An analysis of the Okun's law for the Spanish provinces

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Resumen:

The relationship between unemployment and GDP, commonly known as Okun's law, has been traditionally analysed in the economic literature. Its application for Spain has been carried out at national level or by regions but it has been less frequent observing it for provinces. This study analyses this relationship during the period spanning from 1985 to 2010 for all Spanish provinces, excluding Ceuta and Melilla. Since our purpose is performing both static and dynamic analyses we resort to the first difference Okun's law specification and to the VAR and PVAR techniques. The results lead us to determine that provinces within regions show large differences in their unemployment variability. It contrasts with the unemployment persistence results, for which the greatest differences are between regions. Dynamic analysis confirms these results but also shows that for most provinces shocks in unemployment affect economic growth in a higher extent than the inverse.

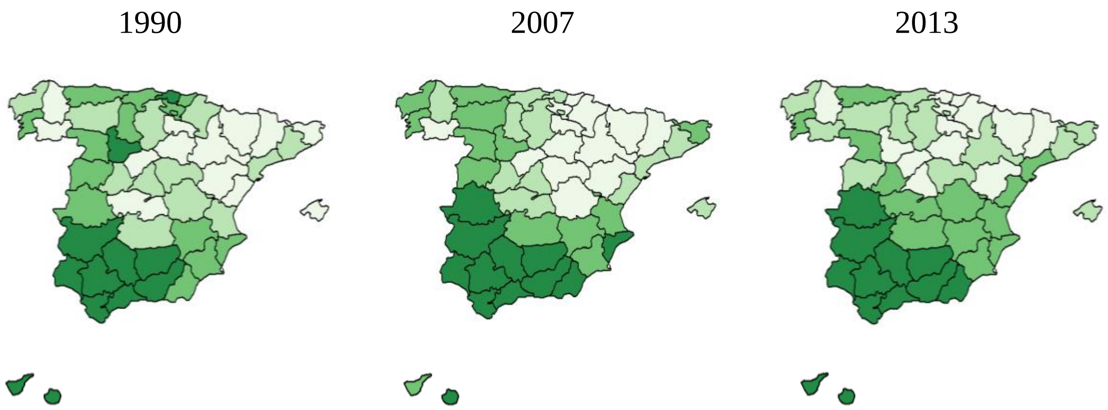
Palabras Clave: Unemployment, Output, Spanish provinces

Clasificación JEL: C32, C33, J23, R11

1. Introduction

The strong impact of economic cycles on unemployment is a Spanish particular feature. However, it is noted that not all provinces show the same volatility in unemployment. Whereas in some of them a strong response of unemployment to changes in the economic cycle is observed, in others unemployment rate varies to a lesser extent. Similarly, we observe provincial differences in unemployment persist over time. The provinces that, prior to the current economic recession, had higher levels of unemployment are the same as those with a higher unemployment rate in 2013. Moreover, they are also the same provinces that in previous decades had more unemployed population. So, despite the measures implemented to promote equity between geographical areas, differences still persist.

Figure 1. Provincial unemployment rate.



However, the geographical areas that have been showing higher unemployment rates over the time do not always have to coincide with those with greater unemployment variability with regard to Gross Domestic Product (GDP) shifts. Therefore, the aim of this paper is determining the relationship between GDP and unemployment for all the provinces in order to observe if provinces with higher unemployment variability are also those ones with higher unemployment rates over the years.

To achieve this objective, we carry out static and dynamic analysis of the relationship between GDP and unemployment. Firstly, we estimate the well-known Okun's law using Ordinary Least Squares (OLS) when we take into account the provinces separately and by Fixed Effects (FE) when we group them in a panel. Then, we perform the dynamic analysis using VAR and PVAR models. We observe how a shock in one of the variables affects the other over time using the Impulse-Response Functions obtained with the VAR and PVAR models.

This work contributes to the previous literature in several ways. The first contribution concerns the provincial approach applied in the analysis. The provincial disaggregation had not been carried out previously in studies examining Okun's law for Spain. This new approach offers interesting results that should be taken into account when economic policies are defined. The second contribution consists in performing a dynamic analysis through VAR and PVAR techniques, which have not been applied at the Spanish provincial level yet.

We organize the rest of the paper as follows. In section 2, we briefly gather the contributions to Okun's law that different authors have done. We also consider the analysis carried out at regional level and for the Spanish economy. In section 3, we describe the methodology that we undertake and section 4 presents the main results we obtain. Finally, section 5 concludes.

2. Literature review

2.1. General overview

The relationship between economic activity and unemployment has been traditionally analysed by using the different specifications of Okun’s law.[1] Okun (1962) formulated the well-known rule of a thumb that assigns approximately a 3 percentage – point of GDP decrease to a 1 percentage – point of unemployment rate increase. Since then, it has been the focus of discussion and analysis. Many authors have submitted it to transformations in order to modify certain theoretical foundations and to achieve a more accurate statistical fit. Furthermore, it has been applied to different economic contexts. It is worth noting the work of Gordon (1984), Evans (1989), Prachowny (1993), Weber (1995), Attfield and Silverstone (1997), Knotek (2007), Owyang and Sekhposyan (2012) and Perman et. al. (2014), among others.

The different authors have defined both static and dynamic specifications of the aforementioned empirical relationship. Evans (1989) considered three lagged periods in

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[1] Okun's law is an empirically observed relationship relating unemployment to GDP. The initial statement of this law supposes that a 3% increase in output corresponds to a 1% decline in the rate of unemployment.

order to observe how past variations in Gross National Product (GNP) and unemployment influenced quarterly values of these variables. He applied a bivariate approach and obtained instantaneous causality and a significant long run relationship between GNP and unemployment rate.

Economists have also analysed the relationship between GDP and unemployment rate in two directions. Whereas Okun seminal study considered unemployment as the exogenous variable, other relevant analysis placed it endogenously. Thus, Okun's coefficient comparisons between both kinds of studies turn out worthless. Another transformation undergone by the empirical relationship has consisted in introducing new variables in the original formula. For instance, Gordon (1984) introduced as explanatory variables the changes in capital and technology regarding their potential level, besides unemployment variations. Prachowny (1993) considered labour supply, workers weekly hours and capacitiy utilization deviations from the equilibrium additionally.

All these transformations have contributed to the fact that there is no consensus about the value of Okun's coefficient. Some authors have confirmed the value initially presented by Okun. Others obtained that the magnitude of the impact of business cycle on unemployment is closer to two instead of three. Finally, there are analyses that show that the Okun's coefficient varies over the period selected and among the countries considered.

Weber (1995) analysed the U.S. economy during the period 1948-1988 and obtained that the long-term coefficient was close to three. However, he acknowledged there was a breakdown in the third quarter of 1973. In the same line, more recent studies such as Knotek (2007) and Owyang and Sekhposyan (2012) considered this empirical relationship is a good approximation in the long term, but they showed the coefficient has not been kept stable over the time.

In this regard, Perman et. al. (2014) conducted a meta-analysis to obtain the "true value" of the Okun's law coefficient. In order to do so, they used a sample of 269 estimates. Among these, they discarded those ones that did not fulfil the pre-established requirements and distinguished between the analyses that considered changes in GDP as the independent variable and the studies that considered unemployment variations exogenously. They quantified the impact of unemployment rate on GDP in -1.02 points.

This value is far away from the three point - coefficient and make obvious that the period and countries selected matters. In the same vein, Lee (2000) acknowledged that Okun's law could be considered valid qualitatively, but not quantitatively. He selected 16 OECD countries to observe if the so - called rule of thumb holds. Lee obtained that, although all countries present a negative relationship between GDP and unemployment, the coefficient that relates these variables varies significantly across countries. Moosa (1997), who considered the G7 countries, had previously obtained the same result.

Therefore, the fact that a significant negative relationship between unemployment and GDP could be accepted for almost all countries and for any period is an interesting empirical result. However, the coefficient divergence across countries and over time is one of the most important criticisms. But this is not the only one. From a labour economics perspective, many authors recognize that unemployment rate does not provide comprehensive information from the labour market situation. In this regard, Benati (2001) and Emerson (2011) established that it leaves out the "discouraged worker" effect, i.e., the unemployed who drop out the labour market as they give up hope about being employed. As a result, this group become part of the inactivity. On the other hand, the "added worker" effect (the entry of inactive in the labour market due to an adverse economic situation), which has been considered by Congregado et. al. (2011), also modifies the unemployment rate.

Moreover, taking into account the unemployment rate alone could also lead to a misinterpretation of the economic situation. Changes in population growth or female labour participation rising can result in an increased unemployment rate not justified by an adverse economic cycle. The information loss, that unemployment rate neglects, has important implications in the Okun's law interpretation.

2.2. From the national to the regional perspective

The main criticism of Okun's law, based on the divergence in its coefficient, has become a tool to compare the labour market performance in the different countries and regions. The regional analysis further allows isolate the impact of labour market institutions. For this reason, many authors have figured out the patterns of unemployment and business cycle by region as well as their relationship to determine the appropriate economic policies to apply.

One of the first authors to apply the Okun's law at regional level was Freeman (2000). He selected eight U.S. areas and obtained, unlike the studies that we mention later, a similar and stable coefficient for all regions. This result shows a high flexibility in the U.S. labour market that favours regional convergence in the unemployment rates. However, Adanu (2005) did not get this level of convergence among Canadian provinces. Moreover, he obtained that the law did not hold for three of the ten provinces analysed. Adanu analysed how unemployment affects GDP during the 1981-2001 period for the Canadian provinces and observed GDP highly varies in the most industrialized provinces when changes in labour occur. This is mainly due to productive jobs are in a greater extent in industrialized provinces.

In European countries, Okun's law holds at national level but when regions are analyzed, some authors obtain that variations in business cycle do not always explain the changes in the unemployment rate. Binet and Facchini (2013) applied the relationship to the twenty two French regions and obtained it is significant for only fourteen of them. They show it is due to high unemployment rates coexist in some regions with above average per capita GDP levels. According to the authors, such situation out of equilibrium is partly a result of a rapid growth of working-age population that has not been absorbed by an employment increase. Also, the great percentage of public sector employment in the regions where the Okun's law does not hold hampers the adjustment to equilibrium.

Lack of significance of Okun's law is even more extended in the Greek regions. Christopoulos (2004) applied a similar analysis to Greek regions and obtained that only six of thirteen have a significant relationship between unemployment and the business cycle. Moreover, the coefficients point out much higher unemployment volatility than in North America. Contrarily to Canadian provinces, most industrialized regions in Greece do not show a significant relationship between unemployment and GDP, probably due to the hysteresis in unemployment.

2.3. The specific case of Spain

The Spanish economy has been characterized by a strong impact of business cycles on unemployment since 1975. In fact, unemployment rate has experienced an upward trend that only has undergone two breakdowns during 1986-1991 and 1995-2007 expansion periods. This unemployment uptrend cannot be justified by the moderate increase in the labour force participation at the national level.

The economic depression which affected Spanish economy since 1975 was mainly attributable to the great instability that took place during the transition to democracy, the shocks produced in the industry as a result of the delayed effect of the oil price increase and the social measures that partly geared to augment wages. As a consequence, in 1985 unemployment rate reached 21.4% and only 47% of the population was occupied. But, in 1986 the entry into the European Union caused a widespread optimism that impacted on the economy and led to a fall in the unemployment rate. This lasted until 1991, when a generalised recession affected the Spanish economy. The cycle change came again in 1995 when labour law reforms favoured wage moderation and boosted temporary jobs. A fueled housing sector development, favoured by low interest rates after the euro adoption, promoted the economic growth and the convergence to the European levels of unemployment occurred. In 2007, whereas the average unemployment rate was around 7% in Europe, in Spain it was at 8%. This degree of unemployment rate variation illustrates the strong impact that GDP has on unemployment in Spain, resulting in a greater Okun's coefficient for this country than for most OECD ones. Since 2008, the bursting of the housing bubble triggered an unprecedented recession and in three years an increase in the unemployment rate of nearly 12 percentage points occurred. This unemployment increase was accompanied by only a 7.8 percentage - point GDP drop, which reinforces the assumption of the high unemployment volatility in Spain.

On the other hand, labour force participation has seemed to be alien to these cycles. It maintained a growing trend that just stalled during 1991-1996 period. This is illustrated by Jimeno and Bentolila (1998), who acknowledge that changes in the Spanish economy have been reflected in the unemployment rate. They also consider this Spanish feature is not commonly observed in the U.S. and most European countries. There, shocks have a greater impact on migration flows and participation respectively.

But, this is not the whole story. National data do not pick up the great diversity that Spanish regions show. There are large disparities between regions in terms of the unemployment rate and unemployment elasticity to business cycles. This is shown by Pérez, et. al. (2002) and Amarelo (2013). They analysed the cases of Andalusia and

Catalonia respectively and compared them with the Spanish results. Pérez, et. al. (2002) obtained for Andalusia a lower unemployment variability to business cycles during the 1984-2000 period than it was obtained for Spain, although when the employment rate was taken into account instead unemployment rate, the reverse result was found. employment variability to output was found higher for Andalusia than for the Spain. Meanwhile, Amarelo (2013) observed unemployment variability in Catalonia was higher than that obtained for Spain.

Maza and Villaverde (2007, 2009), who observed the Okun's law for all Spanish regions, attributed the differences between regions to the productivity growth. They obtained neither development degree nor spatial patterns can explain these differences.

3. Data sources and methodology

3.1. Data sources and variable definition

The analysis of the output variations effect over unemployment rate requires three macroeconomic data sets: real GDP and unemployment and labour force participation data. The analysis is carried out annually at provincial level and the period we focus is spanning between 1985 and 2010 due to lack of more recent data.

The selected period allows us to consider the entry of Spain into the European Union and the industrial reconversion, which took place right after this event, the creation of the welfare state, the economic expansion, partly dependent on an oversized housing sector, and the recent crisis that began in 2008 and still persists. Meanwhile, province as the unit of analysis implies a thorough study which specifically takes into account each area weaknesses and allows defining individual policies which will have a greater impact.

The number of selected Spanish provinces for the analysis is 50. It includes all peninsular provinces and the islands. We only omit Ceuta and Melilla autonomous cities due to their singularity and the lack of disaggregation in some series of the employment and output data. The information has been taken out from Spanish National Institute of Statistics (INE). We resort to the Contabilidad Regional de España CRE (Spanish Regional Accounting) to obtain nominal GDP by province and the Índice de Precios al Consumo IPC (Consumer Price Index CPI) data set to deflate nominal output and obtain a proxied measure of real GDP. Using CPI as GDP deflator is a consequence of the GDP deflator lack of data at the provincial level. INE only supplies information about rates of variation of real GDP by region, hence provincial CPI becomes the most suitable indicator to remove the effect of prices in the output. Furthermore, unemployment and labour force participation information, which is required to draw up the unemployment rate, is provided by the Encuesta de Población Activa EPA (Labour Force Survey).

TABLE 1: SOURCES OF INFORMATION

Data	Information	Detailed Components	Source
Real GDP	Real GDP is obtained from the nominal GDP deflated by CPI. We construct a homogeneous series for the aforementioned data sets for the period spanning 1985-2010.	Nominal GDP (CRE 86, CRE 00, CRE 08) IPC (IPC 83, 92, 11)	CRE IPC
Unemployment	Unemployment is the overall number of people aged 16 and older, who have not been working for at least an hour during the reference week for money or other kind of remuneration. Unemployment does not include people who are temporarily absent from work due to illness, vacation, etc.	-	EPA
Labour Force Participation	Labour force participation is the overall number of people aged 16 and older, who supply labour for the production of goods and services or are avalaible and able to be incorporated to work.	-	EPA

INE provide us non homogeneous panel data sets. Nominal GDP is in different year basis and we have to homogenize it taking 2010 as the year basis. Moreover, CPI is only available for provinces capitals after 1993 and we use the index for the provincial capitals in the previous years. Meanwhile, occupation and participation data are furnished according to different criteria based on the time when information was collected. In this case, we follow De la Fuente (2012), who makes the required adjustments in order to link the 1976-1995 and 1996-2004 occupation and participation series to the 2005-2013 series. The differences are mainly due to sample replacement and methodological changes such as: questionnaires modifications and adjustments in the definition of occupation and unemployment. These annual and state adjustments will be distributed among the provinces considering their weighting in the state occupation and labour force participation data.

3.2. Methodology

The analysis of the relationship between output and unemployment requires checking that series are stationary as a first step. Firstly, we do it for every province and afterwards, we aggregate all provincial series in a panel that is tested by the panel unit root tests we mention later. Then, we obtain the regression using MCO and FE for provinces and the panel respectively and finally, we perform a dynamic analysis by using VAR and PVAR techniques.

3.2.1. Unit Root Testing

Unit root testing is a necessary procedure before estimating. It allows us to know whether the processes generated are stationary and, therefore, the obtained results are not spurious and have economic sense. Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP) are some of the most applied tests. In both, the null hypothesis assumes that series are generated by integrated processes whereas the alternative establish the series is stationary. The difference between them is in the way the serial correlation problem is dealt. Whereas ADF introduces additional lags as regressors of the variable that is susceptible to present a certain autocorrelation degree, PP makes a non-parametric correction of the t-test statistic, i.e., PP test uses Newey–West (1987) standard errors to account for serial correlation. ADF test obtain better results for finite samples, but PP is robust to heteroskedasticity and unspecified autocorrelation.

However, these traditional unit root tests do not consider the existence of structural breaks in the series. So, the presence of structural breaks would provoke that ADF and PP tests tend to have low power. Glynn et. al. (2007) establish that structural breaks generate a bias in ADF and PP tests that reduces their ability to reject a false unit root hypothesis. Perron (1989) was the first author to mention this and he developed a procedure based on ADF test that accounted for only one exogenous break. His analysis broke with the idea proposed by Nelson and Ploser (1989), who stated random shocks were not transitory and did have permanent effect in the economies. However, the

Perron procedure is severely criticized by many economists. Some of them are Christiano (1992), who established pre-test analysis of the data can lead to bias in the unit root test or Zivot and Andrews (1992), who proposed an endogenous determination of the break to reduce this bias. The Zivot-Andrews test allows for a structural break, which is registered the time period in which ADF t-statistic is the minimum. Later versions, such as Perron and Vogelsang (1992) distinguish between additive and innovative outliers. Clemente, Montañés and Reyes (1998) contemplate this break distinction, but they go further and consider the possible existence of two breaks.

In our study, we conduct the ADF and PP traditional tests but we also apply Zivot-Andrews and Clemente-Montañés-Reyes tests, which assume structural breaks in the series. Applying both kinds of tests guarantees robustness in determining if the series are stationary.

The lag length selection criterion has been different for each test. For the ADF test, we have observed for every province the lags that are significant at 90% level and we have chosen the maximum number of significant lags. Meanwhile, we have recurred to the default number of Newey-West lags to calculate the standard error for the PP test.[2]

After conducting individual unit root tests, panel-data unit root tests are applied in order to complete our analysis and get an overall view of the GDP and unemployment rate of the Spanish provinces. They give additional information and increase the value of unit root tests based on single series. There is some literature about them and many attempts to remove cross-sectional dependence. Now, because of Pesaran (2007), Moon and Perron (2004), Maddala and Wu (1999) works we are far more advanced in this issue than the initial essays of the Levin-Lin (2002) and Im-Pesaran-Shin (2003). In our work we apply the Fisher-type, Levin Lin Chu, Im Pesaran Shin and Hadri LM tests. In the first three tests, the null hypothesis considers the presence of unit roots in, at least, one of the series that form the panel and stationarity is assumed under the alternative hypothesis. Otherwise, Hadri LM test considers in its null hypothesis that the series are generated by stationary processes.

[2] This number of lags is given by the following formula: $\text{int}\{4(T/100)^{2/9}\}$.

The main advantages of Fisher-type test are that it can use different lag lengths in the individual ADF regressions and can be applied to any other unit root test. Moreover, it performs better than the aforementioned Levin-Lin and Im-Pesaran-Shin test under cross-sectional dependence. Otherwise, Hadri test is an extension of Kwiatkowski et. al.(1992) tests for panel data. It provides us added value due to, as Hadri (1999) acknowledges, testing both the unit root and the stationary hypothesis, we are able to make a distinction between the stationary series, the series that has a unit root and those ones for which we are not sure if they are stationary or integrated.

In all the tests the lag length[3] set is chosen according to Österholm (2004), who selects the maximum number of lags from the individual tests. The maximum significant number of lags obtained in the individual ADF test is that we use to determine the lag length of the panel unit root tests[1].

3.2.2. Okun's law specifications

Once we know that the series which we are working with are stationary, we can figure out the relationship between GDP and unemployment variables and then analyse their dynamics.

In order to observe the relationship that the aforementioned variables maintain, we resort to the difference version of the Okun's law.

$$(u_t - u_{t-1}) = \alpha + \beta_1(y_t - y_{t-1}) \qquad (1)$$

This specification is considered in our analysis due to the unobservability of the potential magnitudes of the variables taken into account, which are considered in the gap version. In addition, the large variability in the unemployment rate observed for Spain and many of its provinces over the selected period makes our specification becomes more accurate than the gap approach. The estimation[4] of the coefficient of

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[3] Other criteria are also used in order to obtain robust results. We also consider the AIC criterion in the Levin Lin Chu and Im Pesaran Shin tests to select the lag length.

[4] We have also estimated the relationship between GDP and unemployment for the Spanish series and the 1985-2010 and 1985-2012 periods. However, the stationarity in second differences of the GDP and unemployment series does not allow us to compare the values with those obtained at the provincial level. Besides, performing the regression in second differences implies a losing relevant information. Therefore, we have decided not to include the results of the Spanish series.

provincial series is performed by using the Ordinary Least Squares method (OLS) while the panel that integrates all provinces requires estimating by fixed effects (FE).

The dynamic behaviour of economic growth and unemployment rate variation is analysed through the VAR and PVAR techniques. It allows us to consider the effect that past values of both variables on each of them. We can write VAR representation as follows:

$$\Delta u_t = \alpha(L)\Delta u_{t-1} + \beta(L)\Delta y_{t-1} + v_t^u$$
$$\Delta y_t = \gamma(L)\Delta y_{t-1} + \eta(L)\Delta u_{t-1} + v_t^y \qquad (2)$$

The VAR analysis answers the question of what is the effect of an output or unemployment innovation on our forecasts for both variables in the near future. VAR models treat GDP and unemployment variables as endogenous and interdependent and analyse the transmission of idiosyncratic shocks across time. Meanwhile, the panel that includes all provincial series requires PVAR technique to determine what the effect of an innovation in any of the variables considered in the relationship is.

The lag order selected in these dynamic analyses is one because we work with annual data and we expect that the variables considered keep some correlation with the same variable lagged one period. The AIC and BIC criteria also obtain that considering one lag in the VAR analysis is optimal for most series.

After performing the estimation, Impulse Response Functions (IRFs) associated show the response of both variables to shocks in any of them. We obtain them for all the provinces by orthogonalizing the variables.

4. Empirical results

4.1. Some stylized facts

The Spanish unemployment rate has experienced a great volatility relative to variations in GDP. The crises have resulted in large increases in unemployment, while economic expansions also mean higher falls in the unemployment rate than Okun's law forecasts. Provinces have suffered differently the unemployment variability.

In this section, we explore the Okun's relationship for all provinces to detect the unemployment behaviour regarding output fluctuations and their dynamics. In order to do so, we deal with the estimation in differences of the aforementioned empirical relationship, firstly conducting the tests that prove the stationarity of the series employed. The dynamic analysis is carried out by using the VAR and PVAR techniques and analysing the impulse response functions.

4.2. Results of unit root tests

Before estimating the relationship between unemployment and output for Spain and its provinces, we must make the necessary checks regarding the stationarity of the series. We conduct two types of tests over variables in levels[5] and first differences. ADF and PP traditional tests are applied, but also Zivot-Andrews and Clemente-Montañés-Reyes, which consider structural breaks. Results from ADF and PP tests over variables in first differences are shown in Table 2. In this table, we can observe the model that we consider, which is individually chosen, and the statistic value of the test, that allow us to accept or reject the null hypothesis.

In the light of the results, both tests mainly lead to reject the null hypothesis of presence of unit roots in the first differenced series at the conventional levels of significance. When we test the first differenced unemployment rate variable, only in 6 of 50 provinces we found that any of tests can not reject the null hypothesis of presence of unit roots. In the case of GDP, in 11 of 50 provinces both tests find problems to reject the null hypothesis.

But these exceptions may be due to the presence of structural breaks in the series that are not detected by ADF and PP tests. We apply Zivot-Andrews and Clemente-Montañés-Reyes tests in order to check whether the results remain the same or, in opposite, change when structural breaks are taken into account. Tables 3 and 4 show the results of Zivot-Andrews and Clemente-Montañés-Reyes tests for the variables in first differences.

[5] Unit root tests of the variables in levels are available from the author on request

TABLE 2: ADF AND PP UNIT ROOT TESTS OVER VARIABLE IN FIRST DIFFERENCES

Province	Unemployment Rate				Natural Logarithm GDP			
	ADF-t		*PP-t*		*ADF-t*		*PP-t*	
	Model	t-Stat.	Model1	*t-Stat.*	Model	t-Stat.	Model1	*t-Stat.*
Álava	NT,C,0L	-4.254**	NT,C	-4.236**	NT,C,0L	-2.738*	NT,C	-2.764*
Albacete	NT,C,0L	-2.875*	NT,C	-2.929*	T,C,0L	-4.683**	T,C	-4.701**
Alicante/Alacant	NT,C,0L	-2.924*	NT,C	-2.896**	NT,C,0L	-2.119	NT,C	-2.292
Almería	NT,C,0L	-3.131**	NT,C	-3.101**	T,C,0L	-3.036*	T,C	-3.066*
Asturias	NT,C,0L	-3.963**	NT,C	-3.919**	NT,C,0L	-3.402**	NT,C	-3.407**
Ávila	NT,C,0L	-1.966	NT,C	-2.088	NT,C,0L	-3.714**	NT,C	-3.716**
Badajoz	NT,C,0L	-3.661**	NT,C	-3.681**	NT,C,0L	-2.786*	NT,C	-2.994*
Balears, Illes	NT,C,0L	-2.825*	NT,C	-2.849*	T,C,0L	-2.488	T,C	-2.653
Barcelona	NT,C,0L	-2.703*	NT,C	-2.765*	NT,C,1L	-2.662*	NT,C	-1.968
Burgos	NT,C,1L	-3.857**	NT,C	-2.949*	NT,C,0L	-3.507**	NT,C	-3.421**
Cáceres	NT,C,0L	-5.470**	NT,C	-5.511**	NT,C,0L	-3.162**	NT,C	-3.217**
Cádiz	NT,C,0L	-2.883*	NT,C	-2.930*	NT,C,0L	-3.204**	NT,C	-3.258**
Cantabria	NT,C,0L	-2.963*	NT,C	-3.027**	NT,C,1L	-2.880*	NT,C	-2.841*
Castellón/Castelló	NT,C,1L	-2.526	NT,C	-1.99	NT,C,0L	-3.174**	NT,C	-3.285**
Ciudad Real	NT,C,0L	-2.680*	NT,C	-2.650*	NT,C,0L	-2.831*	NT,C	-2.741**
Córdoba	NT,C,0L	-3.491**	NT,C	-3.528**	T,C,0L	-4.200**	NT,C	-3.925**
Coruña, A	NT,C,0L	-3.460**	NT,C	-3.464**	NT,C,0L	-3.504**	NT,C	-3.490**
Cuenca	NT,C,0L	-3.137**	NT,C	-3.114**	NT,C,0L	-3.904**	NT,C	-3.915**
Girona	NT,C,0L	-3.191**	NT,C	-3.212**	NT,C,0L	-3.354**	NT,C	-3.366**
Granada	NT,C,0L	-2.247	NT,C	-2.344	NT,C,0L	-1.822	NT,C	-1.823
Guadalajara	NT,C,0L	-2.431	NT,C	-2.483	NT,C,0L	-3.098**	NT,C	-3.156**
Guipúzcoa	NT,C,0L	-3.317**	NT,C	-3.346**	NT,C,0L	-3.065**	NT,C	-3.107**
Huelva	NT,C,0L	-4.804**	NT,C	-4.799**	NT,C,0L	-4.149**	NT,C	-4.169**
Huesca	NT,C,1L	-4.203**	NT,C	-3.603**	NT,C,0L	-4.163**	NT,C	-4.196**
Jaén	NT,C,0L	-4.537**	NT,C	-4.540**	NT,C,0L	-5.309**	NT,C	-5.338**
León	NT,C,0L	-3.422**	NT,C	-3.398**	NT,C,0L	-5.210**	NT,C	-5.219**
Lleida	NT,C,0L	-2.910*	NT,C	-2.846*	NT,C,0L	-3.871**	NT,C	-3.805**
Lugo	NT,C,0L	-3.607**	NT,C	-3.610**	NT,C,0L	-4.076**	NT,C	-4.114**
Madrid	NT,C,0L	-2.312	NT,C	-2.339	NT,C,0L	-1.763	NT,C	-1.989
Málaga	NT,C,0L	-2.557	NT,C	-2.668*	NT,C,0L	-1.818	NT,C	-1.919
Murcia	NT,C,0L	-2.376	NT,C	-2.465	NT,C,0L	-2.647*	NT,C	-2.769*
Navarra	NT,C,1L	-3.462**	NT,C	-2.518	NT,C,0L	-3.297**	NT,C	-3.309**
Ourense	NT,C,0L	-3.247**	NT,C	-3.289**	NT,C,0L	-4.245**	NT,C	-4.273**
Palencia	NT,C,0L	-3.360**	NT,C	-3.368**	T,C,0L	-5.015 **	T,C	-5.032**
Palmas, Las	NT,C,0L	-2.476	NT,C	-2.45	NT,C,0L	-1.986	NT,C	-2.077
Pontevedra	NT,C,1L	-3.083**	NT,C	-2.536	NT,C,0L	-2.32	NT,C	-2.452
Rioja, La	NT,C,0L	-3.413**	NT,C	-3.421**	NT,C,0L	-3.833**	NT,C	-3.854**
Salamanca	NT,C,0L	-4.040**	NT,C	-4.026**	T,C,0L	-3.188	T,C	-3.340*
Sta. Cruz de Tenerife	NT,C,0L	-3.082**	NT,C	-3.084**	NT, C, 0L	-3.824**	NT,C	-3.828**
Segovia	NT,C,0L	-3.891**	NT,C	-3.862**	NT, C, 0L	-3.612**	NT,C	-3.619**
Sevilla	NT,C,1L	-3.367**	NT,C	-2.604	NT,C,0L	-2.593	NT,C	-2.611
Soria	NT,C,0L	-3.964**	NT,C	-3.934**	NT, C, 0L	-5.571**	NT,C	-5.577**
Tarragona	NT,C,0L	-3.018**	NT,C	-2.992*	NT, C, 0L	-4.318**	NT,C	-4.352**
Teruel	NT,C,0L	-4.112**	NT,C	-4.191**	NT, C, 0L	-4.031**	NT,C	-4.011**
Toledo	NT,C,1L	-3.926**	NT,C	-2.808*	NT,C,0L	-2.851*	NT,C	-3.085**
Valencia/València	NT,C,0L	-2.631*	NT,C	-2.694*	NT,NC,0L	-2.253	NT,C	-2.29
Valladolid	NT,C,0L	-2.987*	NT,C	-3.030**	NT, C, 0L	-3.762**	NT,C	-3.714**
Vizcaya	NT,C,0L	-3.624**	NT,C	-3.617**	NT, C, 0L	-3.088**	NT,C	-3.145**
Zamora	NT,C,0L	-3.785**	NT,C	-3.716**	NT, C, 0L	-4.461**	NT,C	-4.458**
Zaragoza	NT,C,0L	-2.633*	NT,C	-2.638*	NT, C, 0L	-1.739	NT,C	-1.828

(**) We can reject the null hypothesis of unit roots with, at least, 95% confidence level.

(*) We can reject the null hypothesis of unit roots with 90% confidence level.

TABLE 3: UNIT ROOT TESTS OVER FIRST DIFFERENCED UNEMPLOYMENT RATE

Province	Zivot- Andrews		Clemente-Montañés-Reyes								
	t-statistic	Year		t-statistic	Years			t-statistic	Years	
Álava	-5.74*	1995	0 AO				0 AO			
Albacete	-4.52	1994	1 AO	-3.89**	2005		2 AO	-5.46	1992	2007
Alicante/Alacant	-4.67*	1995	1 AO	-3.06	2006		1 AO	-4.35**	2007	
Almería	-5.01**	2008	1 AO	-4.60**	2005		1 AO	-5.22**	2006	
Asturias	-5.31**	2009	0 AO				2 AO	-5.65**	2000	2008
Ávila	-4.23	2008	1 AO	-2.98	2005		2 AO	-5.54**	1993	2007
Badajoz	-5.04**	1996	1 AO	-4.28**	2005		1 AO	-4.55**	2008	
Balears, Illes	-4.20	2008	1 AO	-3.56**	2005		1 AO	-5.40**	2007	
Barcelona	-3.58	1995	1 AO	-4.097**	2003		1 AO	-4.83**	2007	
Burgos	-5.59**	2008	1 AO	-5.73**	2005		2 AO	-6.61**	1998	2006
Cáceres	-6.20***	2008	0 AO				0 AO			
Cádiz	-4.89**	2008	2 AO	-5.50**	1995	2007	2 AO	-5.46	1993	2007
Cantabria	-5.03**	1997	0 AO				2 AO	-5.98**	1995	2008
Castellón/Castelló	-4.03	2008	1 AO	-2.80	2005		1 AO	-14.25**	2007	
Ciudad Real	-4.33	2008	2 AO	-4.39	1998	2005	2 AO	-7.60**	1999	2007
Córdoba	-5.22**	2008	2 AO	-6.26**	1998	2007	2 AO	-5.76**	1998	2007
Coruña, A	-4.23	1995	1 AO	-4.03**	2008		2 AO	-4.70	2003	2007
Cuenca	-6.68***	2009	1 AO	-1.47	2005		2 AO	-7.37**	1994	2007
Girona	-5.15**	1998	1 AO	-3.64**	2004		2 AO	-17.77**	1996	2007
Granada	-4.07	2008	2 AO	-5.89**	1995	2004	2 AO	-5.40	1996	2006
Guadalajara	-4.93**	2008	1 AO	-5.44**	2005		1 AO	-3.39	2006	
Guipuzcoa	-5.65***	1997	0 AO				0 AO			
Huelva	-5.73***	2008	0 AO				2 AO	-3.33	2000	2007
Huesca	-5.90***	1997	0 AO				0 AO			
Jaén	-5.82***	1997	0 AO				2 AO	-5.39	1997	2007
León	-5.01**	2008	1 AO	-4.05**	2004		2 AO	-4.33	1998	2008
Lleida	-5.27**	2008	1 AO	-5.89**	2005		0 AO			
Lugo	-5.32**	2009	2 AO	-4.89**	1996	2005	2 AO	-6.63**	1993	2008
Madrid	-3.95	1997	1 AO	-3.13	2005		1 AO	-3.00	2007	
Málaga	-4.22	2008	1 AO	-3.48	2005		1 AO	-4.23	2006	
Murcia	-4.37	2008	2 AO	-4.60	1995	2005	1 AO	-3.17	2007	
Navarra	-5.67***	1997	2 AO	-5.56**	1991	2005	1 AO	-4.62	2006	
Ourense	-6.55***	2000	0 AO				2 AO	-5.81**	1998	2003
Palencia	-5.01**	1997	1 AO	-4.23**	2005		1 AO	-3.77	2007	
Palmas, Las	-5.64***	2008	1 AO	-3.02	2005		1 AO	-4.20	2007	
Pontevedra	-4.67*	1997	2 AO	-3.23	1996	2008	0 AO			
Rioja, La	-5.35***	1996	1 AO	-4.48**	2005		1 AO	-4.26**	2007	
Salamanca	-4.71*	2008	1 AO	-4.10**	2005		1 AO	-4.31**	2006	
Santa Cruz de Tenerife	-5.79***	2008	1 AO	-5.12**	2005		2 AO	-5.59**	1992	2006
Segovia	-4.52	2008	1 AO	-4.44**	2005		2 AO	-5.12**	1989	2006
Sevilla	-4.19	1998	1 AO	-4.24**	2003		1 AO	-3.12	2007	
Soria	-7.71***	2009	1 AO	-5.80**	2006		1 AO	-5.78**	2008	
Tarragona	-4.73*	2008	1 AO	-2.82	2005		1 AO	-3.60	2007	
Teruel	-6.02***	1997	1 AO	-5.17**	2006		1 AO	-5.25**	2007	
Toledo	-5.37***	2008	1 AO	-0.14	2005		1 AO	-5.16**	2006	
Valencia/València	-3.66	2008	1 AO	-3.20	2005		1 AO	-3.34	2007	
Valladolid	-4.39	2008	1 AO	-4.36**	2008		1 AO	-3.98	2008	
Vizcaya	-4.94**	1996	1 AO	-3.87**	2005		0 AO			
Zamora	-4.96**	2009	1 AO	-4.85**	2008		2 AO	-6.28**	1996	2008
Zaragoza	-4.29	1995	1 AO	-3.12	2004		1 AO	-4.09	2007	

(***) We can reject the null hypothesis of unit roots with 99% confidence level.

(**) We can reject the null hypothesis of unit roots with 95% confidence level.

(*) We can reject the null hypothesis of unit roots with 90% confidence level.

TABLE 4: UNIT ROOT TESTS OVER FIRST DIFFERENCED GDP NL

Province	Zivot- Andrews		Clemente-Montañés-Reyes							
	t-statistic	Year	Outlier	t-statistic	Año 1	Año 2	Outlier	t-statistic	Año 1	Año 2
Álava	-4.47	2008	2 AO	-4.26	1996	2008	2 IO	-7.01**	1995	2008
Albacete	-6.03***	1998	1 AO	-4.72**	2007		1 IO	-5.25**	1989	
Alicante/Alacant	-4.23	2008	2 AO	-4.15	1997	2006	2 IO	-5.29**	1994	2007
Almería	-5.00**	1996	1 AO	-4.99	2005		1 IO	-4.03	2007	
Asturias	-5.39***	2008	1 AO	-4.29	2009		1 IO	-4.33**	2008	
Ávila	-4.85**	1998	1 AO	-4.53	1989		1 IO	-4.31**	1990	
Badajoz	-3.07	2009	1 AO	-3.45	2005		2 IO	-3.97	1991	1994
Balears, Illes	-4.45	1997	1 AO	-3.02	2005		1 IO	-3.43	2007	
Barcelona	-3.66	1997	2 AO	-4.82	1990	2005	2 IO	-5.14	1991	2006
Burgos	-4.96**	2009	1 AO	-1.06	2005		1 IO	-0.81	2008	
Cáceres	-5.28**	1999	2 AO	-4.76	1992	1997	2 IO	-4.54	1993	1997
Cádiz	-3.91	2008	1 AO	-3.89**	2005		2 IO	-2.28	1992	2007
Cantabria	-4.18	1998	1 AO	-4.02**	1991		0 IO			
Castellón/Castelló	-4.61*	2007	1 AO	-4.72**	2007		0 IO			
Ciudad Real	-4.82**	1998	0 IO				0 IO			
Córdoba	-5.43***	1998	0 AO				2 IO	-5.62**	1990	1995
Coruña, A	-4.43	2008	1 AO	-4.24**	2009		0 IO			
Cuenca	-4.84**	2008	1 AO	-4.66**	2005		0 IO			
Girona	-5.42***	2008	1 AO	-4.59**	2004		1 IO	-4.94**	2006	
Granada	-3.20	1998	1 AO	-2.90**	2009		0 IO			
Guadalajara	-5.12**	1990	1 AO	-3.80**	1991		2 IO	-5.33	1988	1995
Guipuzcoa	-4.44	2008	0 AO				0 IO			
Huelva	-4.96**	2008	1 AO	-5.06**	2007		1 IO	-4.71**	2007	
Huesca	-5.65***	2009	2 AO	-4.97	1998	2006	0 AO			
Jaén	-6.15***	1992	0 AO				0 IO			
León	-6.98***	2008	2 AO	-7.79**	2002	2007	2 IO	-7.41**	2003	2007
Lleida	-5.03**	1996	1 AO	-5.09**	2008		0 IO			
Lugo	-5.67***	2000	0 AO				1 IO	-4.45**	2007	
Madrid	-3.44	2008	2 AO	-2.51	1991	2007	1 IO	-2.61	2006	
Málaga	-3.46	1997	2 AO	-4.31	1996	2007	2 IO	-3.84	1995	2006
Murcia	-4.36	2008	1 AO	-3.25	2005		2 IO	-9.96**	1994	2007
Navarra	-4.47	1997	1 AO	-3.37	1987		2 IO	-4.53	1988	1995
Ourense	-6.25***	1999	2 AO	-5.30	1998	2006	0 IO			
Palencia	-6.19***	1989	1 AO	-4.58**	2005		1 IO	-4.95**	1993	
Palmas, Las	-3.63	1997	1 AO	-2.96	2005		1 IO	-5.53**	2006	
Pontevedra	-3.71	2008	1 AO	-3.43	2009		0 IO			
Rioja, La	-5.57***	2008	2 AO	-2.58	1993	2005	2 IO	-4.09	1995	2007
Salamanca	-5.24**	2000	1 AO	-3.16	2007		1 IO	-10.25**	1998	
Santa Cruz de Tenerife	-5.37***	2008	1 AO	-4.99**	2005		1 IO	-5.01**	2007	
Segovia	-5.46***	1997	1 AO	-4.63**	2005		1 IO	-5.21**	2006	
Sevilla	-3.86	1997	2 AO	-2.73	1991	2007	1 IO	-7.82**	2006	
Soria	-6.49***	1990	1 AO	-6.35**	1990		0 IO			
Tarragona	-1.83	1999	2 AO	-5.71**	1996	2004	2 IO	-5.82**	1997	2003
Teruel	-4.83**	2009	2 AO	-4.53	1991	1995	1 IO	-4.03	1991	
Toledo	-3.71	2008	1 AO	-3.88**	2009		0 IO			
Valencia/València	-4.78**	1997	1 AO	-3.16	2005		0 IO	-4.65	1995	2007
Valladolid	-4.75**	2008	1 AO	-4.25**	2005		0 IO			
Vizcaya	-4.28	1997	1 AO	-3.22	2005		2 IO	-8.94**	1990	1995
Zamora	-7.35***	1999	0 AO				1 IO	-4.35**	1995	
Zaragoza	-3.14	2008	1 AO	-2.65	2009		2 IO	-4.41	1987	2006

(***) We can reject the null hypothesis of unit roots with 99% confidence level.
(**) We can reject the null hypothesis of unit roots with 95% confidence level.
(*) We can reject the null hypothesis of unit roots with 90% confidence level.

Tables 3 and 4 report unemployment rate and GDP provincial series are mostly stationary in first differences. These tests prove the stationarity of the series of the first differenced unemployment and GDP of the Spanish provinces. Nevertheless, estimating Okun's relationship for Spain is also one of the objectives of this work. Therefore, testing the stationarity of the panel that comprise all provincial series is also one of the tasks we have to carry through.

The panel unit root tests that we perform, whose results are shown in Table 5, find unit root processes in levels and stationarity in first differences, just as we obtained for provincial series. Levin Lin Chu, Im Pesaran Shin and Fisher Type (conducted as a ADF test) tests reject the null hypothesis of unit root processes in the first differenced variables at 99% confidence level. Meanwhile, Hadri LM test cannot reject stationarity at any of the conventional confidence levels.

TABLE 5: PANEL UNIT ROOT TESTS OVER FIRST DIFFERENCED VARIABLES

	Unemployment Rate		GDP NL	
Test	Model	First Diff.	Model	First Diff.
Hadri LM	c, 1lag	0.9373	c, 1lag	-0.7417
Levin Lin Chu	c, 1lag	-13.636***	c, 1lag	-14.2811***
Im Pesaran Shin	c, 1lag	-15.7274***	c, 1lag	-18.5058***
Fisher Type (conducted as a ADF)	c, 1lag	-17.4637***	c, 1lag	-20.3716***

(***) We can reject the null hypothesis of unit roots with 99% confidence level.
(*) We can reject the null hypothesis of unit roots with 90% confidence level.

4.3. Static analysis

Now, the next step is estimating the relationship between GDP and unemployment. We construct a first difference specification for the provinces and the panel that integrates all of them.

The estimation of provincial series is performed by the method of ordinary least squares (OLS) while the panel requires estimating by fixed effects (FE). In table 7, we can observe the estimation of the Okun's relationship for provinces and the panel.

Coefficients point out the influence that a percentage point of GDP variation has on the unemployment rate. We have ordered the provinces attending the value of this coefficient and we can observe the great differences between them.

TABLE 6: ESTIMATION RESULTS

Province	$\ln GDP_t - \ln GDP_{t-1}$			
	Coeff.	St. Error	R-squared	Observations
Barcelona	-0.725***	(0.130)	0.684	25
Cádiz	-0.717***	(0.0898)	0.593	25
Valencia/València	-0.696***	(0.153)	0.629	25
Palmas, Las	-0.663***	(0.184)	0.528	25
Málaga	-0.644***	(0.165)	0.419	25
Murcia	-0.629***	(0.141)	0.610	25
Balears, Illes	-0.617***	(0.145)	0.589	25
Madrid	-0.557***	(0.114)	0.682	25
Zaragoza	-0.553***	(0.129)	0.519	25
Sevilla	-0.541***	(0.137)	0.520	25
Granada	-0.529***	(0.147)	0.454	25
Castellón/Castelló	-0.517***	(0.138)	0.539	25
Alicante/Alacant	-0.485**	(0.174)	0.404	25
Ávila	-0.475***	(0.134)	0.376	25
Ciudad Real	-0.462***	(0.103)	0.564	25
Santa Cruz de Tenerife	-0.461**	(0.196)	0.333	25
Álava	-0.458***	(0.0935)	0.611	25
Jaén	-0.444***	(0.111)	0.337	25
Pontevedra	-0.443***	(0.103)	0.513	25
Asturias	-0.441***	(0.103)	0.380	25
Córdoba	-0.433***	(0.110)	0.414	25
Badajoz	-0.431***	(0.0917)	0.410	25
Guipuzcoa	-0.377***	(0.0900)	0.454	25
Cantabria	-0.377**	(0.160)	0.361	25
Vizcaya	-0.373**	(0.170)	0.321	25
Girona	-0.369***	(0.122)	0.385	25
Coruña, A	-0.344**	(0.150)	0.226	25
Almería	-0.343***	(0.122)	0.324	25
Tarragona	-0.336**	(0.129)	0.300	25
Navarra	-0.335***	(0.0807)	0.530	25
Huesca	-0.332***	(0.0938)	0.355	25
Valladolid	-0.329***	(0.105)	0.270	25
Lleida	-0.319***	(0.102)	0.296	25
Huelva	-0.303**	(0.137)	0.109	25
Ourense	-0.299*	(0.158)	0.104	25
Segovia	-0.287**	(0.114)	0.341	25
Burgos	-0.276**	(0.117)	0.203	25
Toledo	-0.264**	(0.106)	0.281	25
Cuenca	-0.242*	(0.137)	0.195	25
Lugo	-0.234***	(0.0552)	0.436	25
León	-0.233**	(0.113)	0.160	25
Cáceres	-0.211**	(0.0972)	0.069	25
Palencia	-0.188**	(0.0776)	0.127	25
Guadalajara	-0.179***	(0.0609)	0.256	25
Zamora	-0.0545	(0.112)	0.007	25
Salamanca	-0.0606	(0.126)	0.007	25
Teruel	-0.0992	(0.103)	0.063	25
Soria	-0.149	(0.111)	0.135	25
Albacete	-0.151	(0.146)	0.041	25
Rioja, La	-0.236	(0.182)	0.119	25
Panel Spain	-0.361***	(0.0260)	0.1078	1250

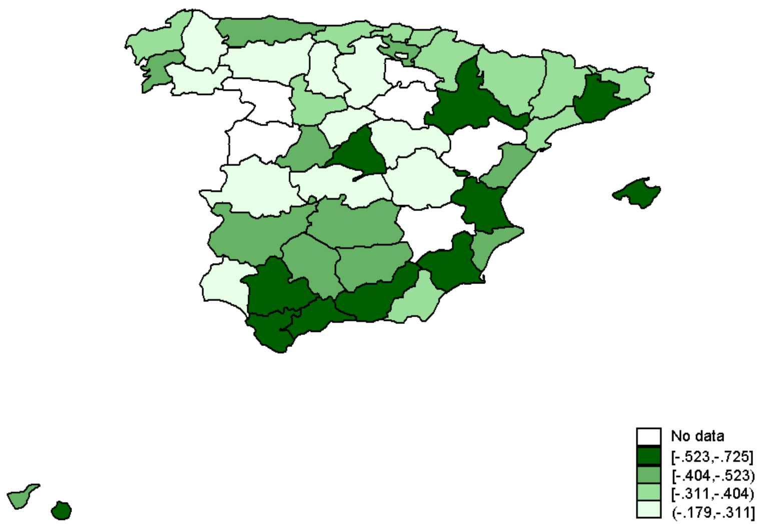
(***) Significant relationship at 99% confidence level.

(**) Significant relationship at 95% confidence level.

(*) Significant relationship at 90% confidence level.

Whereas for Barcelona or Cádiz a percentage point of GDP variation is accompanied by a change on the unemployment rate in the opposite direction whose value is higher that 0.7, for Guadalajara or Palencia GDP shifts barely affect unemployment absolute value does not reach 0.2 percentage points. This is a clear example of the duality of the Spanish labour market. There are some provinces where unemployment highly responds to shifts in the economic activity, whereas some others show low variability or even not show any relationship. This is shown in Map 1. It shows that provinces which present greater unemployment variability are the southern provinces as well as the provinces where the capital of the region is. This distinction is because variability in these two groups of provinces is presumably due to different causes. Provinces where regional capitals are such as Madrid, Barcelona, Valencia or Zaragoza are the areas where economic activity is concentrated whereas peninsular south is a traditional depressed area where unemployment is accompanied by lack of economic activity.

Map 1. Unemployment volatility for the Spanish provinces.



Meanwhile, panel estimation states that a percentage point of variation in GDP result in an unemployment rate change in the opposite direction that is quantified in 0.365 percentage points. This value is not comparable with that obtained by other authors for Spain due to panel estimation gives equal weight to all regions, so in this case it yields a downward biased value of the unemployment variability. This is because very populous provinces that present higher unemployment and economic activity in absolute terms are among those having greater unemployment variability.

4.4. Dynamic analysis

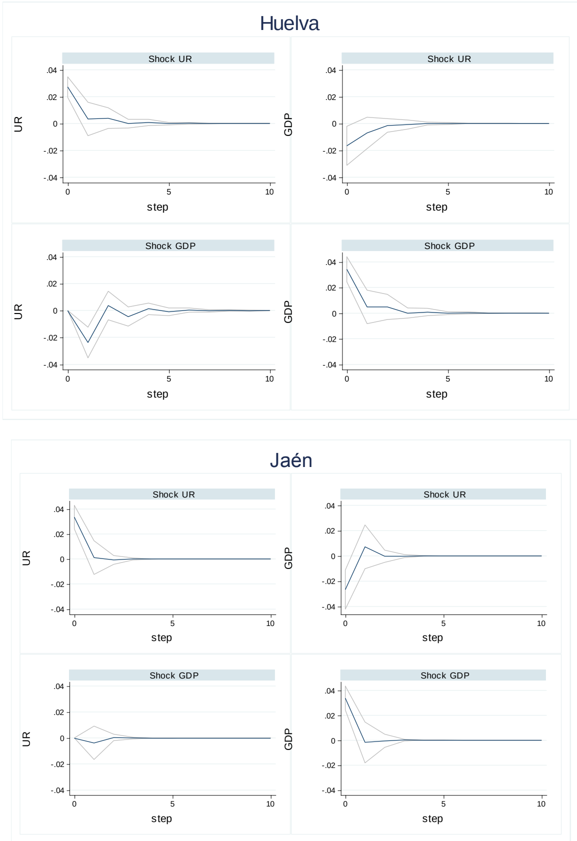
The dynamic effects of innovations in economic growth and unemployment rate variation are analysed through the VAR technique and the impulse-response function associated. We pretend to know the effect of disturbances in economic and unemployment rate growths regarding past values of these variables. IRF shows in an easily interpretable way this effect. We have estimated a bivariate VAR for all provinces and we have obtained their orthogonal impulse-response functions. As can be expected the effect that a shock in the output growth generates on itself is positive. The same occurs for the first differences of the unemployment rate variable. Besides, the effect that an innovation in the unemployment rate variation has on the economic growth is negative and sizable. However, in some cases shocks in GDP growth have no effect on the unemployment variable. In other provinces, the effect of the shock in the economic growth is negative but small in magnitude.

Nonetheless, impulse-response function representations are quite similar for all the provinces.[6] Only significant differences are observed for Huelva, where shocks in GDP growth initially do not affect unemployment, then is observed that unemployment rate growth is negatively influenced until the pattern reverts. It is also striking the case of Jaén, for which a shock in unemployment has firstly a negative effect and around the second and third term becomes positive.

For all provinces, the effect that an innovation has on the aforementioned variables vanishes over time. It shows that shocks in GDP and unemployment have not permanent effect on unemployment rate variation and economic growth, i.e., the considered variables do not suffer hysteresis.

[6] IRF representations for all provinces are available from the author on request.

Figure 2. IRF for some provinces



4. Conclusions and future research

This paper has examined the empirical relationship between GDP and the unemployment rate for the Spanish provinces. This analysis has been carried out considering static and dynamic specifications. Okun's law first difference version is used in order to perform static analysis whereas VAR and PVAR methodology allow us to observe the effect that an innovation in the economic growth or in the unemployment rate variation has on both variables over time.

The main results obtained in this study indicate that the provincial analysis matters. Our analysis provides further information than previous studies for Spain which considered the region as their geographical scope of analysis. We find that provinces within regions show a different response in the unemployment rate regarding GDP variations. It is found that most provinces where economic activity is concentrated suffer higher unemployment variability. In these provinces it is the capital of the region and there urban activities predominate. We also find that differences between south and north of

Spain exist. Whereas provinces in the south of Spain experiment great volatility, it is observed that in the north unemployment rate remains more stable.

Therefore, the patterns that explain the differences between provinces in terms of the unemployment rate variability are different. Firstly, the economic activity level, capitality and degree of urbanization could explain why urban provinces show higher unemployment variability. Secondly, the geographical situation should also be considered, with particular emphasis on the south and north distinction. These patterns give us an insight of the factors that should be considered in future research as possible determinants of unemployment variability.

However, we cannot ensure that provinces that have been showing higher levels of unemployment over time are those with higher variability in employment. Distinction between recession and expansion periods would provide more light in this issue. This distinction would be also useful to expand our knowledge about the dynamic relationship between GDP and unemployment and the causality direction, which has been found in this study in both directions, although we find that a shock in the variation of the unemployment rate affects more strongly to the economic growth than the reverse.

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