individuals aged over 55 years old. When this kind of population loses their job they are in a situation in which finding a new job is a serious challenge and it is very likely that they will not find another job. Because of this reason many incentives were implemented for companies to accept anticipated retirements from these persons because otherwise they would become part of the already worrying long-term unemployed people. On the other hand, countries like Germany and Luxembourg managed to lower their long-term unemployment rate, whereas in Ireland, just like in Spain, this rate was seriously elevated since the beginning of the financial and economic crisis; in both countries job creation was weak. In the case of Austria and Italy, the employment destruction provoked by the beginning of the crisis lowered ingeniously according to the Annual Report submitted by the European Central Bank and the Spanish Bank. Thus, it must be kept in mind that the unemployment rate was not affected only by the difficulties of finding a new job, but also by the possibility of losing the one that people had. Nonetheless, it is obvious that the unemployment rate diminishes gradually as age and educational level are higher.

Figure 2: Unemployment rate by gender in 2013



Source: Eurostat. 2013 Data.

Figure 2 refers to the unemployment per gender, in which one can notice how the discrepancy between the female and male unemployment was reduced due to the fact that the unemployment was harsher for male than for females. This discrepancy was more pronouncedly diminished in countries like Spain, Ireland and Portugal, finding its lowest rate in Spain in 2013 as we can wee in Figure 2. However in Ireland this difference is greater and the male unemployment rate is superior to the female one.

Going on with the discrepancy between the employment supply and demand, the situation of the German and Swiss market is radically different from the one in Ireland and Spain, as in neither Germany nor Switzerland can we see a significant difference between supply and demand and we can even notice it dropping during the analysed timeframe in the following project.

Hence, there is a great interest for the implementation of new policies destined to improve the unemployment conditions that would reduce the unemployment rate, in other words, it is necessary to implement these policies as they will enable the access to the labour market for this type of people. It´s also necessary to provide higher wage flexibility as by doing so salaries can better adjust to the variations between supply and demand. On the contrary, in the case of wage inflexibility, salaries could not adjust correctly. Nonetheless, Michele Belot and Jan Van Ours (2011) carried out an econometric and panel data study to analyse the institutions role on the unemployment

rate, for that purpose they analysed 20 countries since 1960 and took into account time dummy variables; the conclusion that they reached was that none of the institutions of the labour market had any important significance and therefore they did not have a great effect on the unemployment rate.

Nevertheless, according to the opinion of the author of this paper, in order to be able to notice how the structural unemployment varied among the countries of the EU-15 we do have to take into consideration institutional rigidities, trade unions, the unemployment insurance system, the wage inflexibility and even the minimum wage of a country, as they are tightly connected to the countries´ labour legislation. Apart from that, it is no surprise that unemployment has significant costs, both economic and social and it leads to loss in production, income and even in the quality of life of the citizens. These social costs have a negative effect on the income distribution as they produce a more significant unevenness of how people receive their share. Consequently, it remains obvious that unemployment is the most serious problem of the labour market in many countries. Companies, as a reaction to the high costs, could carry out several measures that intend to reduce working hours, wages or that could even result in the dismissal of workers in order to remain in the labour market.

Bertola et al. (2010) estimate probit models and confirm through their econometric analysis the negative link between wages and the temporary adjustment of workers and also confirms that the existence of this kind of workers reduces the possibility to achieve stronger wage flexibility. Abbritti and Weber (2010) build up a new keynesian theoretical model that includes nominal and real rigidities, besides other perturbations, and they sum up that the wage inflexibility determines an increase in the volatility of the unemployment rate.

What is more, the studies realised by Arpaia and Pichermann (2007) confirm that Spain, Greece, Ireland and Luxembourg show higher wage inflexibility. In their econometric research they observe that the evolution of the increase of salaries and decrease of rigidity determine the inflexibility of the real salary and thus its rigidity against unemployment. Moreover, they observe that companies harshly penalise the lack of experience of young people and because of that they offer temporary, part time and even underpaid jobs.

In this manner, imperfections of the labour market affect the unemployment negatively, including youth unemployment, as young people find out that it is a real obstacle to find better jobs. We have to take into consideration that the unemployment rate is not symmetrical among the countries belonging to EU-15, as we have already mentioned

before; some of them are more affected than the others. If we focus on the current data published by Eurostat we can check that countries like Austria and Germany were the two countries that registered the lowest unemployment rates, at 4.9% and 5% respectively, and the higher ones were registered in September 2014 in Greece 25.7% and in Spain 23.9%. Compared to what had happened in 2013, only four countries increased their unemployment rates whereas the others managed to lower them. For example, in Greece the unemployment rate improved from 28% in 2013 to 25.7% in 2014 and Spain from 25.8% to 23.9%.

Moreover, the failure of European economies in providing jobs is imminent compared to other economies like for instance in the United States, which registered a growth of the nongovernmental employment between 1970 and 1998 of 70% whereas in Europe this type of employment only revealed a 5% growth during the same timeframe.

But the weakness of the behaviour of the labour market in the euro area can be observed to a greater extent if we have a close look at the growth of the employment in the private sector, in which the number of jobs raises when the unemployment rate is superior in order to incorporate into the labour market those people that have been unemployed for a long while.

In Europe it is very important to take into account the different international features and the regulations carried out within the labour market to be able to explain the evolution of the unemployment. It is important, due to the existence of the structural rigidities that block the redistribution of workers, that is, they stop unemployed people from finding jobs quickly. The immediate consequence is a growth of the structural unemployment rate and therefore of the unemployment rate, as when the former one grows the structural unemployment is affected in the same way. For this specific reason, one of the objectives of the labour reform is to eliminate the structural rigidities.

The differences between countries can be a result of the existing dissimilarities between the adopted agreements and regulations, as these, as we have seen before, affect the labour market, like for instance, the salaries negotiation. In the case of Spain, the unemployment is affected on a large scale by this negotiation, as these are centralised in an intermediate way and, that is why sometimes the interests of employers and hiring companies are not taken into consideration and what is more they don´t take into consideration workers´ interests.

In the current circumstances of the labour market, there are several aspects that should be kept in mind like public programs established by European countries and unemployment benefits. On the one hand, public programs are assigned for the

workers to reduce the unemployment rate; these are presented to those people that have a certain degree of disability, as for example in Spain, in this kind of countries they try to implement new measures to reduce this high rate. On the other hand, unemployment benefits, also known as subsidies, have a great influence on the unemployment rate. This happens because there are people that do not appreciate their jobs or they are not eager to find new jobs and as a consequence they are going to spend more time being unemployed. For instance, United Kingdom is setting measures to control this type of benefits and in this way they want to prevent these benefits from becoming detrimental for the unemployment of the country.

Since the beginning of the recession many labour reforms have been carried out in the countries belonging to the European Union; these reforms have determined an increase of the part time contracts. In Spain, for example, working hours have not only been reduced but also underpaid part time jobs have increased. This situation is nothing but ideal for the country.

One of the objectives that are taken into account when implementing a labour reform is to reduce or eliminate the structural rigidities; reduce distortions of incentives; suppress regulations restrictions and finally reduce the equilibrium unemployment rate.

If the adjustment of the labour market is slow, the gap between the structural unemployment rate and the NAIRU rate would be larger and in this case they would not be equivalent. However, excessive regulations for the labour market is not the correct solution either because even if we carry out employment protectionist measures that could reduce unemployment, this can provoke companies not to hire new employees and then the measures would determine a growth of the unemployment rate.

In this manner, through the unemployment rate we can evaluate the success or the failure of the macroeconomic policies defined by governments and even evaluate if the established educational measures have been the adequate ones. Moreover, using the Phillips curve we get a visual vision of the wage flexibility and unemployment, i.e. we can check how unemployment affects the wage flexibility of the countries. Even more, the very convexity of the curve shows how inflation and unemployment deteriorates when the unemployment rate reaches lower levels than the natural unemployment rate.

Thirdly and lastly, in order to continue with the corresponding research of the variation of the unemployment rate we have to analyse if the unemployment rate for countries belonging to the Europe 15 converges its natural unemployment rate or if we encounter the so called Hysteresis, which is strictly associated to the presence of unit roots in the model. The concept of Hysteresis is known as a variation that takes place when one

variable, in this case the unemployment has passed through a shock and cannot return to its original value after that shock, but it varies and reaches another level. In other words, a shock appears at a certain time that alters the unemployment rate of one country and it is possible that due to this effect this rate does not go back to its normal level not even after the shock disappears completely and consequently this has an effect over NAIRY and will impede it from going back to its original value. As a result it is fair to analyse how the unemployment rate developed through time as it is strictly and closely linked to its past. If the analysed unemployment rate were superior to its Non-Accelerating Inflation Rate of Unemployment (NAIRU), the inflation would tend to decrease and as a result the price raise would diminish; on the contrary, if the unemployment rate were inferior to the NAIRU, inflation would accelerate and as a consequence the price raise would be higher. Consequently, we must bear in mind that the unemployment rate is the result of variations or shocks that had an impact on the economy of countries over a long period of time.

3. UNIT ROOT AND STATIONARITY TEST

We are going to analyse the temporal series corresponding to the countries that form the Euopean Union 15 and because of that we gathered data from the Eurostat page with monthly values of the unemployment rate of these countries since January 2006 until November 2014.

We want to research if the growth or decrease of the analysed series is produced by: a) the presence of a stationary process that varies due to a deterministic trend (Trend Stationary); b)on the contrary, if the process that our sample follows is the result of the presence of a unit root and for that reason it varies due to a stochastic trend (Difference Stationary) or c) if the studied sample is a consequence of a stationary process that varies due to different level changes.

Nonetheless, the main purpose is to analyse if the shocks produces in the analysed series are permanent or temporary, that is, the purpose of the project is to study how the unemployment rates varied in the countries that form EU-15 and see if they return to its initial level after the shock that they suffered; in other words, if the so called Hysteresis occurs I(1). Moreover, we also want to analyse if there is any variation of the NAIRU, I(0), or a structural change, I(0) with trend. Before we start with the analysis of these samples, we are going to have a look at the problems that show up when we apply the stationarity tests and unit roots within this project.

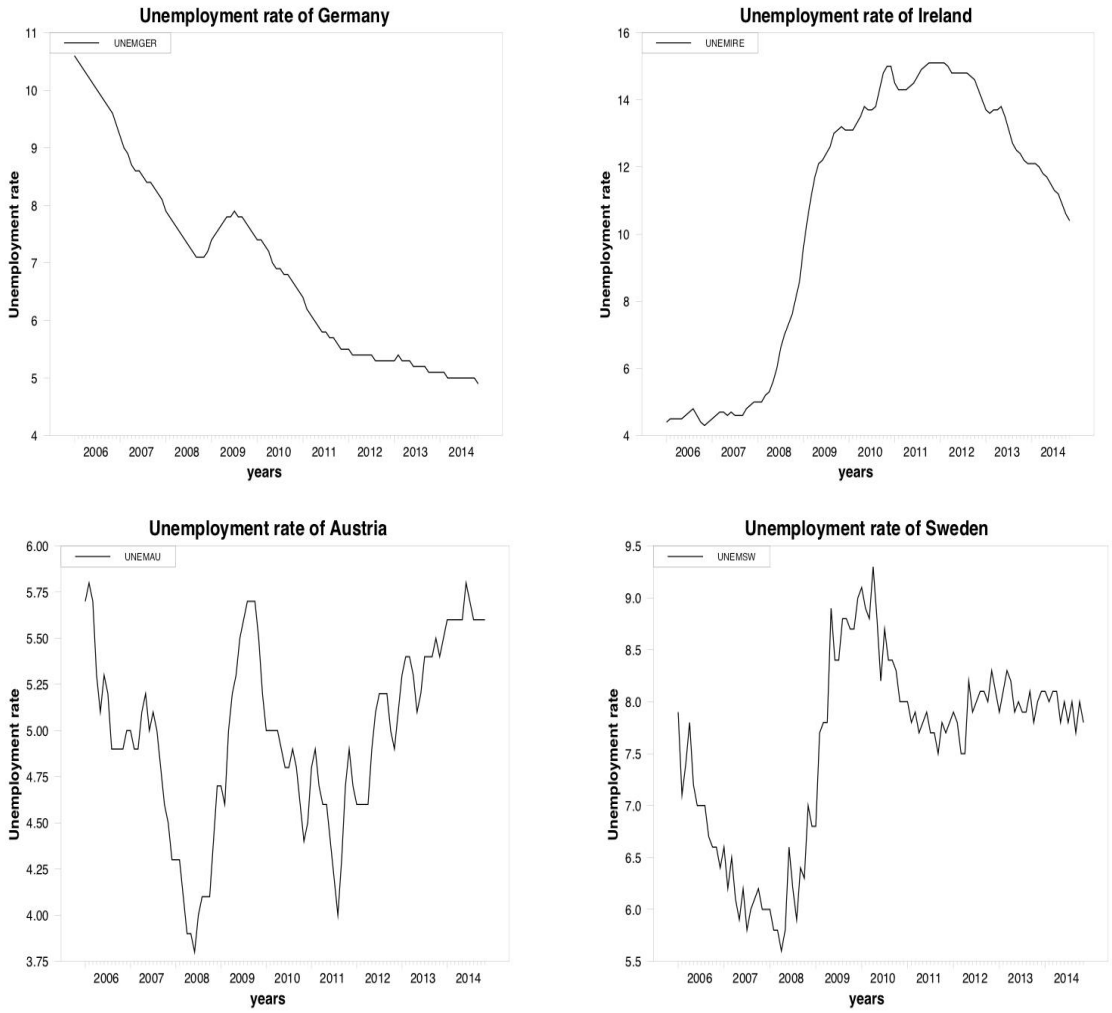
Thus, we have to take into account if a series possesses unit roots and if it follows or not a stationary process. That is, depending on if a series is stationary or not we will see if the economic shocks are transitory or if, on the contrary, they are permanent. The procedure of the analysis for the unit roots consists in performing a graphical analysis, the study of the obtained correlograms and the application of unit roots test and stationarity test. Although we can perform a visual test of the temporal series, the conclusions that we reach can be erroneous and in order to avoid that it is more convenient to carry out several tests.

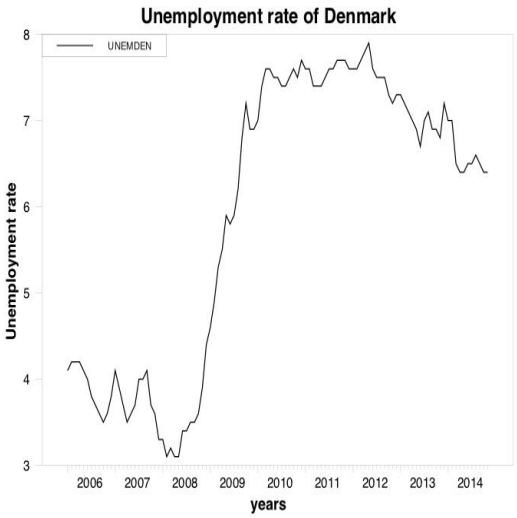
3.1 Graphical analysis

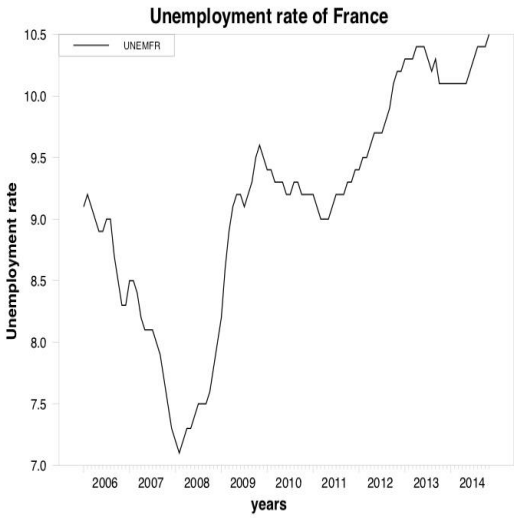
Starting with a graphical analysis we can notice if a series is characterised as stationary or not. In the series is stationary, the graph will fluctuate around an average value, in this case the unemployment rate would oscillate around the natural unemployment rate. However, if the series is non-stationary, we would notice a trend that does not fluctuate around an average value, that is, it does not oscillate around the natural unemployment rate.

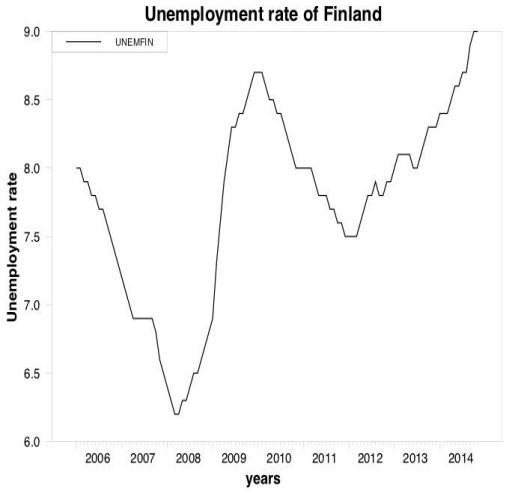
In our case, we are going to compare and analyse the graphs of the countries belonging to EU-15.

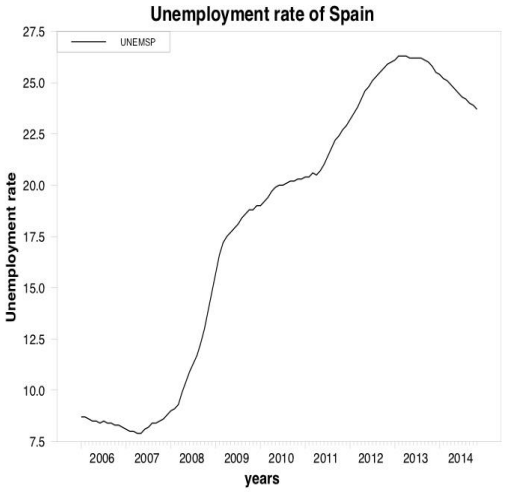
Figure 3. Unemployment rates (in logs)

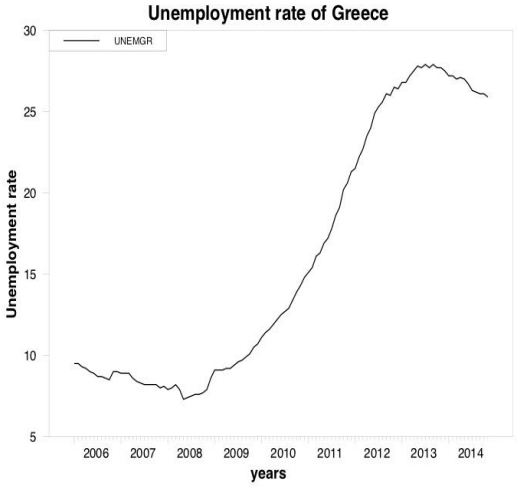


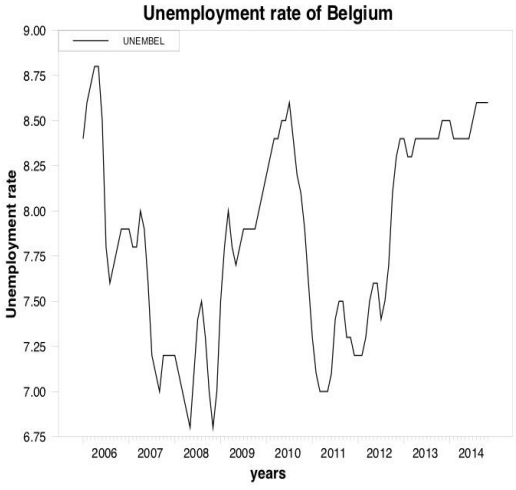

Unemployment rate of Denmark
UNEMDEN
Unemployment rate
years

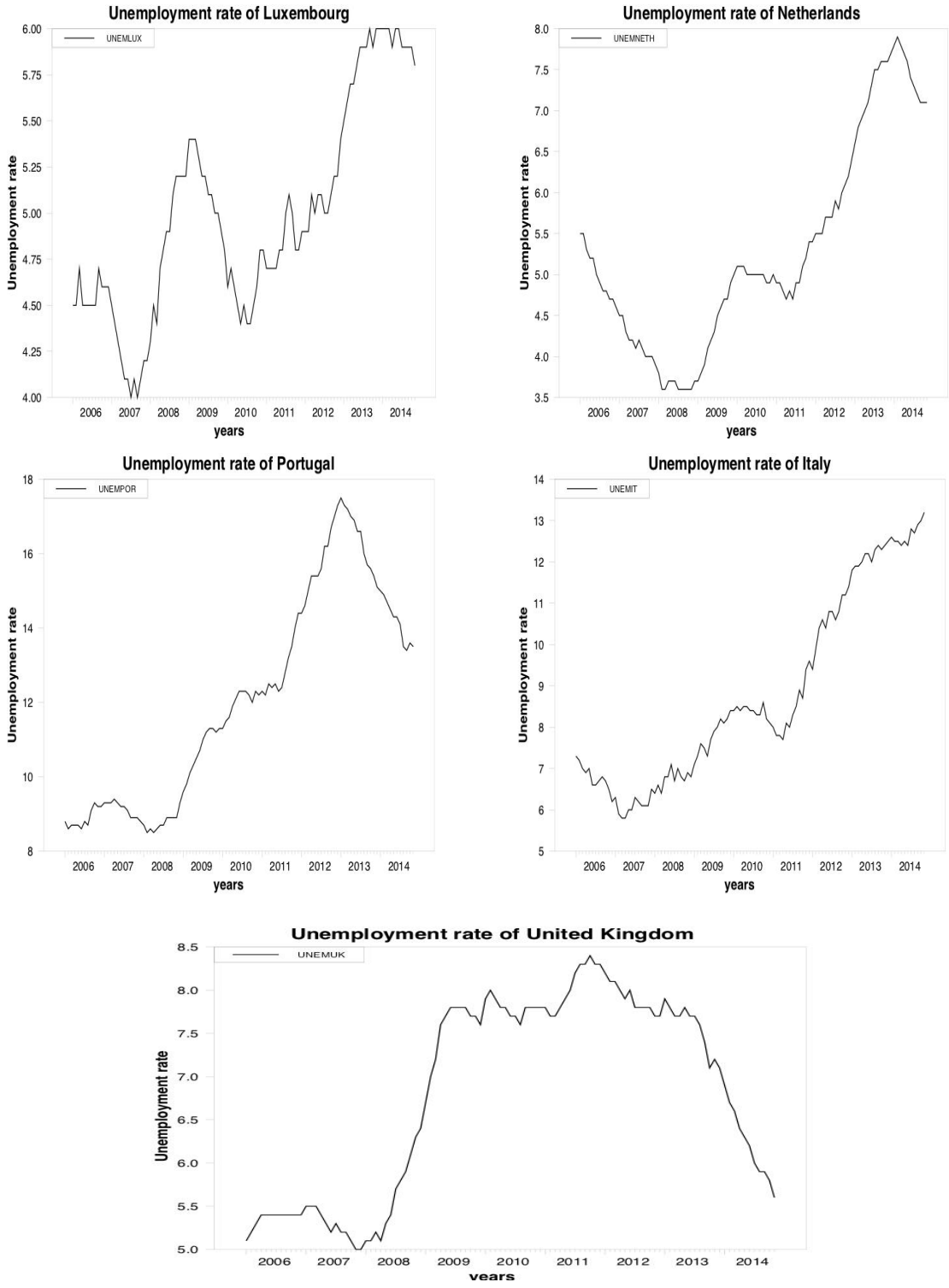

Unemployment rate of France
UNEMFR
Unemployment rate
years


Unemployment rate of Finland
UNEMFIN
Unemployment rate
years


Unemployment rate of Spain
UNEMSP
Unemployment rate
years


Unemployment rate of Greece
UNEMGR
Unemployment rate
years


Unemployment rate of Belgium
UNEMBEL
Unemployment rate
years



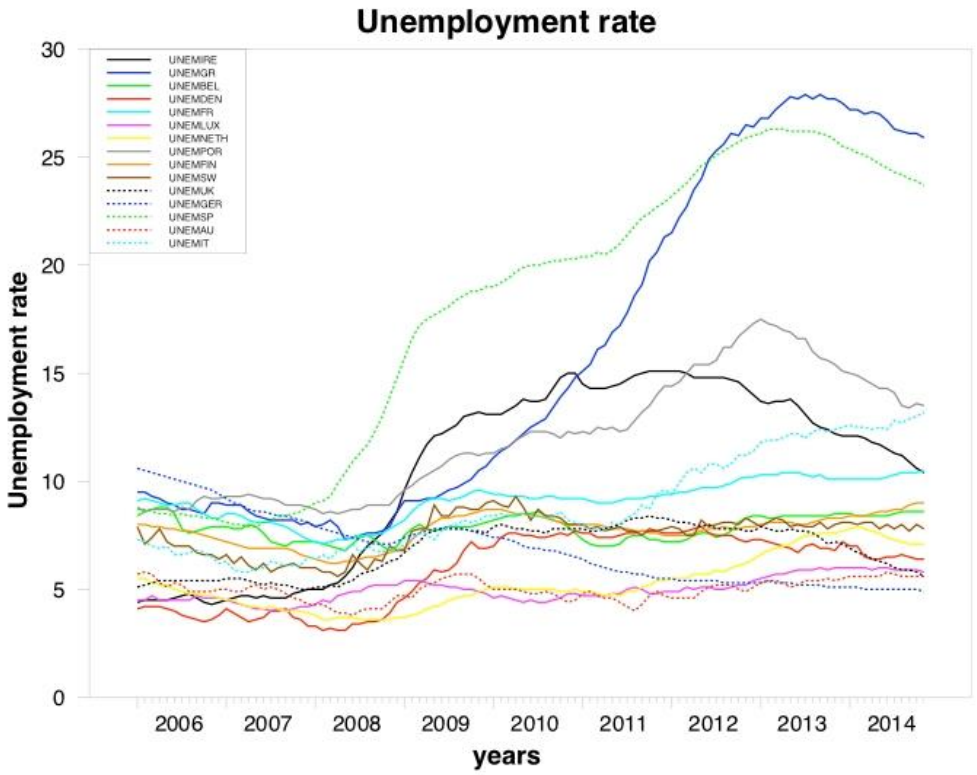
Source: Compiled by the author of this paper in RATS

In the following image we can find the graphics that show the unemployment rate of the 15 countries that we are observing throughout this project since 2006 until the end of 2014. We can notice how in the specific cases of Austria, Sweden and Belgium we find

a great volatility of the unemployment rate between 2006 and 2014 and therefore we know for sure that the evolution of this particular variable does not fluctuate around an average value, that is, it does not fluctuate around its natural unemployment rate; this can be a consequence of the presence of different economic shocks that affect these countries. The series of the unemployment rate for Germany presents a strong tendency to decrease throughout the analysed timeframe. Nonetheless, the series displays a small oscillation in 2008, but it managed to level off. This series looks like it follows a random walk, i.e., a stochastic process and for that reason it may have a unit root.

On the other hand, in Ireland we encounter a structural change with positive trend and in 2010 it looks like it levels off, however, in 2012 another structural change is produces and it changes the trend of this sample. Visually, it seems that the series follows a structural model I(0) with trend. In Sweden and Denmark we also encounter two structural changes whose average value varies and it does not return to the initial one. France and Belgium follow a random walk without a determined pattern. Spain, for example seems to be a series with structural changes with trend, that is, I(0) with trend.

Figure 4. The unemployment rate (in logs) of all countries



Source: Compiled by the author of this paper in RATS

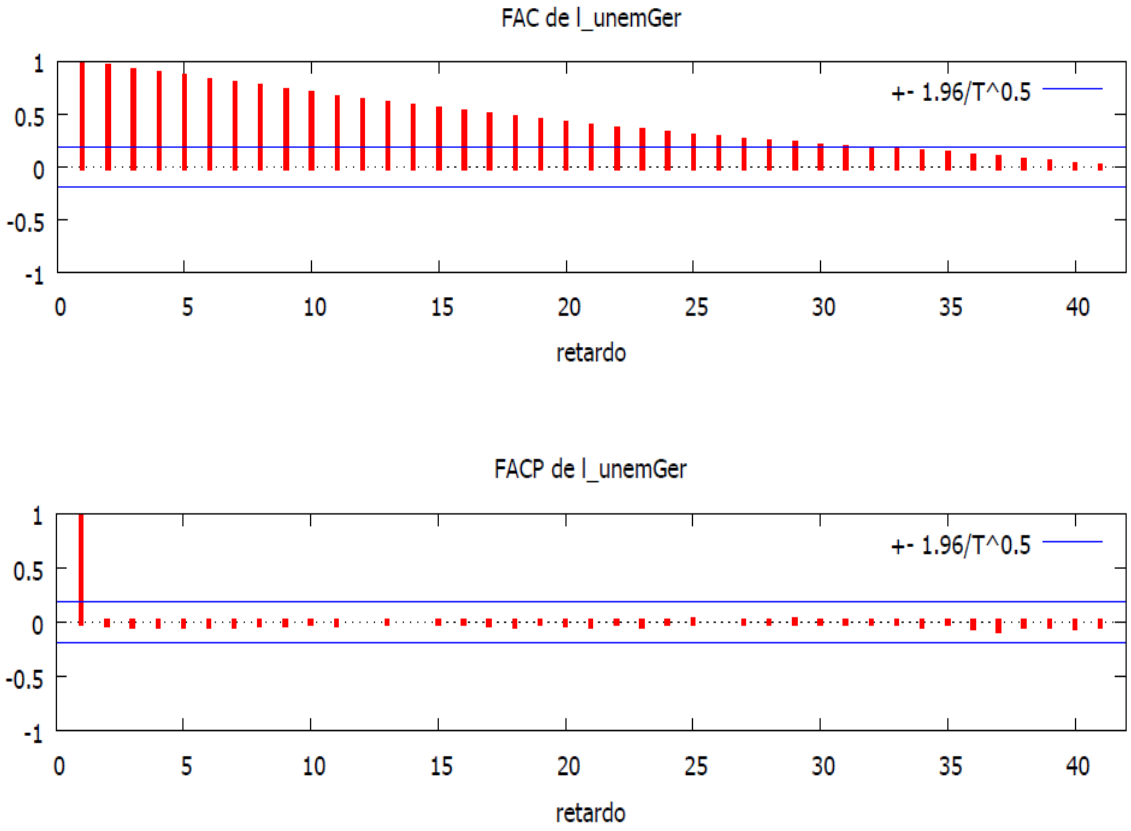
The figure 4, shows simultaneously the variations of the unemployment rates for the countries that we are studying in this paper. Nevertheless, the study of these graphics is not enough to be able to reach firm conclusions regarding the stationarity of the samples. Because of that, by looking at them we can have an idea of how the variable evaluated and if they show any structural changes in the series or not.

Secondly, another kind of graphical analysis is the analysis of the correlograms of the series. In this way it is not necessary to apply any type of test to determine if there are unit roots in the samples or not.

3.2 Autocorrelation and correlogram

By creating these correlograms we will be able to notice if there is ant correlation between the errors of the sample, or, to put in in other words, we could check if we encounter white noise in the analysed series and also determine if we encounter unit roots. A sample shows the presence of a unit root if the value that we obtain in the correlogram is almost 1 and subsequently tends to slowly reach 0. On the contrary, if the series is stationary the first value that we obtain in the correlogram is below 1 and approaches 0 quickly.

Figure 5. Germany's correlogram and autocorrelogram

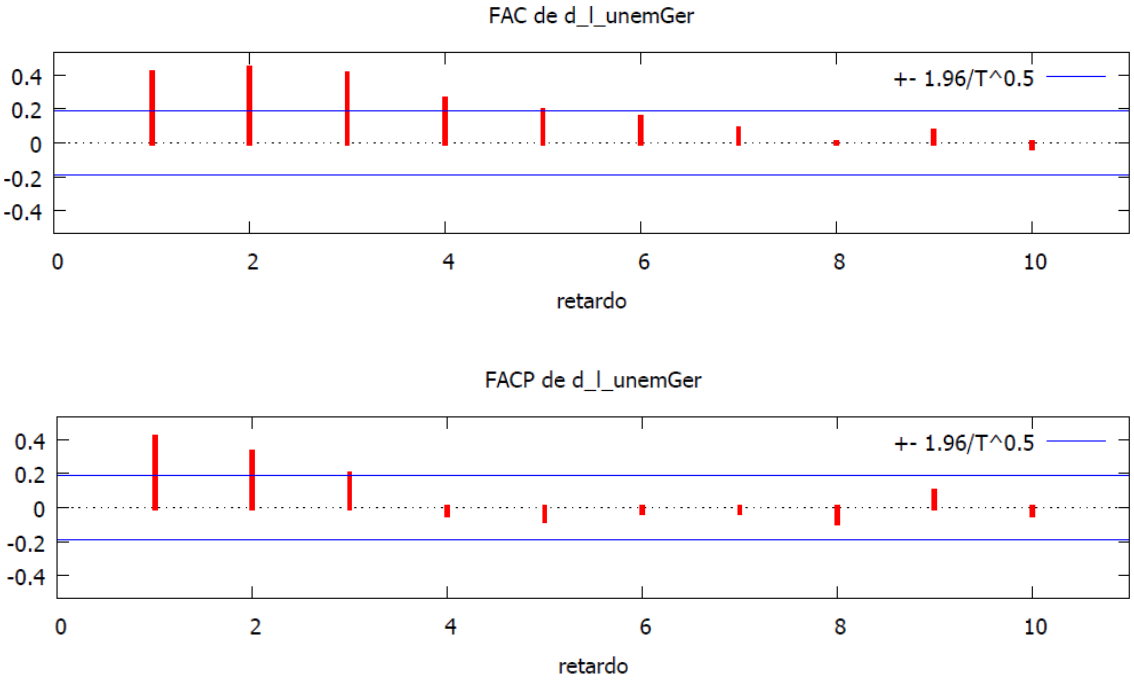


Source: Compiled by the author of this paper in GRETL

Figure 5 shows the correlogram and autocorrelogram of Germany; in it we can clearly see that we are dealing with a temporal series that is non-stationary, since the coefficient of autocorrelation starts from a very high level and slowly decreases towards 0 as the lag extends. In this case, the autocorrelation disappears when we have approximately 36 lags. Because of that we can say stat the analysed series has unit roots due to the fact that the values of the correlogram decrease gradually towards zero.

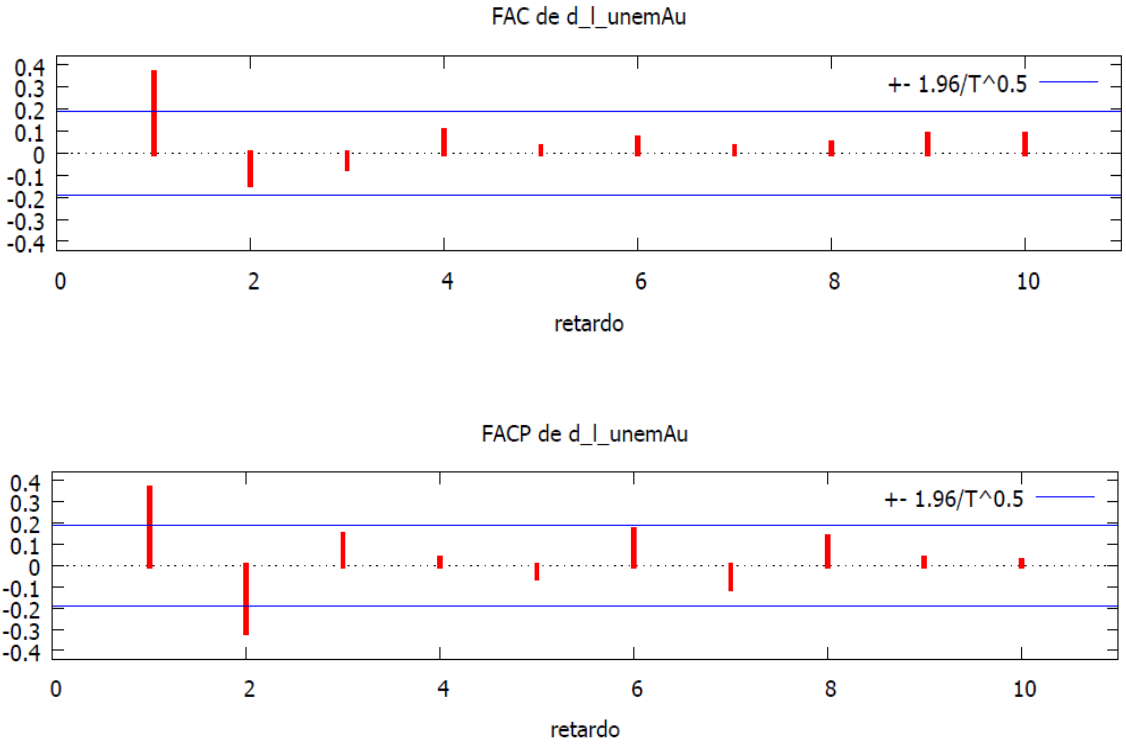
It must also be taken into consideration that the coefficients of autocorrelation are dependent, that is, if the first column is correlated with the second it will also be correlated with the third one because the second would be tightly correlated with the third. Because of that, it is important to take into account the partial autocorrelation as this one eliminates this type of dependencies between different columns of the correlogram.

Figure 6. Germany's autocorrelogram and correlogram (first difference of log)



Source: Compiled by the author of this paper in GRETL

Figure 7. Austrias's autocorrelogram and correlogram (first difference of log)



Source: Compiled by the author of this paper in GRETL

Figure 6, shows the total and partial correlogram for the first difference of the logarithm for the samples of Germany and Austria. In the case of Germany we can notice that after we apply the first difference we cannot achieve to make it be a stationary series and it still has a unit root. However, Austria does become a stationary sample when we apply the first difference, the first coefficient of the series tends to approach 0 rapidly.

3.3 Unit roots tests

On the one hand, we have those tests that analyse if we encounter unit roots in a temporal series; one of them is the test that Dickey and Fuller proposed (1979), however, this kind of test raises some issues due to the fact that it is possible that the null hypothesis will be rejected in favour of the alternative when in fact things do not go like that and for this specific reason Perron (1989) establishes the following solution to the test that Dickey and Fuller proposed: extend this contrast by adding dummy variables to the model and in this way they will fold the change in the structure of the series; nonetheless, this test doesn´t indicate exactly at which point the change takes place in the structure of the series. According to Dickey Fuller, the ADF test is based on the following definition:

$$\Delta Y_t = \beta_1 + \beta_{2t} + (p-1)Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \qquad (1)$$

where ε_t is an error term with white noise; by this we mean that the model has zero average, constant variance and it is not correlated. . ΔY_{t-1} is the number of differences that are included in the model and β_{2t} is a vector of deterministic terms. The ADF test contrasts if the null hypothesis is H_0: (p-1) = 0 compared to the alternative H_1: (p-1) ≠ 0 or in other words H_0: p = 1 compared to the alternative H_1: p ≠ 1. In this analysis if we rejected the null hypothesis the series would become stationary, on the contrary it would be non-stationary and it would also include a unit root. However, it would not be enough to observe if the sample is stationary or not, but we would also have to analyse if the model has constancy and trend or not.

As a response to the problems that the ADF test presents, Ng and Perron (1995) propose another unit root test starting from the one developed by Dickey and Fuller and they suggest selecting the number of lags based on the size of the sample and in this way avoid including a greater number of lags to the sample that would lead us to erroneous results.

3.4 Stationarity tests

Furthermore, the KPSS test, proposed by Kwiatkowski et al., (1991), performs a stationarity contrast around a lineal or level trend, compared to the null hypothesis in case of the presence of unit root. That is, the null hypothesis contrasts that Y_t is I(0), where H_0: $\sigma_\varepsilon^2 = 0$ and its alternative hyphotesis is H_0: $\sigma_\varepsilon^2 > 0$.

$$y_t = \beta' D_t + \mu_t + u_t \qquad (2)$$

where D_t contains the deterministic components like the constant or time trend, μ_t is a pure random walk with variance σ_ε^2.

Nevertheless, in spite of the fact that we can use as a complementary method the contrast proposed by Dickey and Fuller, the results that we obtained in this test, just like in the case of the ADF test, can be altered by the presence of structural changes in the analysed sample, just as we mentioned. Because of that, it would be more convenient to perform the test established by Lee-Strazicich (2003).

Lee and Strazicich (2003), propose a test in which we can notice the specific moment in time when structural changes take place in the analysed sample through the Lagrange Multiplier (LM), thus for this test we do take into account the exact moments in which the structural changes take place; because of this specific reason, the Lee-Strazicich would not determine us to reject the null hypothesis in favor of the alternative and therefore would not lead us to erroneous conclusions regarding stationarity that can occur when we perform the previous types of tests.

4. RESULTS

Now that we explained the methodology for the study of the stationarity (stagnation) and of the unit roots we will proceed and analyse the monthly series of the unemployment rate for countries that form the European Union 15 during the January 2006- November 2014 timeframe. Data has been extracted from the Eurostat database.

This performed empirical analysis begins with the application of contrasts of Unit root and stationarity that do not show changes in the sample structure. Finally, after completing the analysis of the results for this type of contrasts that do not show changes of the sample, we will extend our research applying tests that take into consideration breaks at diverse points in time.

4.1 The application of ADF and Ng and Perron test

The study carried out begins with the application of contrasts that do not reflect breaks in the sample like the ADF test. However, besides taking into consideration the problems that this test presents and that have been explained before, it is very important to take into account the number of lags included in the test at the moment of conducting the contrast, as an erroneous election of them can determine distortions of the size of the contrast and of the final conclusions.

Table 1. ADF^{OLS} NG and Perron (2001) unit root test for level and trend.

European 15 unemployment rate.

Country	ADF^{OLS}	MZ_{α}^{GLS}	MZ_{t}^{GLS}	MSB^{GLS}	MP_{T}^{GLS}
Austria	-2.86	-3.67	-1.28	0.34**	68.26**
Belgium	-2.67	-3.74	-1.23	0.34**	51.03**
Denmark	-1.34	-1.22	-0.65	0.53**	86.86**
Findland	-2.76	-0.74	-0.48	0.65**	99.91**
France	-2.99	-1.21	-0.73	0.61**	90.29**

Germany	-2.40	-1.00	-0.52	0.52**	87.14**
Greece	-3.04	-0.52	-0.50	0.96**	207.36**
Ireland	-0.32	1.01	1.02	1.01**	224.48**
Italy	-3.37*	-2.52	-1.05	0.42**	120.117**
Luxembourg	-2.52	-4.45	-1.48	0.33**	94.07**
Netherlands	-2.72	-0.49	-0.42	0.87**	189.97**
Portugal	-1.04	-0.26	-0.14	0.55**	94.74**
Spain	-1.92	0.58	0.52	0.89**	164.59**
Sweden	-2.24	-6.15*	-1.75*	0.28**	128.39**
United Kingdom	0.38	1.56	1.14	0.73**	151.34**

Note: The symbols *, ** and *** stand for rejection of the null hypothesis of unit root at 10, 5 and 1% respectively. The critical values for the ADF test are -3.98(1%), -3.45(5%) and -3.13(10%). The critical values for the Ng and Perron test are -8.100, -1.980, 0.233 and 3.170 for $MZ\alpha$, MZ_t, MSB and MP_t respectively of the 5% of significance and -5.700, -1.620, 0.275 and 4.450 for $MZ\alpha$, MZ_t, MSB and MP_t respectively of the 10% of significance.

Table 1 presents the results of the ADF and Ng and Perron (2001) unit root tests when there are level and trend. Given the logarithms of the unemployment rate of the countries that belong to the EU-15.

We realised the ADF analysis with level and trend for the temporary series of these countries, the p-asymptotic values that was obtained for all of them is superior to the critical values, for this reason we can observe that none of the studied countries is stationary, due to the fact that the null hypothesis is not rejected in favour of the alternative, except in the case of Italy which we could consider stationary with a 10% of significance. Even in this case, there is a clear empirical proof that the unemployment rate of the countries that form EU-15 are non stationary so they have a unit root. For this test we used a total of 2 lags, except in some cases in which the lags have been different: 11, 1, 6, 5 or even 3.

Concerning the results obtained in the Ng and Perron test and according to the critical values for the 15 samples that we analyzed, both the statistical value as the lead us to the same conclusions: the null hypothesis is not rejected, except in the specific case of Sweden in which there is a significant hypothesis rejection of 10%, therefore in this series it would be 10% stationary. In spite of this, there is clear empirical proof that there are unit roots in these series.

Because of this, both ADF test and these 2 proofs corresponding to the Ng and Perron test lead us to the conclusion that the series collected in our sample are neither stationary nor do they have a unit root. Nonetheless, these results of the Ng and Perron test show incoherency as in both cases it shows two more statistics and in both cases the presence of root units is rejected at any level of significance that we have studied. Nevertheless, it is very probable that this type of occurrences happen while performing the Ng and Perron test, although we will focus more on the two tests performed earlier. As a consequence, we could say that even if the result is contradictory, the analysed series would be non stationary with unit roots.

Regarding the significance of the tendency in the ADF test, in order to check if it is significant or not we would look at the obtained value in the rejection area of not. If the hull hypothesis were rejected in favour of the alternative one, the trend would be significant and for that reason the series would be a non stationary, unit root, trend and constant sample. On the contrary, we would perform the same analysis eliminating the model trend. In the specific case of Italy, the trend scores high at 10%.

Table 2. ADF^{OLS} NG and Perron (2001) unit root test for level.

European 15 unemployment rate.

Country	ADF^{OLS}	MZ_{α}^{GLS}	MZ_{t}^{GLS}	MSB^{GLS}	MP_{T}^{GLS}
Austria	-2.37	-2.81	-1.18	0.42**	65.66**
Belgium	-1.75	-3.15	-1.23	0.39**	46.31**
Denmark	-1.20	-0.15	-0.15	0.97**	101.08**
Findland	-1.16	-0.17	-0.13	0.72**	52.74**
France	-0.89	0.01	0.01	0.76**	58.99**
Germany	-1.67	1.32	3.81**	2.88**	773.16**
Greece	-2.05	1.08	2.40**	2.22**	372.45**
Ireland	-1.75	0.25	0.59	2.33**	387.66**
Italy	-0.01	-2.52	-1.05	0.42**	120.117**
Luxembourg	-0.88	-0.08	-0.05	0.57**	100.63**
Netherlands	-0.57	0.19	0.21	1.08**	99.87**
Portugal	-1.30	0.39	0.64	1.62**	202.25**
Spain	-3.32**	0.75	2.17**	2.88**	637.44**
Sweden	-1.20	-5.13	-1.60	0.31**	133.56**
United Kingdom	-1.07	-0.29	-0.38	1.31**	133.58**

Note: The symbols *, ** and *** stand for rejection of the null hypothesis of unit root at 10, 5 and 1% respectively. The critical values for the ADF test are -3.46(1%), -2.88(5%) and -2.57(10%). The critical values for the Ng and Perron test are -8.100, -1.980, 0.233 and 3.170 for MZα, MZ_t, MSB and MP_t respectively of the 5% of significance and -5.700, -1.620, 0.275 and 4.450 for MZα, MZ_t, MSB and MP_t respectively of the 10% of significance.

Table 2 presents the results of the ADF and Ng and Perron (2001) unit root tests when there is level. The results that we obtained lead us to the same conclusion that we reached before, except in the case of Spain in which the series becomes stationary when we eliminate the trend of the model, and for that reason, the econometric model would include a constant in the Spain series. On the contrary, the series for Italy for this new test becomes non stationary for the three degrees of significance. Making reference to the results that we obtained in the Ng and Perron test, the statistical lead us to the same conclusions that the ADF test, however, in this case all 15 series are non stationary. Nonetheless, the statistical lead to the same conclusion for all samples, as Germany, Greece and Spain are stationary according to this statistic, so they would include a constant in the econometrical models of these countries.

Table 3. ADF^{OLS} NG and Perron (2001) unit root test for first differences.

European 15 Unemploment rate

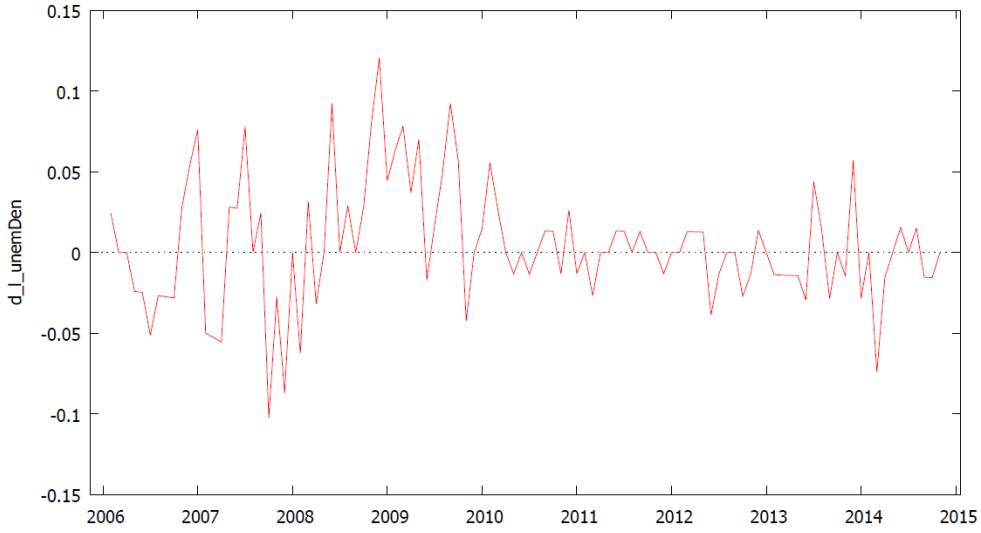
Country	ADF^{OLS}	MZ_{α}^{GLS}	MZ_{t}^{GLS}	MSB^{GLS}	MP_{T}^{GLS}
Austria	-3.38**	-42.68**	-4.62**	0.11	151.88***
Belgium	-7.08***	-27.26**	-3.68**	0.14*	46.31***
Denmark	-4.76***	-44.11**	-4.69**	0.11	209.81***
Findland	-4.72***	-30.58**	-3.91**	0.13	173.72***
France	-4.97***	-27.46**	-3.71**	0.13	133.77***
Germany	-6.42***	-42.26**	-4.57**	0.11	207.23***
Greece	-1.53	-37.33**	-4.31**	0.11	179.70***
Ireland	-3.53***	-18.83**	-3.01**	0.16**	125.83***
Italy	-11.95***	-52.42**	-5.11**	0.10	323.05***
Luxembourg	-5.75***	-52.40**	-5.10**	0.09	304.75***

Netherlands	-3.81***	-45.41**	-4.76**	0.10	234.35***
Portugal	-6.91***	-26.35**	-3.62**	0.13	175.11***
Spain	-2.35	-12.08**	-2.44**	0.20***	141.62***
Sweden	-5.46***	-29.21**	-3.81**	0.13	186.74***
United Kingdom	-3.58***	-34.52**	-4.01**	0.12	189.56***

Note: The symbols *, ** and *** stand for rejection of the null hypothesis of unit root at 10, 5 and 1% respectively. The critical values for the ADF test are -3.46(1%), -2.88(5%) and -2.57(10%). The critical values for the Ng and Perron test are -8.100, -1.980, 0.233 and 3.170 for $MZ\alpha$, MZ_t, MSB and MP_t respectively of the 5% of significance and -5.700, -1.620, 0.275 and 4.450 for $MZ\alpha$, MZ_t, MSB and MP_t respectively of the 10% of significance.

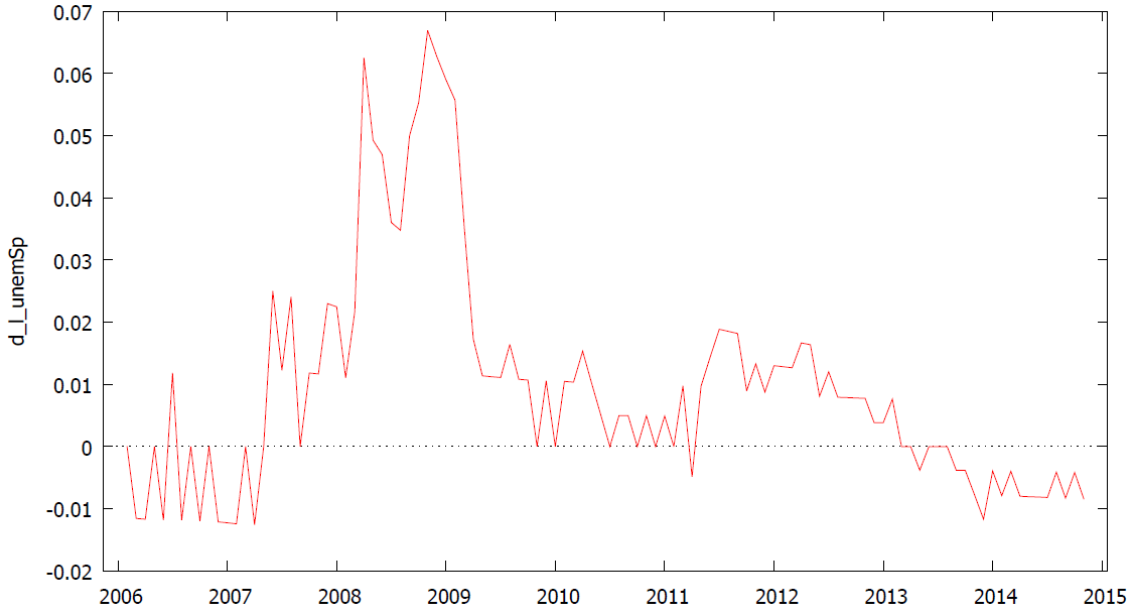
Carrying out the first difference of the analysed series we make them become stationary, except in the case of Greece and Spain. In the previous case was a stationary sample and by realising the first difference of its logarithm it became non stationary. Thus, by carrying out the first difference of the logarithm we manage to eliminate the tendency of these series and turn them into stationary.

Figure 8. Unemployment rate of fist difference of Denmark (in logs)



Source: Compiled by the author of this paper in GRETL

Figure 9. Unemployment rate of first difference of Spain (in logs)



Source: Compiled by the author of this paper in GRETL

Figure 8 and 9, show the temporary series in Denmark and Spain after realising the first difference of the logarithm of the series. We can notice how Denmark´s sample would be stationary in the analysed timeframe on the project, however the Spanish sample does not.

4.2 The application of KPSS test

The results that we obtained after applying the KPSS test are the following:

Table 4. KPSS stationarity test.

European 15 Unemployment rate.

Countries	η_t^{trend}	η_t^{Level}	η_t^{FD}
Austria	0.19**	0.43*	0.18
Belgium	0.19**	0.44*	0.15
Denmark	0.35***	1.61***	0.23
Findland	0.13*	0.91***	0.26
France	0.16**	1.52**	0.24
Germany	0.15**	2.15***	0.24
Greece	0.34***	2.08***	0.51**
Ireland	0.49***	1.66***	0.79***
Italy	0.26***	2.06***	0.37*
Luxembourg	0.17**	1.43***	0.08
Netherlands	0.37***	1.62***	0.57**
Portugal	0.20**	2.02**	0.29
Spain	0.39***	2.01***	0.43*
Sweden	0.22***	1.01***	0.17
United Kingdom	0.44***	1.20***	0.77***

Note: The critical values for the η_t when there are tendency are 0.216(1%), 0.146(5%) and 0.120 (10%) but when there are not tendency this critical values are 0.739(1%), 0.463(5%) and 0.349(10%). The critical values for the First Differences are 0.734(1%), 0.466(5%) and 0.347(10%). This symbols *, ** and *** stand for rejection of the null hypostesis of stationarity at 10, 5 and 1% respectively.

Table 4 presents the results of applying the Kwiatkowsky *et al*. (1992) stationarity test for the timeframe series of the fifteen countries that for the European Union 15. We analyse the timeframes when there is trend, for the level variables and for the first differences of the series.

As we can see in Table 4, we reject the null hypothesis at 5% of significancy for all countries except Finland, where we can only reject at 1% of significancy when for the analysed model there is trend. this means that the unemployment rate of each one of the countries is not stationary and therefore we encounter unitary units for these models.

When we realize the same analysis but only when we add level to the model, samples remain non stationary. Nevertheless, for Austria and Belgium we can only reject the full hypothesis at a significancy level of 1%, compared to the previous case in which we could reject it at 5%.

Finally, when we perform the first difference of the logarithm of the series, these become stationary, that is, the average, the variance and the autocovariance remain constant in time, regardless of the moment at which the contrast is realised, of the stationarity or the unit roots. Nonetheless, not all contrasted variables become stationary when we perform the first difference of the logarithm of the variables as Greece, Ireland and United Kingdom remain non stationary and because of that the average and the variance of their unemployment rates vary in time.

4.3 Lee and strazicich unit root

In order to avoid reaching erroneous conclusions on the existence of unit roots in the series, we realized the test that Lee and Strazicich (2003) suggest with two structural changes.

Lee and Strazicich based their test in the one performed by Perron (1989) in which they took into consideration three models: The model A that showed a structural change of the constant, model B that allowed a structural change of the trend and last, model C, that allowed changes of both constance and trend. Lee and Strazicich take into account for their test models A and C.

This test allows us to carry out the correspondent analysis for the two structural changes of the series and for that reason we achieve higher flexibility when we perform the test.

Table 5. Lee and Strazicich (2003) unit root test (in log).

European 15 unemployment rate

Variables	Type of Model	Structural Change	Statistic LM	k	Decision
Ireland	Model C	2008:05/2010:02	-1.69	106	I(1)
Greece	Model C	2008:09/2012:09	-3.19	106	I(1)
Belgium	Model C	2008:11/2011:01	-3.16	106	I(1)
Denmark	Model C	2008:09/2010:01	-3.59	106	I(1)
France	Model C	2007:10/2009:02	-2.51	106	I(1)
Luxembourg	Model C	2008:03/2010:04	-2.52	106	I(1)
Netherlands	Model C	2007:11/2013:02	-1.93	106	I(1)
Portugal	Model C	2007:11/2012:11	-2.29	106	I(1)
Finland	Model C	2008:12/2010:10	-1.73	106	I(1)
Sweden	Model C	2008:03/2010:05	-5.69	106	I(0)
United Kingdom	Model C	2008:12/2012:11	-1.78	106	I(1)
Germany	Model C	2008:12/2011:04	-2.18	106	I(1)
Spain	Model C	2006:11/2008:11	-1.37	106	I(1)
Austria	Model C	2008:11/2011:08	-3.13	106	I(1)

Italy	Model C	2006:12/2012:02	-3.30	106	I(1)

Note: The critical values for the Lee and Strazicih when there are two structurals changes are -6.16 (1%), -5.59 (5%) and -5.27 (10%) when λ_1 is 0.4 and λ_2 is 0.4. When λ_1 is 0.4 and λ_2 is 0.6 the critical values are -6.41 (1%), -5.74 (5%) and -5.32 (10%). If λ_1 is 0.4 and λ_2 is 0.8 the critical values are -6.33 (1%), -5.71 (5%) and -5.33(10%). When λ_1 is 0.6 and λ_2 is 0.6 the critical values are -6.45 (1%), -5.67 (5%) and -5.31 (10%). If λ_1 is 0.6 and λ_2 is 0.8 the critical values are -6.42 (1%), -5.65 (5%) and -5.32(10%). When λ_1 is 0.8 and λ_2 is 0.8 the critical values are -6.32 (1%), -5.73 (5%) and -5.32 (10%).

The model carried out in this project is the C one and Lee and Strazicich test allows us to analyse if there are ruptures both in constance or in trend. Table 5 shows the obtained results and the value of the statistic LM of each one of the 15 series. The chosen critical values for each one of the series varied according to the result of the following equation:

$$\lambda_j = \frac{T_{BJ}}{T} \qquad (3)$$

Where T_{BJ} is the number of the observation where the structural change is produces and T is the total number of observations in the sample. λ_1 is the year in which the first change occurs and λ_2 is the moment in which the second change occurs in the sample.

We notice that in 14 of the 15 analysed series there is a rupture, that is, there are unit roots and therefore these series are non stationary. Except in the case of Sweden that, unlike the previous conclusions obtained with the ADF test, KPSS test and Ng and Perron test we do not encounter unit toots and therefore the sample is stationary, without rupture.

Table 6. Lee and Strazicich (2003) unit root test of first differences (in log).

European 15 unemployment rate.

Variables	Type of Model	Structural Change	Statistic LM	k	Decision
Ireland	Model C	2008:02/2009:05	-5.61	105	I(0)
Greece	Model C	2008:11/2010:11	-7.68	105	I(0)
Belgium	Model C	2008:10/2011:06	-5.45	105	I(1)

Denmark	Model C	2008:10/2009:09	-8.77	105	I(0)
France	Model C	2008:02/2011:05	-6.19	105	I(0)
Luxembourg	Model C	2008:01/2010:07	-10.31	105	I(0)
Netherlands	Model C	2008:11/2013:09	-8.91	105	I(0)
Portugal	Model C	2010:06/2013:01	-7.85	105	I(0)
Finland	Model C	2008:03/2009:12	-5.82	105	I(0)
Sweden	Model C	2009:08/2011:06	-12.41	105	I(0)
United Kingdom	Model C	2008:06/2011:03	-7.97	105	I(0)
Germany	Model C	2008:09/2011:11	-7.24	105	I(0)
Spain	Model C	2008:09/2011:11	-4.46	105	I(1)
Austria	Model C	2008:04/2011:09	-7.46	105	I(0)
Italy	Model C	2007:04/2011:02	-14.05	105	I(0)

Note: The critical values for the Lee and Strazicih when there are two structurals changes are -6.16 (1%), -5.59 (5%) and -5.27 (10%) when λ_1 is 0.4 and λ_2 is 0.4. When λ_1 is 0.4 and λ_2 is 0.6 the critical values are -6.41 (1%), -5.74 (5%) and -5.32 (10%). If λ_1 is 0.4 and λ_2 is 0.8 the critical values are -6.33 (1%), -5.71 (5%) and -5.33(10%). When λ_1 is 0.6 and λ_2 is 0.6 the critical values are -6.45 (1%), -5.67 (5%) and -5.31 (10%). If λ_1 is 0.6 and λ_2 is 0.8 the critical values are -6.42 (1%), -5.65 (5%) and -5.32(10%). When λ_1 is 0.8 and λ_2 is 0.8 the critical values are -6.32 (1%), -5.73 (5%) and -5.32 (10%).

Table 6 show the results that were obtained through RATS in the Lee-Strazicich test after performing the first difference to the logarythms of the fifteen series. Unlike the results obtained when we performed the test upon the logarythms of the series, the unemployment rate of thirteen of the countries become stationary and moreover there are no ruptures within the samples. However, the variables of the unemployment rate for Spain and Belgium continue to be non stationary even after carrying out the first difference of the logarythm of the series. Apart from that, ruptures are still found in the sample. Compared to the results that we obtained in the previous tests, we notice that in the case of Spain in particular, when we perform the first difference of the logarythm during the KPSS test, the sample becomes stationary, however, at 1% it remained still non stationary. For the ADF test and the ng and Perron, in the case of the first difference it was also non stationary. Thus, in this case they lead to the same conclusions as the application of the Lee-Strazicich test. On the other hand, in the case of Belgium we encounter the opposite occurrence to what we obtained previously as the previous test run lead us to the conclusion that the unemployment rate of this series would become stationary when we performed the first difference of the Belgium logarythm.

5. CONCLUSION

After performing the amplified Dicke-Fuller test, KPSS, Ng and Perron and Lee and Strazicich we can reach the conclusion that the evolution of the unemployment rate in the countries that form the European Union 15 follow a non-stationary process, in spite of the fact that we managed to make this variable become stationary in most of the cases after we performed the first difference of the logarithm. This fact reveals that unemployment rates of these countries have unit roots and because of this reason the unemployment rates do not tend to return to their natural unemployment rate as different shocks in the economy of these countries make them vary in a permanent way and therefore determine the onset of the hysteresis. Beside these shocks in economy, the rigidities of the labour markets can represent a great obstacle for this rate to return to its initial natural value in many countries.

The economic crisis, as we well know, has not affected all countries of the European Union 15 equally and in some of them the increase of the unemployment rate has been superior than in others, as in the cases of Spain, Greece and Italy, compared to Germany and Austria. This shock in the economy has caused countries with higher unemployment rate to carry out different measures that have the purpose to reform the labour markets and try to reduce this high unemployment rate and make it go back to its initial level that it had before the beginning of the great crisis. Spain, for example, as we already mentioned before has experimented a strong destruction of its employment and that led to an increase of its unemployment rate. For that reason, just like Italy, Spain has established several measures in order to achieve an improvement of the wage flexibility and boost employment and in this way try to reduce the rigidity of the labour market. In Greece, reforms have focused on reforming the minimum wage of the country. United Kingdom, on the contrary presents a higher flexibility of its labour market and this fact allows workers to find a new job quickly in case they lose their previous one and therefore UK manages to reduce the long-term unemployment. The labour market in Germany also shows a great flexibility, in this country the temporariness of job contracts is higher and there are a higher number of part time workers.

Thus, it is very important for countries that present a high labour rigidity to achieve a greater flexibility of their labour markets, taking actions that would allow a greater wage

flexibility that would reduce the employment protection and that would manage to significantly lower the negotiating power of workers through syndicates. Moreover, it would be convenient to achieve the increase the mobility of workers among different countries and in this way reduce the unemployment rate. On the other hand it would also be very important to make wages more flexible as in this way they would better adapt to the economic conditions that occur at different moments in time. These economies should also provide incentives for the unemployed population to find other jobs and in this way avoid people from turning to unemployment subsidies, besides establishing restrictions to avoid an easy access to these benefits. Additionally, it is of great interest to create different alternatives destined to reduce the long term unemployment and for this reason, one of the policies that could be carried out in these countries is to establish those policies that aim to improve the training of those people that have a lower educational level, as they represent one of the sectors most severely affected by the unemployment; applying this policy would avoid this king of people to remain unemployed for a long period of time and therefor the long term unemployment rate would decrease. Another measure would be the creation of employment policies that facilitate the access to the labour market for these people.

Also, in order to achieve a higher labour market flexibility, we have to implement measures that have the purpse to eliminate the temporariness of job contracts. For example, Germany established before any other country belonging to EU-15 this type of policies and as we already mentioned before, achieved to establish more part time jobs contracts.

If we manage to reduce the rigidity of the labour market maybe we will be able to stop the effect of the economic shocks and prevent them from affecting the unemployment rate permanently and therefore it would tend to return to its natural and initial level. This fact would determine temporal series to become stationary, in other words, the unemployment rate would fluctuate around its natural unemployment rate.

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