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

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Abstract

The inverse relationship between unemployment and Gross Domestic Product (GDP) growth, commonly known as Okun's law, has been traditionally analysed in the economic literature. Its application for Spain has been carried out at the national level or for the autonomous communities but it has not been analysed for provinces, the territorial level closer to local labour markets. This study analyses this relationship during the period spanning from 1985 to 2011. After testing the time series properties of provincial GDP and unemployment, we specify statiic and dynamic versions of the Okun's law using VAR and PVAR techniques. Both static and dynamic analyses lead us to determine that provinces show large differences in their unemployment sensitivity to GDP shocks. In particular, provinces where economic activity is concentrated and Southern provinces are those suffering from higher cyclical variations in unemployment rates.

JEL classification: C32, C33, J23, R11
Keywords: Unemployment, Output fluctuations, Spanish provinces

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1. Introduction

The strong impact of business cycles on unemployment is a Spanish particular feature. The high increase in unemployment during the current economic downturn is a clear example of this great variability of the unemployment rate. Since 2008 and in just six years the unemployment rate has more than tripled, accounting in 2013 for 26% of the working population. However, this phenomenon is not confined to recession periods. Before this economic crisis, Spanish economy had experienced a continuous growth reducing unemployment rates from 20% of the labour force population to levels slightly above the European average.

Nevertheless, unemployment sensitivity to Gross Domestic Product (GDP) shifts is not the same for all regions. Villaverde and Maza (2009) found that whereas in some regions a great unemployment response to changes in the economic cycle is observed, in others unemployment rate varies to a lesser extent. They attributed these differences to the unequal growth of productivity between regions. But, analysing the differences regarding the impact of GDP on unemployment for autonomous communities could be somehow misleading. It is important to consider regional units that are closer to local labour markets, as this is the territorial dimension that really matters to firms and workers. In fact, autonomous communities show great internal differences in the level of economic activity, diverse urbanization degree and lack of uniformity in the productivity level and productivity growth. In this regard, the provincial approach implies a thorough and rigorous analysis that provides more light to the patterns and differences in the unemployment sensitivity to economic variations. Still in the regional analysis, provincial approach situates us closer to the local level.

Therefore, the aim of this paper consists in analysing the differences between provinces in the unemployment response to GDP variations. In order to do so, we consider static and dynamic specifications to determine the relationship between the aforementioned variables for all Spanish provinces. Firstly, the static analysis is carried out by using the difference version of the Okun's law, whereas VAR techniques are used to perform the dynamic analysis. The analysis is complemented using panel and PVAR models in order to compare provincial results with the aggregate dynamics of unemployment and GDP.

Our results show that there are great differences between provinces regarding the unemployment sensitivity to variations in economic conditions. Both static and dynamic analysis suggest that provinces where economic activity is concentrated and southern provinces are those ones that suffer to a higher extent the impact of GDP shocks on unemployment.

This finding justifies resorting to a provincial approach as we also find that autonomous communities are not homogenous. So, one of the contributions of this paper concerns the need to consider a provincial approach when we analyse the Spanish labour market from a regional perspective. It has not been carried out previously in studies examining Okun's law for Spain. This new scope of analysis offers interesting results that should be taken into account when economic policies are defined. The second contribution consists in performing a dynamic analysis of the Okun's law through VAR and PVAR techniques, which have not been applied at the Spanish provincial level yet.

The rest of the paper is organized as follows. In section 2, we briefly gather the contributions to Okun's law, including specific analysis for Spain.. In section 3, we describe the methodology that we undertake and section 4 presents the main results that 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

[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.

(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. For instance, Evans (1989) considered three lagged periods in 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 additional directions. First, 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. Second, 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 capacity utilization deviations from the equilibrium additionally.

All these transformations have contributed to the fact that there is no consensus about the value of the 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 points - 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[2].

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 isolating 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 applied it to 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

[2] 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.

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 analysed, 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 sensitivity to GDP variations 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 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 has only 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 affected 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 fuelled 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 2007, 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 variability 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, they cannot find significant differences from the Spanish value. Meanwhile, Amarelo (2013) observed that unemployment variability in Catalonia was higher than that obtained for Spain. Villaverde and Maza (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 effect of the output variation on the unemployment rate requires three macroeconomic data sets: real GDP, 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 2011. 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 that specifically takes into account each area weaknesses and allows defining individual policies that will have greater impact. The number of selected Spanish provinces for the analysis is 50, excluding Ceuta and Melilla. The information has been taken out from the Spanish National Institute of Statistics (INE). We resort to the Contabilidad Regional de España CRE (Spanish Regional Accounts) 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 for part of the considered period. 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

INE provides us non homogeneous panel data sets. Nominal GDP is in different year basis and we have to homogenize it taking 2011 as the year basis. Moreover, CPI is only available for provinces 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 are 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 estimate the relationship between GDP and unemployment. We use the difference version of the Okun's law and estimate it by using Ordinary Least Squares (OLS) and Fixed Effect (FE) for provinces and the panel respectively. 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 establishes the series are 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 the ADF test that accounted for only one exogenous break. His analysis broke with the idea proposed by Nelson and Plosser (1982), who stated random shocks were not transitory and did have permanent effect in the economies. However, the Perron procedure is severely criticised by many economists. Some of them are Christiano (1992), who established that a pre-test analysis of the data could 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 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.[3]

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 the 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 such as Pesaran (2007), Moon and Perron (2004), Maddala and Wu (1999), 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. Hadri test is an extension of Kwiatkowski et. al.(1992) tests for panel data and it provides us added value due to, as Hadri (1999) acknowledges, by testing both the unit root and the stationary hypothesis we are able to make a distinction between the stationary series, the series that have unit roots and those ones for which we are not sure if they are stationary or integrated.

In all the tests the lag length[4] 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 for the panel unit root tests.

3.2.2. Okun's law specifications

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

[4] 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.

Once we know that the series that 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.

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

where $u_t - u_{t-1}$ represents the difference between unemployment rates in periods t and t-1, $y_t - y_{t-1}$ is the variation of the GDP natural logarithm that takes place between t and t-1 periods. 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 of the coefficient of provincial series is performed by using the Ordinary Least Squares method (OLS) method, 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 have on each of them. We can write VAR representation as follows:

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

where Δu_t and Δy_t represents respectively unemployment rate and GDP natural logarithm variations between periods t and $t-1$; $\alpha(L)$, $\beta(L)$, $\gamma(L)$ and $\eta(L)$ are respectively the vectors of the coefficients relating past values of the variables associated to current values; v_t^u and v_t^y are vectors of the idiosyncratic errors.

The VAR analysis allows answering the question of what is the effect of an output or unemployment innovation regarding past values of these variables. 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 the PVAR technique[5]. 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 orthogonalising the variables.

4. Empirical results

The Spanish unemployment rate has experienced a great variability relative to variations in GDP. The crises have resulted in large increases in unemployment, while economic expansions have also meant higher falls in the unemployment rate than initial statement of the Okun's law forecasted. Provinces have suffered differently the unemployment sensitivity to GDP variations. In this section, we explore the Okun's relationship for all provinces and the panel to detect the unemployment behaviour regarding output fluctuations and their dynamics. In order to do so, we firstly conduct the tests that prove the stationarity of the series employed and then we perform the static and dynamic analyses to estimate the aforementioned empirical relationship.

[5] In order to apply PVAR technique, we resort to Ryan Decker program, which is an update version of the Inessa Love original package, which is used in Love and Zicchino (2006), among others.

4.1. *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 the variables in levels[6] 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.

TABLE 2

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 for 1 province we found that any of tests cannot reject the null hypothesis of presence of unit roots. In the case of GDP, in 14 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. According to these results, unemployment rate and GDP provincial series are mostly stationary in first differences. This allows us estimating the relationship between the variables considered as in most of the literature.

TABLES 3 AND 4

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

As previously mentioned, we have also carried out panel unit root tests. Results are shown in Table 5 and confirm the results obtained for provincial series: unit root processes are found in the levels of the variables while we cannot reject stationarity in first differences. In particular, the Levin Lin Chu, Im Pesaran Shin and Fisher Type (conducted as an 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

4.2. Static analysis

In this section we estimate 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 the provincial series is performed by the method of ordinary least squares (OLS) while the panel requires estimating by fixed effects (FE).

The results of the estimation of the Okun's relationship for the Spanish provinces and the provincial panel are shown in table 6. Coefficients point out the influence that a percentage point of GDP variation has on the rate of unemployment. We have ordered the provinces attending the value of this coefficient and we can observe the great differences between them. Whereas for some provinces such as Barcelona or Cádiz a percentage point of GDP variation is accompanied by a change in the opposite direction of the unemployment rate whose value is higher than 0.6, for Palencia, Cáceres or Guadalajara GDP shifts barely affect unemployment. The absolute value of the relationship coefficient does not reach 0.2 percentage points. This is a clear example of the divergence in 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 present any relationship. Map 1 shows that provinces that present greater unemployment sensitivity to GDP variation are the southern ones as well as the provinces where economic activity is concentrated. This distinction is because sensitivity to business cycles in these two groups of provinces is presumably due to different causes. Madrid, Barcelona, Valencia or Zaragoza are provinces where the respective autonomic capital is. Also, in these provinces large population is concentrated, they are mostly urban areas and show a high level of economic activity. Whereas the south is a traditional depressed area where unemployment is accompanied by lack of economic activity. In the peninsular centre, with the exception of Madrid, and in the north of Spain is observed that employment remains much more stable. It is affected in a lesser extent by cyclical changes in the economy. 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 0.353 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 Okun's coefficient. This is because very populous provinces that present higher unemployment and economic activity in absolute terms are among those having greater unemployment sensitivity to GDP variations.

TABLE 6

MAP 1

4.3. Dynamic analysis

The dynamic analysis allows us to observe the effect of economic growth shocks on unemployment, but also the impact of innovations in unemployment rate variation on GDP growth. However, as we did earlier in the static analysis, we mainly focus in the first issue.[7] Through the VAR technique, we observe for all provincial series the effect on unemployment rate of the GDP growth disturbances regarding past values of unemployment rate variation and economic growth. The impulse response functions associated (IRFs) shows in an easily interpretable way this effect. So, we have estimated a bivariate VAR for all provinces and we have obtained their orthogonal impulse-response functions. The orthogonal IRF representations for all Spanish provinces are reported in Figure 1. The effect of GDP growth shocks is observed for 6 periods. The confidence bands are defined by the grey shaded area that is around the line that points

[7] Full results from the VAR and PVAR analysis are available from the author on request.

out the effect of GDP growth shocks on unemployment. We can observe that for all provinces the effect of shocks on unemployment is negative but the magnitude of these shocks and the persistence varies across provinces. In provinces such as Cádiz, Jaén or Valencia the initial effect of the shock is very sharp, whereas in Barcelona, Madrid or Sevilla this initial effect is not so steep but the shock is more persistent. There are also provinces for which we cannot observe any impact on unemployment. This is the case of Albacete or Zamora, among others. As in the static analysis, we observe that provinces greatly differ in their unemployment response to economic shifts. In this case, the characteristics of the technique employed allow us to observe not only the effect of the shock in the period when it occurs, but also the impact that this shock has over time. Table 7 shows for the Spanish provinces the impact of these shocks in the period when they occur as well as the cumulative effect after 2, 4 and 6 periods. We have ordered the provinces attending the magnitude of impact of the shock. In the top of the table are the provinces for which the cumulative effect of the shock is higher at period 6. Again, we can find in the first positions of the table the provinces where economic activity is concentrated and some southern provinces. The bottom is composed by the provinces for which the static analysis acknowledged the impact of GDP on unemployment was relatively low or not significant. Map 2 gathers in a clearer way the cumulative effect of GDP growth shocks on unemployment. As we have previously mentioned, we get results comparable to those obtained in the static analysis. In this case, Málaga are not between the provinces with higher sensitivity to GDP shifts. Contrarily, Almería, Badajoz and Huelva does become part of this group. Peninsular centre remains the geographical area where lower effect of GDP shocks on unemployment is observed.

FIGURE 1

TABLE 7

MAP 2

After observing for all provinces the effect of economic growth shocks, we apply the PVAR technique in order to observe the effect of shocks for the panel that integrates all Spanish provinces. In this case, we show the effect that unemployment and GDP shocks have on themselves and on the other variable. 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. The effects that shocks have on the other variable are negative. It should be mentioned that the effect that an unemployment rate growth shock has on economic growth takes place after one period due to we have orthogonalized the variables. GDP growth affects unemployment rate variation contemporaneously, but unemployment rate variation affects economic growth with a lag. Results from PVAR analysis can be observed in Figures 2 and 3. They show the IRFs representations when a shock in economic growth and a shock in unemployment rate variation are respectively produced. The standard errors are calculated using Monte Carlo simulations with 500 replications. From these figures, we can draw that the GDP growth shocks have higher effect on both variables than the unemployment shocks. This is also observed in Table 8, which shows the cumulative effect of shocks for the panel of provinces.

FIGURES 2 and 3

TABLE 8

However, the ordering of the variables in the VAR model could determine the results obtained with this methodology up to now. For this reason, and in order to check the robustness of previous results, we change the ordering of the variables. In other words, we want to know if the results obtained in Figure 1 differ from those ones obtained when we consider that economic growth shocks affect unemployment rate variation with a lag. The variables orthogonalization in the opposite direction than it was assumed before implies that shocks barely affect unemployment rate variation for many provinces. There are clear exceptions such as Barcelona, province where shocks on economic growth still have a great impact. But, as Figure 4 shows provinces such as Madrid, Valencia, Sevilla or Santa Cruz de Tenerife, among others, obtain different results when the order of the variables changes. It also shows that in Albacete or Zamora, like in some other provinces, shocks in GDP growth does not have any effect regardless the order of the variables in the VAR analysis.

FIGURE 4

5. Final remarks and future research

This paper has examined the empirical relationship between economic activity 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 the static analysis whereas VAR and PVAR methodology allow us to observe the effect that an innovation in the economic growth has on unemployment rate variation.

The main results obtained in this study indicate that the provincial analysis matters. Our analysis provides further information than previous studies for Spain that 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. Both static and dynamic analyses conclude that provinces that suffer in a higher extent the economic shocks on unemployment are those ones where economic activity is concentrated and some southern provinces. Meanwhile peninsular centre, excepting Madrid, is the geographical area where unemployment is the least affected by economic shifts.

From these results, we can assume that the North-South pattern and the degree of economic activity play a fundamental role in the unemployment sensitivity to changes in GDP. However, an analysis of determinants of the sensitivity of unemployment to variations in the economic activity would provide more light to this issue. Therefore, our research in the near future is going to focus on determining the influencing factors that provoke the unemployment sensitivity to GDP variations differ across Spanish provinces.

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TABLES

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	Labour force 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

TABLE 2: UNIT ROOT TESTS OVER VARIABLES IN FIRST DIFFERENCES

Province	Unemployment Rate				GDP (Natural logarithm)			
	ADF-t		*PP-t*		*ADF-t*		*PP-t*	
	Model	t-Stat.	Model1	*t-Stat.*	Model	t-Stat.	Model1	*t-Stat.*
Álava	NT,C,0L	-4.3401**	NT,C	-4.3152**	NT,C,0L	-2.9184**	NT,C	-2.9414**
Albacete	NT,C,0L	-2.9747**	NT,C	-3.0240**	T,C,0L	-4.6703**	T,C	-4.6670**
Alicante/Alacant	NT,C,0L	-3.0620**	NT,C	-3.0354**	T,C,0L	-1.9603	T,C	-2.0225
Almería	NT,C,0L	-2.8541*	NT,C	-2.7565*	T,C,0L	-2.5549	T,C	-2.5640
Asturias	NT,C,0L	-3.9725**	NT,C	-3.9472**	NT,C,0L	-3.0955**	NT,C	-3.1020**
Ávila	NT,C,0L	-2.6123*	NT,C	-2.7139*	NT,C,0L	-3.5218**	NT,C	-3.5223**
Badajoz	NT,C,0L	-3.5773**	NT,C	-3.6150**	T,C,0L	-3.0489	T,C	-3.2314*
Balears, Illes	NT,C,0L	-2.9158**	NT,C	-2.9390**	T,C,0L	-2.6417	T,C	-2.7743
Barcelona	NT,C,0L	-2.7529*	NT,C	-2.8135*	NT,C,0L	-1.4944	NT,C	-1.5516
Burgos	NT,C,1L	-4.3130**	NT,C	-3.2502**	NT,C,0L	-3.5531**	NT,C	-3.4834**
Cáceres	NT,C,0L	-5.5945**	NT,C	-5.6300**	NT,C,0L	-2.9549**	NT,C	-3.0063**
Cádiz	NT,C,0L	-3.0025**	NT,C	-3.0438**	NT,C,0L	-2.8506*	NT,C	-2.9086**
Cantabria	NT,C,0L	-3.0156**	NT,C	-3.0829**	T,C,0L	-2.7936	T,C	-2.9649
Castellón/Castelló	NT,C,0L	-2.1541	NT,C	-2.2915*	NT,C,0L	-3.2087**	NT,C	-3.3164**
Ciudad Real	NT,C,0L	-2.7521*	NT,C	-2.7197*	NT,C,0L	-2.7974*	NT,C	-2.6942*
Córdoba	NT,C,0L	-3.3545**	NT,C	-3.4207**	T,C,0L	-4.2576**	T,C	-4.3211**
Coruña, A	NT,C,0L	-3.4540**	NT,C	-3.4690**	NT,C,0L	-2.6861*	NT,C	-2.6191*
Cuenca	NT,C,0L	-3.4739**	NT,C	-3.4459**	NT,C,0L	-3.8879**	NT,C	-3.9059**
Girona	NT,C,0L	-3.0999**	NT,C	-3.1304**	NT,C,1L	-1.4340	NT,C	-2.9063**
Granada	NT,C,0L	-2.4437	NT,C	-2.5567*	NT,C,0L	-1.9032	NT,C	-1.8953
Guadalajara	NT,C,0L	-2.6211	NT,C	-2.6615*	NT,C,0L	-3.0171**	NT,C	-3.0790**
Guipúzcoa	NT,C,0L	-3.3379**	NT,C	-3.3918**	NT,C,0L	-2.8571*	NT,C	-2.9089**
Huelva	NT,C,0L	-4.7314**	NT,C	-4.7313**	NT,C,0L	-4.2095**	NT,C	-4.2311**
Huesca	NT,C,1L	-4.1560**	NT,C	-3.7785**	NT,C,0L	-4.1637**	NT,C	-4.2276**
Jaén	NT,C,0L	-4.5335**	NT,C	-4.5484**	T,C,0L	-5.5028**	T,C	-5.5530**
León	NT,C,0L	-3.5080**	NT,C	-3.4897**	NT,C,0L	-4.4714**	NT,C	-4.5412**
Lleida	NT,C,1L	-4.2100**	NT,C	-3.4461**	NT,C,0L	-3.5335**	NT,C	-3.4752**
Lugo	NT,C,0L	-3.6691**	NT,C	-3.6798**	NT,C,0L	-3.9376**	NT,C	-4.0086**
Madrid	NT,C,0L	-2.5025	NT,C	-2.5369*	NT,C,0L	-1.8478	NT,C	-2.0250
Málaga	NT,C,0L	-2.4461	NT,C	-2.5271*	NT,C,0L	-1.8913	NT,C	-2.0157
Murcia	NT,C,0L	-2.6864*	NT,C	-2.7921*	NT,C,0L	-1.4259	NT,C	-1.4573
Navarra	T,C,1L	-3.6520**	T,C	-3.1516**	NT,C,1L	-1.9620	NT,C	-3.1012**
Ourense	NT,C,2L	-5.0280**	NT,C	-3.7997**	NT,C,0L	-4.1791**	NT,C	-4.2379**
Palencia	NT,C,0L	-3.2371**	NT,C	-3.2467**	T,C,0L	-5.3529**	T,C	-5.3341**
Palmas, Las	NT,C,0L	-2.6309*	NT,C	-2.6195*	NT,C,0L	-1.9159	NT,C	-2.0075
Pontevedra	NT,C,0L	-2.3506	NT,C	-2.5137	NT,C,0L	-1.7539	NT,C	-1.8881
Rioja, La	T,C,0L	-3.7760**	NT,C	-3.2703**	T,C,0L	-3.2922**	T,C	-3.3368*
Salamanca	NT,C,0L	-4.1156**	NT,C	-4.1050**	T,C,0L	-3.7084**	T,C	-3.7651**
Sta. Cruz deTenerife	NT,C,0L	-3.1854**	NT,C	-3.1877**	NT,C,1L	-1.5230	NT,C	-3.4959**
Segovia	NT,C,0L	-3.9177**	NT,C	-3.8861**	NT,C,0L	-3.3546**	NT,C	-3.3590**
Sevilla	NT,C,0L	-2.5063	NT,C	-2.6326*	NT,C,0L	-2.4388	NT,C	-2.4352
Soria	T,C,0L	-4.5460**	T,C	-4.5363**	NT,C,0L	-5.6521**	NT,C	-5.6604**
Tarragona	NT,C,0L	-3.0756**	NT,C	-3.0471**	NT,C,0L	-4.1084**	NT,C	-4.1696**
Teruel	NT,C,1L	-1.8340	NT,C	-4.1201**	NT,C,0L	-4.0569**	NT,C	-4.0484**
Toledo	NT,C,0L	-2.7404*	NT,C	-2.7707*	NT,C,0L	-2.5388*	NT,C	-2.7592*
Valencia/València	NT,C,0L	-2.6687*	NT,C	-2.7276*	NT,C,0L	-1.9302	NT,C	-1.9216
Valladolid	NT,C,0L	-3.2225**	NT,C	-3.2559**	NT,C,0L	-3.1913**	NT,C	-3.0225**
Vizcaya	NT,C,0L	-3.5781**	NT,C	-3.5990**	NT,C,0L	-2.5256*	NT,C	-2.6269*
Zamora	NT,C,0L	-3.9595**	NT,C	-3.9143**	NT,C,0L	-4.5428**	NT,C	-4.5422**
Zaragoza	NT,C,0L	-2.5406*	NT,C	-2.5320*	NT,C,0L	-1.2897	NT,C	-1.3290

NT: No trend; T: Trend; NC: No Intercept; C: Intercept; 0L: 0 lags included; 1L: 1 lag included; 2L: 2 lags included.
(**) 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 UNEMPLOYMENT IN FIRST DIFFERENCES

	Zivot-Andrews			Clemente-Montañés-Reyes						
	t-statistic	Year	Outliers	t-statistic	Years		Outliers	t-statistic	Years	
Álava	-5.4415***	1995	0 AO				2 IO	-7.0608**	1993	2007
Albacete	-4.6138*	1994	1 AO	-3.9399**	2005		2 IO	-5.0296	1992	2007
Alicante/Alacant	-4.2939	1995	1 AO	-4.5730**	2007		1 IO	-4.2610**	2007	
Almería	-5.5579***	2008	1 AO	-5.1773**	2005		1 IO	-5.7720**	2006	
Asturias	-5.3707***	2009	0 AO				2 IO	-5.4224	2000	2007
Ávila	-3.9956	2008	1 AO	-3.4886	2004		1 IO	-3.8457	2006	
Badajoz	-5.1635**	1996	1 AO	-4.3963**	2005		2 IO	-5.6946**	1993	2007
Balears, Illes	-4.1136	1995	1 AO	-6.4611**	2007		1 IO	-5.8571**	2007	
Barcelona	-3.5999	1995	1 AO	-4.3400**	2005		1 IO	-4.1322	2006	
Burgos	-5.9221***	2008	1 AO	-6.0052**	2005		1 IO	-3.6211	2006	
Cáceres	-6.2679***	2008	0 AO				0 IO		2000	
Cádiz	-4.9084**	2008	2 AO	-5.4411	1995	2007	2 IO	-5.1404	1993	2007
Cantabria	-5.4721***	1997	2 AO	-3.2812	1994	2005	1 IO	-597.5612**	2007	
Castellón/Castelló	-4.5756*	2008	1 AO	-4.1231**	2005		1 IO	-4.5277**	2006	
Ciudad Real	-4.1883	2008	1 AO	-3.2304	2005		1 IO	-7.8294**	2006	
Córdoba	-5.3384***	2008	1 AO	-5.7231**	2007		2 IO	-5.6849**	1998	2007
Coruña, A	-4.3977	1995	1 AO	-4.0982**	2008		2 IO	-4.8523	2003	2007
Cuenca	-5.2320**	2008	1 AO	-1.8110	2005		1 IO	-15.0459**	2007	
Girona	-4.9410**	1998	1 AO	-3.5961**	2007		1 IO	-4.6705**	2006	
Granada	-3.7159	2007	2 AO	-5.9275**	1995	2004	1 IO	-4.7254**	2005	
Guadalajara	-5.0698**	2008	1 AO	-5.5498**	2005		1 IO	-4.0469	2006	
Guipuzcoa	-5.7113***	1997	1 AO	-3.8839**	2005		0 IO		1992	
Huelva	-5.9192***	2008	1 AO	-6.0639**	2007		2 IO	-3.2378	2000	2007
Huesca	-6.1900***	1997	0 AO				1 IO	-5.3170**	2007	
Jaén	-5.9625***	1997	2 AO	-4.9246	1996	2007	2 IO	-5.7242**	1997	2007
León	-4.9960**	2008	1 AO	-4.1172**	2004		1 IO	-5.2780	1998	2007
Lleida	-6.6024***	2008	1 AO	-3.7742**	2005		1 IO	-5.6932**	2006	
Lugo	-5.3509***	2009	2 AO	-5.0417	1996	2005	2 IO	-7.1998**	1993	2007
Madrid	-3.7719	1997	1 AO	-3.1380	2005		1 IO	-3.1825	2006	
Málaga	-4.1512	2008	1 AO	-3.3468	2005		1 IO	-4.0197	2006	
Murcia	-4.7478*	2008	1 AO	-3.4002	2005		1 IO	-3.9655	2006	
Navarra	-5.0212**	1997	2 AO	-5.1918	1991	2005	1 IO	-4.7737**	2006	
Ourense	-7.1934***	2000	0 AO				2 IO	-5.6535**	1998	2008
Palencia	-5.1847**	1997	1 AO	-4.4056**	2005		1 IO	-4.4989**	2006	
Palmas, Las	-4.6299	2008	1 AO	-5.0404**	2005		1 IO	-4.2150	2006	
Pontevedra	-4.1383	2008	1 AO	-3.2259	2009		1 IO	0.2588	2006	
Rioja, La	-5.5148***	1996	1 AO	-4.6449**	2005		1 IO	-4.4076**	2007	
Salamanca	-4.7899*	1995	0 AO				0 IO			
Santa Cruz de Tenerife	-5.1820**	2008	1 AO	-5.1308**	2005		2 IO	-7.4914**	1992	2006
Segovia	-4.6547*	2008	1 AO	-4.6549**	2005		1 IO	-5.2629	1989	2006
Sevilla	-3.3781	2008	1 AO	-3.1059	2007		1 IO	-3.3450	2006	
Soria	-6.8873***	2009	1 AO	-5.9716**	2006		1 IO	-6.7424**	2007	
Tarragona	-4.4937	2008	1 AO	-3.1315	2005		1 IO	-4.5842**	2006	
Teruel	-4.0441	1997	1 AO	-5.0337**	2005		2 IO	-6.0361**	1993	2007
Toledo	-4.7128*	2008	0 AO				2 IO	-5.8984**	1994	2006
Valencia/València	-3.6519	1995	1 AO	-3.2389	2005		1 IO	-3.5603	2006	
Valladolid	-4.6401*	2008	1 AO	-0.0889	2005		1 IO	-4.2834**	2007	
Vizcaya	-5.2280**	1996	2 AO	-4.2814	1995	2005	1 IO	-4.3991**	2007	
Zamora	-5.0068**	1995	1 AO	-4.7609**	2008		2 IO	-7.1788**	1996	2007
Zaragoza	-4.3899	1995	1 AO	-3.3316	2006		1 IO	-3.5758	2006	

NT: No trend; T: Trend; NC: No Intercept; C: Intercept; 0L: 0 lags included; 1L: 1 lag included; 2L: 2 lags included.
(***) 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	Year 1	Year 2	Outlier	t-statistic	Year 1	Year 2
Álava	-4.2834	2008	2 AO	-5.3172	1996	2006	2 IO	-9.6526**	1995	2007
Albacete	-6.2632***	1998	1 AO	-4.7301**	2007		1 IO	-4.7628**	1989	
Alicante/Alacant	-4.0762	2008	1 AO	-3.6470**	2009		2 IO	-5.3703	1994	2007
Almería	-4.5901*	1996	1 AO	-3.5318	2005		1 IO	-4.2321	2006	
Asturias	-5.4985***	2008	1 AO	-4.4522**	2009		2 IO	-6.0306**	1998	2007
Ávila	-4.9596**	1998	0 AO				2 IO	-6.2950**	1988	2006
Badajoz	-3.2341	2009	1 AO	-3.4020	2005		1 IO	-3.8288	2007	
Balears, Illes	-4.6287*	1997	1 AO	-3.1821	2005		1 IO	-3.6373	2007	
Barcelona	-3.1178	2008	2 AO	-3.3226	1990	2005	1 IO	-3.1931	2006	
Burgos	-5.0130**	2009	1 AO	-1.0219	2005		1 IO	-1.7121	2007	
Cáceres	-5.4860***	1999	0 AO				2 IO	-3.5527	1993	1997
Cádiz	-4.0440	2008	1 AO	-3.9582**	2005		2 IO	-2.7857	1992	2006
Cantabria	-4.1476	1997	1 AO	-3.4478	2009		1 IO	-3.7906	2006	
Castellón/Castelló	-4.6313*	2007	1 AO	-4.6699**	2007		1 IO	-4.0232	2007	
Ciudad Real	-4.9075**	1998	1 AO	-3.6479**	2005		1 IO	-3.6566	2006	
Córdoba	-5.5630***	1998	0 AO				2 IO	-6.3215**	1990	2006
Coruña, A	-4.1480	2009	1 AO	-4.4424**	2009		2 IO	-4.1892	2000	2007
Cuenca	-4.9821**	2008	1 AO	-4.8091**	2005		1 IO	-4.8149**	2006	
Girona	-5.4883***	2008	1 AO	-3.0689	2004		2 IO	-5.4895**	1997	2006
Granada	-3.4694	1997	1 AO	-3.3460	2004		1 IO	-3.1848	2005	
Guadalajara	-4.8262**	1990	2 AO	-3.6037	1991	1996	0 IO			
Guipuzcoa	-4.5453	2008	1 AO	-3.7338**	2004		1 IO	-3.9639	2005	
Huelva	-4.9539**	2007	1 AO	-5.0940**	2007		1 IO	-4.5940**	2007	
Huesca	-5.8809***	2009	2 AO	-5.2918	1998	2006	2 IO	-6.5284**	1997	2007
Jaén	-6.1741***	1997	0 AO				0 IO		1989	
León	-6.7731***	2008	1 AO	-6.8503**	2008		2 IO	-7.2401**	2003	2007
Lleida	-5.0180**	1996	1 AO	-5.2296**	2008		1 IO	-4.7726**	2008	
Lugo	-5.7905***	2000	1 AO	-4.9848**	2007		2 IO	-5.5086**	1998	2006
Madrid	-3.8092	2008	2 AO	-4.3226	1991	2007	1 IO	-3.9343	2006	
Málaga	-4.1515	2008	1 AO	-3.7830**	2009		2 IO	-4.8448	1995	2007
Murcia	-3.3689	1997	2 AO	-4.2668	1996	2007	2 IO	-3.7924	1995	2006
Navarra	-2.9503	1996	1 AO	-3.4405	2005		1 IO	-4.4352**	2006	
Ourense	-6.4138***	1999	2 AO	-5.8580**	1998	2007	1 IO	-5.1740**	2007	
Palencia	-6.6050***	1989	1 AO	-4.8703**	2005		1 IO	-2.3002	2006	
Palmas, Las	-3.6359	1997	1 AO	-3.0454	2005		2 IO	-10.8037**	1998	2006
Pontevedra	-3.7003	2008	1 AO	-3.5483	2009		1 IO	-3.6362	2006	
Rioja, La	-5.5330***	2008	1 AO	-4.6602**	2009		2 IO	-4.2038	1995	2007
Salamanca	-6.0307***	2000	1 AO	-3.1650	2007		0 IO		2009	
Santa Cruz de Tenerife	-5.6561***	2008	1 AO	-5.2446**	2005		1 IO	-5.7461**	2006	
Segovia	-5.5680***	1997	1 AO	-4.7823**	2005		2 IO	-0.8590	1995	2006
Sevilla	-3.9509	1997	2 AO	-2.7896	1991	2007	1 IO	-6.7182**	2006	
Soria	-6.5526***	1990	1 AO	-6.4220**	1990		2 IO	-6.4457**	1988	2007
Tarragona	-1.9861	1996	2 AO	-5.7355**	1996	2004	1 IO	-5.2718**	2006	
Teruel	-4.9722**	2009	1 AO	-1.1786	1989		1 IO	-4.0805	1991	
Toledo	-3.8877	2008	1 AO	-3.8888**	2009		1 IO	-3.8538	2008	
Valencia/València	-4.8277**	1997	1 AO	-2.7838	2010		2 IO	-4.7505	1995	2007
Valladolid	-4.8147**	2008	1 AO	-4.1603**	2009		1 IO	-4.8740**	2006	
Vizcaya	-3.9874	1997	1 AO	-3.7123**	2008		2 IO	-4.4603	1995	2007
Zamora	-7.5695***	1999	1 AO	-4.8633**	2004		1 IO	-4.6554**	2005	
Zaragoza	-3.1879	2008	1 AO	-2.7833	2009		2 IO	-4.4927	1987	2006

NT: No trend; T: Trend; NC: No Intercept; C: Intercept; 0L: 0 lags included; 1L: 1 lag included; 2L: 2 lags included.

(***) 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 5: PANEL UNIT ROOT TESTS OVER FIRST DIFFERENCED VARIABLES

	Unemployment Rate		GDP NL	
Test	Model	First Diff.	Model	First Diff.
Hadri LM	c, 1lag	1.0001	c, 1lag	0.119
Levin Lin Chu	c, 1lag	-14.5758***	c, 1lag	-13.9239***
Im Pesaran Shin	c, 1lag	-16.7515***	c, 1lag	-18.532***
Fisher Type (conducted as a ADF)	c, 1lag	-18.5478***	c, 1lag	-20.3016***

C: intercept included; 1lag: 1 lag included.
(***) 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.

TABLE 6: ESTIMATION RESULTS

Province	$\ln GDP_t - \ln GDP_{t-1}$			
	Coeff.	St. Error	Observations	R-squared
Cádiz	-0.683***	-0.0905	26	0.599
Barcelona	-0.648***	-0.133	26	0.645
Valencia/València	-0.629***	-0.153	26	0.591
Palmas, Las	-0.612***	-0.171	26	0.518
Balears, Illes	-0.561***	-0.131	26	0.578
Murcia	-0.555***	-0.156	26	0.381
Málaga	-0.528***	-0.139	26	0.555
Zaragoza	-0.528***	-0.111	26	0.543
Castellón/Castelló	-0.522***	-0.134	26	0.549
Sevilla	-0.510***	-0.124	26	0.518
Madrid	-0.486***	-0.109	26	0.619
Granada	-0.484***	-0.137	26	0.421
Ciudad Real	-0.458***	-0.0962	26	0.574
Álava	-0.450***	-0.0979	26	0.599
Jaén	-0.449***	-0.107	26	0.358
Córdoba	-0.447***	-0.103	26	0.442
Ávila	-0.435***	-0.124	26	0.351
Asturias	-0.427***	-0.0954	26	0.395
Badajoz	-0.425***	-0.0778	26	0.445
Sta. Cruz deTenerife	-0.419**	-0.172	26	0.323
Pontevedra	-0.411***	-0.0835	26	0.535
Girona	-0.386***	-0.101	26	0.445
Guipúzcoa	-0.385***	-0.0851	26	0.473
Vizcaya	-0.364***	-0.128	26	0.363
Almería	-0.356***	-0.0884	26	0.41
Alicante/Alacant	-0.355*	-0.177	26	0.293
Cantabria	-0.353**	-0.139	26	0.366
Navarra	-0.328***	-0.0725	26	0.541
Tarragona	-0.328***	-0.117	26	0.307
Coruña, A	-0.319**	-0.118	26	0.253
Huesca	-0.317***	-0.0904	26	0.34
Huelva	-0.312**	-0.134	26	0.113
Ourense	-0.302*	-0.153	26	0.11
Valladolid	-0.300***	-0.0863	26	0.286
Segovia	-0.284***	-0.101	26	0.362
Toledo	-0.256***	-0.0875	26	0.302
Lleida	-0.255**	-0.109	26	0.212
Burgos	-0.254**	-0.115	26	0.177
Lugo	-0.230***	-0.0508	26	0.446
Cuenca	-0.224*	-0.129	26	0.173
León	-0.223**	-0.1	26	0.167
Palencia	-0.199**	-0.0761	26	0.132
Cáceres	-0.195**	-0.0895	26	0.066
Guadalajara	-0.184***	-0.0554	26	0.273
Rioja, La	-0.268	-0.161	26	0.159
Albacete	-0.155	-0.125	26	0.048
Soria	-0.15	-0.11	26	0.132
Teruel	-0.113	-0.0995	26	0.081
Salamanca	-0.0743	-0.112	26	0.011
Zamora	-0.055	-0.109	26	0.008
Panel Spain	-0.3529***	0.0219	1300	0.2859

(***) Significant relationship at 99% confidence level.
(**) Significant relationship at 95% confidence level.
(*) Significant relationship at 90% confidence level.

TABLE 7: CUMULATIVE EFFECT OF SHOCKS IN GDP (FD)

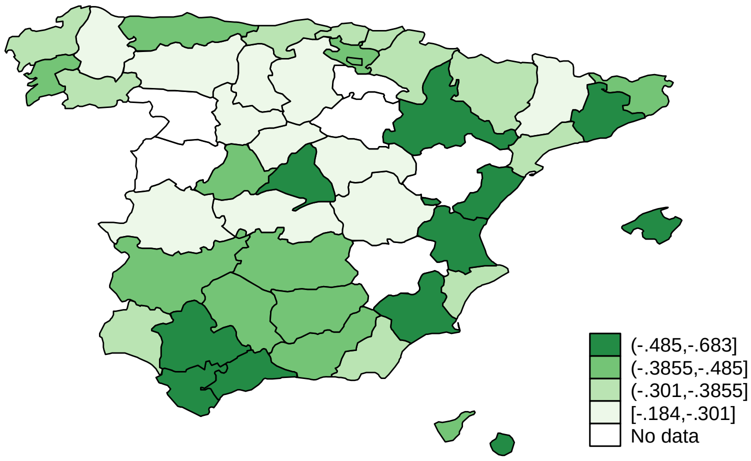
Unemployment rate (First Difference)				
Provinces	0	2	4	6
Barcelona	-0.01213	-0.03223	-0.04463	-0.05193
Cádiz	-0.01774	-0.03764	-0.04381	-0.04577
Palmas, Las	-0.01461	-0.03126	-0.04023	-0.04531
Sevilla	-0.01194	-0.02955	-0.03726	-0.04071
Almería	-0.01326	-0.02869	-0.03623	-0.03991
Zaragoza	-0.00954	-0.02376	-0.03291	-0.03876
Murcia	-0.01143	-0.02637	-0.03407	-0.03798
Huelva	-0.01135	-0.03367	-0.0368	-0.03727
Madrid	-0.00895	-0.02212	-0.02982	-0.03432
Badajoz	-0.01369	-0.02807	-0.03243	-0.03378
Castellón/Castelló	-0.01215	-0.02534	-0.03106	-0.03355
Valencia/València	-0.01529	-0.02787	-0.03151	-0.03256
Balears, Illes	-0.01496	-0.02677	-0.03079	-0.03228
Pontevedra	-0.00824	-0.02092	-0.02777	-0.03153
Ciudad Real	-0.01201	-0.02518	-0.02956	-0.03104
Cantabria	-0.00621	-0.02225	-0.02841	-0.0304
Córdoba	-0.01657	-0.0273	-0.02887	-0.0291
Girona	-0.01045	-0.02321	-0.02672	-0.02772
Santa Cruz de Tenerife	-0.01372	-0.02456	-0.0268	-0.02726
Jaén	-0.02075	-0.02482	-0.02475	-0.02475
Asturias	-0.01134	-0.02202	-0.02362	-0.02388
Granada	-0.01125	-0.0203	-0.02255	-0.02301
Álava	-0.0148	-0.02054	-0.02171	-0.02194
Ourense	-0.00769	-0.02056	-0.02172	-0.02184
Guipuzcoa	-0.00846	-0.01938	-0.02109	-0.02128
Valladolid	-0.00756	-0.01666	-0.01932	-0.0201
Alicante/Alacant	-0.00971	-0.017	-0.01917	-0.01986
Málaga	-0.01388	-0.02188	-0.0209	-0.01964
Toledo	-0.00742	-0.01513	-0.01779	-0.01871
Cuenca	-0.00716	-0.01704	-0.01834	-0.01852
Cáceres	-0.00587	-0.01661	-0.0182	-0.01846
Guadalajara	-0.00732	-0.01485	-0.01727	-0.018
Vizcaya	-0.00959	-0.01595	-0.01729	-0.01758
Navarra	-0.00745	-0.01425	-0.01638	-0.01705
Rioja, La	-0.00856	-0.01454	-0.01609	-0.01649
Segovia	-0.01049	-0.01433	-0.01468	-0.01471
Lleida	-0.00648	-0.01309	-0.01405	-0.0142
Coruña, A	-0.00726	-0.01287	-0.01393	-0.01414
Tarragona	-0.00792	-0.01277	-0.01364	-0.0138
Teruel	-0.00412	-0.01177	-0.01324	-0.01352
León	-0.00621	-0.01211	-0.01277	-0.01285
Lugo	-0.00741	-0.01322	-0.01284	-0.01282
Huesca	-0.0084	-0.01137	-0.01162	-0.01164
Albacete	-0.00317	-0.00897	-0.01078	-0.01132
Palencia	-0.00544	-0.01018	-0.01097	-0.0111
Salamanca	0.000246	-0.00746	-0.00956	-0.01011
Soria	-0.00557	-0.00954	-0.00973	-0.00975
Ávila	-0.0098	-0.00988	-0.00905	-0.00887
Zamora	-0.00039	-0.00272	-0.00288	-0.00289
Burgos	-0.00426	-0.00254	-0.00184	-0.00178

TABLE 8: CUMULATIVE EFFECT OF SHOCKS FOR THE PANEL OF PROVINCES

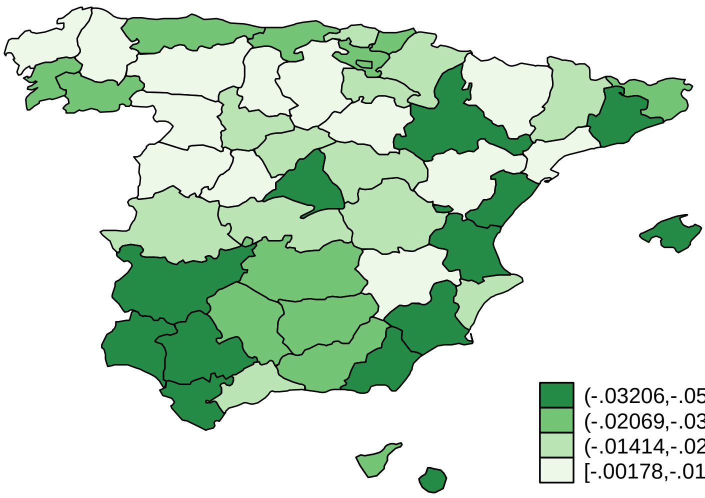
	0	2	4	6
UR response to a UR Shock	0.0194	0.025	0.0264	0.0268
GDP response to a UR Shock	0	-0	-0.0061	-0.0066
UR response to a GDP Shock	-0.0096	-0	-0.033	-0.0344
GDP response to a GDP Shock	0.0325	0.058	0.0665	0.0692

MAPS

MAP 1: UNEMPLOYMENT SENSITIVITY TO ECONOMIC SHOCKS - STATIC ANALYSIS.



MAP 2: UNEMPLOYMENT SENSITIVITY TO ECONOMIC SHOCKS - DYNAMIC ANALYSIS.



FIGURES

FIGURE 1. PROVINCIAL OIRF REPRESENTATIONS

FIGURE 2. RESPONSE TO GDP GROWTH SHOCKS FOR THE PANEL OF PROVINCES

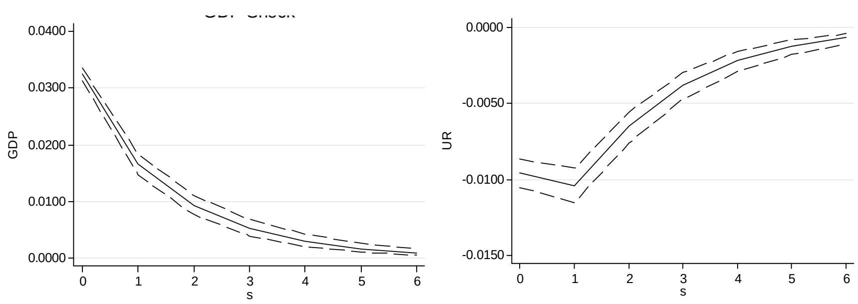


FIGURE 3. RESPONSE TO SHOCKS IN UNEMPLOYMENT CHANGES FOR THE PANEL OF PROVINCES

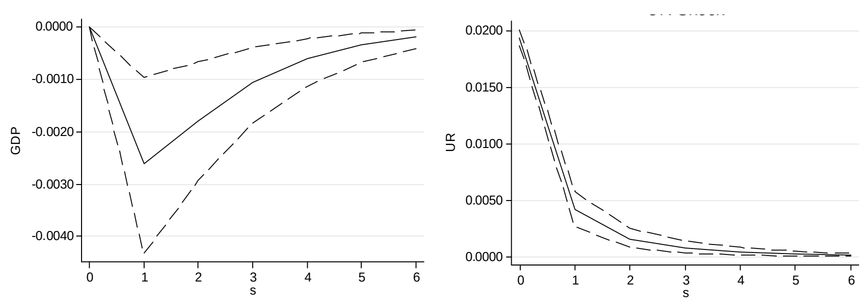
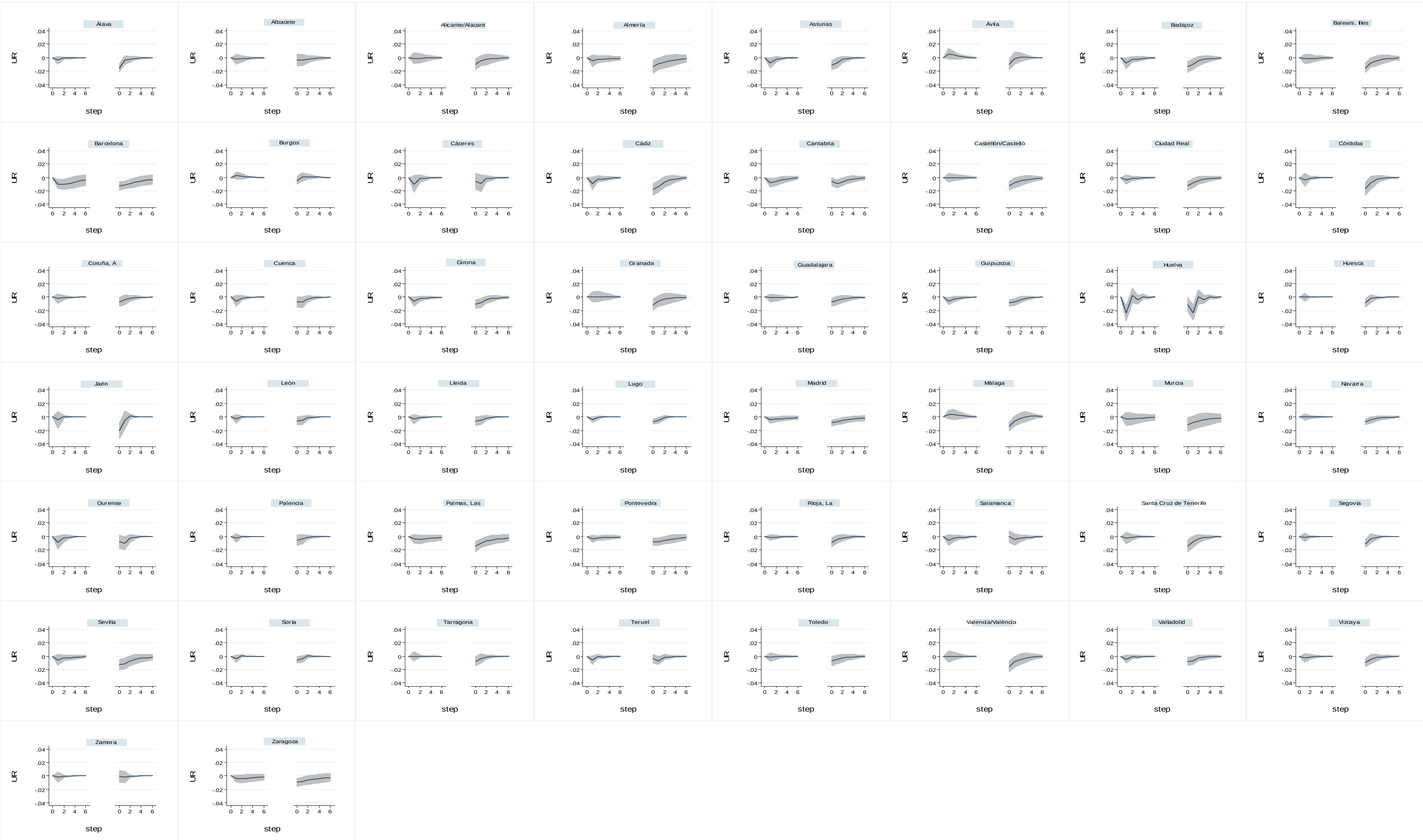


FIGURE 4. ORTHOGONALIZING THE VARIABLES IN TWO DIRECTIONS. EFFECTS ON UNEMPLOYMENT RATE CHANGES WHEN GDP GROWTH SHOCKS OCCURS



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