E C O N O M I C S B U L L E T I N

Okun's law in the Spanish regions

José Villaverde
University of Cantabria

Adolfo Maza
University of Cantabria

Abstract

The purpose of this paper is to analyse Okun's law for Spain and its seventeen regions over the period 1980-2004. Based on its "gap" specification and using two different detrending techniques, the results show that an inverse relationship between unemployment and output holds for most of the Spanish regions and for the whole country. However, the quantitative values of Okun's coefficients for these regions are quite different. In addition, the coefficients for each region varied across the two detrending techniques. Even so, these coefficients are lower than those initially estimated by Okun and others.

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1 Introduction

Although in the last quarter of the century, Spain has largely and gradually reduced its per capita GDP differences with the EU-15 (in PPS terms from 74.2% in 1980 to 89.9% in 2004), these continue to be relatively high. There is no doubt that both these phenomena (income convergence and Spain being below the EU-15 average) are somehow related to the unemployment rates there exists in the country; in particular, even though these have declined a lot in the last decade –promoting convergence-, the fact is that they have also been traditionally high and are still above the EU-15 average.

As for the Spanish regions, it is also true that all of them have converged to the per capita income of the EU-15. However, the speed of convergence has varied a lot across regions, a result that, among other things, seems to be related to the ample and persistent differences in regional unemployment rates.

Thus, the implementation of adequate policies to continue with the reduction of unemployment –and then with a higher growth of output- is also one of the main goals of Spanish national and regional policymakers. In order to devise these policies it would be crucial to elucidate if there is a relationship between unemployment and output (real GDP). This relationship, known as Okun's law (Okun, 1962, 1970), simply postulates the existence of a negative empirical relationship between changes in the unemployment rate and output.

In the last two decades a large number of empirical studies have investigated the validity of this law (for a rapid reference, see Adanu, 2005) with findings that, on the whole, tend to support it. Notwithstanding, it has been shown that the absolute value of the estimated Okun coefficient, initially considered to be in the vicinity of three –an increase in unemployment of one percentage point above its natural rate reduces GDP by three percentages points-, not only varies a lot according to the time and spatial samples under consideration (Perman and Tavera, 2004), but also tends to be well below three. Furthermore, it is also important to note that, generally speaking, the values of this coefficient change according to the model specification of Okun's law and the method employed to estimate it.

Although the empirical study of Okun's law has indeed blossomed since the publication of Prachowny's paper (1993), most of it only deals, to the best of our knowledge, with data at national level, which means that no consideration is paid to regional characteristics of both product and labour market dynamics. Fortunately, in the last few years some studies have tried to overcome this shortcoming, thus introducing a regional dimension in the analysis of the relationship between output and unemployment (Freeman, 2000; Christopoulos, 2004; Adanu, 2005). Drawing from this recent literature, this paper aims to estimate Okun's coefficient for the seventeen Spanish regions and, to some extent, to explain their differences; this is important not only in order to know by how much the unemployment rate of these regions causes changes in output but also the mechanism through which these effects take place. For a country that has suffered considerably from the persistence of high regional unemployment dispersion, the knowledge of this relationship for every region is important from the point of view of the implementation of appropriate economic policies.

The remainder of the paper is organized as follows. Section 2 describes the data and methodology. In Section 3 the empirical results are shown and discussed. Finally, in Section 4 the main conclusions are presented.

2 Data and methodology

2.1. Data

This paper centres on the Spanish regions. Since 1978 Spain has been organised in 17 NUTS II regions (see Figure 1) with very different demographic and economic sizes, different levels

of development (GDP per capita) and different rates of unemployment. In order to explore the validity of Okun's law at regional level in Spain, the data used in this paper are drawn from the *Instituto Nacional de Estadística* (National Statistics Institute) database. This official source offers information on real GDP and unemployment rate for all seventeen Spanish regions; all the series are annual and, for reasons of homogeneity, the sample period runs from 1980 to 2004.

Figure 1. Spanish regions.

Basic statistics are reported in Table 1. If we consider this table in conjunction with Figure 1, it can be seen that, in addition to Madrid, the most prosperous regions (higher GDP per capita and productivity, and lower unemployment rate) are located in the Mediterranean Basin (Cataluña) and the Ebro river valley (Aragón, Navarra, La Rioja and País Vasco)[1]. On the other hand, it can be seen that four regions (Andalucía, Cataluña, Comunidad Valenciana and Madrid) concentrate more than 50% of the Spanish population and GDP and that their joint share in these variables increased between 1980 and 2004. Finally, it is important to note that, with the exception of La Rioja (the smallest region of Spain and the one with the lowest unemployment rate) the more prosperous regions have reduced their unemployment rates over time, whereas there is no clear pattern for the rest of the regions.

2.2. Methodology

As suggested by Okun (1970), there are two classes of Okun's law specifications: the first-difference model and the "gap" model. According to the first-difference model, the relationship between the natural log of observed real output (y_t) and the observed unemployment rate (u_t) is given by the expression:

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

where α is the intercept, β is Okun's coefficient and ε is the disturbance term. In order for this specification to be correct one of these two conditions have to be met: first, those series

[1] For further reference about the Spanish regions, see Villaverde (2006).

between brackets have to be stationary; second, if they were nonstationary they have to be cointegrated to avoid spurious regressions. The traditional approach to test for stationarity and cointegration is the Dickey-Fuller test.

Table 1. Regional basic statistics

	Population		GDP		GDP per capita		Unemployment	
	1980	2004	1980	2004	1980	2004	1980	2004
Andalucía	17.2	17.9	13.0	14.0	75.6	78.2	17.4	17.1
Aragón	3.2	2.9	3.1	3.1	98.0	107.6	8.6	5.6
Asturias	3.0	2.5	2.6	2.2	84.7	87.9	8.4	10.4
Baleares	1.7	2.2	1.8	2.2	105.6	98.7	8.0	9.2
Canarias	3.6	4.4	3.7	3.9	102.1	88.2	12.3	12.0
Cantabria	1.4	1.3	1.3	1.3	98.2	97.5	7.5	10.5
Castilla y León	7.0	5.8	6.4	5.7	91.8	98.4	8.5	10.7
Castilla - La Mancha	4.5	4.3	3.6	3.5	80.5	81.1	10.7	9.5
Cataluña	15.8	15.8	18.6	18.2	118.1	114.9	12.2	9.7
Comunidad Valenciana	9.7	10.6	9.5	9.7	98.6	91.8	9.7	10.4
Extremadura	2.9	2.5	1.5	1.8	53.4	71.3	15.0	17.2
Galicia	7.5	6.4	6.4	5.4	84.9	84.3	5.0	13.6
Madrid	12.3	13.5	15.6	17.4	126.4	129.1	12.5	6.7
Murcia	2.5	3.0	2.4	2.5	95.2	81.6	9.8	10.7
Navarra	1.4	1.4	1.8	1.7	131.3	128.7	11.9	5.5
País Vasco	5.7	4.9	7.6	6.4	133.3	130.1	12.4	9.7
Rioja (La)	0.7	0.7	0.7	0.7	97.8	110.0	5.2	5.6
Spain	100.0	100.0	100.0	100.0	100.0	100.0	11.4	11.0

From the point of view of the "gap" model, derived from an extended production function and some ancillary relationships in the labour market (Prachowny, 1993), the specification is given by the expression:

$$(y_t - y_t^*) = \alpha + \beta\left(u_t - u_t^*\right) + \varepsilon_t \qquad (2)$$

where y^* represents the log of potential output, u^* is the natural rate of unemployment and the other symbols have the same meaning as in equation (1). In this second specification, the left-hand side term represents the output gap, whereas $\left(u_t - u_t^*\right)$ captures the unemployment gap. In other words, the difference between the observed and potential real GDP captures the cyclical level of output; in the same vein, the difference between the observed and natural rate of unemployment represents the cyclical rate of unemployment. It is obvious that the stationary or cointegration conditions of these gaps also have to be fulfilled.

Of the two Okun's law specifications previously mentioned we have opted for the second, the so-called "gap" model. A major problem with this model is that there are no observable data on y^* and u^* so they have to be estimated, which means it is necessary to generate y and u trend series; a problem then arises concerning the choice of the detrending method. To relatively overcome this problem, and in order to test for the robustness of the Okun's coefficients, we have applied two different detrending techniques: first, a quadratic trend to decompose both the y and u series into their trend and cyclical components; second, we have used the Hodrick-Prescott (HP) filter. Although there are other detrending methods (see, for example, the Baxter-king filter, the Beveridge and Nelson method, the Kalman filter and the Harvey structural times-series approach) the truth is that there is no definitive way of doing this, for each one of the proposed methods has its advantages and disadvantages.

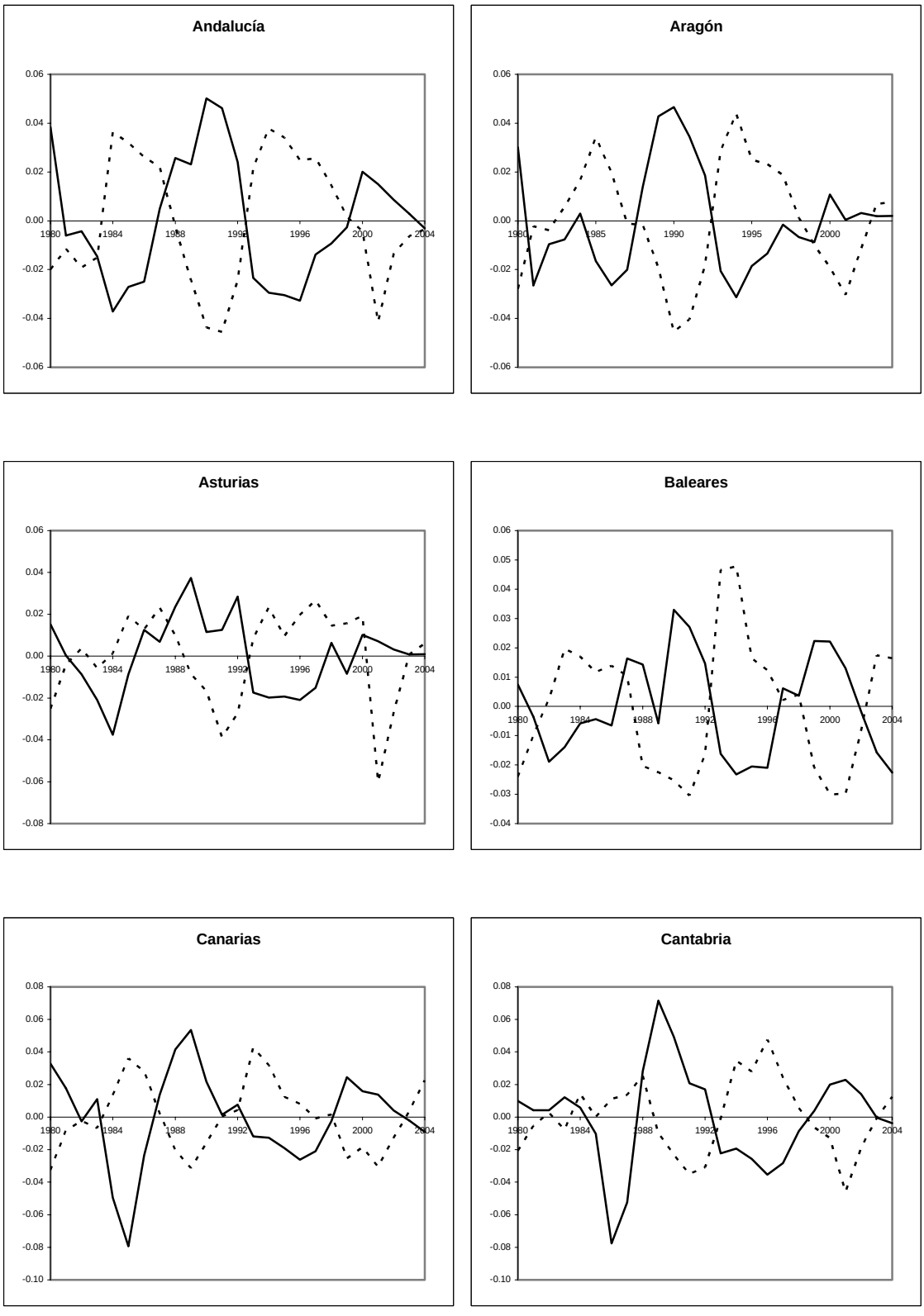

Figure 2. Regional and national differences in business cycles.

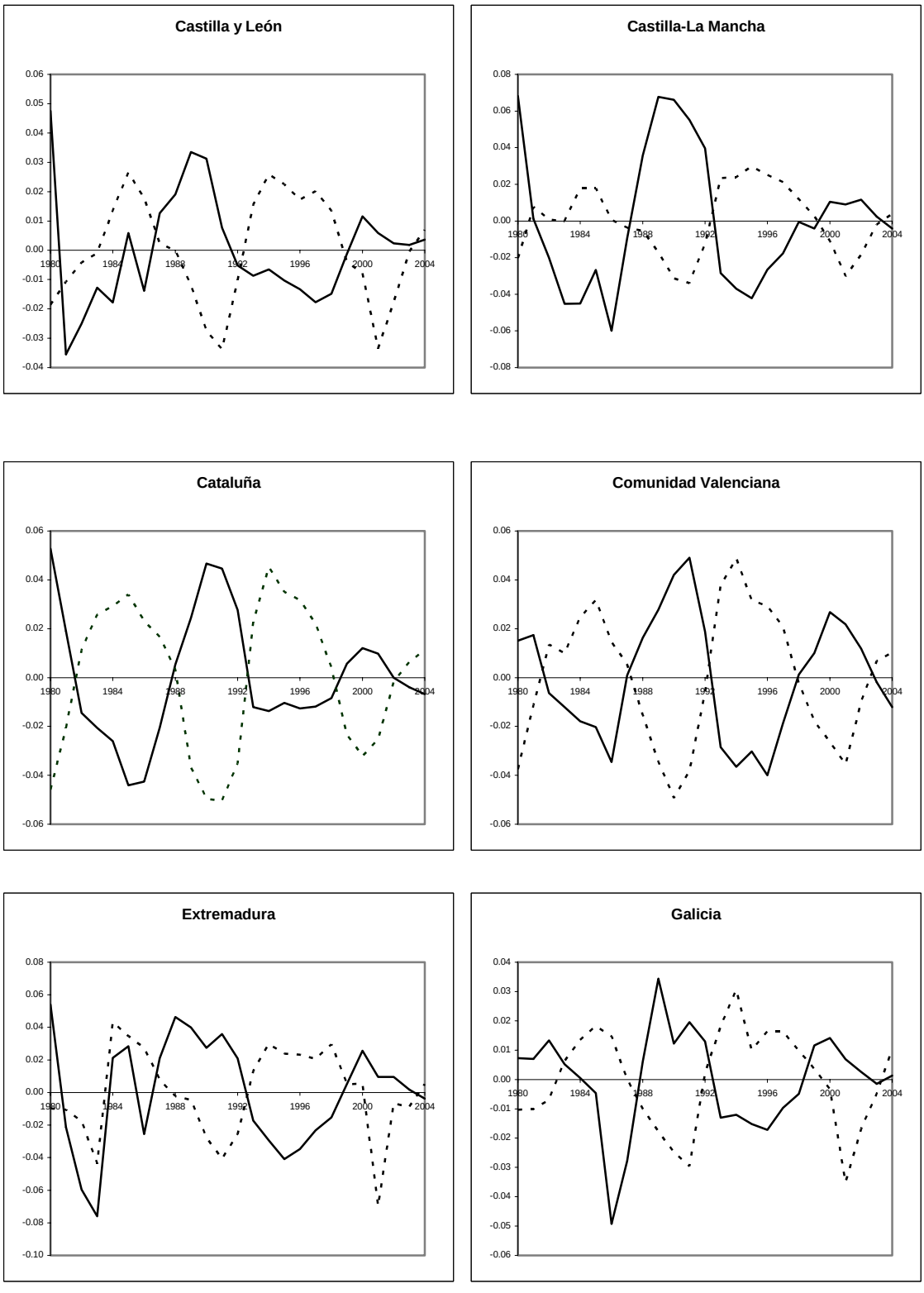

Figure 2. Regional and national differences in business cycles *(cont.)*.

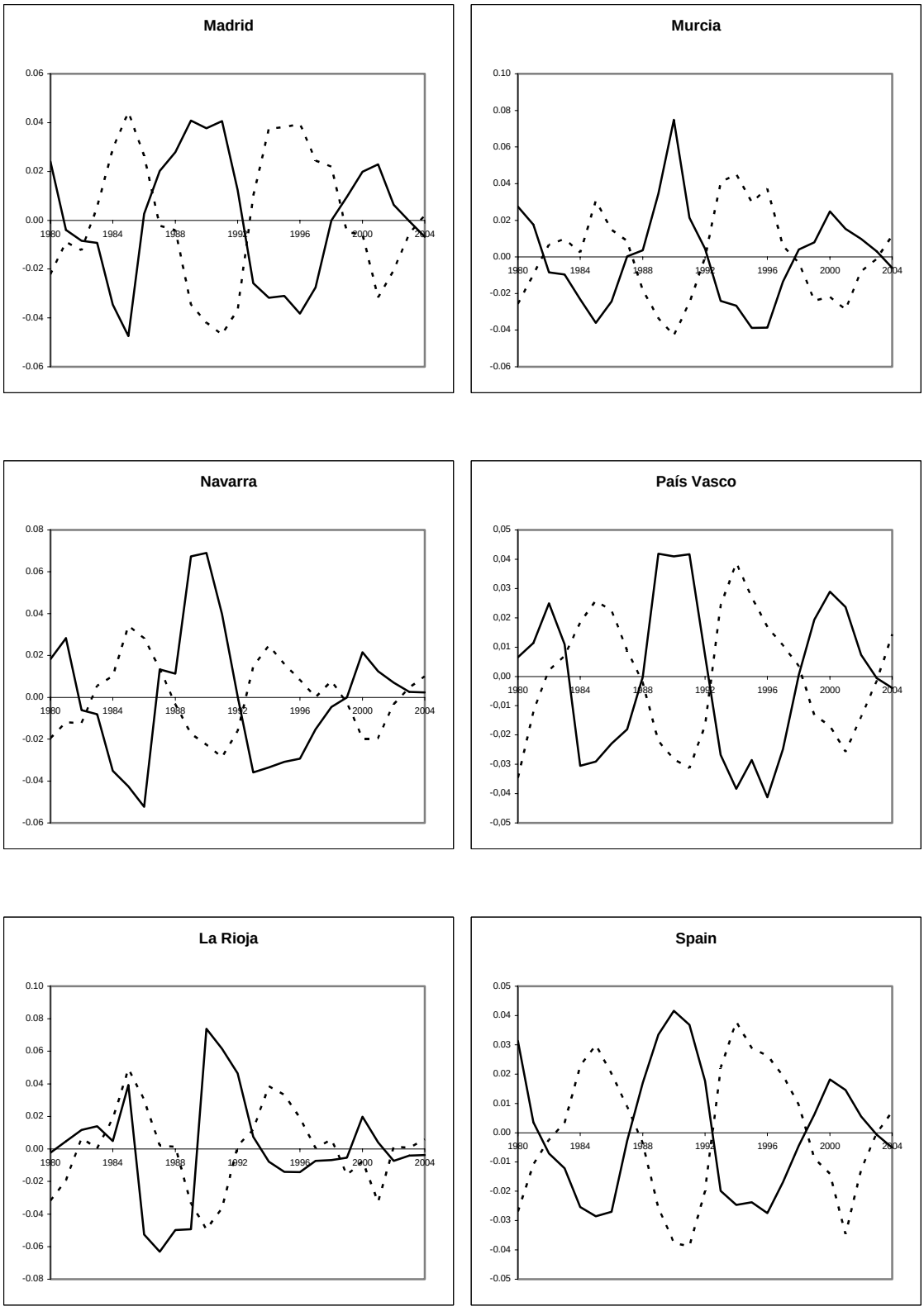

Figure 2. Regional and national differences in business cycles *(cont.)*.

3. Empirical results: The regional Okun coefficients

In this section we test the "gap" model of Okun's law for Spain and its seventeen regions. In order to do so, we follow a four-step process.

As stated before, in the first step the unemployment and output gaps (or cyclical components) were generated using two different detrending methods: a quadratic trend and the HP filter.

In the second step, these cyclical components of the unemployment and output series for all regions and Spain as a whole were plotted (see Figure 2 above)[2], showing that, as a general rule, the inverse relationship between these two variables hypothesised by Okun's law seems to hold; the only obvious exceptions (see the plot for the initial years of the sample) are those of Extremadura and La Rioja. It is also important to note that the plots of the cyclical components of output and unemployment of the largest regions tend to be very similar to the plot for Spain. As expected, this simply means that the impact of these larger regions on the national gaps is larger than that of the smaller regions.

After that, the third step of the empirical analysis has been to perform unit root tests on the gaps of the unemployment and output series. If those series were nonstationary, then the estimation of Okun's law would produce biased and misleading results. Although the standard test for unit roots is the augmented Dickey-Fuller (ADF) we have not only employed it, but for robustness we have also used the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The results obtained by applying these two tests to each region and Spain are reported in Table 2. According to the ADF test most of the series are stationary. The stationarity of the series is even more clearly established when the KPSS test is computed; in this case, all of the series prove to be I(0) for the two detrending methods.

Table 2. Unit root tests

	Output gap				Unemployment rate gap			
	Quadratic trend		HP filter		Quadratic trend		HP filter	
	ADF	KPSS	ADF	KPSS	ADF	KPSS	ADF	KPSS
Andalucía	-4.1*	0.06	-4.3*	0.06	-3.2*	0.06	-3.4*	0.06
Aragón	-2.7*	0.07	-3.0*	0.06	-3.5*	0.06	-3.7*	0.05
Asturias	-3.8*	0.08	-4.4*	0.07	-2.8*	0.06	-3.1*	0.05
Baleares	-2.5	0.05	-2.3	0.06	-3.3*	0.05	-3.1*	0.05
Canarias	-4.5*	0.05	-3.4*	0.05	-3.4*	0.06	-3.4*	0.07
Cantabria	-3.9*	0.06	-4.1*	0.05	-3.9*	0.05	-3.4*	0.06
Castilla y León	-3.1*	0.09	-4.2*	0.07	-3.4*	0.06	-3.8*	0.06
Castilla - La Mancha	-3.7*	0.06	-3.6*	0.06	-2.9*	0.07	-2.8*	0.07
Cataluña	-3.8*	0.07	-4.4*	0.06	-3.7*	0.05	-4.1*	0.05
Comunidad Valenciana	-4.1*	0.06	-4.4*	0.06	-4.0*	0.05	-4.9*	0.06
Extremadura	-3.3*	0.09	-2.9*	0.08	-3.6*	0.06	-3.7*	0.06
Galicia	-4.2*	0.05	-3.9*	0.05	-3.2*	0.07	-3.5*	0.06
Madrid	-1.4	0.07	-0.4	0.06	-3.8*	0.06	-4.1*	0.06
Murcia	-4.1*	0.06	-4.1*	0.06	-4.6*	0.06	-4.4*	0.06
Navarra	-4.4*	0.06	-4.6*	0.05	-4.0*	0.05	-3.1*	0.05
País Vasco	-3.5*	0.06	-3.8*	0.06	-3.1*	0.05	-3.6*	0.06
Rioja (La)	-3.6*	0.05	-4.0*	0.05	-3.0*	0.05	-5.5*	0.05
Spain	-4.2*	0.06	-4.6*	0.05	-3.7*	0.05	-3.7*	0.06
Panel**	-9.6*		-10.7*		-9.4*		-9.9*	

Notes: a) ADF test under H_0: variable is nonstationary; b) KPSS test under H_0: variable is stationary; c) * = significant (rejection of the unit root hypothesis) at 10% level; d) ** IPS test under H_0: variable is nonstationary.

[2] For ease of reference we only show the gaps obtained with the HP filter.

However, considering the relatively short time span of our sample (25 years) recent literature (see e.g. Im et al. 2003) considers that the ADF tests applied to our gap (cyclical) series could have low power; in order to solve this potential problem we have applied the Im-Pesaran-Shin (IPS) panel unit root test. This is, in fact, a multiple-series unit root test applied to panel data structures and based on averaging individual ADF unit root tests. The results obtained (see the last row of Table 2) clearly show that the output and unemployment gap series are I(0).

The fourth and final step of the empirical analysis has then consisted in the OLS estimation of Okun's law by using the output and unemployment gaps series generated in the first step. The most interesting results (Table 3) are as follows:

Table 3. Estimates of Okun's law

	Quadratic trend		HP filter	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Andalucía	-0.92	-8.45	-0.83	-7.73
Aragón	-0.79	-6.14	-0.73	-6.13
Asturias	-0.45	-2.52	-0.32	-2.08
Baleares	-0.60	-7.33	-0.58	-5.96
Canarias	-0.92	-4.86	-1.04	-6.02
Cantabria	-0.85	-3.69	-0.79	-3.36
Castilla y León	-0.62	-2.90	-0.49	-2.50
Castilla - La Mancha	-1.41	-5.11	-1.55	-5.81
Cataluña	-0.80	-8.18	-0.76	-9.95
Comunidad Valenciana	-0.89	-13.16	-0.86	-12.62
Extremadura	-0.31	-1.04	-0.11	-0.44
Galicia	-0.54	-3.38	-0.61	-3.64
Madrid	-0.90	-9.86	-0.83	-8.47
Murcia	-0.95	-9.20	-0.97	-9.77
Navarra	-1.35	-5.03	-1.50	-6.90
País Vasco	-1.08	-7.73	-1.08	-8.38
Rioja (La)	-0.38	-1.40	-0.35	-1.29
Spain	-0.96	-13.84	-0.91	-13.92
Panel	-0.80	-18.36	-0.74	-17.75

1.- It so happens that Okun's law is confirmed for 15 out of 17 regions. For the regions in which the law holds, the implementation of aggregate demand policies would be appropriate to reduce unemployment, while for those regions in which the law does not hold, other types of policies should be considered. These regional differences in the trade-off between unemployment and output constitute a clear argument for the implementation of a regional policy.

2.- The results obtained with the quadratic trend (QT) and the HP filter show, for each region, roughly the same coefficients (the correlation coefficient is 0.98); then, and in striking contrast to the Freeman (2000) results for the US, there tends to exist a close correspondence throughout the two detrending methods.

3.- Generally speaking, the differences in Okun's coefficients are notable and statistically significant across regions. In particular, the largest effects of the changes of unemployment on the changes in output are observed in Castilla-La Mancha and Navarra while the lowest correspond to Asturias. Due to the low t-statistics, no conclusions about the relationship between output and unemployment changes can be drawn for Extremadura and La Rioja whatever the detrending method employed. Thus, it seems that, in a similar way to the Greek (Christopoulos, 2004), American (Freeman, 2000) and Canadian (Adanu, 2005) cases, there is no obvious pattern explaining the regional aspects of Okun´s law in Spain.

4.- As for the estimation carried out for the panel, the results obtained with the two detrending methods show that Okun's law is confirmed. Finally, and in accordance with Freeman (2000), it so happens that the pooled estimation of Okun's coefficient yields roughly the same values as the estimation at national level; however Okun's coefficients are slightly lower with panel data.

4 Concluding remarks and policy issues

This note has estimated Okun's coefficients for the Spanish regions by means of using a conventional "gap" specification. Several findings have emerged from our empirical analysis. First of all, that Okun's law holds for most of the regions and, in particular, for the whole country. Secondly, that the regional response of output to unemployment is found to be very varied with values ranging[3] from a minimum of 0.32 in Asturias and a maximum of 1.55 in Castilla-La Mancha. Thirdly, panel estimation produces consistent but lower coefficients than those obtained at national level. In any case, and this is the fourth and final conclusion, it is crucial to note that the quantitative values of Okun's coefficients are much lower than those estimated by authors such as Okun (1962), Gordon (1984) and Moosa, (1997), and more in accordance with those produced by Christopoulos (2004) for the Greek regions.

The previous conclusions allow us to assert that the situation of the labour market in Spain – and its regions- has been hindering the rate of convergence to the EU-15. Thus, from a political perspective, two additional conclusions are evident. In order to accelerate the speed of convergence with the EU-15 it would be necessary, both at the national and regional level, to implement policies devoted to reduce the unemployment rate and to boost productivity.

As for the reduction in unemployment, a better performance of the national and regional labour markets is needed to make them more efficient and flexible. Tax and benefit system reforms aimed at increasing work incentives (e.g, reducing the tax wedge) and greater wage flexibility (based in a less centralised collective bargaining system and in a better understanding between the parties involved in the wage bargaining process)[4] seem to be pertinent (Maza and Villaverde, 2007). In the same way, an increase in interregional labour mobility, removing restrictions related to issues such as housing, employment information and the use of different official (national or regional) languages, could also contribute to the fall in unemployment.

In order to enhance productivity growth, the conventional recipes are appropriate. We mainly refer to policies committed to promote human capital, R+D and innovation, but also to policies related to product market reform (mainly through an increase in competitive pressure) as well as improvements in basic and technological infrastructures.

Finally, four possible extensions of the paper seem to be indicated. First, to employ more sophisticated detrending methods. Second, to explain differences in Okun´s coefficient between regions. Third, to study whether Okun's law is symmetric or asymmetric (have expansions and contractions of unemployment the same absolute effect on output?). And finally, to check if Okun's coefficient is stable over time (are there no structural breaks in the relationship?).

[3] When the HP filter is employed.

[4] These developments may be supported by the induced pressure of globalisation on wages and the increase of migratory flows to Spain and, in particular, some of its regions.

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