UNIVERSITY OF ATHENS
Department of Economics

Economics Discussion Reports

Unemployment disparities and persistence
Assessing the evidence from Greek regions, 1981-2008

Sarantis Lolos and Evangelia Papapetrou

October 2011
No 2011 / 4

Department of Economics
8 Pesmazoglou Street, Athens 10559, Greece
www.econ.uoa.gr

Unemployment disparities and persistence
Assessing the evidence from Greek regions, 1981-2008

Sarantis Lolos
Department of Economics and Regional Development,
Panteion University, Athens, Greece

Evangelia Papapetrou
Bank of Greece, Economic Research Department
and University of Athens, Greece

September 2011

Abstract

This paper brings fresh empirical evidence on the factors responsible for the existence of regional unemployment disparities and unemployment persistence, the case of Greece (1981-2008) been taken as an example. The GMM methodology used in the study enables us to test for the existence of deterministic factors of regional unemployment and to account for spatial unemployment interactions. The empirical results of the dynamic model we used, point to the existence of significant spillover among regional labour markets that are responsible for the asymmetric and persisting behaviour of regional unemployment in Greece. Our results leave great scope for European regional policy to operate for the reduction of regional unemployment.

Key words: Regional unemployment; spatial spillovers; Greece

JEL classification: J640, J680, C230, R230

Acknowledgements
The authors wish to thank Yannis Sakelis and Theodoros Mitrakos for providing them with data and useful insights into the developments of regional unemployment in Greece. The views expressed in this paper are those of the authors and not necessarily those of their respective institutions.

Address for correspondence: Evangelia Papapetrou, Bank of Greece, Economic Research Department, 21 El. Venizelou, 102 50 Athens, Greece, Tel: +30 210 320.2377, Fax: +30 210 323.3025, E-mail: epapapetrou@bankofgreece.gr

1. Introduction

The existence of geographical disparities in unemployment within national economies is a central issue in economics. Although regional unemployment rates broadly move in line with the national rate, differences across regions remain over longer periods of time. The issue of regional unemployment within a country deserves special attention, since the observed wide disparities persisting for long, have adverse social repercussions which may distort social cohesion and lead to a regional divide within the country. Besides, persisting regional unemployment differentials may undermine the efficiency of macro policies by reducing output and putting upward pressure on inflation in an asymmetric manner.

Until the mid nineties, the regional dimension of European unemployment was highly disregarded and most of the empirical studies were carried out on UK and US data. The interest in regional unemployment for European countries started only in the second half of the nineties and many studies set up the basis for the empirical analysis of regional unemployment. A great number of these studies consider the issue as if the regional labour markets behave independently to each other. However, it is only in recent years that the spatial dimension of regional labour markets is explicitly addressed.

The purpose of this paper is to bring new evidence of the driving forces of regional unemployment disparities. The case of Greece over the period 1981-2008 serves as an example in our empirical investigation. Contrary to the case of other European countries with substantial regional unemployment disparities, such as Spain and Italy,[1] empirical evidence of the behaviour of regional unemployment in Greece is almost absent. An exception is the study by Christopoulos (2004) investigating the existence of Okun's Law at regional level for the period 1973-93. Even in European regional panel studies, Greek regions are heavily underrepresented mainly due to scarcity of quantitative information at regional level.[2] Our study, by bridging the gap between evidence from Greece on the issue and that of other European countries, may provide a better understanding of regional unemployment in Europe. Besides, the sharp geographical differences between regions make the case study of Greece even more important.

The rate of unemployment in Greece has almost tripled over the 1980s and 1990s exceeding 12 percent in 1999. It started declining thereafter but it has remained high for a decade. At the same time, over the period 1981-2008 the behaviour of unemployment has not been uniform across regions, the structure of regional unemployment showing fairly high persistence. However, over the same period, regional unemployment disparities are diminishing at a very slow rate.

Our empirical model offers an explanatory framework for the evolution of regional unemployment disparities and unemployment persistence. It is a dynamic model incorporating region specific labour supply and demand factors, such as labour productivity, labour force participation, population density, industry mix and the

[1] See, *inter alia*, the studies by Jimeno and Bentolila (1998), Lopez-Bazo et al. (2002), Bande and Karanassou (2006) for Spain; also, Kostoris Padoa Schioppa and Basile (2002), Limosani (2004) for Italy.

[2] For instance, in Decressin and Fatás (1995), Greece is considered a single region; in Niebuhr (2003), Zeilstra and Elhorst (2006) Greece is altogether excluded form the European panel.

growth of employment. In addition, the spatial association of regional labour markets evidenced in our results offers explanations for the asymmetric and persisting behaviour of regional unemployment.

The Generalized Method of Moments (GMM) methodology used in the study enables us to test for the existence of deterministic factors of regional unemployment and examine possible spatial unemployment interactions. It allows us to estimate regional asymmetries and test how unemployment in one region affects and how it is also affected by unemployment in other regions.

The paper proceeds as follows: Section 2 briefly surveys the theoretical and empirical explanations of regional unemployment differentials. Section 3 presents the stylized facts of unemployment in Greece. Section 4 discusses the model specification and methodological issues of the empirical analysis. Section 5 presents the empirical findings, while Section 6 summarizes the results and concludes the issue.

2. Unemployment Disparities

There are two conceptually different views explaining why the unemployment rate varies from one area to another: the equilibrium view and the disequilibrium view (Marston, 1985). The disequilibrium view assumes that the unemployment rates will eventually equalize across space, but due to a sluggish adjustment process in the regional labour markets, adverse shocks (e.g. a factory closure) have persistent after effects. Alternatively, regional unemployment disparities may be viewed as an equilibrium outcome, which sometimes is labelled the natural rate of unemployment. Each region tends to its natural rate of unemployment determined by demand and supply side factors and institutional variables which exhibit little variation over time. Thus, full adjustment is never achieved.

Numerous hypotheses have been proposed in the literature for the explanation of regional unemployment differentials. Unemployment disparities are mostly interpreted as a result of limited interregional labour mobility or of differences in the characteristics of the regional labour markets.

The unemployment-vacancy approach establishes an inverse relationship between the unemployment and the vacancy rates (Cheshire, 1973; Jones and Manning, 1992), while the cyclical sensitivity models explain the rate of regional unemployment by the national rate (Thirlwall, 1966; Brechling 1967) and also by other variables (Gordon, 1985; Taylor and Bradley, 1997; Baddeley et al., 1998).[3] In other models, a compensating differential for the higher probability of unemployment is considered to be either regional amenities (Marston 1985, Montgomery 1993) or higher wages (Pissarides and McMaster, 1990; Layard et al., 1991; Groenewold, 1997). Other approaches emphasize the wage setting mechanisms and obtain regional NAIRU curves (Blackley, 1989; Payne 1995) or "wage curves" (Blanchflower and Oswald, 1994; Card, 1995), while the "accounting identity" approach relates regional unemployment to the main determining factors of labour supply -participation rate, migration and commuting- and labour demand (Gordon, 1988).

However, these models offer partial explanations of regional unemployment since they give emphasis on some factors and ignore others. A more complete approach of the issue for empirical and theoretical analysis refers to the influential

[3] The references sited here are only indicative of the literature on the subject.

work of Blanchard and Katz (1992) which links together labour demand, labour supply and wage setting factors.[4] The application of the Blanchard and Katz (1992) model to the US case showed that regional unemployment disparities are not persistent due to high labour and firm mobility. In the follow up study by Decressin and Fatás (1995) for European regions, it is shown that the adjustment of regional unemployment to shocks is driven by labour force behaviour rather than by migration owing to limited wage flexibility and labour mobility.

The persistence of regional unemployment disparities in several countries over long periods of time gives credence to the equilibrium unemployment view.[5] The central hypothesis of almost all theoretical models and empirical studies of regional unemployment determination is a stable equilibrium outcome. Elhorst (2003), in his comprehensive survey of the relevant literature rightly notes that whichever model is adopted, it results in the same reduced form equation of the regional unemployment rate.

Empirical research has proposed a number of variables for the explanation of regional unemployment differentials.[6] Most empirical treatments regard the different theoretical approaches as complementary and use explanatory variables designed to capture a number of them. Nonetheless, current empirical models view regional unemployment as eventually depending on factors of labour supply (a collection of factors affecting natural change in the labour force, labour force participation, migration and commuting), labour demand and wage setting mechanisms.

A common characteristic of most of these studies is that they consider the issue of regional labour market adjustment without accounting explicitly for its spatial dimension. Regional labour markets are essentially treated as isolated entities. However, as observed by Nierbuhr (2003), spatial aspects are, in some respect, considered through the analysis of factors such as migration although migration takes place in a non-spatial world, since the location of origin and destination of migration is unimportant.

In recent years, there is a growing interest in the spatial association of regional unemployment and spatial factors are explicitly accounted for in regional unemployment studies. It is believed that various types of spatial interactions relating to factors such as migration, commuting, interregional trade and the location decision of firms link regions together. Spatial interactions which are exposed to the frictional effects of distance lead to a spatial dependence of regional labour market developments.

Empirical evidence shows that the probability of migration diminishes with the increase of geographical distance between origin and destination. Furthermore, the direct costs of moving rise with distance while the benefits from migration become increasingly unknown (Tassinopoulos and Werner, 1999; Helliwell, 1998). Also, frictions relating to distance have a significant impact on the determination of the

[4] Recent contributions aim at explaining regional disparities within explicit unemployment models, such as efficiency wage models, job-matching models and insider-outsider models. See, for instance, Fujita et al. (1999), Pench et al. (1999), Epifani and Gancia (2005).

[5] However, if regional unemployment varies randomly over time, workers may not have stable preferences across regions.

[6] See Elhorst (2003) for a critical presentation of the various explanatory variables used in empirical research of the issue.

labour matching approach. Burda and Profit (1996) and Burgess and Profit (2001) analyse the significance of distance in relation to job searching behaviour of workers and recruiting behaviour of firms across regions. They provide evidence for the existence of spatial interactions in job matching in the cases of Britain and the Czech Republic.

Burridge and Gordon (1981) discuss spatial effects of regional labour markets in the case of Britain. They show that migration, induced by variations of regional employment growth, has an equilibrating impact on regional unemployment differentials. Evidence for spatial interaction between regional labour markets in Britain is also provided by Mohlo (1995), where local unemployment is affected not only by local employment growth but also by unemployment in neighbouring areas. The significance of spatial spillover effects on local unemployment adjustment to local shocks for the case of US is reported by Bronars and Jansen (1987). Lopez-Bazo et al. (2002) investigate the determinants of regional unemployment in Spain and their results point to increasing spatial dependence in the distribution of regional unemployment rates. Also, Badinger and Url (2002) find that spatial effects account for about one-fifth of the variation in the unemployment rate in Austria. Aragon *et al.* (2003), using a spatially autocorrelated error model for the Midi-Pyrénées region of France, show that unemployment differences largely reflect variations in amenities. Trendle (2003) employs spatial econometric techniques to determine the significance of economic and demographic factors affecting differences in regional unemployment in Queensland.

Overman and Puga (2002) show that a polarization process of European regional unemployment rates has been the result of changes in relative labour demand which have been similar across geographical neighbours. Idiosyncratic characteristics, national or regional, can only partly explain this neighbouring effect which is strong both within and across national borders. Further empirical evidence for a significant degree of spatial dependence among regional labour markets in EU is provided by Niebuhr (2003).

3. Features of the Greek Labour Market

From the second energy crisis in the late 1970s to the early 1990s, the Greek economy almost stagnated (real GDP per head increased at a rate of about 1 percent). It was also characterized by macroeconomic imbalances, such as large public deficits and persistent and high inflation rates. Greece's poor economic performance over that period, resulting from wild swings in economic policy, prevented the country from bridging the GDP gap *vis-à-vis* the European average. However, over the 1990s Greece embarked on a sustained effort, modernizing its productive structures and stabilizing the economy in view of meeting the Maastricht criteria. Since the mid-1990s and for over a decade Greece had had an impressive economic record compared with the EU scores (GDP rose by about 4-5 percent annually), resulting in nominal and real convergence towards the EU average. The successful economic policies together with the EU structural support enabled the country to reduce regional income disparities and improve regional cohesion (Tsionas 2002, Lolos 2009).

The evolution of the unemployment rate in Greece is shown in Figure 1. Starting from a low level of 2 percent over the second half of the 1970s, the rate of unemployment increased sharply after the second energy crisis till the first years of the 1980s (1979: 2 percent; 1981 4 percent; 1983: 8 percent) and over the rest of the

1980s it remained at the level of 7-8 percent. Over the 1990s, the rate of unemployment increased gradually reaching the highest level of about 12 percent in 1999. Since 2000 the rate of unemployment has been on a descending trend moving to around 8 percent in mid 2000s.

< Insert **Figure 1** somewhere here >

The rise of unemployment (1980s and 1990s) can be explained by the increase in the labour force participation, especially of women and by the sectoral restructuring of the economy and particularly the reduction in employment in the primary sector. In addition, the improvement in the educational level of the workforce may have widened the gap between qualifications of employment seeking people and the required skills of the offered jobs leading to higher unemployment (Mitrakos and Nikolitsa, 2006). The fall of unemployment after 2000 should be attributed to the dynamism shown by the Greek economy relating to EMU entrance. The continuous reduction in unemployment is certainly related to important legislative and other policy interventions, especially to the targeted employment policy and the active unemployment measures, mainly financed by the European Structural Funds. Also, the rise in public employment, especially since early 2000s, facilitated the drop in unemployment.

However, the evolution of the rates of unemployment has not been uniform across regions. Table 1 provides summary statistics on regional unemployment in Greece over the period 1981-2008 (selected years). Some regions, such as Crete, are close to full employment (with unemployment not exceeding 5 percent), while other regions, such as Western Macedonia register high rates of unemployment (around 15 percent). Also, the increased difference between the highest (maximum) and the lowest (minimum) rates of regional unemployment reflects the increased probability and therefore difficulty in finding a job across regions.

< Insert **Table 1** somewhere here >

Also, the structure of regional unemployment presents fairly high persistence, judged by the correlation between the rates of regional unemployment rankings (Figure 2). In Greece the Spearman coefficients of ranking of the rates of regional unemployment change very little over time. In fact over the period 1981-2008 the rank-order correlation coefficients drop by about 30 percent in fifteen years, a decline by about as much as in France and Italy.[7]

< Insert **Figure 2** somewhere here >

On the other hand, differences in the rates of regional unemployment, as depicted by the standard deviation,[8] broadly follow the pattern of the country's unemployment rate (Table 1). However, another measure of dispersion, the coefficient of variation in the rates of regional unemployment[9] follows a descending path which shows that unemployment disparities are diminishing over time. This is an indication that labour market conditions in the various regions tend to resemble to

[7] In the cases of France and Italy, the drop in the rank-order correlations of the rates of regional unemployment rankings over the period 1980-1994 is about 25 percent. See the evidence presented in Galiani *et al.* (2005, Table 1).

[8] The standard deviation is weighted by the population.

[9] The coefficient of variation is the standard deviation of the unemployment rates divided by the average rate of unemployment, also weighted by the population.

each other. Thus, irrespectively of the movement of the country's average rate of unemployment, there is a convergence process of the rates of regional unemployment over the whole 1981-2008 period (Figure 3). The average annual rate of reduction in regional unemployment disparities is 1.7 percent.

< Insert **Figure 3** somewhere here >

The Greek labour market is characterized by low employment and participation rates. Although employment in Greece has risen over the last two decades, the employment rate remains low (about 55 percent) being well below the EU average. The overall low employment rate is attributed to women, since that for men is at about the level of EU average. Another characteristic of the Greek labour market is the high percentage of self-employment. In recent years self-employment amounts to almost 25 percent of total employment while salary and wage earners do not exceed 60 percent.

Value added in Greece is mainly produced by services, with the contribution of the tertiary sector exceeding 70 percent of the country's GDP. The share of the secondary sector is around 20 per cent, while that of the primary sector is reduced to less than 10 percent of GDP in recent years. The presence of the primary sector is strong (10-18 percent) in roughly *half* of the regions (Thessaly, Eastern Macedonia-Thrace, Peloponnesus, Northern Aegean, Western Greece, Western Macedonia and Crete). Relatively important is the industrial sector (above 30 percent) in only *two* regions (Central Greece and Western Macedonia), while services have their higher share (about 80 percent) in the Greek islands and in Attica.

Most Greek regions have a high share of employment in the primary sector of the economy. Employment in agriculture represents more than 25 percent of total employment in *five* regions (Peloponnesus, East Macedonia and Thrace, Thessaly, Western Greece and Crete) but its share is decreasing. Industrial employment represents around 15 percent of total employment (from 22 percent in 1981) across regions, with the exception of Western Macedonia and Central Greece where the industrial employment share exceeds 30 percent. In 2003 employment in services represents around 55 percent of total employment in Greece but it exceeds 70 percent in regions with a strong presence of the tourist industry (Attica, Crete, Aegean and Ionian Islands).

Until very recently Greece had strict employment protection legislation (EPL). Strict employment protection legislation, such as restrictive lay-off procedures, is related to lower short-term unemployment and greater long-term unemployment. Moreover, strict EPL rules tend to shift employment into the informal sector, intensifying labour market segmentation in Greece (*OECD*, 1999). Hours and conditions of employment are subject to extensive government legislation. The unemployment compensation system is rather poor and assistance to those seeking entrance to the labour market is limited. Part-time employment remains low and recently legislation was passed permitting it in the public sector. Greece's labour market institutions have undergone broad changes in recent years.[10]

At the beginning of the 1990s, a new institutional framework for collective bargaining was introduced and the collective bargaining system was decentralized and

[10] For an extensive discussion on various features of the Greek labour market, see *inter alia*, Papapetrou (2006).

broadened and was freed from direct government control by abolishing compulsory arbitration. In 2010 there have been further changes in relation to the institutional features of collective bargaining and the labour costs in Greece with the aim of increasing labour market flexibility and productivity.

4. The empirical model

The point of departure of the empirical analysis is a reduced form model of the Blanchard and Katz (1992) variety. It is a dynamic model incorporating region specific variables and spatial interactions as follows:

$$u_{i,t} = f(u_{i,t-1,} X_{i,t}, S*u_{i,t}) \quad (1)$$

where $u_{i,t}$ is the unemployment rate of region i in period t; $X_{i,t}$ is the array of explanatory variables of the rate of regional unemployment; $S*u_{i,t}$ is the spillover effect on regional unemployment. The selection of explanatory variables is based on existing evidence of the factors affecting regional unemployment in Greece. Also, owing to scarcity of Greek regional data, the use of specific variables is dictated by the availability of reliable data.[11]

It should be noted that it is not easy *a priori* to place the expected signs of the explanatory variables for the rate of regional unemployment, since different theories go around on the impact many of these explanatory variables may have on the regional unemployment rate; and the overall effect of a particular explanatory variable that jointly affects regional labour supply, demand and wage setting is most uncertain. As a result, the possible effect of a particular variable on regional unemployment is mostly an empirical matter.

The explanatory variables included in the empirical model are the following:

(i) Lagged rate of unemployment. Many studies have used a lagged dependent variable to explain regional unemployment on the grounds that regional unemployment rates are highly correlated in time and they usually change by small amounts (e.g. Blanchard and Katz, 1992; Decressin and Fatás, 1995).

(ii) Employment growth. The degree of employment growth is a frequently used indicator of regional labour demand factors. The effect of employment growth on the unemployment rate is negative almost by definition. Considering the accounting identity, the unemployment rate decreases as a result of one extra job, whether it is filled by an unemployed, a non-participant or a job migrant. Indeed, almost all sixteen empirical studies reviewed by Elhorst (2003) report a negative sign. However, the effect of employment growth needs not to be necessarily negative since the effort to create more jobs may come about through induced migration, thus leading to higher instead of lower unemployment rates (Harris and Todaro, 1970).

(iii) Participation rate. The participation rate incorporates the labour supply side effect on regional unemployment. The expected effect of labour participation on unemployment is positive since (from the accounting identity) higher labour supply leads to higher unemployment. However, the relevant literature has

[11] Although labour demand and supply factors are taken into account, data limitation does not allow the explicit incorporation into the model of factors such as regional migration, commuting and the wage setting mechanism.

produced controversy about its effects on the unemployment rate, with a negative effect to be dominant (see Elhorst, 2003).

The negative effect can be explained by the association of the level of participation rates with the level of skills and commitment to working life of the population (Fleisher and Rhodes, 1976). Thus, low participation rates reflect higher risks for people with these characteristics of becoming unemployed. The negative effect is possibly reduced in regions with a larger share of female participation and high levels of hidden unemployment. In contrast, the effect of the participation rate on unemployment rate is expected to be positive (Layard, 1997). If the participation rate increases, the number of unemployed should also increase, *ceteris paribus*. However, this effect might not be also positive, *mutatis mutandis*, since increased participation encourages the growth of more local jobs ("people cause jobs") and also because more jobs encourage people to enter the labour market.

(iv) Population density. Population density is another labour supply variable as an indicator for large and dense regional labour markets (Elhorst 2003, Taylor and Bradley 1997, Niebuhr 2003). A denser labour market may affect the efficiency of the matching process, since more jobs offered and more job seekers imply better and quicker matches thus leading to lower unemployment. However, a denser labour market may increase the time needed to gather information for job opportunities reducing the likelihood of quick matches. Also high population density may also reflect amenities leading to higher unemployment. Therefore, the expected sign of the effect of population density on the regional rate of unemployment is not *a priori* given.

(v) Labour productivity. In the long run, the level of productivity does not affect the natural rate of unemployment. In the short run, however, labour productivity affects the rate of unemployment but its expected impact can be either positive or negative.

According to Mortensen and Pissarides (1994), structural changes associated with technological advances may affect unemployment positively. Indeed, studies such as Galiani *et al*. (2005) find a positive relationship between the rate of regional unemployment and labour productivity. This finding is explained by the compensating wage differentials theory as a determinant of equilibrium unemployment differences among regions or it may reflect an out-of-equilibrium phenomenon capturing some short run effects of the technological change on unemployment. On the other hand, Basile and De Benedictis (2004), using a simple General Oligopolistic Equilibrium efficiency-wage trade model, provide empirical evidence of a nonlinear -also a linear one- negative relationship between labour productivity and regional employment in the case of European regions. Also, Limosani (2004), building on Layard *et al*. (1991) framework, proposes potential channels through which productivity influences regional unemployment and finds a significant negative relationship for Italy.

(vi) Industry mix. Regional industrial specialization seems to affect regional unemployment (Summers, 1986). It is believed that declining industries generally show low employment rates and growing industries high rates. Therefore, regions specializing in declining industries (e.g. agriculture) are expected to exhibit higher unemployment rates compared to those specializing in growing industries (e.g. services). Thus, the regional industry mix in terms of employment (employment shares) can give an account of the variation in unemployment rates between regions.

The employment shares of different industries/sectors are used as explanatory variables of regional unemployment by many empirical studies, but their results are mixed.[12] The direction and strength of these supply side effects on regional unemployment is related to factors like the industrial mismatch and the employment multipliers of the various industrial sectors.

(vii) Spatial effects. Spillover effects, leading to spatial dependence, are usually captured by the spatially lagged dependent variable. This specification implies that, starting from a steady state pattern of regional unemployment, region-specific shocks do not only affect the respective labour market, but instead they spillover to neighbouring regions. The spatial pattern of regional unemployment can be due to factors, such as the behaviour of individuals towards migration and participation, the behaviour of firms towards location, interregional trade and the wage setting mechanisms. The induced changes in unemployment in neighbouring regions again spillover to adjacent labour markets, including the location where the shock originated. This process of spatial adjustments continues until a new steady-state pattern of regional unemployment is achieved.

In view of the above presented discussion, we estimate a regional unemployment rate equation using annual data for the 13 regions of Greece over the 27 year period 1981-2008.[13] Specifically, the following model is considered:

$$u_{it} = \beta_o + \beta_1(u_{it-1}) + \beta_2(dempl_{it}) + \beta_3(dpart_{it}) + \beta_4(dens_{it}) + \beta_5(prod_{it-1}) + \beta_6(esagr_{it}) + \beta_7(escon_{it}) + \beta_8(espubl_{it}) + \beta_9(uD_{it}) + \varepsilon_{it}$$

for $t = 1981, 1982, \ldots, 2008$ and $i = 1, 2, \ldots, 13$ (2)

The dependent variable u_{it} is the rate of regional unemployment in region i at time t calculated as the ratio of the number of unemployed over the labour force. The first regressor u_{it-1} is the lagged dependent variable. It accounts for possible autocorrelation and gives an estimate of the degree of unemployment persistence.

The next seven regressors, $dempl_{it}$, $prod_{it-1}$, $dpartic_{it}$, $dens_{it}$, $esagr_{it}$, $escon_{it}$ and $espubl_{it}$ are the region specific variables. The variable $dempl_{it}$ is the rate of change in total employment, while $prod_{it-1}$ is labour productivity (of the previous year) of region i at year t, measured by the ratio of real gross value added over total employment. The variable $dens_{it}$ is the economically active population per sq. km. The variable $dpartic_{it}$ is the change in the participation rate, where the participation rate in region i is defined as the ratio of the economically active to total population. The economically active population is the sum of employed and unemployed people. The variables $esagr_{it}$, $escon_{it}$, and $espubl_{it}$ are the employment shares in region i in the sectors of agriculture, construction and public (non-market) services respectively. The

[12] See the review by Elhorst (2003) who also raises some questions on the way employment shares are used in empirical research.

[13] The 13 regions of Greece are Eastern Macedonia-Thrace, Central Macedonia, Western Macedonia, Thessaly, Epirus, Ionian Islands, Western Greece, Central Greece, Attica, Peloponnesus, Northern Aegean, Southern Aegean and Crete.

employment share in region i is defined by the ratio of employment in the particular sector to total employment.[14]

The regressor uD_{it} captures spillover effects with respect to distance between regions. Matrix D is a distance-weighting matrix and accounts for distance spillover effects. The i, j elements of matrix D (wD_{ij}) are elements of the inverse geographical distance between regions (d^{-1}_{ij}), where d_{ij} is the arc geographical distance between two regions i and j.[15] Thus the distance spillover variable in equation (2) is given by:

$$uD_{it} = \sum_{j=1}^{13} w^{D}_{ij} u_{jt} \tag{3}$$

for $i = 1, 2,\ldots, 13$; $j = 1, 2,\ldots, 13$; where u_{jt} is the dependent variable in equation (2).

The specification of the spillover variables in equation (3) implies, via equation (2), that the spillover effect is disseminated among regions. Therefore, high unemployment in a region, perhaps due to a region-specific shock, can potentially, via uD_{it}, affect unemployment in all regions. As an illustration, an increase in unemployment in region j could affect unemployment in region i if they are close to each other in terms of geographical distance. The unemployment in region i, in turn, could affect unemployment in region k if they are close to each other, etc. Thus, a change in unemployment in region j could, in this manner, affect unemployment in all related regions, which could then feedback to region j. Therefore, since inverse distance is used in our formulation, we expect β_9 to be positive.

Finally, ε_{it} is an error term which it is assumed to have a mean of zero, to be independently distributed over all i and t and to account for size and other differences between the regions, to be heteroskedastic over i, namely $\text{var}(\varepsilon_{it}) = \sigma_i^2, i = 1,\ldots,13.$

We now discuss in more detail the interpretation of the spillover effects in terms of equation (2). The solution of the equation for u_{it} is given by:

$$\begin{aligned} u_{it} = \Theta^{-1}\{ & \beta_o + \beta_1(u_{it-1}) + \beta_2(dempl_{it}) + \beta_3(dpart_{it}) + \beta_4(dens_{it}) + \beta_5(prod_{it-1}) \\ & + \beta_6(esagr_{it}) + \beta_7(escon_{it}) + \beta_8(espubl_{it}) + \varepsilon_{it} \} \end{aligned} \tag{4}$$

where the spatial multiplier Θ is given by $\Theta = [I - \beta_9 uD_{it}]$

Equation (4) is a reduced form equation in levels. It should be clear that once the spillover variable uD_{it} is added to the equation, not only the dependent vector u_{it} depends on the spillover variable but every coefficient of the explanatory variables is also a function of the spatial spillover variable.

This is so since the level of the unemployment rate in each region (u_{it}) firstly depends upon a *direct* effect (direct component) related to the coefficients of the

[14] The source of data for employment, unemployment, gross value added and population is the Hellenic Statistical Authority (EL.STAT). Data for the construction of the sectoral employment shares and the participation rate is obtained from the database of Cambridge Econometrics. Population and employment variables refer to the segment between 15-64 years of age.

[15] For the calculation of the arc geographical distance between regions and the construction of matrix D we obtained the two co-ordinates of the capital city of each region which are then transformed into decimal.

explanatory variables of the estimated equation. The direct effect is the same for all regions. Secondly, it depends upon an *indirect* effect (indirect component) which is related to the rate of unemployment in all neighbouring regions. The indirect effects are spillovers of the direct effects, both being local in the sense that only the regions undergoing an exogenous shock and their neighbours are affected. Obviously the indirect effects vary from one region to another. In addition, further spatial spillover effects are also *induced* by the initial direct and indirect effects. Hence, the total effect of a change in an explanatory variable is the sum of the direct, indirect and induced effects. The direct effect is not region-specific and is represented by the coefficients of the explanatory variables, while the indirect and the induced effects are region-specific.[16]

In more detail, let θ_{ij} be the *i,j*-th element of Θ^{-1}. Then, the change in the expected value of the rate of unemployment in the *j*-th region with respect to a change in an explanatory variable, say employment growth in the *i*-th region ($dempl_{it}$), is via (4):

$$\frac{\partial \mathrm{E}(\upsilon_{jt})}{\partial dempl_{it}} = \vartheta_{ji}\beta_2, \quad j = 1,....,13 \tag{5}$$

Similar expressions could be presented for all explanatory variables of the model.

In general, θ_{ij} will not be zero unless β_9=0, which is the case of no spatial spillover effect. In the absence of spillover effects, the dependent variable in each region will only respond to a change in one of its own explanatory variables. Clearly, the magnitude of the cross derivative in equation (5) depends upon the direct effect of employment growth on the rate of unemployment of that region, which is β_2. It also depends upon an indirect spillover effect, which is θ_{ij}. There will also be induced effects arising from the direct and indirect effects. Generalizing, it should be clear that the rate of unemployment in a given region is affected by the values of all significant variables in (4) in all regions because of the existence of spatial spillover effects.

5. Empirical Results

Panel data estimation is used in the empirical analysis to estimate equation (2). Panel data have the advantage of increasing the sample size; they are better suited to examine the dynamics of change and are able to handle complicated behavioural models. However, panel data estimation faces several estimation and inference problems since the estimation method should combine both cross section and time series dimensions.

The estimation of equation (2) raises several issues. First, endogeneity is likely to be present. The endogeneity problem can arise because of the existence of reverse causality. It might be the case that all explanatory variables may be jointly determined by the rate of unemployment. This means that the error term of equation in period *t* is correlated with the explanatory variables and earlier shocks, but uncorrelated with the error term in period *t+1* and subsequent shocks. Second, some independent variables may be predetermined in the sense that they are uncorrelated with the error term in

[16] For a detailed explanation and the interpretation of the coefficients of the spatial lag model, see Abreu *et al.* (2004).

period *t* but they are correlated with the error term in period *t-1*. Finally, unobserved hetererogeneity may arise across regions.

To address successfully the above issues the orthogonal deviations generalized method of moments (GMM) estimator is used, since it tackles successfully all these problems and are obtained asymptotically efficient and consistent estimators (Bond 2002). The Arellano and Bond (1991) estimators are used with lagged dependent and lagged independent variables acting as instruments. The GMM estimator makes use of the orthogonality conditions to allow for efficient estimation in the presence of heteroskedasticity of unknown form. Arellano and Bover (1995) and also Blundell and Bond (1998) suggest that this type of estimator is efficient for panels with large time dimension (T).[17] Since there are more instruments than the right-hand side variables, the estimated regression equations are over-identified. To assess the validity of the different specifications, we compute the Sargan (1964) test for over-identifying restrictions which amounts to a test of the exogeneity of the explanatory variables, and AR1 and AR2 tests for autocorrelation.

Thus, equation (2) is estimated employing balanced panel data and using the GMM methodology. In the estimation method, fixed region effects are used and it is assumed that none of the explanatory variables is predetermined.[18] All regressors used in the empirical analysis influence the unemployment rate and vice versa. Our estimation methodology adheres to labour economic theory and the findings of empirical research emphasizing the interdependence of regional variables. Indeed, Elhorst (2003), in his survey on the theoretical and empirical explanations of regional unemployment, notes that the general picture emerging from the literature is that the rate of regional unemployment both affects and is affected by one or more additional regional labour market variables. To solve the problem of endogeneity equation (2) is estimated using the GMM estimation method with fixed region effects and employing as instruments several lags of unemployment growth and two lags of the explanatory variables.

The results from the Arellano and Bond estimator are reported in Table 2. Four types of diagnostic tests are carried out for the estimated equations. The first test is the Wald joint test.[19] The estimated statistic is high enough to reject at 1% level of significance the null hypothesis that jointly all explanatory variables except the dummies are equal to zero. The second is the Wald joint test for the dummy variables (fixed effects). The estimated statistic is high enough to reject at 1% level of significance the null hypothesis that jointly all dummies are equal to zero. The third test is the Sargan test of over-identifying restrictions. The estimated statistic does not reject the null hypothesis that the over-identifying restrictions are valid; the instruments are valid. Finally, the AR1 and AR2 tests for autocorrelation are conducted. The estimated values do not reject the hypotheses that there is no serial correlation in the regression disturbances.

[17] In the present study the time dimension is 27 years. Thus T is large enough to avoid inefficiency problems.

[18] Note that, once fixed effects are included in the model, it makes no difference whether equation (2) is estimated using regional variables in levels or in relative terms to national variables.

[19] All reported Wald tests follow the chi-squared distribution.

In the empirical analysis, two alternative models of the regional unemployment rate are estimated and the results are shown in Table 2. Model 1 is a more traditional model where regions are considered to behave more or less independently to each other. Model 2 is an extended version of the first model to capture spatial interdependence.

< Insert **Table 2** somewhere here >

The empirical results of Model 1 are as follows:

(i) The coefficient of *lagged dependent variable* (u_{it-1}), reflecting the degree of unemployment persistence, is positive and statistically significant.

To deal with serial dependence, the unemployment rate $u_{i,t}$ is regressed on its serial lagged value $u_{i,t-1}$. The dynamic specification of our model allows for the study of short and long run effects and explores the degree of persistence of the rate of regional unemployment in Greece. The stationary properties of the unemployment rate are also tested. In particular it is tested whether unemployment is a non-trended I(1) process, like a standard random walk. Panel unit root tests are employed to examine the order of integration of the variable in this panel data set. In particular the Levin, Lin and Chu (2002) test which allows for heterogeneity is estimated to test the hypothesis that unemployment has common unit root process. The estimated value of the *t*-statistic for this unit root test is equal to -1.80 which rejects the null hypothesis for the presence of a unit root.

Our empirical results show that 64.3 percent of a shock to regional unemployment will be affecting the rate of unemployment after one year. Hence, in the case of no spillover effects, a shock equal to the standard error of the regression would increase unemployment by 2.09 percentage points. In the first year after the shock, the rate of unemployment will increase by 1.34 percentage points, in the second year will increase by 0.86 points and in the third year unemployment would be 0.55 percentage points higher than its original (pre-shock) level. Thus, in the case of Greece there is a fair degree of unemployment persistence to idiosyncratic shocks.

This empirical result is generally in accord with other European evidence. There are several empirical studies such as Decressin and Fatás (1995) for Europe, Jimeno and Bentolila (1998) for Spain and Kostoris *et al.* (2002) for Italy, which estimated a high degree of unemployment persistence.

(ii) The effect of *employment growth* ($dempl_{it}$) on the rate of regional unemployment is negative and statistically significant, a result in line with that of the majority of empirical studies. It is the case in Greece that the unemployment rate in a region decreases as a result of the creation of extra jobs in that region. Our empirical results indicate that in the long-run one percent increase in employment growth will suppress the rate of unemployment by 0.25 percentage points.

(iii) An increase of the change in the regional *participation rate* ($dpart_{it}$) leads to an increase in unemployment rate, since the estimated coefficient is positive and statistically significant. In the case of more people searching for a job in an environment of limited job opportunities, the more people become unemployed.[20] The

[20] The positive coefficient might be the combined outcome of female and male participation rates on regional unemployment working in opposite directions. Anagnostopoulos (2006) using disaggregated data on male and female participation rates -available from 1994

positive effect is in contrast to the results of many empirical studies (see Elhorst, 2003) but it is in line with the result reported by Galiani *et al*. (2005). The empirical results indicate that in the long-run a rise by one percent in the change in the participation rate burdens the rate of unemployment by 0.49 percentage points.

(iv) Our results show that in the densely populated Greek regions the labour matching process is facilitated leading to lower rates of unemployment in those regions. The *population density* variable ($dens_{it}$) enters the estimated relationship with a negative and statistically significant coefficient. This result is in contrast to that of some empirical studies (Taylor and Bradley 1997 for Germany, Italy and UK and Niebuhr 2003 for EU) but it is reasonable in the case of Greece given the geomorphology of the country and the uneven distribution of the population in the various regions.

(v) Our empirical results show that an upward shock in *labour productivity* of the previous period ($dprod_{i,t-1}$) increases the rate of regional unemployment, the estimated coefficient being positive and statistically significant (at 10 percent level of significance though). This finding can be explained by the structural and technological changes taking place in Greece over the whole period under study. This result is in line with the studies of Basile and De Benedictis (2004) for US and Galiani *et al*. (2005) for Argentina, to mention some recent studies, but it is in contrast to the result of Limosani (2004) for Italy; Böckerman (2003) for Finland; Zeilstra and Elhorst (2006), Basile and De Benedictis (2004) for European regions.

(vi) As regards the three *industry mix* variables (agriculture, public services and construction), the effect of sectoral employment shares on the rate of regional unemployment is negative.

The impact of the statistically significant employment share of the declining agricultural sector ($esagr_{it}$) has pushed the rate of regional unemployment up, while the outflow of rural labour will continue to inflate total unemployment in future. The negative but not statistically significant impact of the rather stable employment share of the construction sector ($escon_{it}$) has not affected regional employment substantially.[21] This finding may be attributed to the fact that non-participants, first-time entrants and in-immigrants acquire new jobs in the construction sector, thus not affecting the rate of unemployment. Finally, the impact of the employment share of public services ($espubl_{it}$) on the rate of regional unemployment is negative and statistically significant, implying the importance of the public sector as an outlet for job creation in Greece. In fact, regions with limited employment opportunities are more likely to depend on the public sector for employment creation, especially on regional and local government employment.[22]

Note that the indicators of sectoral employment composition may also reflect the skill structure of the labour force. Since structural changes that have taken place in Greece are characterised by the expansion of employment in services at the expense of employment in agriculture, employment shares may act as a proxy for human capital in the various sectors. In our case, the employment share of the public sector

---

onwards- finds a positive relationship between regional unemployment and female participation and also a negative relationship for male participation.

[21] Over the period 1981-2008, the employment share of agriculture decreased from about 30 to 10 percent and that of construction remained stable at less than 10 per cent.

[22] See also Taylor and Bradley (1997).

may play this role, since according to Papapetrou (2006) people working in the public sector tend to have higher educational skills compared to those of the private sector.

In Table 2 are also presented the empirical results of Model 2, which is an extended version of Model 1 that includes spatial effects. The same diagnostic tests are carried out and the empirical results appear similar but as it will be discussed below, they have a different interpretation. The estimated coefficients retain their signs although the level of statistical significance in some of them is lower. The addition of the spillover variable improves the standard error of the regression.

(vii) The estimated coefficient of the *spatial effect* in Model 2 is positive and statistically significant. The coefficient of the spatially lagged dependent variable points to significant spillover effects.[23] Apart from the relevant fundamentals incorporated in Model 1, spillover effects seem to be a considerable explanatory factor of the variation in the rate of regional unemployment in Greece.[24] Thus, the unemployment rate in a specific region is also affected by developments in unemployment rates in neighbouring regions and vice versa. This effect fades out with the increase in geographical distance of neighbouring regions.

Recalling the discussion of Section 4, when accounting explicitly for spatial spillover effects the impact of the explanatory variables on the rate of regional unemployment consists of the direct component which is uniform across regions and the indirect and induced components that vary from one region to another. As a result, the coefficients of Model 2 have a different interpretation to those of Model 1.

The empirical results of Model 2 show that 49.1 percent of a shock to regional unemployment will be affecting directly the rate of unemployment after one year (calculated on the assumption that β_9=0). However, there will also be a region-specific indirect effect and its value for the country average is equal to 22.5 percent. The magnitude of the indirect effect results from the coefficient of the direct effect and the coefficient of adjustment of the model (0.459 x 0.491). Thus for Model 2 the total effect is equal to 71.6 percent, a value higher but close to that of Model 1 (64.3 percent).[25] Note that in Model 2 about ⅔ (0.491 x 0.716) of the unemployment shock is the same in all regions, while the remaining ⅓ (0.225 x 0.716) varies across regions. Thus, if we apply a shock equal to the standard error (1.923) of the regression equation of Model 2, the rate of regional unemployment increases by 0.94 percentage points in the first year, as a result of the direct effect. In addition there will be a region-specific indirect (country average) effect of 0.43 percentage points. Therefore, the degree of unemployment persistence in the first year will be equal to 1.38 percentage points, a value higher but comparable to that of Model 1 (1.34 percent).

---

[23] In order to gain further insight into the mechanisms that may cause spatial dependence of regional unemployment, we experimented with alternative types of spatial lag models in the estimation procedure, such as dependent variable spatial lag models, with no particular success though. Also, for the construction of the distance-weighting matrix D, alternatively to the arc geographical distance, we used the travel time distance which depends on kilometre distance and the convenience of access. However, we came to very similar empirical results.

[24] This variable may also catch the effect of missing variables.

[25] Note that the calculated value of the total effect is somewhat lower than the actual one since we have taken into account only the direct and indirect effects ruling out the induced effects, the value of which is very low anyway. The same applies to the calculation of the impact of the employment growth variable, discussed below.

To clarify the issue, we give an account of the degree of unemployment persistence in the case of an unemployment shock originating from two different regions. The first one is *East Macedonia-Thrace*, a "peripheral" region located in the North-East part of Greece neighbouring mainly to Central Macedonia. The second one is *Thessaly*, a "central" region of Greece surrounded by a number of regions. For Model 2, using an expression similar to equation (5), a shock in unemployment in the "peripheral" region affects the rate of unemployment by 0.64 percentage points after one year, while a shock in the "central" one affects the rate of unemployment by 0.79 percentage points ($[I - \beta_9 uD]^{-1}\beta_1$). Thus if there is an unemployment shock in *East Macedonia-Thrace* equal to the standard error of the regression, the rate of unemployment in Greece will increase by 1.24 percentage points in the first year, while the same shock in *Thessaly* will increase unemployment by 1.51 percentage points; and the same shock in all regions will increase unemployment by 1.38 percentage points. In other words, the model allowing for the spatial unemployment spillover effects induces an asymmetric reaction of regional unemployment persistence to shocks.

Figure 4 depicts unemployment persistence in Greece due to a shock in unemployment (e.g. a factory closure) in the *i*-th region. As shown in the empirical results the degree of unemployment persistence in Greece depends on which regions the unemployment shock is originated from. Thus, unemployment persistence is lower when the shock originates from "peripheral" regions (East Macedonia-Thrace, Ionian and Aegean Islands, Crete) bordering with a few regions, since unemployment in the particular regions is affected by unemployment changes in a few adjacent regions. On the contrary, when the unemployment shock comes from "central" regions (Thessaly, Central Greece) bordering with many regions, unemployment persistence is higher since unemployment in these regions is strongly affected by unemployment changes in neighbour regions.

< Insert **Figure 4** somewhere here >

Furthermore, as shown in Figure 5, there appears to be a positive relationship between the degree of unemployment persistence and the rate of regional unemployment in Greece (1981-2008). Unemployment seems to be more persistent when unemployment shocks originate from regions with high unemployment rates. In addition, regions with high unemployment rates are the "central" regions while regions with lower unemployment rates are the "peripheral" ones. This finding offers an explanation of the persisting regional unemployment disparities in Greece. Thus, the regionally induced degree unemployment persistence seems to cluster in space; and as a result the structure of regional unemployment disparities remains.

< Insert **Figure 5** somewhere here >

We turn to the interpretation of the impact of the explanatory variables on the rate of regional unemployment. The existence of spatial unemployment spillovers gives rise to a regionally asymmetric impact of each one of the explanatory variables on the dependent variable of the model. This is so since for each variable the total impact consists of a direct component which is uniform across regions and an indirect component which is region-specific.[26] As an example we examine the impact of employment growth ($dempl_{it}$) on the rate of regional unemployment.

[26] The induced component is assumed away.

On the basis of the results of Model 2 and using equation (5), an increase in employment growth by one percent across regions will have a beneficial impact on the rate of regional unemployment of 0.30 percentage points. Of the total employment impact, 0.16 percentage units are due to a uniform across regions direct effect, while 0.14 percentage units are due to the region-specific indirect effect. In the case of the "peripheral" region of *East Macedonia-Thrace*, an increase in employment growth will have a beneficial impact on the rate of unemployment of 0.25 percentage units, while a boost in employment in the "central" region of *Thessaly* will decrease the rate of unemployment by 0.35 percentage points.

Consequently, since the effectiveness of employment creation policies in affecting regional unemployment is lower if policies are applied in "peripheral" regions compared to actions in "central" regions, our results imply that a reduction in unemployment through actions in "peripheral" regions necessitates more effort in terms of employment growth compared to the effort needed in "central" regions. In other words, because of the existence of spatial unemployment spillovers, *ceteris paribus*, the effectiveness of factors affecting the rate of regional unemployment is weakened in "peripheral" regions and it is strengthened in "central" regions.

6. Conclusions

This paper attempts to bring empirical evidence on the driving forces of regional unemployment disparities and unemployment persistence. To this end, we estimated a dynamic model for the rate of regional unemployment, using balanced panel data for the 13 Greek regions over the period 1981-2008. The empirical model incorporates region specific variables and spatial interactions in order to test for regional unemployment spillover effects. The GMM estimation methodology used in the study allows us to investigate the existence of deterministic factors of regional unemployment and examine possible spatial unemployment associations.

The empirical analysis shows that regional unemployment variations are related to labour demand and supply factors, such as the growth of employment, the participation rate, the population density, the productivity of labour and the industry mix. In addition, the empirical results point to the existence of significant spillover effects among regional labour markets. Also, past unemployment developments have a substantial effect on regional unemployment and provide us with a measure of unemployment persistence. The findings of the dynamic model indicate that regional unemployment in Greece exhibits a fair degree of persistence which is close to the EU rather than the US experience.

Furthermore, when accounting for spatial unemployment spillovers, the degree of unemployment persistence differentiates with respect to the region from which an unemployment shock has originated. Unemployment seems to be more persistent if an unemployment shock comes from "central" regions, which are also the ones that exhibit higher rates of unemployment; and less persistent if the shock comes from "peripheral" regions, which are also the ones with lower rates of unemployment. This positive relationship between the regionally induced degree of unemployment persistence and the rate of regional unemployment offers an explanation of the persisting regional unemployment disparities in Greece.

In addition, the empirical results show that the existence of spatial unemployment spillovers differentiates across regions the effectiveness of the

determining factors of the rate of regional unemployment. The effectiveness of these factors is weakened in "peripheral" regions and it is strengthened in "central" regions.

Our empirical findings call for a strengthening of the employment creation process for the reduction of regional unemployment. To this end, it seems that a uniform across regions boost in employment is beneficial, since it reduces regional unemployment disparities, i.e. by curtailing unemployment more in high unemployment regions and less in low unemployment regions. However, a uniform increase in employment does not lead us to the implementation of a horizontal policy, i.e. the same policy across regions. The achievement of a uniform increase in employment across regions necessitates the implementation of region specific policies since the various regions have very different behavioural and structural characteristics.

Thus, our empirical findings point to region specific policies for the reduction of regional unemployment and regional unemployment disparities. In this respect two comments are in order. First, the policy makers are faced with a dilemma because the effectiveness of policy measures differs from one region to another. In "peripheral" regions policy measures are less effective (and more effort is needed) but the drop in unemployment is fast since there is relatively low unemployment persistence. In "central" regions policies are more effective (and less effort is required) but the reduction in unemployment is slower since there is relatively high unemployment persistence. Second, regional policies should lay emphasis on high unemployment regions, but because of the substantial spatial unemployment spillovers they should not leave other regions out. Accordingly, policy measures for the reduction of unemployment should be applied to the whole country but more attention should be paid on areas with more acute unemployment problems.

From the policy perspective, our results leave great scope for European regional policy to operate. Policy measures for the decline of unemployment call for the strengthening of the employment creation process along with policies intending to boost the economic capabilities of high unemployment regions. This could be achieved through the improvement of economic infrastructure and human potential and they are within the philosophy of the EU structural funding.

We believe that a better understanding of regional unemployment disparities allows for the design and implementation of suitable policies related to the EU cohesion policies and becomes even more important for European countries. We also believe that the conclusions drawn could be instructive to other countries facing similar economic realities.

7. References

Abreu, M, De Groot, H, and R. Florax (2004), *Space and Growth: A Survey of Empirical Evidence and Methods*, Tinbergen Institute Discussion Paper, 129/3.

Anagnostopoulos, L. (2006), *Determinants of regional unemployment in Greece, 1995-2005*, Unpublished MA dissertation, Department of Economics and Regional Development, Panteion University, Athens (in Greek).

Aragon, Y., Haughton, D., Haughton, J., Leconte, E., Malin. E., Ruiz-Gazen, A. and C. Thomas-Agnan (2003), "Explaining the pattern of regional unemployment: The case of the Midi-Pyrénées region", *Papers in Regional Science*, 82, 155-174.

Arellano, M., and S. Bond (1991), "Some tests of specifications for panel data: Monte carlo evidence and an application to employment equations", *Review of Economic Studies,* 58, 277-297.

Arellano, M., and O. Bover (1995), "Another look of the instrumental variable estimation of the error component model", *Journal of Econometrics* 68, 29-51.

Baddeley, M., Martin R., and P. Tyler (1998), "Transitory shock or structural shift? The impact of the early 1980s recession on British regional unemployment", *Applied Economics* 30, 9-30.

Badinger, H. and T. Url (2002), "Determinants of regional unemployment: Some evidence from Austria", *Regional Studies*, 36, 9, 977-988.

Bande, R. and M. Karanassou (2006), *Labour market flexibility and regional unemployment rate dynamics: Spain 1980-1995*, Working Paper No. 574, Department of Economics, Queen Mary College, University of London.

Basile, R. and L. De Benedictis (2004), *Regional unemployment productivity in Europe and the US*, European Regional Science Association, Conference Paper.

Blackley, P. R. (1989), "The measurement and determination of state equilibrium unemployment rates", *Southern Economic Journal* 56, 440-456.

Blanchard, O. J. and L. Katz (1992), "Regional evolutions", *Brookings Papers on Economic Activity*, 1: 1992, 1-61.

Blanchflower, D. G. and A. J. Oswald (1994), *The Wage Curve,* MIT, Cambridge.

Blundell, R and S. Bond (1998) "Initial conditions and moment restriction in dynamic panel data models", *Journal of Econometrics, 8*7, 114–144.

Böckerman, P. (2003), "Unravelling the Mystery of Regional Unemployment in Finland", *Regional Studies,* 37, 4, 331–340.

Brechling, F. (1967), "Trends and cycles in British regional unemployment", *Oxford Economic Papers* 19, pp.1-21.

Bronars, S. G. and D. W. Jansen (1987), "The geographical distribution of unemployment rates in the US: A spatial time series analysis", *Journal of Econometrics*, 36, 251-279.

Burda, M. C. and S. Profit (1996), "Matching across space: Evidence on mobility in the Czech Republic", *Labour Economics*, 3, 255-278.

Burgess, S. and S. Profit (2001), "Externalities in the matching of workers and firms in Britain", *Labour Economics*, 8, 313-333.

Burridge, P. and I. Gordon (1981), "Unemployment in the British Metropolitan labour areas", *Oxford Economic Papers*, 33, 274-297.

Card, D. (1995), "The wage curve: A review", *Journal of Economic Literature* 33, 85-799.

Cheshire, P. C. (1973), *Regional unemployment differentials in Great Britain,* Cambridge University Press, National Institute of Economic and Social Research.

Christopoulos, D. K. (2004), "The relationship between output and unemployment: Evidence from Greek regions", *Papers in Regional Science*, 3, 7, 611-20.

Decressin, J. and A. Fatás (1995), "Regional labour market dynamics in Europe", *European Economic Review*, 39, 1627-1655.

Elhorst, J. P. (2003), "The mystery of regional unemployment differentials: Theoretical and empirical explanations", *Journal of Economic Surveys*, 17(5), 709-749.

Epifani, P. and G. Gancia (2005) "Trade, migration and regional unemployment", *Regional Science and Urban Economics*, 35, 625– 644.

Fleisher B. M., and G. Rhodes (1976), "Unemployment and the labor force participation of married man and women: a simultaneous model", *The Review of Economics and Statistics*, 58, 398-406.

Fujita, M., Krugman, P. and A. J. Venables (1999), *The Spatial Economy: Cities, Regions, and International Trade*, The MIT Press, Cambridge.

Galiani, S., Lamarche, C., Porto, A. and W. Sosa-Escudero (2005), "Persistence and regional disparities in unemployment (Argentina 1980–1997)", *Regional Science and Urban Economics*, 35, 375– 394.

Gordon, I. R. (1985), "The cyclical sensitivity of regional employment and unemployment differentials", *Regional Studies* 19, 95-110.

Gordon, I. R. (1988), "Evaluating the effects of employment changes on local unemployment", *Regional Studies,* 22, 135-147.

Greenwood, M. J. (1985), "Human migration: Theory, models, and empirical studies", *Journal of Regional Science,* 25, 521-544.

Groenewold N. (1997), "Does migration equalise regional unemployment rates? Evidence from Australia", *Papers in Regional Science,* 76, 1-20.

Harris, J. R. and M. P. Todaro (1970), "Migration, unemployment, and development: a two sector analysis", *American Economic Review*, 60, 126–42.

Helliwell, J. F. (1998), *How Much do national Borders matter?* Brookings Institution Press, Washington, D. C.

Jimeno J. F. and S. Bentolila (1998), "Regional unemployment persistence (Spain, 1976–1994)", *Labour Economics*, 5, 25–51.

Jones, D. R. and D. N. Manning (1992), "Long term unemployment, hysteresis and the unemployment-vacancy relationship: A regional analysis", *Regional Studies,* 26, 17-29.

Kostoris Padoa Schioppa, F. and R. Basile (2002), *Unemployment Dynamics in the "Mezzogiornos of Europe": Lessons for the Mezzogiorno of Italy*, CEPR Working Paper No 3594.

Layard, R. (1997), "Preventing long-term unemployment: an economic analysis" in D. J. Snower and G. de la Dehesa (eds.) *Unemployment Policy*, Cambridge University Press, Cambridge, 333-356.

Layard, R., Nickell S. and R. Jackman (1991), *Unemployment, Macroeconomic Performance and the Labour Market,* University Press, Oxford.

Levin, A., Lin, C. F., and C. S. J. Chu (2002), "Unit root tests in panel data: Asymptotic and finite-sample properties", *Journal of Econometrics*, 108, 1-24.

Limosani, M. (2004), "Beyond regional institutions: widening unemployment differentials in Italy", *Labour*, 18 (3), 503-514.

Lolos, S. (2009), *The Greek Regions: Convergence and Cohesion*, Gutenberg, Athens (in Greek).

Lopez-Bazo, E., Del Barrio, T. and M. Artis (2002), "The regional distribution of Spanish unemployment", *Papers in Regional Science*, 81, 365-389.

Marston, S. T. (1985), "Two vies of the geographic distribution of unemployment", *Quarterly Journal of Economics*, 100, 57-79.

Martin, R. (1997) "Regional unemployment disparities and their dynamics", *Regional Studies*, 31, 237-252.

McCormick, B. and S. Sheppard (1992), "A model of regional contraction and unemployment", *Economic Journal,* 102, 366–377.

Mitrakos, Th. and D. Nikolitsa (2006), "The duration of unemployment in Greece: Developments and characteristics", *Economic Bulletin*, Bank of Greece, 27, 7-46, (in Greek).

Mohlo, I. (1995), "Spatial autocorrelation in British unemployment", *Journal of Regional Science*, 35, 641-658.

Montgomery, E. B. (1993), *Patterns in regional labour market adjustment: The United States vs. Japan*, NBER, Cambridge, Working Paper No. 4414.

Mortensen, D. and C. Pissarides (1994), "Job creation and job destruction in the theory of unemployment", *Review of Economic Studies*, 61, 3, 397– 416.

Niebuhr, A. (2003), "Spatial interaction and regional unemployment in Europe", *European Journal of Spatial Development*, 5, October.

OECD (1999), *Employment Outlook*, Paris.

Overman, H. and D. Puga (2002), "Unemployment clusters across Europe's regions and countries", *Economic Policy*, 34, 115-47.

Papapetrou, E. (2006), "The Public-private sector pay differential in Greece", *Public Finance ,* 35 *(4)*, 450-473.

Partridge, M. D. and D. S. Rickman (1997), "The dispersion in US state unemployment rates: the role of market and non-market equilibrium factors", *Regional Studies,* 31, 593-606.

Payne, J. E. (1995), "A note on real wage rigidity and State unemployment rates", *Journal of Regional Science,* 35, 319-332.

Pench, L., Sestito, P. and E. Frontini (1999), *Some unpleasant arithmetic of regional unemployment in the EU: Are there any lessons for EMU?,* Technical Report 134, European Commission, Economic Papers, Brussels.

Pissarides, C. A. and I. McMaster (1990), "Regional migration, wages and unemployment: Empirical evidence and implications for policy", *Oxford Economic Papers,* 42, 812-831.

Sargan, J. (1964), "Wages and prices in the United Kingdom: a study in econometric methodology",in *Econometric Analysis for National Planning*, 2eds. P.E. Hart, E. Mills abd J.K. Whitaker, London: Butterworth..

Summers, L. H. (1986), "Why is the unemployment rate so very high near full employment?", *Brookings Papers on Economic Activity*, 2, 339-383.

Tassinopoulos, A. and H. Werner (1999), "To move or not to move: migration of labour in the European Union", *IAB Labour Market Research Topics 35.*

Taylor, J. and S. Bradley (1997), "Unemployment in Europe: A comparative analysis of regional disparities in Germany, Italy and the UK", *Kyklos,* 50, 221-245.

Thirlwall, A. P. (1966), "Regional unemployment as a cyclical phenomenon", *Scottish Journal of Political Economy,* 13, 205-219.

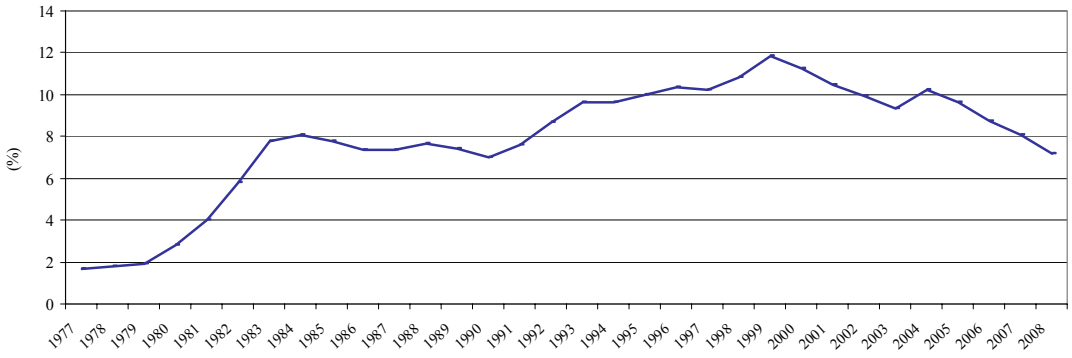
Trendle, B. (2003), *Regional variation in Queensland's unemployment rate*, Working Paper No. 7, May.

Tsionas, E. (2001), "Another look at regional convergence in Greece", *Regional Studies*, 36 (6), 603-609.

Zeilstra, A. S. and J. P. Elhorst (2006), *Unemployment rates at the regional and national levels of the European Union: An integrated analysis*, Paper presented at the 46th European Regional Science Association, 30 August - 3 Sept., Volos.

Tables and Figures

Figure 1: Rate of unemployment in Greece, 1977-2008



Source: EL.STAT.

Table 1
Rate of regional unemployment in Greece

Region	1981	1983	1990	1999	2003	2008
Greece	4,0	7,8	7,0	11,9	9,3	7,2
East Macedonia-Thrace	1,6	4,6	5,6	13,0	10,2	8,4
Central Macedonia	4,5	7,8	6,3	11,8	10,0	8,3
Western Macedonia	4,5	7,8	10,0	14,4	16,0	12,4
Thessaly	2,8	5,9	7,8	13,1	10,6	7,1
Epirus	2,8	6,0	3,2	14,2	11,5	9,2
Ionian Islands	1,9	4,0	3,4	5,8	10,3	9,0
Western Greece	2,6	5,7	7,6	12,0	9,5	9,3
Central Greece	4,1	7,7	6,5	15,2	9,5	8,3
Attica	6,0	11,1	8,8	12,6	8,7	6,0
Peloponnesus	2,1	4,5	5,8	7,9	8,5	7,1
Northern Aegean	4,1	6,6	4,7	11,7	7,6	4,2
Southern Aegean	3,0	4,8	4,5	7,6	10,9	7,1
Crete	1,6	4,6	2,4	7,6	5,2	5,1
Minimum	1,6	4,0	2,4	5,8	5,2	4,2
Maximum	6,0	11,1	10,0	15,2	16,0	12,4
Max-Min Difference	4,5	7,0	7,6	9,4	10,8	8,2
Standard Deviation (*)	0,56	1,02	0,80	1,17	0,82	0,56
Coefficient of Variation (*)	0,14	0,13	0,11	0,10	0,09	0,08

Source: EL.STAT; (*) weighted by population.

Figure 2a: Ranking of rate of regional unemployment betw een 1985 and 1995

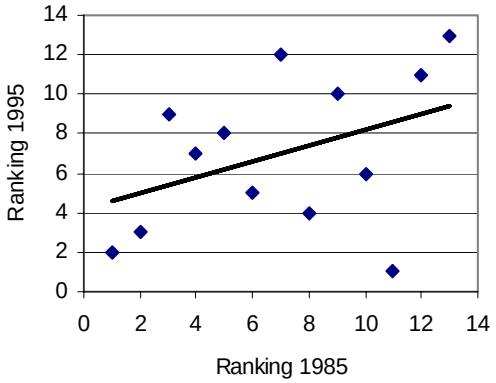
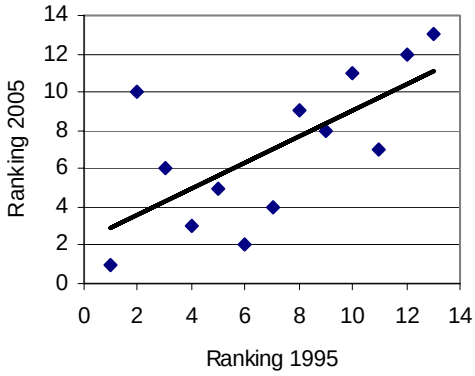
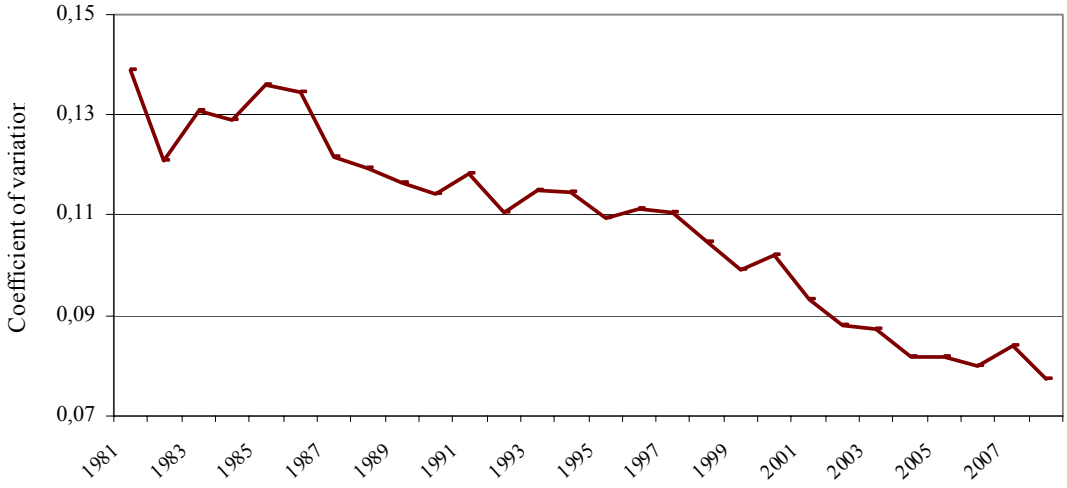


Figure 2b: Ranking of rate of regional unemployment betw een 1995 and 2005



Source: EL.STAT.

Figure 3: Convergence of rates of regional unemployment, Greece 1981-2008



Source: EL.STAT.

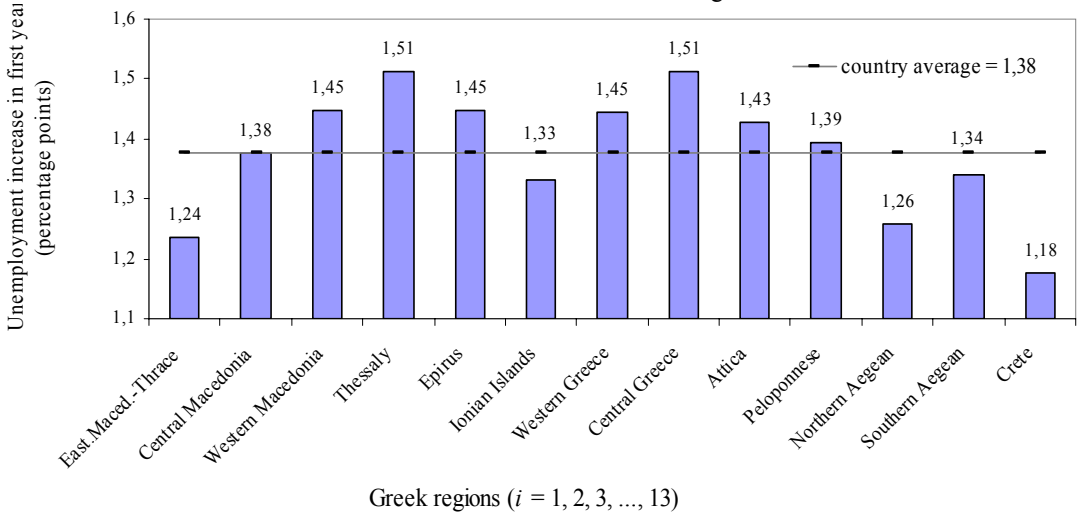
Table 2

Panel estimation using GMM methods (Arellano and Bond estimator)
Dependent Variable: Rate of regional unemployment (u_{it})

Variables	Model 1	Model 2
u_{it-1}	0.643*** [14.1]	0.491*** [8.36]
$dempl_{it}$	-8.842*** [-4.92]	-8.089*** [-4.58]
$dpart_{it}$	17.631** [-2.51]	10.417* [-1.62]
$dens_{it}$	-0.018*** [4.68]	-0.041*** [-4.40]
$prod_{it-1}$	0.054* [-1.52]	0.053* [1.52]
$esagr_{it}$	-6.058*** [-3.83]	-1.782 [-0.77]
$escon_{it}$	-5.513 [-0.53]	-4.586 [-0.47]
$espubl_{it}$	-6.787*** [-3.21]	-1.782* [-1.85]
uD_{it}		0.459*** [6.26]
S. E. of regression	2.090	1.923

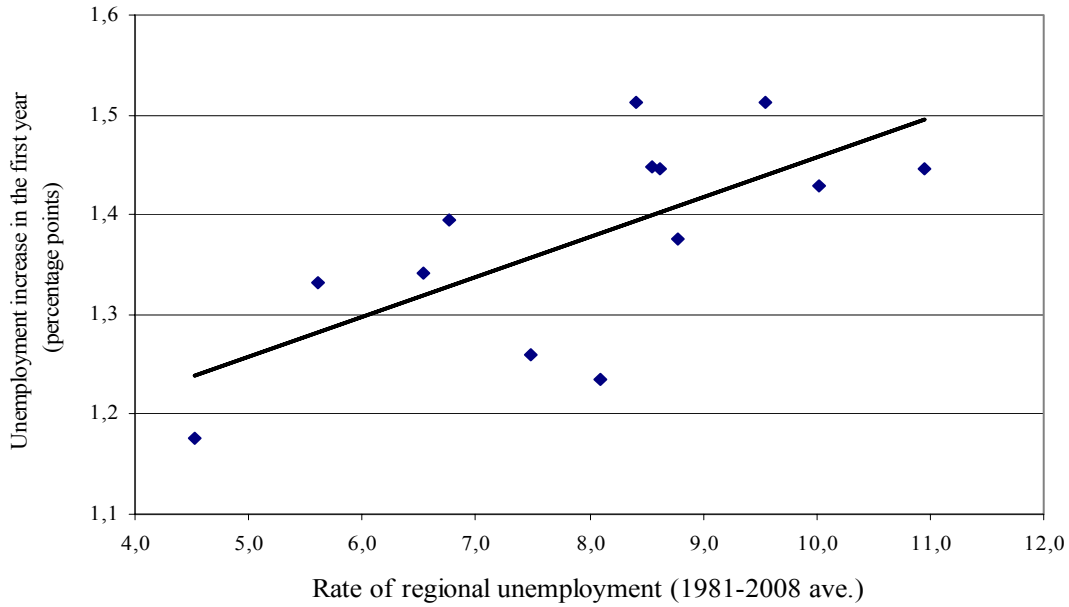
Notes: Figures in brackets are t-statistics. The signs (***), (**) and (*) indicate significance at 1%, 5% and 10% level respectively. First differences are used in the estimation of the panel models.

Figure 4: Unemployment persistence in Greece (1981-2008)
due to a shock of one standrd error in region *i*



Source: Results of Model 2

Figure 5: Unemployment persistence and rate of regional unemployment



Source: Results of Model 2 and EL.STAT.