Volume 33, Issue 1

Okun's law in the french regions: a cross-regional comparison

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Abstract

This article tackles one central issue in the regional science literature: the persistence of regional disparities in unemployment within national economies. Our approach is original as Okun's coefficients are estimated for each of the 22 administrative French regions over the period 1990–2008, taking into account cross-regional disparities in a panel data specification. Estimates show that the coefficients exhibit regional differences. Indeed, Okun's law is confirmed in fourteen regions, although it does not hold in the other eight regions. Finally, region-specific factors that explain the results that are not significant are identified, and policies to reduce unemployment in French regions are examined.

1. Introduction

The implementation of adequate policies to reduce unemployment is crucial for national and regional authorities. Indeed, as cross-regional disparities are large and persistent in most countries, unemployment policy cannot only be considered from a national perspective. Obviously, the success of policy measures depends on the regional labour market conditions.

The most widely used variable for explaining the unemployment rate is per capita gross product. More precisely, one major issue is the analysis of the functional relationship between unemployment and Gross Domestic Product (GDP). This rather complex relationship has been formalized by Okun (1962) who related deviations from the natural rate of unemployment to changes in real output, and provided policy makers with a guide to the employment effects of higher output growth. He showed that every percentage point that the unemployment rate falls below the natural unemployment rate corresponds to a rise in real output of three per cent a year.

Since Okun's seminal contribution, this law has been frequently found to hold at the country level, in macroeconomic empirical studies. But there are very few studies analysing the relationship at the regional level. In this paper, we estimate Okun's coefficients using regional panel data for France over the period 1990–2008. France is an interesting case study since the country exhibits a persistently high dispersion of unemployment rates across its regions.

The contribution of the paper to literature is twofold. As well as estimating Okun's law at the regional level in France for the first time, to the best of our knowledge, it also explicitly introduces spatial heterogeneity into the model to be estimated. To do so, the specification used includes one specific Okun's coefficient for each region.

Our findings show that the law holds for only fourteen regions, and that Okun's coefficients are not statistically significant for the eight other French regions. On this empirical basis, the implementation of an economic policy more appropriate for the reduction of unemployment in each region must be analysed. For the regions in which the law holds, conventional nationwide policies to stimulate GDP might be sufficient. In contrast, region-specific policies should be implemented in those regions where the law does not hold (such as interregional labour mobility, public spending in terms of transport infrastructures to reduce the costs of spatial mobility, education and apprenticeship policies or a combination of these). In France, all these policies are provided by the decentralized regional authorities. But regional structures have dissimilar features. Therefore, the implementation of the appropriate policies to reduce unemployment must differ from one region to another.

The rest of this paper proceeds as follows. In Section 2, the literature analysing Okun's law at the regional level is reviewed. In Section 3, the specification of the model is discussed. Data used in the empirical analysis are described in Section 4. In Section 5, after presenting the empirical results, regional specific efficient policies to tackle unemployment are discussed. Additionally, the issue of the lack of correlation between unemployment and GDP fluctuations in eight regions is addressed. Section 6 provides some conclusions.

2. Empirical evidence on Okun's law at the regional level

Following the seminal papers by Okun (1962) and Prachowny (1993), a large number of empirical studies have analysed Okun's law at the national level. They generally provide support for the empirical validity of the law. Since Freeman (2000), few articles have investigated this issue at the regional level. The existing literature can be summarized as follows.

Freeman (2000) tested Okun's law for eight US regional economies during the period 1958–1998 to analyse the regional differences in the responsiveness of output to reductions in unemployment. He concluded there are slight interregional differences in the magnitude of Okun's coefficients, in the range of −1.84 to −3.57. Apergis and Rezitis (2003) estimated Okun's coefficients using annual data for eight regions in Greece over the period 1960–1997. They asserted that the coefficients do not exhibit interregional differences except for the cases of two regions with coefficients of −2.97 and −3.56 respectively. However, these two articles give little interpretation of their results. Christopoulos (2004) also investigated Okun's law for thirteen Greek regions and provided evidence that the relationship can be confirmed for only six regions under study (Okun's coefficients are in the range of −0.37 to −1.70). The high proportion of long-term unemployed people might explain why changes in unemployment and output do not move together in the seven other regions.

Next, Adanu (2005) estimated Okun's coefficients for ten Canadian provinces over the period 1981−2001 and found values ranging from −0.30 to −2.14. He concluded that the coefficients are higher, in absolute value, in the relatively more industrialized provinces with higher populations and output. In these regions, the loss in real GDP when a trained person loses his or her job exceeds that of a less trained person. Villaverde and Maza (2007, 2009) found different quantitative values of Okun's coefficients (ranging from -0.32 to -1.55, with two non-significant values) for seventeen Spanish regions over the period 1980–2004. They also found a positive correlation between the evolution of productivity and the coefficients.

To summarize, most of those empirical studies show substantial regional differences in the coefficient values. On this empirical basis, few authors give prescriptions for reducing unemployment in the regions under study. From the Keynesian perspective, Christopoulos (2003) suggested the adoption of demand management policies to reduce the level of unemployment in regions where the law holds. He proposed subsidizing employment or financing the local infrastructure in regions where the law is not observed. From a neoclassical perspective, Apergis and Rezitis (2003) suggested improving labour market flexibility to increase the productivity of the overall economy and decrease unemployment in all regions. In addition, Villaverde and Maza (2009) concluded that a nationwide supply policy to increase labour flexibility should be combined with specific local policies to increase interregional mobility in regions for which the law does not hold.

3. Empirical methodology

After describing the gap specification that we used for this study, specific econometric issues are discussed.

3.1 Gap specification

Two specifications are generally used in the literature to estimate Okun's coefficients: difference model or the gap model. Okun (1962) used the difference model. But we have opted for the gap model, as have numerous recent studies.

Output and unemployment variables are expressed in terms of the cyclical components or deviations from long-term trends. The specification commonly used in the literature is provided by the following expression:

$$(y_{it} - y_{it}^*) = \beta(u_{it} - u_{it}^*) + \varepsilon_{it} \qquad (1)$$

The index i refers to a region and the index t to a time period.

y is the logarithm of observed or actual output and y^* is the logarithm of equilibrium output. u^* is the natural unemployment rate and u is the actual unemployment rate, expressed as a percentage. The left-hand side term $(y_{it} - y^*_{it})$ is the output gap which represents the cyclical level of output. In the same way $(u_{it} - u^*_{it})$ measures the unemployment gap and captures the cyclical unemployment rate. ε_{it} is the error term.

If Okun's law is valid, the coefficient β is negative: for every 1% increase in unemployment rate, the GDP will be at an additional β % lower than its potential GDP. But Okun's coefficients may not be statistically significant, which means that unemployment is not responsive to changes in output. This can be explained in different ways.

First, a rise in labour force participation will tend to increase unemployment if the growth in production is lower than the increase in the labour force. In this case, a regional policy to subsidize labour mobility is efficient. Second, when labour market flexibility is low, growth fails to create jobs. Labour market rigidities are explained by national legislation (for example a large tax wedge or a minimum wage). But, Okun's coefficient can also vary according to the skill levels of employees and labour productivity. An increase in labour productivity can mean that real net output grows without net unemployment rates falling (the phenomenon of "jobless growth").

3.2 Econometric issues

There are three important issues to consider in estimating the expression (1). Firstly, as y* and u* cannot be observed we have to estimate them, using available filtering techniques to separate the trend from cycles. In our study, the cyclical components are extracted by using the Hodrick-Prescott (1980) filter as it has become the standard method for detrending in the literature. Time series decomposition is applied to the level of the unemployment rate and to the logarithm of real GDP for each region.

The second issue is whether or not the error terms are serially autocorrelated. When the null hypothesis of no autocorrelation in the error term is rejected, estimation methods to deal with serial correlation must be implemented. The third step is to check for the stationnarity of the gap variables using unit root tests.

4. Data description and unit root tests

The local public sector in France comprises four overlapping administrative divisions. In order, from the lowest level up, there are 36,680 municipalities, 2,599 groups of municipalities, 100 departments, and 22 metropolitan regions. French regions, which were created by decentralization laws in 1982, form the highest level of local government in France and are specialized in economic policy.

Annual data on unemployment and output covering the period 1990–2008 have been taken from the *National Institute of Statistical and Economic Studies* (INSEE) for the 22 French administrative regions, and this corresponds to the regional division of Eurostat at the NUTS 2 level. Real GDP per capita is measured at 2000 prices. A panel data specification is chosen due to the small time dimension of our data.
Table 1 exhibits the GDP and unemployment rate values in 1990 and 2008. Average yearly regional GDP growth rates between 1990 and 2008 are into brackets (in column 2008).

Table 1. GDP and Unemployment, 22 French regions, 1990-2008.

Region	GDP (Million Euros)		GDP per capita (Euros)		Unemployment rate (%)	
	1990	2008	1990	2008	1990	2008
Alsace	33,252	44,839	18,188	28,470 (1.68%)	4,82	6.45
Aquitaine	50,147	73,198	15,545	27,562 (2.13%)	8,45	7.40
Auvergne	22,713	28,923	14,947	25,630 (1.36%)	8,47	6.75
Basse-Normandie	23,558	30,151	14,788	24,813 (1.39%)	7,80	7.00
Bourgogne	28,667	36,490	15,747	26,427 (1.36%)	7.15	6.47
Bretagne	45,779	69,862	14,217	26,547 (2.38%)	7.95	6.15
Centre	43,800	57,771	16,433	26,541 (1.55%)	6.65	6.47
Champagne	24,818	31,486	16,404	27,835 (1.38%)	8.22	8.00
Corse	4,063	5,910	13,492	24,232 (2.12%)	10.02	7.72
Franche-Comté	18,898	24,593	15,508	25,010 (1.49%)	6.20	7.05
Haute-Normandie	32,167	42,651	16,491	27,990 (1.59%)	9.40	8.00
Ile-de-France	339,597	472,482	27,471	47,155 (1.86%)	6.52	6.60
Languedoc-Roussillon	34,515	50,693	13,924	23,726 (2.16%)	11.75	10.65
Limousin	12,134	15,259	14,635	24,794 (1.29%)	6.87	6.15

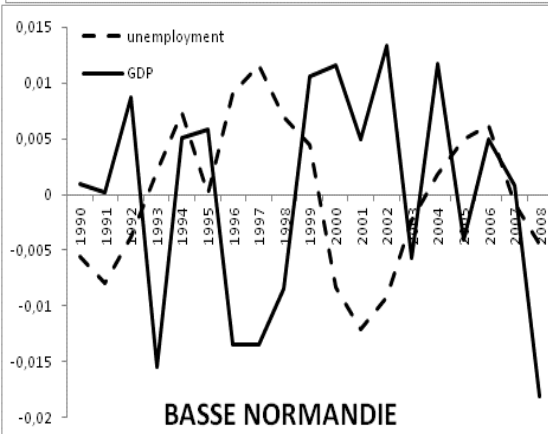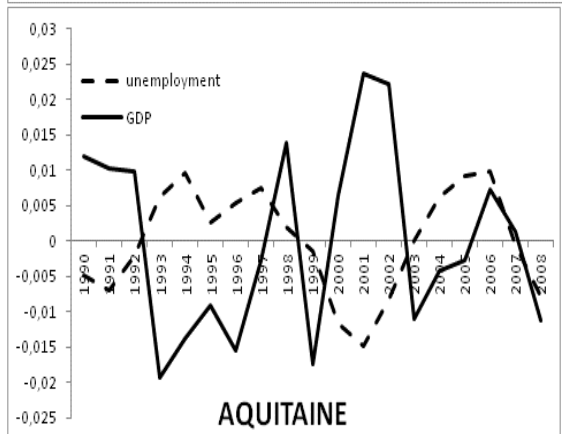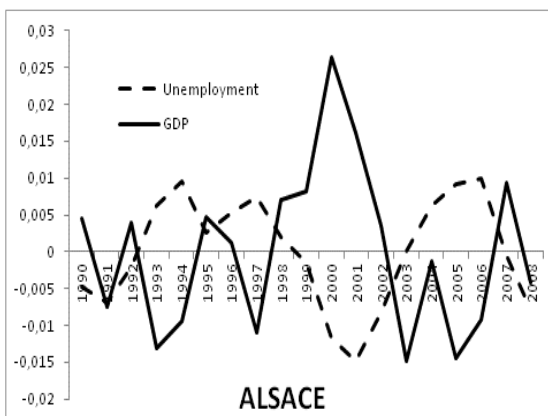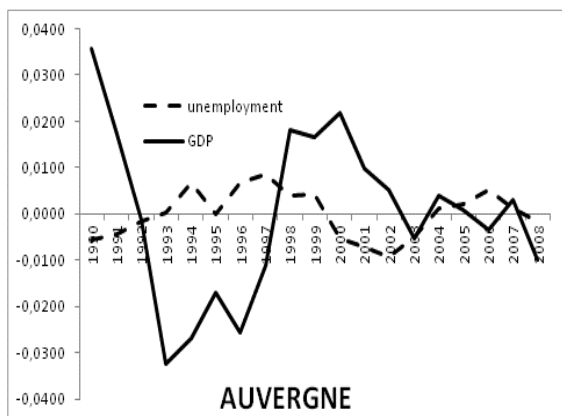|						
Pays-de-Loire	52,391	81,616	15,111	27,533 (2.5%)	8.10	6.10
Lorraine	39,469	48,079	14,983	24,606 (1.11%)	7.52	7.70
Midi-Pyrénées	43,491	64,888	15,440	27,384 (2.26%)	7.77	7.52
Nord-Pas-de-Calais	63,137	83,604	13,923	24,866 (1.57%)	11.55	10.60
Provence-Alpes-Côte d'Azur	82,525	117,350	16,418	28,949 (1.98%)	10.07	8.92
Picardie	30,795	38,366	15,079	23,890 (1.23%)	8.42	8.60
Poitou-Charentes	25,920	37,168	14,282	2,259 (2.02%)	8.95	7.17
Rhône-Alpes	110,456	159,066	18,132	30,601 (2.05%)	6.7	6.5

Data sources: INSEE, local data

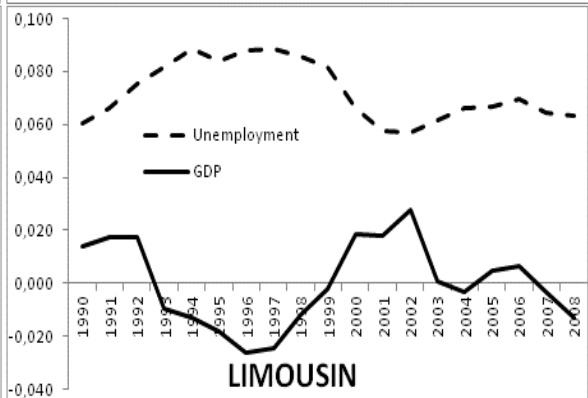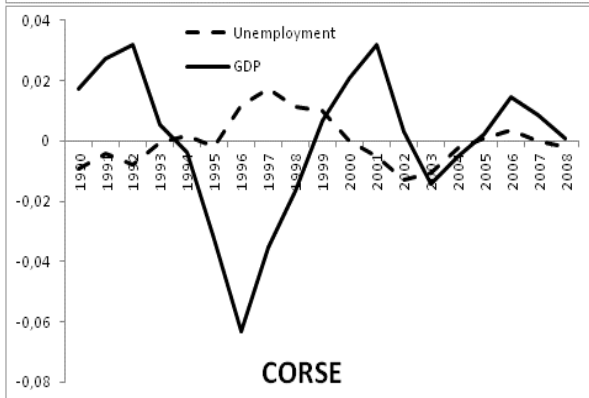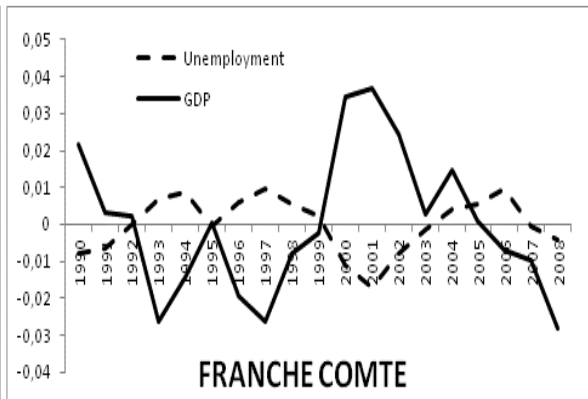Unemployment is a major problem in France, as the unemployment rate has risen from an average of 7.5 per cent in 2008 to 10.2 per cent in 2012. But these average values conceal heterogeneous situations in regional labour markets, as shown in Table 1. Indeed, unemployment rates differ between the regions from an average of 6.10 per cent in *Pays de Loire* to 10.65 per cent in *Languedoc-Roussillon* in 2008. Therefore, unemployment policies have to deal with disparities in the regional labour market situation.

Figures into brackets also show persistent regional differentials in GDP growth over the period 1990–2008. They also point out the separation between south-western regions and the north-eastern industrialized regions. Indeed, the most dynamic French regions are located in the west (*Bretagne, Aquitaine* and *Pays-de-Loire)* or in the south of the country (*Languedoc-Roussillon, Midi Pyrénées and Rhône-Alpes).* Finally, those figures show that with the exception of *Midi-Pyrénées* and *Rhône-Alpes* which experienced stable unemployment rates, the most prosperous regions have reduced their unemployment rates over the time period under study.

The cyclical components of regional unemployment and GDP series are displayed and discussed in figure 1 for all the French regions.

Figure 1. Regional cyclical components of unemployment and GDP

AUVERGNE

ALSACE

AQUITAINE

BASSE NORMANDIE

CHAMPAGNE

BRETAGNE

BOURGOGNE

CENTRE

HAUTE NORMANDIE

FRANCHE COMTE

CORSE

LIMOUSIN

LANGUEDOC ROUSSILLON

ILE DE FRANCE

PAYS DE LOIRE
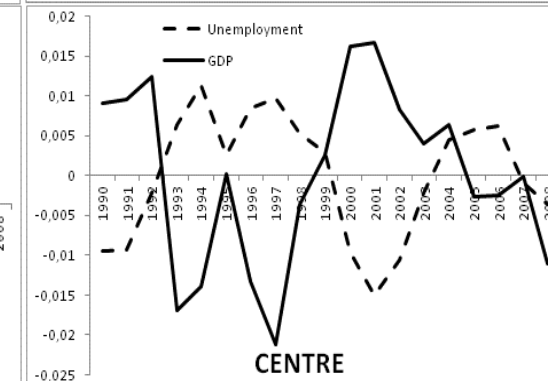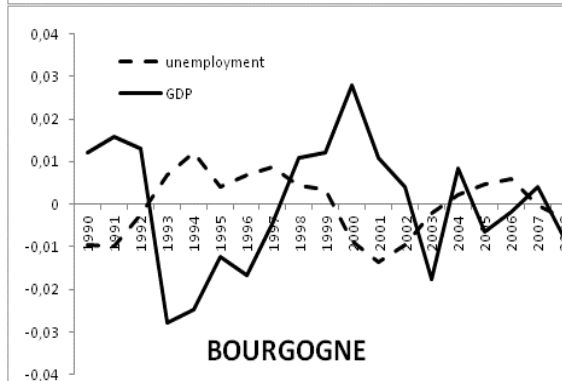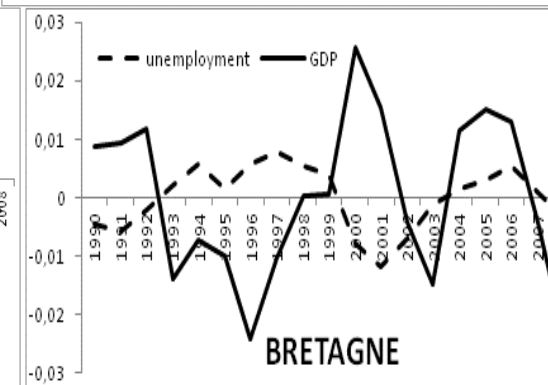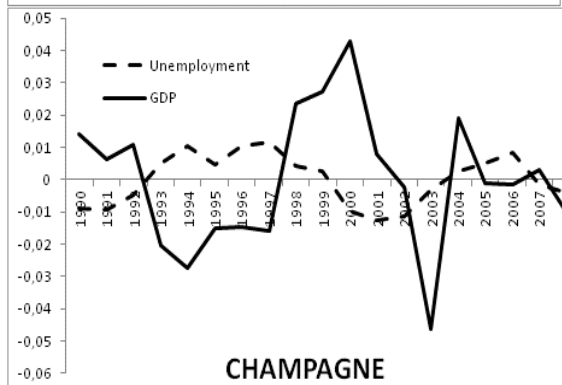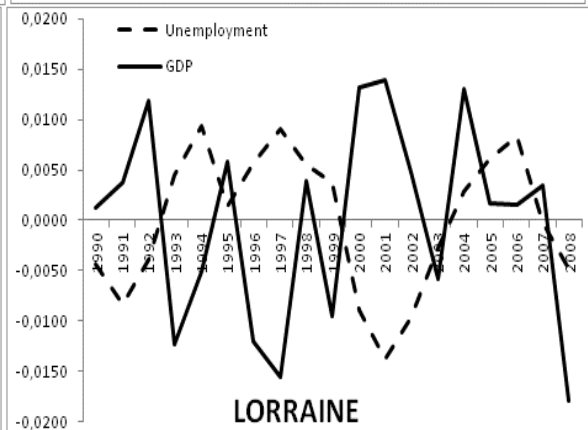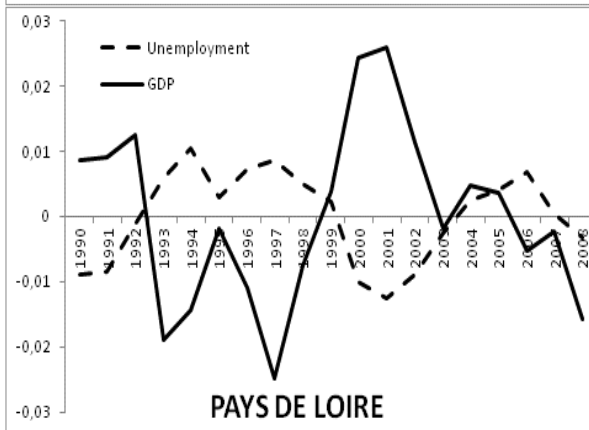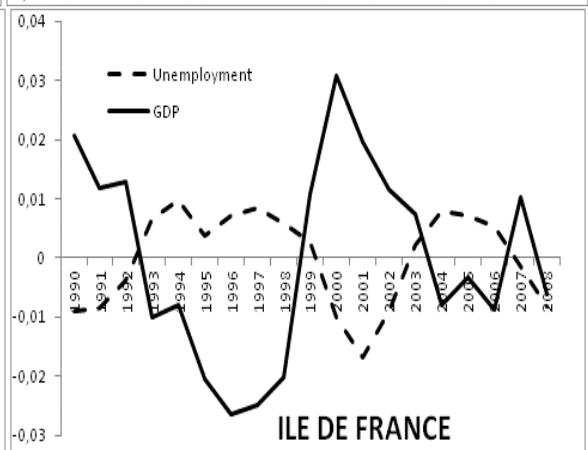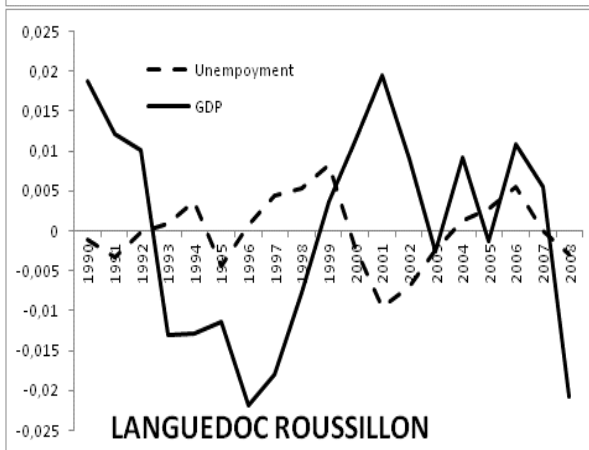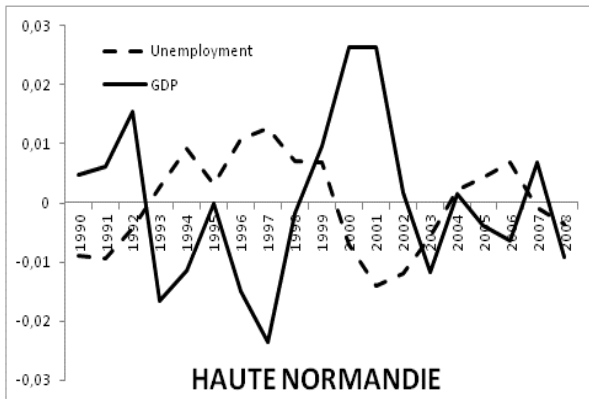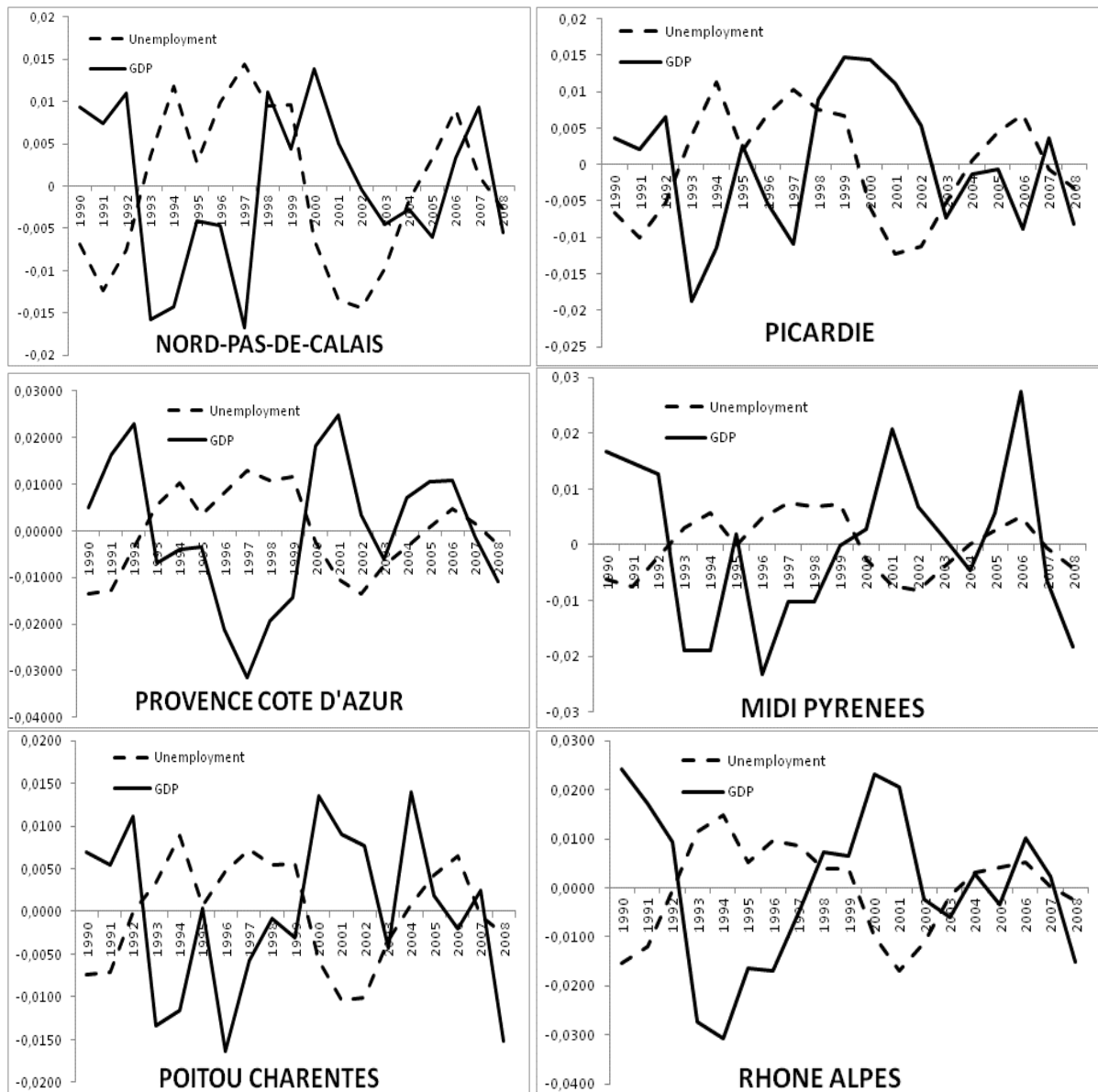
LORRAINE

We observe that the inverse relationship between these two variables seems to hold (at least till 2003 for *Aquitaine*, *Bretagne*, *Corse*, *Languedoc- Roussillon*, *Pays de Loire*, *Lorraine*, *Midi-Pyrénées*, *Nord-Pas-de-Calais*, *Provence-Côte d'Azur*, *Rhône-Alpes*).

As suggested by Moosa (1997), the GDP and unemployment series often tend to cross close to the zero line (except for *Limousin*), indicative of the coincident equilibrium that one would expect from the two series. Further, the amplitude of the GDP series is often larger than that of the unemployment series, except for *Basse-Normandie*, *Limousin*, *Lorraine*, *Nord-Pas-de-Calais*, *Picardie* and *Poitou-Charentes*.

Unit root tests using both the ADF Dickey-Fuller and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) procedures are compared to check for the robustness of the results. Corresponding results obtained with the maximum lag chosen by Schwert criterion are displayed in Table 2.

Table 2. Unit root tests

Region	Output gap		Unemployment gap	
	ADF test statistic	KPSS test statistic	ADF test statistic	KPSS test statistic
Alsace	-2.979**	0.0932	-3.602***	0.0679
Aquitaine	-3.18**	0.0863	-3.479**	0.0782
Auvergne	-2.54*	0.0835	-2.696*	0.0844
Basse-Normandie	-3.666***	0.0961	-2.82*	0.0796
Bourgogne	-2.629*	0.0762	-3.292***	0.0831
Bretagne	-2.823**	0.0816	-3.062**	0.0768
Centre	-2.33	0.0937	-3.156**	0.0794
Champagne	-2.99**	0.0682	-2.753*	0.0825
Corse	-3.09**	0.0925	-2.56*	0.104
Franche-Comté	-1.72	0.104	-3.114**	0.0727
Haute-Normandie	-2.74*	0.0751	-2.698*	0.0872
Ile-de-France	-2.748*	0.0843	-2.698*	0.0715
Languedoc-Roussillon	-2.11	0.100	-3.319**	0.0594
Limousin	-2.646*	0.0938	-1.96	0.282
Lorraine	-3.73***	0.0997	-3.31**	0.0733
Pays-de-Loire	-2.37	0.0917	-3.024**	0.0816
Picardie	-2.744*	0.101	-3.063**	0.0856
Poitou-Charentes	-3.14**	0.102	-2.86**	0.0811
Midi-Pyrénées	-2.75*	0.101	-3.169**	0.093
Nord-Pas-de-Calais	-3.26**	0.073	-2.776*	0.0888
Provence-Côte-d'Azur	-2.844**	0.096	-3.034**	0.106
Rhône	-2.68*	0.0825	-3.28**	0.0864

ADF test under H_0: variable is nonstationary. KPSS test under H0: variable is stationary. *** significant at the 1% level (respectively ** and * at the 5% and 10% levels).

These results show that the output and unemployment gap series are stationary. These extracted cyclical components will be used to test Okun's law in the next section.

5. Regional estimates of Okun's coefficients

In a preliminary step, Okun's parameter is assumed to be constant across regions and the corresponding pooled estimation of (1) with ordinary least squares (OLS) gives a significant value $\hat{\beta} = -0.21$. This value is in line with the previous times series approach of Moosa (1997) who reported a coefficient equal to −0.369 for France. But the Breush-Pagan test reveals the presence of heteroscedasticity with a p-value equal to 0.0041, which can be interpreted as spatial heterogeneity. Therefore, the cross-regional variations of Okun's parameter are included in the specification.

Estimates obtained with OLS are reported in Table 4. As the Wooldridge test for panel data reveals first-order autocorrelation (AR(1)), we also implemented the generalized least squares (GLS) procedure developed by Baltagi and Wu (1999). The results of this are shown in the last row of the table.

Table 4. Okun's coefficients for each of the 22 French regions, 1990-2008

Region	OLS Coefficient (t-statistic)	GLS with AR(1) disturbances Coefficient (t-statistic)
Alsace	−0.96 (−2.54)**	−0.97 (−2.22)**
Aquitaine	−0.97 (−2.57)**	−0.91 (−2.07)**
Auvergne	−1.70 (−3.03)***	−1.50 (−2.38)**
Basse-Normandie	−0.57 (−1.37)	−0.48 (−0.99)
Bourgogne	−1.33 (−3.50)***	−1.32 (−2.93)***
Bretagne	−0.96 (−-1.92)*	−0.85 (−1.46)
Centre	−1.12 (−3.10)***	−1.08 (−2.54)**
Champagne-Ardenne	−1.04 (−2.93)***	−1.17 (−2.76)***
Corse	−1.65 (-4.67)***	−1.25 (−3.00)***
Franche-Comté	−1.95 (−5.21)***	−1.81 (-4.24)***
Haute-Normandie	−1.05 (−3.00)***	−1.06 (−2.54)**
Ile-de-France	−1.63 (−4.57)***	−1.35 (−3.28)***
Languedoc-Roussillon	−0.89 (−1.40)	−0.53 (−0.81)
Limousin	−0.02 (−0.63)	−0.023 (−0.43)
Lorraine	−0.66 (-1.65)	−0.73 (−1.57)
Midi-Pyrénées	−1.30 (−2.39)**	−1.04 (−1.67)*
Nord-Pas-de-Calais	−0.45 (−1.47)	−0.53 (−1.45)
Pays de Loire	−1.53 (−3.83)***	−1.47 (−3.11)***
Picardie	−0.53 (−1.39)	−0.60 (−1.35)
Poitou-Charentes	−0.88 (−1.84)*	−0.84 (−1.56)
Provence-Alpes-Côte-d'Azur	−1.13 (−3.51)***	−1.03 (−2.66)***
Rhone-Alpes	−1.32	−1.28

	(−4.28)***	(−3.53)***
R²	0.29	0.33
Breush-Pagan heteroscedasticity test (p-value)	0.96	
Wooldridge test for autocorrelation (p-value)	0.0001	

Note: *Significance level: *** for 1%, ** for 5 % and * for 10 %.*

First, the results are fairly stable across the estimation methods. Second, our specification permits heteroscedasticity to be removed, as suggested by the Breush-Pagan test. Heteroscedasticity observed in the preliminary estimates can stem from the structural instability of Okun's coefficients. Finally, the main regression results are summarized in Table 5.

Table 5. Regional heterogeneity: Okun's coefficients value and significance at the 10% level with GLS estimates

Insignificant	Significant
Basse-Normandie, Bretagne, Languedoc-Roussillon, Lorraine, Limousin, Nord-Pas-de-Calais, Picardie and Poitou-Charentes.	*Aquitaine (−0.91), Alsace (−0.97), Provences-Alpes-Côte-d'Azur (−1.03), Midi-Pyrénées (−1.04), Haute-Normandie (−1.06), Centre (−1.08), Champagne-Ardenne (−1.17), Corse (−1.25), Rhône-Alpes (−1.28), Bourgogne (−1.32), Ile-de-France (−1.35), Pays de Loire (−1.47), Auvergne (−1.50), Franche-Comté (−1.81).*

Okun's coefficients always have the correct negative sign. Our results are significant for fourteen regions only where output is responsive to unemployment changes, and in the range of −0.91 to −1.81. The largest effect of the variation in the cost of unemployment in terms of the loss in real GDP is observed in the region of *Franche-Comté* where a reduction of unemployment by 1% leads to an increase of regional output by 1.81%. All the regions with a high Okun's coefficient (in absolute value) exhibit per capita private R&D spending that is at least twice as great as the regional average (source Regio, Eurostat). Therefore, the loss in real GDP when highly skilled workers lose their jobs is probably higher than in other regions. For the regions in which the law holds, conventional nationwide policies to stimulate GDP might be sufficient to reduce unemployment.

Empirical results show that output is not responsive to changes in unemployment for eight French regions where Okun's coefficients are not statistically significant. Obviously, spatial variations in the coefficient might reflect specific regional configurations. Indeed, the structure of the regional economy, population and labour market conditions might contribute to the explanation of these mixed results. Thus, it is instructive to propose to gain an understanding of the regional patterns where the law does not hold, in order to develop appropriate policy responses to reduce regional unemployment.

As shown in Table 1, four of these regions (*Basse-Normandie*, *Bretagne, Limousin* and *Poitou-Charentes*) exhibit lower than average unemployment rates . But three of the regions

have high unemployment which is persistently above the national average over the period of the study (*Languedoc-Roussillon*, *Nord-Pas-de-Calais* and *Picardie*). Christopoulos (2004) suggests that in these regions a high proportion of long-term unemployed people might explain why levels of unemployment and output do not move together.

More generally, unemployment might result from changes in production that are not matched to changes in education; and, the spatial mismatch between where workers live and where jobs are located accounts not only for individuals who are unemployed but also for individuals who are underemployed (Croce and Ghignoni, 2011). Over-education is a multifaceted phenomenon in the labour market of advanced economies (Croce and Ghignoni, 2011). If wages are not flexible enough or firms do not adapt their jobs to workers characteristics, a mismatch will tend to persist, so regional apprenticeship policies might be helpful in giving people the skills they need to do the available jobs.

Furthermore, a region can face a persistent unemployment problem if its labour force growth rate exceeds the employment growth rate. Again, in this situation, a regional policy to help workers move to other regions in order to get jobs can help reduce regional unemployment. That might be the case for *Bretagne* and *Languedoc-Roussillon* which experienced high population growth levels during the period under study, with average yearly growth rates of 0.67 per cent and 1.14 per cent respectively, which are greater than the national average growth rate of 0.42 per cent each year (source Regio, Eurostat).

Finally, the percentage of people employed in the public sector could also explain why the results obtained are not significant, as this is relatively high for the eight regions where the law does not hold (greater than 35 per cent of total regional employment). Therefore, labour market rigidities might partly be explained by a high proportion of the total workforce in public employment (source Regio, Eurostat).

6. Conclusion

In this article, the link between unemployment and growth from a regional perspective are considered. More precisely, Okun's law at the French regional level has been investigated for the first time. This relationship has important implications for economic policy, particularly in considering prescriptions for reducing unemployment.

Using a panel dataset including all the 22 French administrative regions for the period 1990–2008, the question of whether Okun's coefficients exhibit regional differences is examined. A generalized least squares estimator to deal with first-order serial autocorrelation to estimate a specific Okun's coefficient for each region is implemented. The results support the empirical validity of Okun's law for fourteen administrative French regions. For these regions, policies which favour economic growth and entrepreneurship are most appropriate.

But, Okun's law does not hold for the eight other regions as the corresponding coefficient is not statistically significant. In these regions policies that favour economic growth are not sufficient, and other policies have to be tried.

Indeed, one common factor in the regions where the law does not hold is identified: that is, they all exhibit a high percentage of public sector employment. But these regions also have

distinctive features. Among the eight regions under consideration, two are regions that have grown relatively rapidly. Regional subsidies which favour mobility out of the region or investment in transport infrastructure at the local level might be increased in these regions. Furthermore, three other regions exhibit persistently high unemployment rates, and education and apprenticeship policies might be helpful in these regions to give people the right skills to do the available jobs.

Finally, our results suggest that any attempt to reduce regional unemployment must address regional labour market specificities. And our findings highlight the role played by decentralized regional authorities in implementing specific regional policies.

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