FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES

SPATIAL STRUCTURE AND REGIONAL GROWTH IN THE EUROPEAN UNION

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SPATIAL STRUCTURE AND REGIONAL GROWTH IN THE EUROPEAN UNION

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Ilmo Sr.

Andrés Faíña Medín, Catedrático de Fundamentos de Análisis Económico y Catedrático Jean Monnet de Economía Industrial Europea de la Universidad de A Coruña, después de examinar exhaustivamente la presente tesis doctoral titulada "Spatial Structure and Regional Growth in The European Union" realizada bajo mi dirección por el profesor del departamento D. Jesús López-Rodríguez autorizo la presentación y defensa de la misma.

Lo que hago constar a los efectos oportunos,

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CERTIFICA QUE

En la reunión del Consello de Departamento de Análisis Económico y Administración de Empresas, celebrada el día 22 de octubre de 2002, se informó favorablemente la lectura de la tesis doctoral presentada por Don JESÚS LÓPEZ RODRÍGUEZ, titulada "SPATIAL STRUCTURE AND REGIONAL GROWTH IN THE EUROPEAN UNION", y dirigida por Don José Andrés Faíña Medín, para acceder al título de Doctor Europeo en CC. Económicas y Empresariales.

Y para que conste a los efectos oportunos, expido la presente en A Coruña a veitidos de octubre de 2002.

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To my beloved grandmother for without whom I never was and I never will be as a small token of gratitude in a deep sea of love

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Chapter one

Introduction

1. Introduction

1.1 An overview of the thesis

Convergence or regional per capita incomes has been a frequent object of study in recent years. Two different lines of research can be usefully distinguished: The first of these has been traced by macroeconomists, who, while studying the growth process, have become interested in applying to the interregional scale of analysis tools originally developed for the international one: Cross-section regressions, Panel data regressions and Markov Chain models (Barro and Sala-i-Martin 1990,1991,1992,1995, Sala-i-Martín 1994,1996, Canova and Marcet 1995, Tondl 1997, 1999, Quah 1986, Fingleton 1997,1999, Magrini 1999). The interest in regional convergence would seem to be an offshoot of international convergence (Blanchard 1991). As a consequence, the same schema originally proposed for the analysis of international convergence has been applied to the regional level, with the only difference that the mobility of capital and labour has been introduced, which according to the neo-classical model should accelerate the process of convergence. In this way the essential role of spatial factors in the regional convergence process has been neglected (Cheshire and Carbonaro, 1995).

The second line of research on regional convergence includes that carried out by regional scientists, who have been challenged by the wave of divergence that has touched different countries during 80s (Amos 1988, Fan and Casetti 1994, Hansen 1995, Maxwell and Hite 1992 and Suarez Villa and Cuadrado Roura 1993). In this case regional convergence has been the exclusive focus of attention and the connection with a long tradition of regional studies is more clearly evident. The common point of reference in these contributions is the classic article by Williamson (1965), in which the process of regional convergence was related to that of national development. According to the so-called *inverted U hypothesis*, regional inequality is expected to grow during the early stages of development, to reach a maximum level during intermediate stages and finally to diminish during mature stages. The asymmetry of the migration of labour and capital during the early stages of development, as well as the different degrees of spatial integration and the different weights of equity objectives in central government policy, were recognized as the principal factors behind the regional divergence-convergence process (Fish, 1984). Although Williamson's study has been extensively discussed in the literature (Gilbert and Goodman, 1976, Krebs, 1982, Therkildsen, 1981), the appearance during the 80's of regional divergence in countries that were in mature stages of development, like the United States, has led regional scientists to reconsider the final tract of the inverted U and to introduce among the casual factors of regional convergence-divergence the adjustment process of an economy to the evolution of technologies, sectors and markets.

Bearing in mind these two strands of regional convergence literature, our goal is to use them in order to study the process of regional convergence in the European Union.

For a better understanding of regional convergence in the EU, the second chapter analyses the spatial structure of Europe using the technique of the "gravity models". Population potentials have been computed for the European Union and for the whole of Europe. These computations show that there is a process whereby the population and

GDP at the core of European space become agglomerated, the area defined by Greater Manchester, London, Paris and the Rhur Valley; Further, the population potentials highlight the important effects enlargement will provoke with respect to the different parts of the spatial structure of Europe. More specifically, Potential contours reflect a displacement of the gravity center of Europe towards the East.

We use alternative measures of regional analysis such as the Gini coefficient to corroborate the spatial concentration of population and GDP over the period 1982-1999. In the last section of chapter two, we analyse regional convergence using the Theil index of concentration. The choice of this index presents the advantage of being weighted, independent of the number of regions and may be broken down into two components, the first of these gives a figure for the inequality between groups as a proportion of total inequality. The second provides us with the within-groups or inter-group inequality as a proportion of the whole. Our findings are, first: Population potentials indicate a displacement of the gravity center of Europe towards the East, and second, population and GDP are concentrated at the "core" of the European territory and this has been a long term tendency, and third, there is a catching-up or convergence process in the income levels among objective 1 regions which has been bringing them closer to the European average since 1988.

A growth model must be able to project correct spatial structure in order to capture the essential features of the convergence process, we show that distance to consumer markets is an influential factor for the income development of a region. We analyse the capacity that population potentials have in determining the levels of development of the

European Union regions. Using a logarithm specification for the relationship between population potentials and levels of development and estimating cross-section regressions for different time periods we assess whether or not the explanatory power of the population potentials maintains constant over time or whether it varies as we move towards 1999, the year in which the most recent data was available.

The results show that population potentials can explain an important portion of the variation in the levels of development in the European Union. Moreover the explanatory power of population potentials in determining the levels of development decreases over time, indicating a certain delocalisation of economic activity. Thus, dynamic income regions have also emerged on the periphery, and need not necessarily be close to rich regions.

Chapter three, analyses the regional convergence in the European Union through cross-section and panel data regressions. We have tested the non/existence of β-convergence for different sub samples of NUTS 2 regions and for different sub periods. More specifically, we estimate β-convergence for the periods 1982-1997, 1982-1986, 1987-1992, 1993-1997 based on the Eurostat and Regio database (ESA79) and for the period 1995-1999 based on the Eurostat and Regio database (ESA95). The results support the hypothesis of absolute β-convergence from 1987 onwards for the regions in EU12 and EU15.

The purpose of chapter four is to look at the effects of regional policy on the growth process of objective 1 regions and to evaluate the challenge involved in the successful extension of EU Regional Policy to Central and Eastern European Countries (CEECs).

We provide evidence which reflects the nature and the extent of the catching-up process experienced by the objective 1 regions, right from the implantation of the regional development programmes. The analysis of this catching-up process was carried out by regressing the gap between the income per capita of objective 1 regions and the average income per capita of the EU15 on a trend variable using a panel data model with fixed effects.

The main results of this chapter underline the positive performance of the objective 1 regions in a period of deepened, intensified competition through the completion of the internal market, liberalization of monetary and capital movements in the EU and within the context of more global competition in the world economy. The reform of the EU Regional Policy has certainly had a key role in the outcome of these results. There are three factors which have been involved in this process:1) The coordination of planning and programming of Structural Funds within the Community Support Frameworks (CSF) 2) an increased focus of its efforts in the regions whose development is lagging behind (objective 1 regions) and 3) an increase in the funding allocated to regional structural interventions. With respect to the Agenda 2000 reforms, the very real success of regional policy for the objective 1 regions will lead to a significant reduction in the proportion of the population receiving assistance.

Simple calculations from the resources foreseen for objective 1 regions, future acceding countries and the Cohesion Fund, show that, maintaining concentration in objective 1 regions and giving the average level of assistance to 90% of the population in the 10 CEEC is compatible with financial balance and the own resources ceiling.

1.2 Resumen en castellano/Spanish summary

La Convergencia de las rentas regionales per capita ha sido objeto frecuente de estudio en los últimos años. Generalmente, se distinguen dos líneas distintas de investigación. La primera de ellas fue la desarrollada por los macroeconomistas, quienes interesados en el estudio de los procesos de crecimiento, intentaron aplicar a los análisis a escala interregional las herramientas originalmente desarrolladas para análisis a escala internacional: Regresiones de sección cruzada, regresiones con datos de panel y modelos da cadenas de Markov (Barro y Sala-i-Martin 1990,1991,1992,1995, Sala-i-Martín 1994,1996, Canova y Marcet 1995,Tondl, 1997, 1999, Quah, 1986, Fingleton 1997,1999, Magrini 1999). El interés en la convergencia regional se deriva de su interés principal, es decir, la convergencia internacional (Blanchard 1991).Como consecuencia, el mismo esquema originalmente propuesto para el análisis de la convergencia internacional se aplicó a nivel regional, con la única diferencia de que se introduce la movilidad de personas y capitales, lo que, de acuerdo con el modelo neoclásico de crecimiento debe acelerar el proceso de convergencia. De esta manera, el papel de factores espaciales no se han tenido en cuenta (Cheshire and Carbonaro, 1995)

La segunda línea de investigación sobre convergencia regional incluye a los economistas regionales, quienes fueron desafiados por la ola de divergencia que tocó a distintos países en la década de los ochenta (Amos 1988, Fan and Casetti 1994, Hansen 1995, Maxwell and Hite 1992 and Suarez Villa and Cuadrado Roura 1993). En este caso la convergencia regional ha sido el único interés y la conexión con la larga tradición de estudios regionales es más evidente. La referencia común en estas últimas contribuciones es el clásico artículo de Williamson (1965), según el cual el proceso de convergencia regional se relaciona con el desarrollo nacional. De acuerdo con la conocida *hipótesis de la "U" invertida*, la desigualdad regional se espera que crezca durante las etapas iniciales del desarrollo, hasta alcanzar un nivel máximo durante etapas intermedias y finalmente disminuya en las etapas finales de desarrollo. La asimetría de los movimientos migratorios de capital y trabajo durante las etapas iniciales del desarrollo, así como los diferentes grados de integración espacial y el distinto peso dados a los objetivos de equidad por las políticas de los gobiernos centrales, han sido reconocidos como los principales factores que están detrás de los procesos de divergencia-convergencia regional. (Fish, 1984). Aunque el estudio de Williamson se ha discutido mucho en la literatura (Gilbert and Goodman, 1976, Krebs, 1982, Therkildsen, 1981), el surgimiento durante los años ochenta de divergencia regional en países que estaban en etapas finales de desarrollo, como por ejemplo el caso de los EEUU) había llevado a los economistas regionales a reconsiderar el camino final de la U invertida e introducir entre los factores causales de la convergencia-divergencia regional el proceso de ajuste de la economía a la evolución de las tecnologías, sectores y mercados.

Teniendo en mente estas dos líneas de investigación en la literatura de la convergencia regional, nuestro objetivo es usarlas para estudiar el proceso de convergencia en la Unión Europea. Creemos que la estructura espacial ha jugado un papel muy importante en el proceso de convergencia regional en la Unión Europea de ahí que con el objetivo de alcanzar una mejor comprensión de ésta, el capítulo 2 analiza la estructura espacial de Europa usando la técnica de los modelos de gravedad. Se han calculado los potenciales de población para la Unión Europea y también para Europa. Estos cálculos demuestran que existe un proceso de concentración de la población y del PIB en el centro de la Unión Europea (el área definida por Gran Manchester, Londres, Paris y el Valle del Rhur). Por otro lado, los potenciales de población resaltan lo efectos que la ampliación provocará en las diferentes partes de la estructura espacial de Europa. Concretamente los contornos de potenciales muestran un desplazamiento del centro de gravedad de la Unión Europea hacia el este. Hemos usado medidas alternativas dentro del análisis regional como son el índice de concentración de Gini para corroborar la concentración de la población y del GDP en el período 1982-1999. En la parte final del capítulo 2, se analiza la convergencia regional usando el índice de concentración de Theil. La elección de este índice tiene la ventaja de que pondera, es independiente del número de regiones y se puede descomponer en dos componentes, uno que nos da la contribución de la desigualdad entre grupos a la desigualdad total y el otro da la contribución de la desigualdad dentro de cada grupo a la desigualdad total. Las conclusiones mas relevantes de este capítulo son las siguientes:

Los potenciales de población demuestran, primero, que existe un desplazamiento del centro de gravedad de Europa hacia el este, segundo, que la población y el PIB están concentrados en el centro del territorio europeo y esta tendencia continua en el largo plazo y tercero que estamos asistiendo a un proceso de catching-up o convergencia entre los niveles de renta de las regiones objetivo 1 y el resto de regiones de la Unión Europea desde 1988 hasta la actualidad.

Por otro lado y tendiendo en cuenta que un modelo de crecimiento debe de tener en cuenta factores espaciales con el objetivo de capturar los rasgos esenciales del proceso de convergencia, demostramos que la distancia a los mercados de consumidores es un factor relevante en la determinación de los niveles de renta de una región. Para ello, analizamos los efectos que los potenciales de población tienen en la determinación de los niveles de desarrollo de una región.

Usando una expresión logarítmica para la relación entre potenciales de población y niveles de desarrollo y estimando regresiones de sección cruzada, evaluamos si el poder explicativo de los potenciales de población se mantienen constantes a lo largo del tiempo o si por el contrario disminuyen a medida que estimamos nuestro modelo con los últimos datos disponibles que son los del año 1999.

Los resultados demuestran que los potenciales de población explican una parte importante de los niveles de renta de las regiones de la Unión Europea. Además, el poder explicativo de los potenciales de población disminuye a lo largo del tiempo, indicándonos una cierta deslocalización de las actividades económicas. Así, han surgido regiones dinámicas en términos de renta en la periferia y éstas no necesitan necesariamente estar cerca de regiones ricas.

El capítulo 3 analiza por un lado la convergencia regional en la Unión Europea a través de regresiones de sección cruzada y regresiones con datos de panel. Hemos comprobado la existencia/inexistencia de convergencia β, para diferentes submuestras y para diferentes subperiodos de las regiones NUTS II de la Unión Europea. De una forma mas concreta, se estimó la convergencia β para los períodos 1982-1997, 1982-1986, 1987-1992 y 1993-1997 basándonos en la base de datos de Eurostat-Regio (ESA79) y para el período 1995-1999 se usaron los datos de Eurostat-Regio basados en el nuevo sistema de contabilidad (ESA95). Los resultados encontrados apoyan las hipótesis de convergencia β desde 1987 hasta la actualidad tanto para las regiones de EU12 como para las regiones de EU15.

El objetivo del capítulo 4 es estudiar los efectos de la política regional en el proceso de crecimiento de las regiones objetivo 1 y el de evaluar el desafío que supone para la política regional europea la ampliación de la Unión Europea a los países de Europa Central y Oriental (PECOs).

En este capítulo aportamos evidencia acerca del proceso de catching-up llevado a cabo por las regiones objetivo 1 de la Unión Europea desde la puesta en marcha de los programas de desarrollo regional. El análisis de este proceso de catching-up se llevó a cabo regresando el gap entre la renta per capita de las regiones objetivo 1 y la renta media de la Unión Europea (EU15) sobre una variable de tendencia usando un modelo de datos de panel con efectos fijos.

Los principales resultados de este capítulo destacan la buena actuación desarrollada por las regiones objetivo 1 en un período especialmente complicado de profundización e intensificación de la competencia con la culminación del mercado interior, liberalización de los movimientos de capitales y financieros y en un contesto de competencia global en la economía mundial.

La reforma de la política regional de la Unión Europea ha estado involucrada en estos resultados debido a:

1) La coordinación de la planificación y programación de los fondos estructurales dentro de los marcos comunitarios de apoyo (CSF), 2)Aumentando el esfuerzo de sus actuaciones en las regiones atrasadas (regiones objetivo 1) y 3) aumentando la financiación asignada a las acciones estructurales regionales. En relación a las reformas llevadas a cabo con la Agenda 2000, el éxito alcanzado por la política regional en las actuales regiones objetivo 1 provocará una reducción muy importante de la población asistida. Cálculos realizados a partir de los recursos previstos para las regiones objetivo 1, futuros países miembros de la Unión Europea (Perspectivas financieras y Marco Financiero EU21- Cumbre de Berlín 1999) y Fondo de Cohesión demuestran que es posible mantener la concentración de la ayuda en las actuales regiones objetivo1 y dar el nivel de ayuda per capita medio que actualmente reciben las regiones objetivo 1 al 90% de la población de los países del centro y este de Europa dentro del presupuesto financiero y del techo de recursos propios.

Chapter two

The spatial structure of Europe

2.1 Introduction

In this chapter[1] we deal with the issue of the spatial structure of Europe. In order to carry out our study, we use the technique of gravity models to compute population potentials, and then plot potential maps, which allow us to represent geographically the main lines of force in terms of population distribution and consequently the main economic activity in the area as well.

We also use the data which corresponds to the future acceding countries in order to better analyse the effects of European Union enlargement from a spatial perspective.

The concept of population potentials allows us to construct a "macroscopic cartography" and gives us a weighted representation of the influence of population on territory, and further enables us to highlight the structural characteristics of the European Union. The potential maps clearly illustrate the nature of the spatial structure of the European Union and its large central agglomeration area: Greater Manchester-London-Paris-Cologne-Rhur Valley. Moreover population potential contours allow us to highlight some policy guidelines for the European Spatial Development Perspective and for the future of the European Regional Policy.

This chapter is organized into eight sections: Firstly, in sections 2.2, 2.3 and 2.4 we take an overview of the gravity models, focusing on their theoretical basis as systemic models inspired by the Newtonian theory of the interaction between masses and forces.

[1] An initial version of this chapter has been presented to the Fifth ECSA-World conference. Brussels 2000, http://www.ecsanet.org/fifth_ecsaworld/index.htm and to the eighth international conference of the Regional Studies Association in Gdansk, Poland on 15th-18th September 2001, http://secure.rogerbooth.co.uk/rsa/gdansk/default.html.

We go on to comment on their use as a technique which enables us to represent the influence that different human settlements exert within a physical geographical space. Specifically we create a plastic image of the distribution and territorial structure of the population, the largest centers of population and the spatial links between the main areas of influence and the activity taking place therein.

Secondly, in section 2.5 potentials of population within the European Union and the whole of Europe are calculated and the corresponding potential maps are drawn up. These maps describe the spatial structure of the European Union and together with the rest of Europe.

Thirdly, in section 2.6 we explore the implications of our computations of population potentials and how they relate to European Union Regional Policy and the broader perspective of European Spatial Development. Potential contours reflect a displacement of the gravity center of Europe towards the East. This phenomenon, means that certain Eastern areas within current EU countries as well as the Central and Eastern European Countries (CEECs) will enjoy important competitive advantages. This dynamic, however, will act to the detriment of the Atlantic periphery whose population potentials will decrease. This trend must be corrected by developing new measures within the context of future European Regional Policy and within the Perspective of European Spatial Development.

Fourthly, in section 2.7 we analyze, on the one hand, the spatial concentration of the population and GDP in the European space using the Gini coefficient of concentration, and on the other, the pattern of disparities in regional income within the European

Union using a decomposable index such as the Theil index. Fifthly, in section 2.8 we analyze the relationship between population potentials and levels of development and finally section 2.9 concludes with the main findings and their interpretations.

2.2 Gravity models and economic theory

Gravity models, as the name suggests, are based on a physical analogy and utilize the formal outline of classical mechanics. Theoretically, the importance of the interrelations between two population centers is proportional to their size and consequently their incomes, or in Newtonian terms their combined mass. Similarly the further away from each other they are, the less important will be the said interrelations. This is roughly analogous to the theory of gravity introduced by Isaac Newton in 1686. Newton postulated that the gravitational force which acts between two bodies in space was in direct proportion to the mass of the two bodies and in inverse proportion to the square of the distance between the bodies.

It was not until the first half of the 19^{th} century that the theory of gravity was applied to human interaction. At that time, Carey (1858-59) theorized "*Gravitation is here, as everywhere, in the direct ratio of the mass and the inverse of the distance*". Work by Ravenstein (1885-1889) and later by Young (1924) confirmed the belief that gravitational function does apply to the migration of people from one area to another.

A key effort in this field is associated with Reilly (1931) in his study of the retail trade areas of moderately sized American towns. Reilly came to the conclusion that: "*Under normal conditions two cities draw retail trade from a smaller intermediate city or town* *in direct proportion to some power of the population of these two large cities and in an inverse proportion to some power of the distance of each of the cities from the smaller intermediate city*". Further examples of the use of the gravity model are available in the works of Stewart (1947-48-50) who presented three primary concepts based on Newtonian physics, demographic force, demographic energy and demographic potential. Zipf (1946-49) examined for pairs of cities interaction phenomena such as bus passenger trips, airline passenger trips, telephone calls etc and the $\frac{P_i P_j}{D_{i,j}}$ factor[2], finding a straight-line relationship between this factor and those phenomena where the entire factor is raised to some power. Isaard and Whitney (1949), Cavanaugh (1950) and Dod (1950) deal with demand and location according to product. Artle (1959) carried out an study on income groups and the interaction among them in the city of Stockholm. Finally the gravity model has been used widely as a model for estimating international trade flows and as a baseline model for estimating the impact of a variety of policy issues, such as regional trading groups, political blocs, patent rights, and various trade distortions[3].

[2] The differences between Stewart and Zipf's uses of the gravity model is that Zipf consider the entire $\frac{P_i P_j}{D_{i,j}}$ factor raised to some power and not only $D_{i,j}$ as it is considered by Stewart. Thus Zipf's findings do not directly test the validity of Stewart's concepts except in the nontypical case when the power of the $\frac{P_i P_j}{D_{i,j}}$ factor is unity. In this case Zipf's use of his so-called $\frac{P_i P_j}{D_{i,j}}$ relationship becomes identical with Stewart's use of demographic energy.

[3] See Tinbergen (1962), Pöyhönen (1963), Aitken (1973), Brada and Mendez (1983), Bikker (1987), Sanso, Cuairan and Sanz (1993) Oguledo and Macphee (1994), McCallum (1995), Helliwell (1996), Wei and Frankel (1997), Bayoumi and Eichengreen (1997), Mátyás (1997), Frakel and Wei (1998), Garman et al. (1998), Evenett and Keller (1998), Frankel et al. (1998), Fitzsimons et al. (1999), Fontagne et al. (1999), Smith (1999),Xu (2000) and Kalirajan (2000).

From a microeconomic perspective, gravity models deal with the question of their theoretical foundations for optimizing the decisions of economic agents. The question is complex, because of the fact that there are connections that have yet to be analyzed in detail. These include the generic and formal minimal action principle associated with Hamilton′s formulation of movement equations.

Anderson (1979) and Bergstrand (1985) derived gravity models from models of monopolistic competition

From a perspective of International trade, Deardorff (1998) demonstrated that the gravity model can be derived within Ricardian and Hecksher- Ohlin frameworks. Other authors who works in the theoretical foundations of the gravity models are Feenstra et al. (1998) and Egger (2000).

Leaving aside these theoretical questions, the gravity formulations are basically empirical models, and their intrinsic value lies fundamentally in their ability, either to predict the interactions among the system's components, or to represent the relationships and structures of the said components. The explanations that follow attempt to do the latter and focus on the treatment of spatial information through the construction of potential maps, based logically on the calculation of potentials of population.

Two further important characteristics of this type of model are that they have a clearly defined structural perspective and are macroscopic in outlook.

- As far as structural perspective is concerned, potential maps constitute a common technique in the social sciences, and this technique assumes that the relationships between the components of a system are influenced by the arrangement of the permanent elements.
- The fact that the models are macroscopic in outlook really means that the gravity models are capable of providing us with a representation made up of aggregate of equipotential population contours of and differing grades or strengths of the potential field, so that they produce a macroscopic representation of populations within a territorial structure.

2.3 The formulation and significance of population potentials

The formal expression of the gravity models is of the type:

$$F_{ij} = K \frac{A_i^{\alpha} . A_j^{\alpha}}{D_{ij}^{\beta}} \tag{2.1}$$

where F_{ij} represents the frequency, intensity or force of the interaction between the places i and j to which are given, respectively, the masses (population, income, etc) A_i and A_j respectively.

D_{ij} refers to the distance (physical, economic etc..) between the points i and j, while K is a constant specific to the phenomena being studied; and alpha and beta are the corresponding exponentials of the variables, all of which are parameters, which are empirically estimated.

To obtain a "macroscopic cartography" of the economic territorial structure we can turn to the analogy of gravity models. In order to simplify the analogy and at the same time increase the model's efficiency, we assume the exponential for the "mass" to be 1 and the exponential for the distance to be 2. In this way the general expression in figure 1 is transformed into the following expression:

$$F_{ij} = K\frac{A_i . A_j}{D_{ij}^2} \tag{2.2}$$

which can be interpreted as the Stewart's definition of demographic force. Later, Stewart also developed the concept of demographic energy, $E_{i,j}$ corresponding to the Newtonian gravitational energy, defining it as:

$$E_{i,j} = K\frac{A_i A_j}{D_{i,j}} \tag{2.3}$$

and demographic potential, ${}_iV_j$ corresponding to the gravitational potential as:

$${}_iV_j = K\frac{A_j}{D_{i,j}} \tag{2.4}$$

It can be seen immediately from equation (2.4) that ${}_iV_j$ only defines the potential created upon city i by one single city, j. It is very easy, however, to measure the total potential of i by merely summing over all different $j's$; i.e.

$${}_iV = K\frac{A_1}{D_{i,1}} + K\frac{A_2}{D_{i,2}} + \dots\dots\dots + K\frac{A_n}{D_{i,n}} = K\sum_{j=1}^{n}\frac{A_j}{D_{i,j}} \tag{2.5}$$

As ${}_iV$ can be computed for every single place, it becomes possible to use iso-lines for mapping the potentials. (as can be seen from Equation (2.5), the demographic potential ${}_iV$, is expressed as population per distance)

The concept of potential of population must be understood as the force or attraction which the population centre A_j would exert on an inhabitant located at the point i in geographical space and conditioned according to the distance between them, D_{ij}.

Therefore, potential maps show the influence each place exerts on all other places and that in this sense they measure the proximity of a place to other places. Intuitively the concept of population potential can be understood as a measure of the demand potential that the whole population exerts over every location in the space. There is a natural link with the concept of demand cones first suggested by Lösch (1954). Population potentials at a given location represent an index of the aggregate market potential from the whole structure of population weighing the number of inhabitants by their distance from this location.

2.4 The construction of potential maps

Population potentials, according to current formulas and formal interpretation, are indices of the influence or relative force that all the centres and population settlements exert at each of the points within the space being considered. In other words, the potential of population at a point may be regarded as a measure of the proximity of the people to that point. In computing the population potential we assume that every person makes a contribution which is positively correlated to his proximity to the point. As we move from rural areas towards a large city there is a rise in the potential value because of the concentration of people there.

The outcome of the computation of population potentials can be represented on a map of the surface by using equipotential contours. The contours which represent altitude above sea level on topographical maps are analogous to population potential maps.

Potential maps are generated through a graphic representation of the various contours of equipotential, and they provide an overall view of the territorial structure of the population and human settlements within a given geographical space.

They provide us with a macroscopic cartography of the big population centres and a classification of territorial areas based on the influence and distribution of the principal conurbations.

Because of this, it is not possible to consider all the points within a given territory, the practical computation of the indices and potential mapping is carried out by using a dot or grid "net".

This net which, is placed over a specific space, defines a finite and manageable set of nodes for the $A_i,{}_iV$ calculations. The potential indices are calculated by going through each node on the net and assigning to it a corresponding "potential" value, that is, the value of its own population weighed against each and every other node and its corresponding population, and divided by the distance separating each node.

The calculations were carried out in the following way: for each "i" node in the net we add the population of each center divided by:

- The distance D_{ij} (measured in kilometers), if it is more than 1, or
- One, if the distance is less than 1.

To this end, an algorithm or "loop" which goes through the whole of the net $\{i\}$ is designed to complete the whole of the space and is computed in order to be able to compile the indices. By joining the points with the same potential index we obtain the population potential contours which form the potential maps, where the strong force lines and agglomeration areas which compose the spatial structure of the economy are reflected.

The population data we used was obtained from the statistics information service of the European Commission, EUROSTAT, and the cartographic data from GISCO. Nowadays, the possibility of enlarging the European Union in order to take in the countries of Eastern Europe is one of the most important European issues and has far reaching implications for this type of study.

The potential indices were calculated and the corresponding maps were made for Russia and for the fifteen present-day members of the European Union. From the group of urban centers in Europe with more than twenty thousand inhabitants the potential index of each point of the net was calculated in ARC/INFO and then, by means of interpolation, the potential population contours were computed in ARC VIEW, by using the SPATIAL ANALYST modulus.

2.5 Spatial structure in the European Union

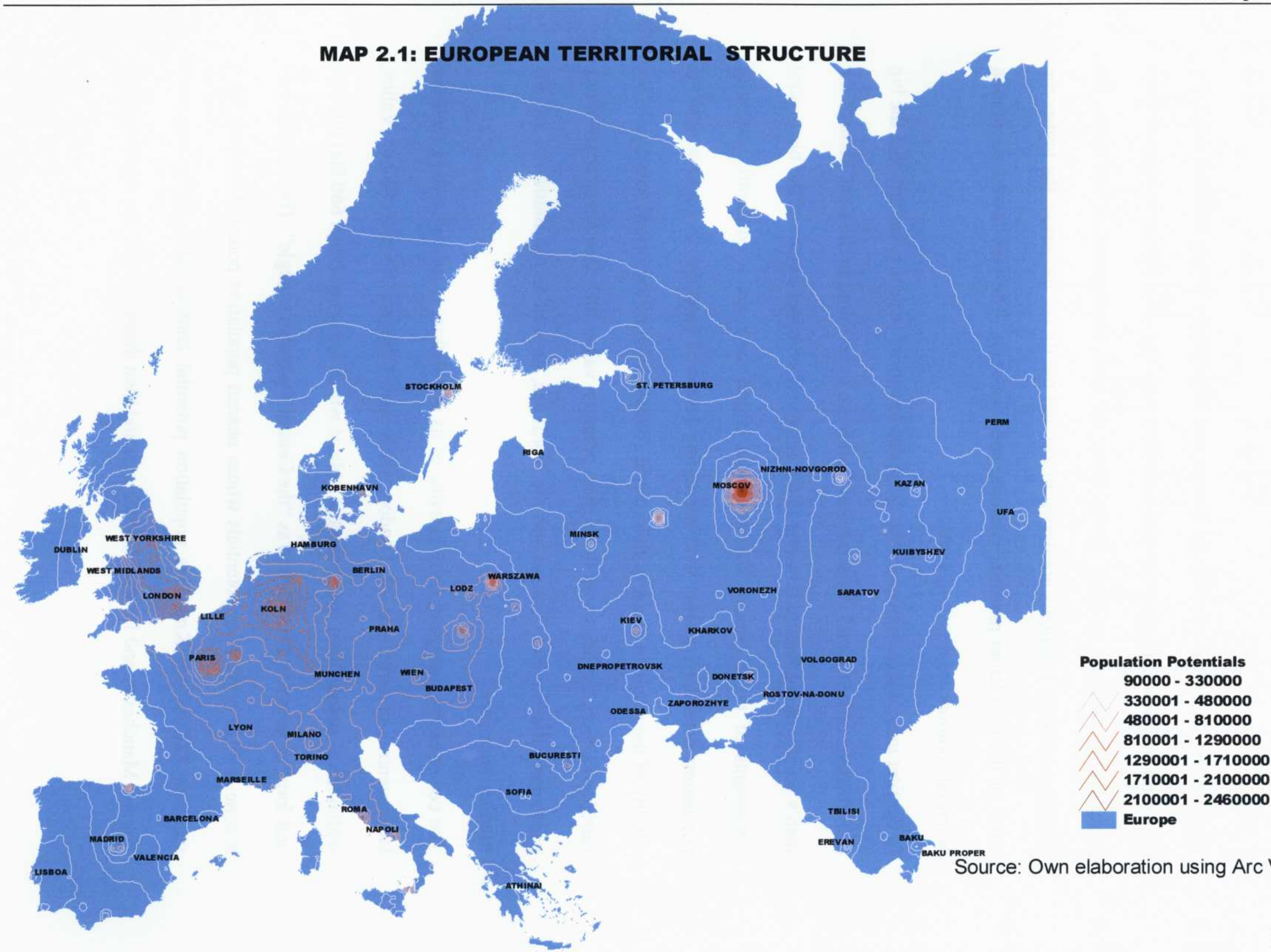
2.5.1 Population contours in an enlarged European Union

There are striking disparities in economic performance between different parts of Europe, particularly between the central and peripheral regions. GDP per head (measured in terms of purchasing power standards, PPS, to take account of differences in price levels) is typically half to two-thirds of the EU average in the Southern periphery (Greece, Southern Italy to Southern and Western Spain and Portugal, and around 60% of the EU average in most of Eastern Germany).

There are also clusters of poorer regions in the Northern periphery, particularly in Northern and Eastern Finland and the North and West of the UK. By contrast, GDP per head is well above average in the more central area extending from the North of Italy through Southern Germany to Austria as well as in the BENELUX countries and Northern Germany. This central area of the EU including the metropolises of London, Paris, Milan, Munich and Hamburg shows an important concentration of the population. This situation can be seen with clarity in the territorial structural maps of Europe that has been plotted with the technique of gravity models.

The following maps reveal the spatial structure of the present-day fifteen-member-European Union plus the ten CEECs and were drawn up by using EUROSTAT data which deals with those centres of population with more than twenty thousand inhabitants. In these maps the value given to each point, i.e. its population potential index, represents the relationship expressed by its distance between the remaining urban centres and their populations.

MAP 2.1: EUROPEAN TERRITORIAL STRUCTURE



Source: Own elaboration using Arc View 8.1

Maps of the territorial structure of Europe and those of its fifteen member states are drawn up by joining together the equi-potentials with the same values in order to form equipotential contours or level curves. Over the blue, background of the maps, the highest population potentials are drawn in red and the darker the shade, the higher the value of the population potential contours and visa-versa. The very lowest population potential contours are drawn in white.

In the first map, which represents the European territorial structure, we find that the big conurbations of Leningrad, Moscow and Gorkij are to be found in the East. Perhaps the map's most striking feature however is the relatively compact nature of the big central settlements of the European Union around which there are a concentric series of population potential contours with decreasing levels of potential. In order to test the validity of the resultant shape of this central concentration of the spatial structure of the European Union, the lines with the highest potential values are extended over sea-areas, particularly the English Channel and the North sea, as well as the Baltic sea and the Mediterranean sea.

The center of the European area, in terms of its population, is located among the three large central conurbations of London, Paris and Cologne-Düsseldorf-Rhur Valley, which have contour-lines with potential indices which are greater than 660.000 inh/Km, and form an area which we define as "the Central European triangle". This area fits into a zone of high population potentials whose nearest population potential contour has a value of 480.000 inh/Km. This population potential contour takes in the region of Greater Manchester and London in the North and then drops towards the region of Paris in the South. From Paris the contour traces a line North East to enclose the region of the Rhur Valley before turning North West to cut the North Coast of Holland, taking in Amsterdam and Rotterdam and then joining up with the contour which embraces the conurbation of Greater Manchester.

A population potential contour with a value of (390.000 inh/Km) begins in the North West of England, taking in the cities of Liverpool, Leeds and Greater Manchester, traces a line to the East round Hamburg and Copenhagen, where it becomes a gentle arc which falls in a North-South direction to take in Berlin, Prague and Viena and the North of Italy (Milan and Turin). After this the contour turns again, to the Northwest to Lyon (without taking in the Rhône Valley) and then absorbs the areas of influence of Paris and London, before linking up with Northwest England.

The largest central population potential contour i.e. the one which takes in the greatest geographical area, corresponds to that with a value of 330.000 inh/Km, and starts in the Northeast in the English area of Grand Manchester-London. From here the contour goes towards the East, taking in Copenhagen before turning in a North-South direction along the Varsovie-Budapest axis. After this, the contour crosses the Adriatic sea, taking in Naples, turns to the Northeast to take in Rome, the North of the Italian Peninsula and the Rhône and Marseille Valley. From here it turns again towards the Northeast before going on to enclose the region of Paris and the coast of Normandy before finally linking up with the southwest of the large English agglomeration area of London-Greater Manchester.

The population potential with a value of 290.000 inh/Km constitutes the widest catchment's area in terms of population space. The contour traces a band which takes in the Northwest of England, goes East to take in Copenhagen, before dropping to the Southwest to Warsaw, from where it moves in a Westerly direction to Budapest before turning sharply towards the West to reach the Adriatic coast. After absorbing the conurbations of Rome and Naples it continues to the West, roughly following the coast and the Gulf of Lion up to Catalonia, and then turns back to the north of England after bordering on the conurbations of the Basque country and Cantabria.

In a similar way, the heavy structural lines of the European territory can be seen on the following nocturnal-light map. This map presents us with a satellite view of the nighttime light emissions from cities, houses, industries and other light sources. The light emissions were captured and recorded using high sensitivity equipment.

Map 2.2: MAPPING CITY LIGHTS WITH NIGHTTIME DATA FROM THE DMSP OPERATIONAL LINESCAN SYSTEM

Although high sensitivity reception techniques make it difficult to distinguish between the distinct intensities of light emissions, there is still a broad similarity between the light emission images and the shape of a central European area based on population potential contours. The similarity is even greater when lower sensitivity nighttime light data are used. Low sensitivity light data do not reflect the variations in the strength of light emissions and as a consequence the characteristic shape of the Central European Area becomes more prominent. The population potential contours around the area that we define as, the "Central European Triangle" are clearly visible in the image below, and were provided by the Earth Viewer[4] system.

Map 2.3: NIGHTTIME LIGHT DIFUSION "EARTH VIEWER"

[4] Nighttimes lights diffusion "Earth Viewer, Nighttimes images composition system from "Earth Viewer" 100 Km. high on 50° North, 5° East. The light diffusion allows to appreciate the intensity differences.

2.5.2 The effect of Enlargement on Population Potentials

The fourth map illustrates the territorial structure of the European Community and was plotted using the same database as that used for map 2.1 "European territorial structure" but in this case was restricted to its fifteen present-day members.

The reduction in the size of the area, through excluding the countries of the east, produces a reduction in the levels of the potential indices. This reduction is derived from the contraction in the size of the spatial field and reinforces the accuracy of the description and the compactness of the areas included within the equipotential contours. Map 2.4 therefore, shows on the one hand, the inner structure of the central areas of population within the European Union, and on the other hand it provides us with the most characteristic features of the peripheral areas. Interestingly in map 2.4, Galicia and the North of Portugal stand out in the Atlantic area as a single homogeneous region. This region forms the southern extreme of an area that includes the west of Ireland, Cornwall and Brittany, spreads over to the Gulf of Biscay and joins the Atlantic side of the Iberian Peninsula.

Although the enlargement of the European Union to the Central and Eastern European Countries is a complex question, it is very interesting to do a first proof through the comparison of population potentials. To this end, the following table (table 2.1) shows the relative increased in the population potentials when we enlarge the potential field from the European Union countries to the whole countries of Europe.

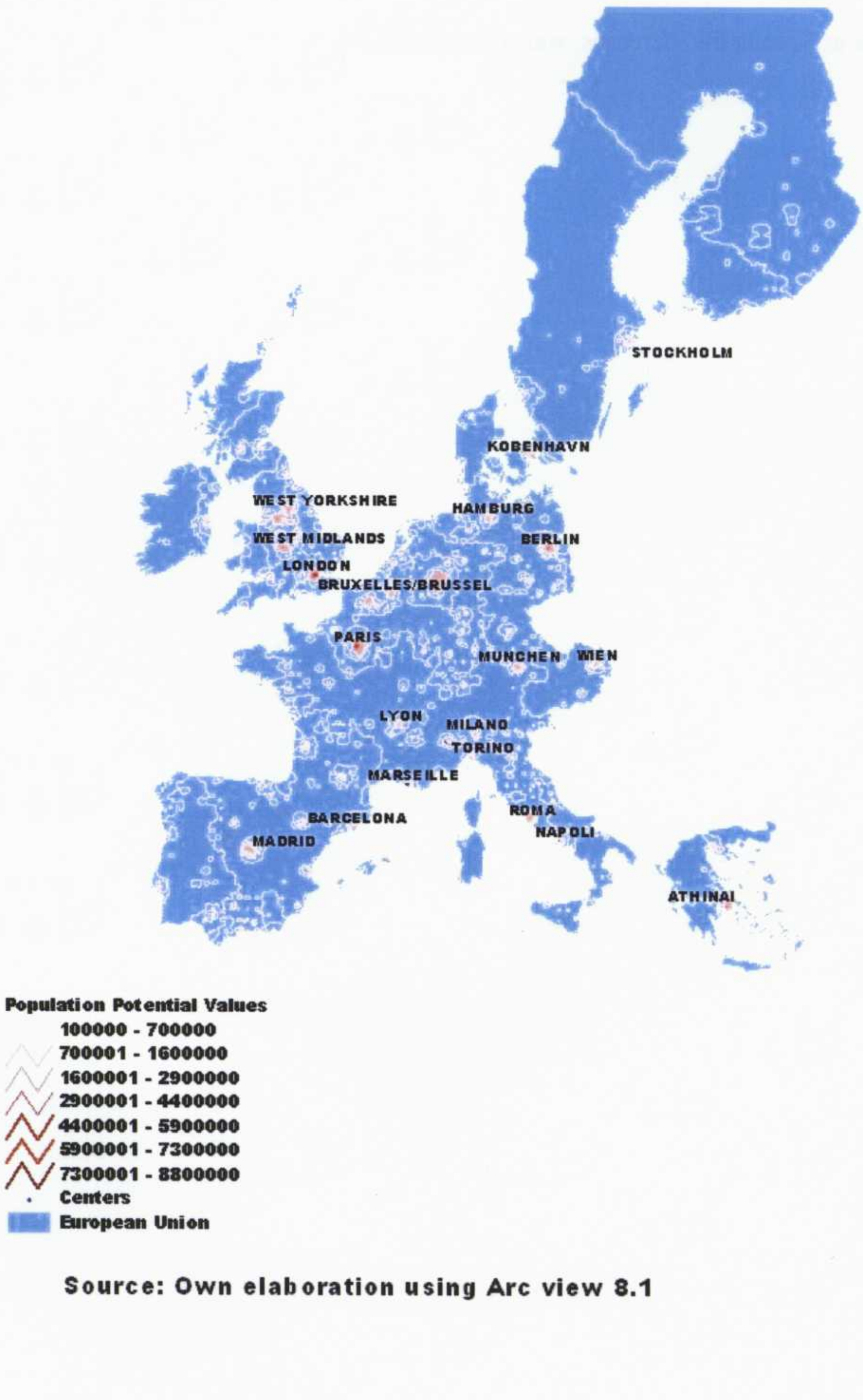
The comparison between *column a* and *column b* reflects the quite surprising differences in population potentials among the different European Union areas. Galicia together with Portugal, alongwith London, have augmented increased their population potentials very little, an increase around 6%, while the population potentials of Madrid, Bilbao, Barcelona and Valencia increased by between 6-7%, as did central cities in the Western part of the continent such as París, Brussels, Amsterdam and Köln.

Table 2.1: POTENTIALS OF POPULATION (measured in Inh/Km)

	European Union (a)	Europe (b)	Incr. (d) (b-a)/a
A Coruña	295	313	5.93%
Vigo	328	347	5.89%
Porto	525	556	5.91%
Lisbon	1.229	1.301	5.87%
Madrid	5.269	5.597	6.22%
Barcelona	3.967	4.238	6.82%
Bilbao	783	832	6.23%
Valencia	1.230	1.313	6.73%
Milan	2.414	2.634	9.12%
Rome	3.989	4.449	11.54%
London	13.207	13.978	5.84%
Venice	496	555	11.92%
Amsterdam	1.321	1.410	6.79%
Hamburg	2.553	2.829	10.82%
Copenhagen	1.906	2.170	13.84%
Estockholm	1.284	1.500	16.79%
Helsinki	646	763	18.26%
Munich	2.012.6	2.258	12.2%
Berlin	4.439.7	5.162	16.27%
Dresden	750.3	884	17.77%
Vienna	2.054.8	2.512	22.25%
París	13.990	14.963	6.95%
Brussels	2.327	2.486	6.86%
Köln	2.162	2.299	6.34%
Amsterdam	1.321	1.410	6.79%

Quite the reverse is true however, in the Italian cities such as Rome and Venice, whose population potentials increased by around 11%. In the Eastern cities of Germany and Austria, this increase was even more dramatic. In Berlin the increase was over 16%, while in Vienna the increases was a stunning 22%.

Map 2.4: Spatial Structure in the European Union



Source: Own elaboration using Arc view 8.1

2.6 Spatial structure and regional policy

2.6.1 The European Spatial Development Perspective

The European Spatial Development Perspective (ESDP) is a suitable framework for the coordination of the sectorial policies and the interventions between the different levels of government (communitarian, national, regional, local, etc.). The aim is to work towards a more balanced competitiveness of the European territory and for sustainable development, by strengthening economic and social cohesion, preserving and managing natural resources and maintaining the cultural heritage. The ESDP is the framework for linking together this triangle of fundamental goals of European policies. It "provides the possibility of widening the horizon beyond purely sectoral policy measures, to focus on the overall situation of the European territory and also take into account the development opportunities which arise for individual regions".

In the context of an open and competitive economy, immersed in the trends of globalisation and change towards new lines of progress based on the economic paradigm of the information society, the knowledge and the innovation, it is necessary to reinforce the factors of regional competitiveness and highlight not only the concepts of regions whose development is lagging behind, but also a wide range of criteria that ensure an adequate level of competitiveness. Such factors are, territorial accessibility and transport, research and innovation, education and vocational training, productive structure, etc..

In a very general way these new dimensions and criteria could be introduced through the ESDP whose guidelines focus on a search for polycentric development spread in an harmonic and balanced way right throughout the European territory. However, this range of dimensions and criteria involves a great deal of risk because of dispersion and enlargement in the areas that may receive assistance. This may damage the effectiveness that European Regional Policy has achieved because of its concentration, in the personal and financial sphere, on the regions whose development is lagging behind.

An important point that should be mentioned is the toward concentration in the spatial structure of Europe. There is no a natural tendency toward an even spread population and economic potentials, at least in terms of spatial development. This means that renewed efforts must be carried out within the context of the ESDP in order to reinforce the initial measures that have been designed to cope with spatial unbalances. Regional problems involving changes in population, globalisation, the location of economic activities, technological development and the information society, transport, telecommunications, energy and the effects of the sectorial policies of the European Union must be analysed by taking into account the emerging trends and the driving forces of the medium and long term patterns of spatial development.

This kind of approach has been initiated in the somewhat experimental branches of the INTERREG programmes, such as the old INTERREG II C and ERDF Pilot Actions and the new INTERREG III B and C where different spatial areas have been selected as new cooperation frameworks to conduct spatial analysis and new ways to implement policy measures.

2.6.2 Population Potentials and the European Spatial Development Perspective (ESDP)

One of the main challenges for the ESDP is to achieve its goals under the conditions of enlargement. Special circumstances in the Accession Countries will make it more difficult to solve problems such as clarifying how investments will be implemented by the public sector, avoiding or reducing the foreseeable conflicts between the different policy fields and so on. This means that spatial coordination will play a greater role in the Accession Countries than in the current Member States. This has implications for issues such us:

a) The planning of the expansion of a trans-national transport infrastructure and the Community's transport policy.

b) Measures for environmental rennovation, in particular, of old industrial zones.

c) Measures for structural adjustments in rural regions.

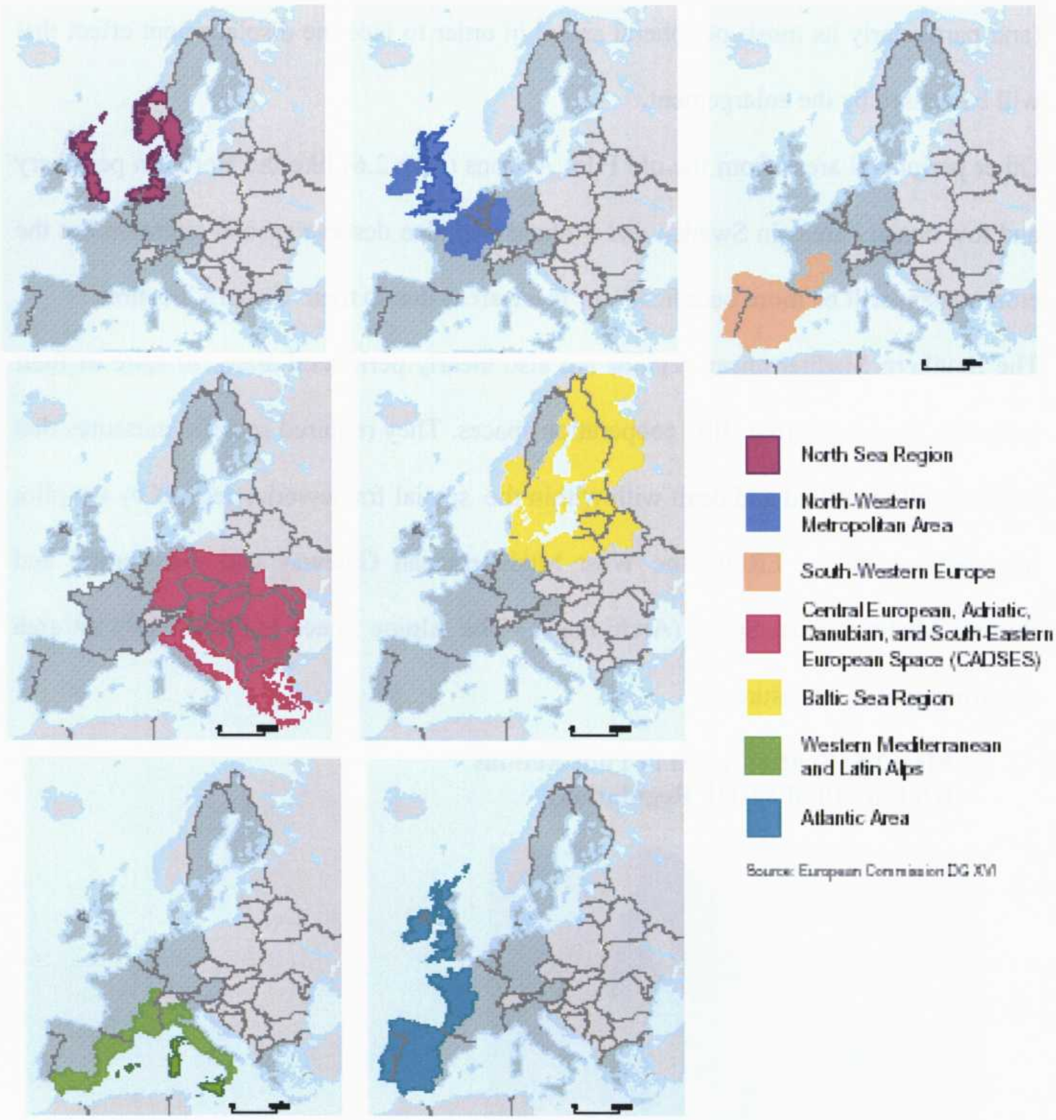
d) Cross-border and trans-national cooperation in spatial development.

However, the CEECs will enjoy a competitive advantage due to their central location in Europe. The calculus of the population potentials for the enlarged European Union (UE25) show that these countries are not peripheral but central in terms of spatial structure and population potentials. In the past, and to some extend they remain peripheral countries because the iron curtain and their central planning economies has isolated them, but in geographical terms and according to the spatial structure of population potentials the CEECs are located in a large central area which is enclosed within a high population potential contour i.e. the one which corresponds with a value of 330.000 inh/Km (see map 2.1). This area forms part of the large cooperation area in the INTERREG II C call Central European, Adriatic, Danubian and South-Eastern European Space (CADSES). However they will be border regions on the Eastern frontier that will probably need special policy measures.

The enlargement of the European Union will imply a movement of the Europe´s center of gravity towards the East that can be clearly shown by the tool of population potentials. Table 2.1, provides a clear example of the asymmetric increase in the population potentials: the more we move towards the East the higher the increase in population potentials. For instance enlargement will increase the population potential of Vienna and Berlin by around 22% and 16% while London, Paris, Lisbon and Madrid will see their population potentials increase by less than 6.5%.

This displacement effect will have an important impact on Western peripheral areas. The main area to be affected will be case is the Atlantic periphery whose core is made up by the regions lying beyond of the 250.000 inh/Km potential contour: The area of Portugal, Galicia and other regions in Western part of Spain, Western Ireland and North-Western Scotland. This area may be linked to other regions (lying in the border of the 330.000-390.000 inh/km) to enclose the Atlantic arc formed by Wales, South Western England, Bretagne, Poiteau, Aquitaine, the Gulf of Biscay and the North of Spain. This area has been called the *Atlantic space* and has been selected as a cross-border and interregional area for cooperation of regional and local authorities in the framework of the new INTERREG programmes (see map 2.5).

Map2.5: Interreg IIIC, Trans-national cooperation programmes

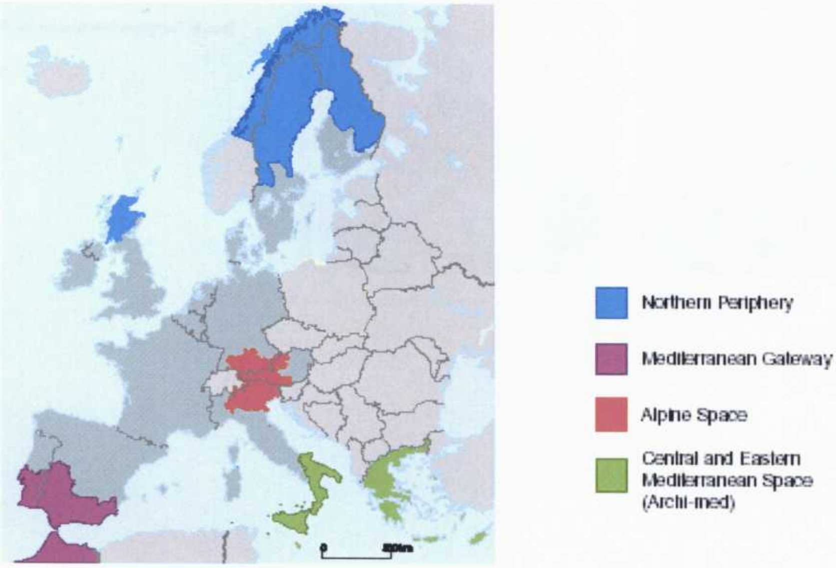


New policy measures must be addressed to reinforce the position of this Atlantic space (and particularly its most peripheral areas) in order to face the displacement effect that will be caused by the enlargement.

Other peripheral areas from the old Pilot Actions (map 2.6) like the Northern periphery and low density areas in Sweden and Finland will also deserve special attention but the enlargement will be more beneficial for these areas due to their Eastern location.

The Southern Mediterranean regions are also clearly peripheral areas. In spite of their inclusion in new Interreg III C cooperation spaces. They required specific measures that will be well identified and dealt with within the spatial frameworks defined by the pilot interventions of the ERDF: the West Mediterranean Gateway and the Central and Eastern Mediterranean Space (Archi-med). The Alpine Space is also clearly an area requiring specific measures .

Map 2.6: Spatial Areas in Pilot Actions (Old art.10 of ERDF Regulation)



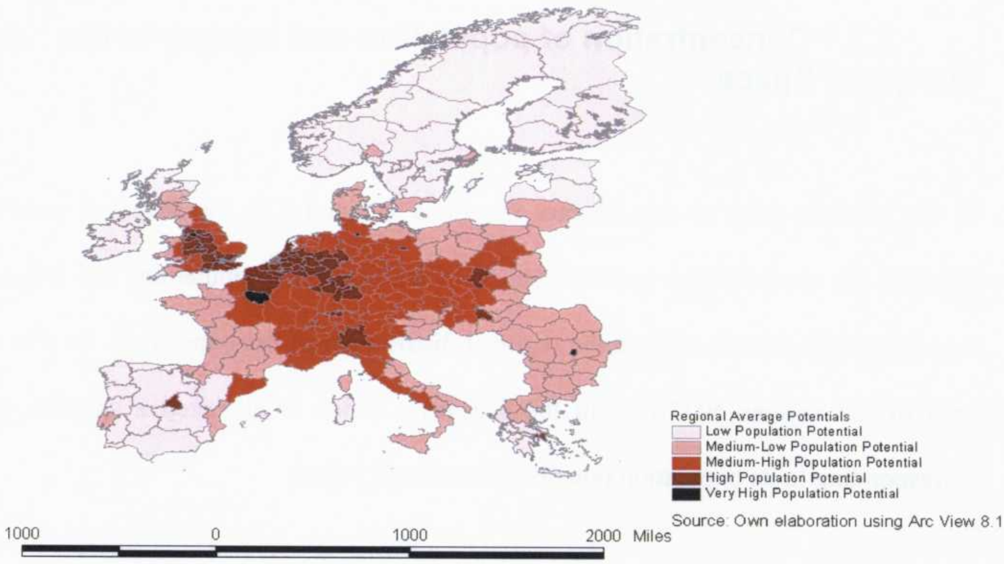
2.7 Spatial concentration of population and GDP and regional convergence

2.7.1 Concentration of population and income in the European Space

In the sections prior to this chapter (Sections 2.5 and 2.6) the maps of potentials reflected the concentration and distribution of the European population. The following map (map 2.7) aims to analyse the regional distribution of the population. To this end, each of the regions NUTS 2[5] in the European Union is allocated a specific value corresponding to its population potential (its average value).

[5]Nomenclature of Statistical Territorial Units is a geographical division of the European Union's Territory that subdivides each Member State into a whole number of regions at NUTS 1 level. Each of these is then subdivided into regions at NUTS 2 level and these in turn into regions at NUTS 3 level. For instance the whole European Union is divided into 78 NUTS 1 regions, 206 NUTS 2 regions and 1093 NUTS 3 regions.

Map 2.7: Population Potentials in EU25



Map 2.7 displays a classification of five levels or weightings of population potentials within the EU25. The value of the population potential is reflected in the relative shade of the colour used, that is, the darker the shade, the higher the population potential and visa versa. The population potentials reflect a concentric distribution of the population, which has its centre an area in which the values are the highest, an area that is commonly known as the Golden triangle (Greater Manchester-London-Paris and the Rhur Valley). This area is surrounded by successive envelopes of decreasing population potential values, which eventually reach the Atlantic periphery where the values are lowest. It is worthwhile reiterating the striking similarity in the distribution of the illumination intensities shown in the night light maps with the distribution of potential

values among the NUTS II regions shown in map 2.7. Another striking feature that can be seen in this map is the core position that the central and Eastern countries have. They are situated within an envelope of medium-high population potential values.

The dynamic evolution of the concentration of the population and the GDP in Europe is traced and studied by means of an statistical analysis which is carried out using the Gini index (Gini, 1935) and the Lorenz curves in order to measure this evolution over time. The Gini Concentration index takes the form of the following mathematical expression:

$$I_G = \frac{\sum_{i=1}^{n-1}(p_i - q_i)}{\sum_{i=1}^{n-1} p_i}$$

where, in our case, p_i represents the accumulated percentage of area and q_i represents the aggregate percentage of population or GDP in function of the variable we are analysing.

First, the Gini indices were calculated by comparing the evolution of the concentration of the population and of the GDP for the regions NUTS 2 in the EU in the years 1984 and 1994 using the data on population and GDP provided by EUROSTAT. In order to facilitate the comparison of the values of the Gini indices, the same number of NUTS 2[6] regions were chosen for each of the years in question. The values for GDP were used in

[6]The appendix contains a list of NUTS 2 regions that were used to calculate the Gini indices between the years 1984 and 1994. In the absence of data for certain NUTS 2 regions between these 2 years, and in the interests of a more complete comparison of the Gini indices, higher level (NUTS 1) data was used.

the form of Purchasing Power Parities (PPS) in constant 1985 values as a basis for regional GDP comparisons and according to ESA79.

Table 2.2 gives the value for the Gini index for the years 1984 and 1994. It can be seen that there has been little increase in the spatial concentration of GDP within the interim period since the value of the Gini index has risen from 0.3517 to 0.3597. Similarly, although this increase is somewhat greater, it can be observed that the index values for spatial concentration of population went from 0.2187 to 0.2322.

Table 2.2: Values of Gini Index

	Spatial Concentration of GDP	Spatial Concentration of Population
1984	0.3517	0.2187
1994	0.3597	0.2322

The relative concentrations of both population and GDP can be represented graphically, and in so doing we obtain a concentration or "Lorenz" curve (Figure 2.0)

The key to the interpretation of the curve lies in observing its proximity to the diagonal. The nearer the curve is to the diagonal, the lower the value for the economic variable in use (in this case the geographical concentration of population and GDP).Thus there is a relationship between the Lorenz curve and the Gini index in the sense that the Gini index is approximately equal to the area enclosed by the diagonal $\overline{OB}$ and the curve divided by the area of the triangle, that is:

$$I_G \cong \frac{AreaOB}{AreaOAB}$$

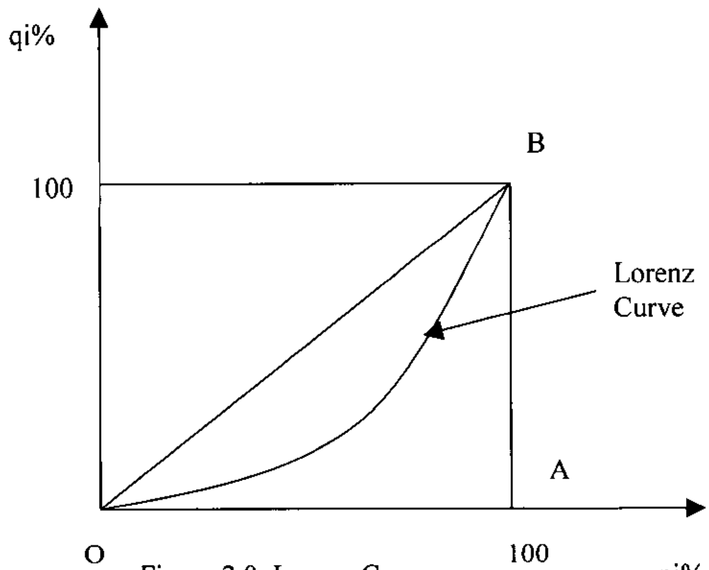


Figure 2.0: Lorenz Curve

When the population concentration is minimal the curve coincides with the diagonal $\overline{OB}$, which means that the area of the numerator will be 0, and $I_G = 0$.

The maximum concentration of population gives a curve formed by the two sides of the square $\overline{OA}$ and $\overline{AB}$. In this case the two areas will be equal and $I_G = 1$. Logically, between these two extreme cases lie intermediate scenarios in which the Lorenz curve is more pronounced when the distribution is more uneven and the concentration is more intense. At this stage it should be pointed out that, although the Gini curve has the advantage that it enables us to express the whole series of complex information that the Lorenz curve represents in the form of one figure or value, it also has the inherent disadvantage that two distribution patterns, which are essentially very different, may in effect possess two indices of concentration of the same value.

The graphs 2.1 to 2.4 represent the Lorenz curves that correspond to the Gini indices calculated for 1984 and 1994. A glance at the graphs reveals that the geographical concentration of the GDP is greater than geographical concentration of the population since the Lorenz curve is more pronounced and further away from the diagonal when considering the concentration of GDP rather than the concentration of the population. Further, as the curve plainly shows, this concentration increases during the period 1984-1994. The calculations carried out and presented in table 2.2 reconfirm this dynamic.

Figure 2.1: Spatial Concentration of Population in 1984
Lorenz Curve

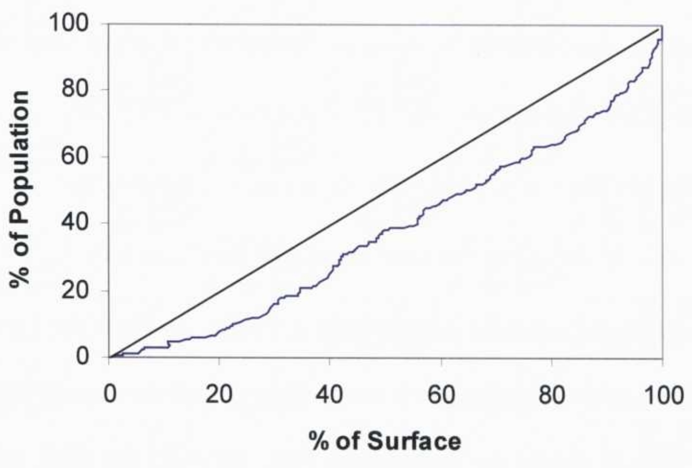


Figure 2.2: Spatial Concentration of GDP in 1984
Lorenz Curve

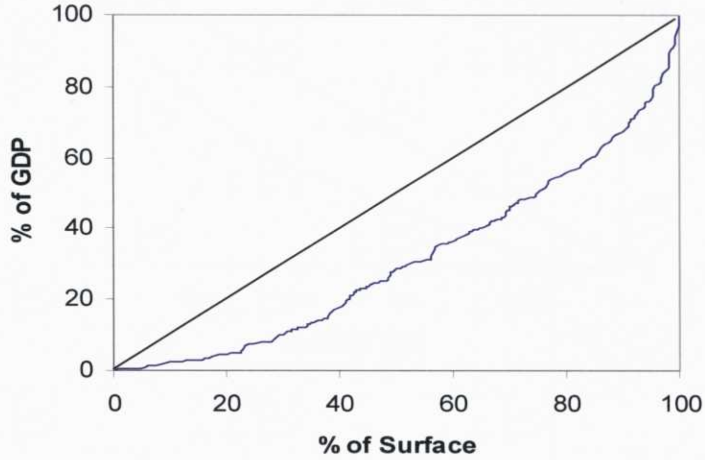
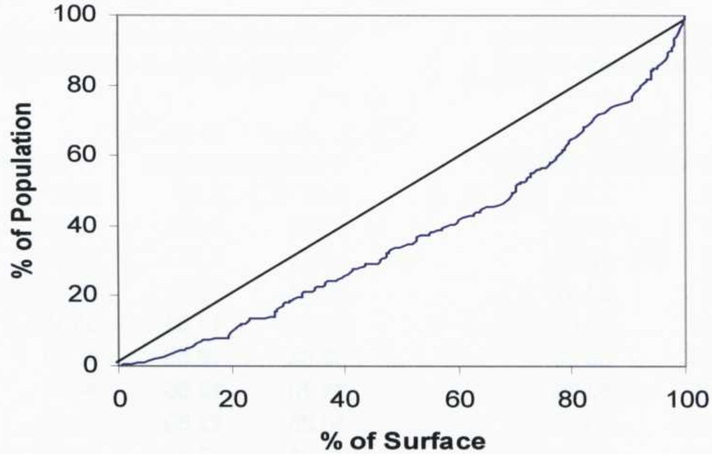
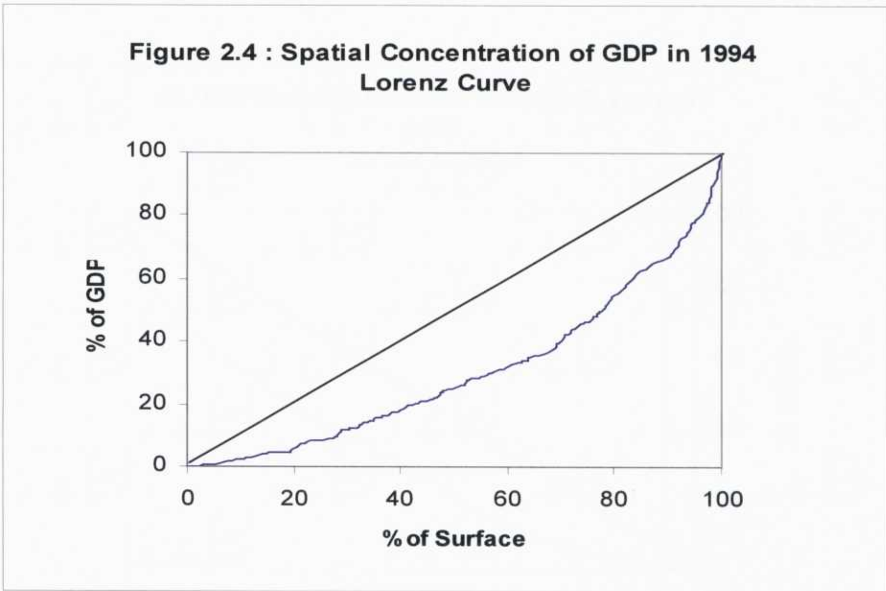


Figure 2.3: Spatial Concentration of Population in 1994
Lorenz Curve





Tables 2.4 and 2.5 give the relative distribution in percentages of population, physical geographical space, and GDP for the 50% of the EU population with the highest income levels in the years 1984 and 1994.

Table 2.4: Spatial Concentration 1984 (Population- Space-GDP)

% of Population	% of surface	% of GDP
4.29	0.68	7.39
10.08	2.39	15.69
15.60	4.73	22.80
20.34	7.78	28.47
25.19	11.68	34.01
30.13	14.94	39.53
33.98	19.28	43.79
39.79	25.26	50.06
45.19	30.75	55.67
49.75	35.68	60.24
50.46	36.69	60.94

Table 2.5: Spatial Concentration 1994 (Population- Space-GDP)

% of Population	% of surface	% of GDP
5.23	0.99	8.78
10.27	2.40	15.93
14.94	4.81	21.88
20.35	7.80	28.34
26.25	13.01	35.10
30.64	16.69	40.01
34.70	19.55	44.41
40.26	22.69	50.28
45.05	27.13	55.14
49.40	29.72	59.39
50.70	30.47	60.64

As one can observe from the table, the intense concentration of the first fifth of the richest population remains constant between the years 1984 and 1994. Specifically, 20.34% of the richest population in 1984 occupied 7.78% of European space and was responsible for 28.47% of GDP. Ten years later 20.35% of the richest population occupied 7.80% of this space and generated 28.34% of GDP. In the following fifth of the population the effects of the increase in the concentration of the population in geographical space become noticeable.

Where the process of concentration becomes more clearly evident is when we reach the 45-50% population band. The data reflects that in 1984, 50.46% of the richest population took up 36.69% of the geographical space while ten years later 50.70% of the population took up 30.47% of the European space, which is to say, approximately half the population took up 6.22% less space in 1994 than in 1984 thus substantially augmenting population concentration.

The identification of the regions that correspond to each of the population bands till reach the 20% of the richest population is given in the following table, table 2.6.

Table 2.6: Comparison between regions and population percentages		
% Population ***up figure 1984*** ***down figure 1994***	**European Union NUTS II regions**	
	1984	**1994**
4.29%-5.33%	Groningen Hamburg Région Bruxelles Île de France Bremen Darmstadt	Hamburg Région Bruxelles Darmstadt Luxembourg Île de France
5.33%-10.07% **5.22%-10.26%**	Oberbayern London Stuttgart Antwerpen	Oberbayern Bremen Outer London Stuttgart Antwerpen
10.07%-15.60% **10.30%-15.20%**	Lombardia Valle d'Aosta Emilia-Romagna Düsseldorf	Valle d'Aosta Lombardia Emilia-Romagna Karlsruhe Trentino-Alto Adige
16.33%-20.34% **15.70%-20.34%**	Karlsruhe Mittelfranken Trentino-Alto Adige Noord-Holland Luxembourg Liguria Piemonte Rheinhessen-Pfalz	Mittelfranken Groningen Düsseldorf Berkshire, Bucks and Oxfordshire Friuli-Venezia Giulia Hannover Veneto
20.83%-25.19%	Alsace Haute-Normandie Köln Hannover Tübingen Rhône-Alpes	West-Vlaanderen Liguria Tübingen Kassel Köln Noord-Holland Utrecht

Table 2.6 allows us to see exactly which regions go to make up the percentages in tables 2.4 and 2.5. It may be observed that there is a stable structure for the regions in which the income levels are highest, that is the 14 regions, which in 1984 represented 15% of the richest European population. In 1994, 11 of these regions remain the same and the extent to which they coincide becomes more accentuated in those regions that represent 5-10 % and 10-15% of the richest population.

Secondly the Gini indices were calculated for the years 1995 and 1999. In this case the values calculated were based on the new accounting system ESA 95 and, in contrast to the previous evaluation, all the NUTS 2 regions in the EU were used[7].

Table 2.3: Values of Gini Index

	Spatial Concentration of GDP	Spatial Concentration of Population
1995	0.3345	0.1955
1999	0.3464	0.2119

While the data in the tables 2.2 and 2.3 are not perfectly comparable since the number of NUTS 2 regions used is different (165 regions in table 2.2 and 205 in table 2.3) and also because of the fact that the GDP values are computed using different accounting systems (ESA79 for Table 2.2 and ESA95 for Table 2.3), it remains clear that the overriding dynamic of a growing concentration, both in terms of population and GDP remains the same in that the trend which characterized the period 1984-1994 appears to be continuing. However, the actual concentration of GDP is greater than the

[7] A list of all of the NUTS 2 regions may be found in the appendix B.

concentration of population. At the same time the rate at which the population becomes more concentrated is greater than the rate at which GDP becomes more concentrated. The graphs 2.5 to 2.8 represent the Lorenz curves that correspond to the Gini indices for 1995 and 1999.

Figure 2.5: Spatial Concentration of Population in 1995
Lorenz Curve

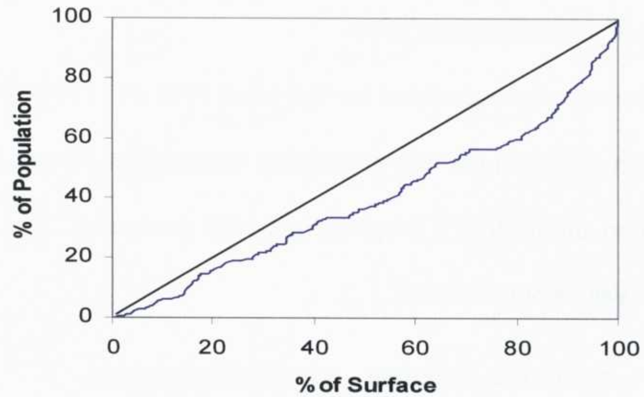


Figure 2.6: Spatial Concentration of GDP in 1995
Lorenz Curve

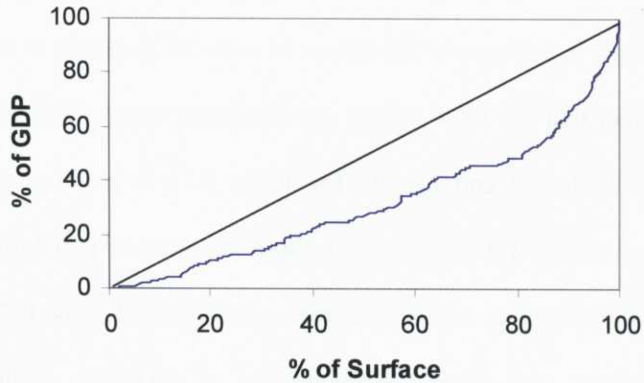


Figure 2.7: Spatial Concentration of Population in 1999 Lorenz Curve

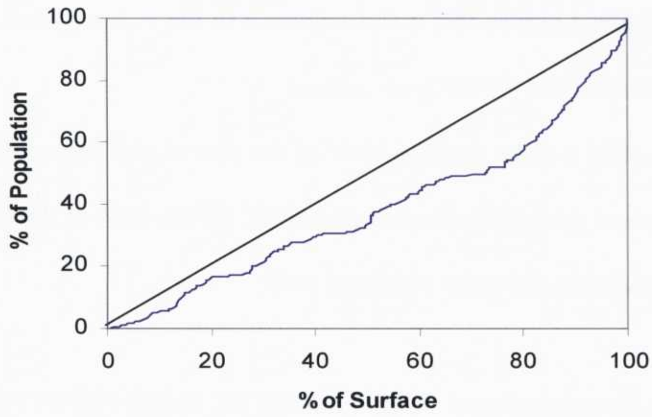
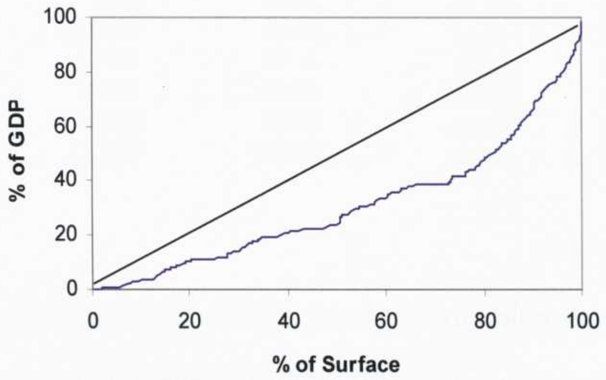


Figure 2.8: Spatial Concentration of GDP in 1999 Lorenz Curve



Graphically it can be observed that the Lorenz curve is more pronounced in 1999 than in 1995 both with respect to the concentration of population and concentration of GDP a fact that would seem to suggest that there is a constant process of spatial densification of the economic variables being analysed. At the same time the distance to the diagonals is greater in those Lorenz curves that make reference to the concentration of GDP thus ratifying the values calculated for the Gini indices.

Tables 2.7 and 2.8 offer a more detailed view of the distribution in percentage form of the population, physical geographical space and GDP[8] for the 50% of the EU population with the highest incomes in the years 1995 and 1999.

Table 2.7: Spatial Concentration in 1995 (Population-Space-GDP)

% of Population	% of Surface	% of GDP
4.89	0.5	8.62
10.85	2.89	17.04
15.25	5.05	22.73
20.6	7.04	29.32
24.92	9.76	34.43
30.36	12.19	40.47
35.77	15.76	46.21
40.49	19.18	51.08
45	30.04	55.65
50.237	37.2	60.71

Table 2.8: Spatial Concentration in 1999 (Population-Space-GDP)

% of Population	% of Surface	% of GDP
4.49	0.49	7.89
10.23	2.43	16.08
15.06	4.97	22.39
20.83	8.19	29.38
25.69	10.4	35.1
30.19	12.69	40.15
35.08	15.12	45.4
40.53	19.06	51.04
45.88	23.18	56.42
50.227	27.2	60.98

Tables 2.7 and 2.8 again reflect the inherent stability in the variables population, area or space and GDP in the first two fifths of the richest members of the EU population, that

[8] These percentages of population, space and GDP for the years 1995 and 1999 have been calculated for all those NUTS 2 EU regions and have been utilized in the calculation of the Gini indices that correspond to these years.

is in 1995, 40.49% of this population occupied just 19.18% of the physical geographical space but accumulated 51.08% of GDP and in 1999 40.53% of the richest part of the population occupied 19.06% of the space and accumulated 51.04% of GDP.

Again, there seems to be a critical frontier that takes shape for the accumulated population at around 45-50% where an intense process of concentration in terms of both population and GDP in spaced appears to taking place. In 1995, 45% of the richest part of the population is situated in 30.04% of the geographical space and is responsible for generating 55.65% of the GDP. In 1999 these figures become 45.88%, 23.18% and 56.42% for population, space and GDP respectively. If we focus on the values that are linked to approximately 50% of the accumulated population we find that the spatial concentration process with respect to the population and GDP is even more strongly evident. Almost the same percentage of population and a greater percentage of GDP are located in approximately 10% less space.

Table 2.9 links the NUTS 2 regions with the percentages expressed in the tables 2.7 and 2.8.

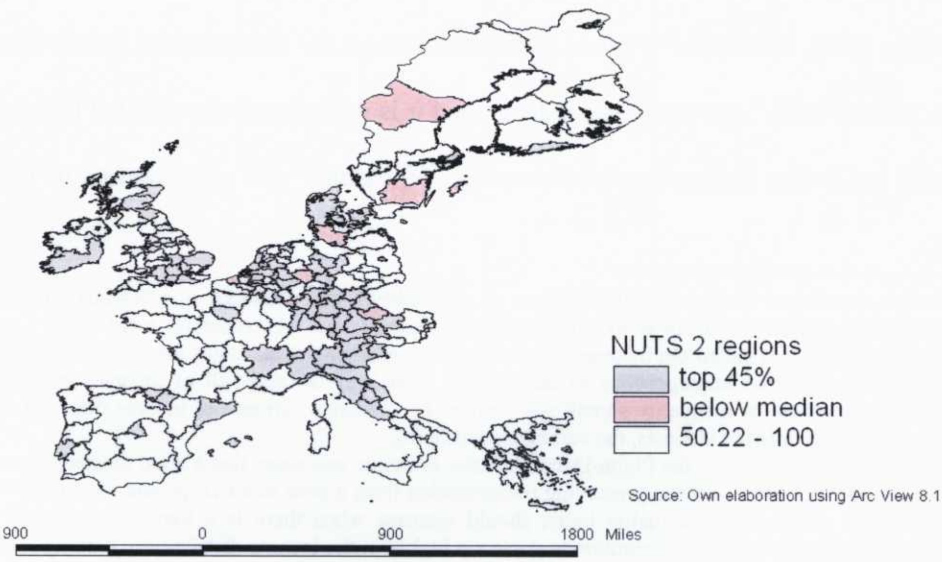
Table 2.9: Comparison between regions and population percentages

% Population ***up figure 1995*** ***down figure 1999***	**European Union NUTS II regions**	
	1995	**1999**
To 4.46% **To 4.49%**	Inner London *Reg. Bruxelles-* *Luxembourg (Grand-* *Duché)* Île de France	Inner London Reg. Bruxelles Luxembourg (Grand- Duché) Hamburg Île de France
4.49%-10.23% **4.46%-10.85%**	Wien Darmstadt Oberbayern Bremen Valle d'Aosta Lombardia Trentino-Alto Adige Stuttgart	Oberbayern Wien Darmstadt Utrecht Bremen Uusimaa (Suuralue) Åland Lombardia
10.85%-15.25% **10.23%-15.06%**	Stuttgart Emilia-Romagna Antwerpen Utrecht Groningen North Eastern Scotland Uusimaa (Suuralue) Salzburg Karlsruhe Stockholm Noord-Holland	Trentino-Alto Adige Noord-Holland Stockholm Stuttgart Emilia-Romagna Berkshire, Bucks & Oxfordshire Valle d'Aosta Salzburg Groningen Mittelfrankene
15.25%-20.60% **15.06%-20.83%**	Düsseldorf Mittelfranken Köln Veneto Piemonte	Antwerpen Karlsruhe North Eastern Scotland Southern and Eastern Veneto Piemonte Düsseldorf

From the tables it can be observed that there is a stable structure in the ranking of the regions that represent 15% of the richest part of the population. Of the 25 regions, which in 1995 made up this 15%, 23 remain in 1999. On looking at the first 5% of the population we find that there is absolute coincidence in the regions.

The following map provides a graphic representation of the values given in the tables 2.8 and 2.9. The representation is based on the localization of those regions that, taken as a whole, accumulate 45% of the richest population. In the map these regions are drawn as areas in grey. The areas drawn in violet represent the following band of aggregate population that is those regions that do not form part of the top 45% but are in the range 45-50%. The rest of the regions are drawn in white.

Map 2.8: Concentration of population 1999



2.7.2 Regional Convergence

The study of convergence of regional per capita incomes can be approached both from a macroeconomic point of view (see Barro and Sala-i-Martín 1990,1991,1992,1995; Sala-i-Martín 1994, 1996, etc.) or by using the tools of the regional scientists such as Amos 1988, Fan and Casetti, 1994, Hansen 1995, Maxwell and Hite 1992, Suarez-Villa and Cuadrado Roura 1993, Terrasi 1998, 2002.

This section follows the second of these approaches and offers the evolution of European regional disparities during the 80's and 90's using a Generalized Entropy Index such as the Theil index of concentration as the main analytical instrument[9]. The Theil coefficient of concentration (Theil, 1967) became a very popular index for analysing spatial distributions. Different authors (Batty, 1974, 1976, Walsh and O'Kelly, 1979, Walsh and Webber, 1977) have shown the merits of this index. No only is it neither scale[10] nor mean dependent[11] and it is not excessively affected by extreme values, but is also independent of the number of regions[12] and can therefore be used to

[9]The vast theoretical and empirical literature on inequalities has produced a substantial number of measures. See Cowell (1995) for an excellent survey of measures and their potential drawbacks.

[10]This characteristic is called the income scale independence principle and states that a desirable measure of inequality should be homogeneous of degree zero, that is if we scale all of incomes by the same number, our measure of inequality should not change. For instance variance of income does not fit this principle (if we double the incomes, the variance quadruples).

[11]This characteristic is called the Pigou-Dalton transfer principle and states that a good inequality measure should rise in response to a mean preserving redistribution from a poor to a rich person or in other words the numerical value of an inequality index should increase when there is a transfer of income from someone lower in the income distribution to someone higher in the income distribution, holding everyone else's income constant. Most measures satisfy this principle being the main exception the variance of logarithms.

[12]This characteristic is called the principle of population or replication invariance and postulates that the distribution of the cake should not depend on the number of the cake receivers. That is, if we measure inequality in an economy with N regions and then merge it with another identical economy, inequality in

compare the inequalities that exist between different regional systems. Moreover, the coefficient is decomposable[13] in between-group and within-group inequalities and in this way it can be used to analyse inequality on different geographical scales simultaneously (Wash and O'kelly 1979, p.271). Furthermore, Bourguignon (1979), Shorrocks (1980) and Cowell (1995) showed that the only inequality indeces that simultaneously satisfy all the principles mentioned are the Generalized Entropy Indeces. These characteristics made the Theil index particularly suitable for analysis of the European case, where regional development has a strong geographical component, thus justifying the adoption of the Theil coefficient. The index is calculated according to the following formulas[14].

Defining $y_i = \frac{GDP_i}{Popul_i}$ as the per capita income of region i and $y_{EU} = \frac{GDP_{EU}}{Popul_{EU}}$ as the average per capita income of the Whole European Union, we can express the regional share of the average European Union per capita income with the x_i variable defined as $x_i = \frac{y_i}{y_{UE}}$. Therefore the Theil index can be expressed in the following way:

the larger economy should be the same (Dalton 1920). Indices such as the weighted coefficient of variation is sensitive to the number of regions and therefore cross-national comparisons of its values are statistically biased.

[13]This characteristic is called the principle of decomposability.

[14]The Theil coefficient can be interpreted as the log of a weighted geometric mean of regional per capita incomes deflated by the national average, the weights being represented by the income shares. A dual form also exists, in which the role of population shares and income shares are interchanged, but we have preferred the original one for its direct relationship with the entropy concept (Theil, 1967,p.127). With respect to the standard deviation of log per capita income, adopted in the analysis of σ-convergence, the Theil coefficient presents the advantage of being weighted, independent of the number of regions and decomposable in between- and within-set shares.

$$IC = \sum_{i} \frac{GDP_i}{GDP_{UE}} \log(x_i) = IC_{br} + IC_{wr} \tag{2.6}$$

$$IC_{br} = \sum_{r} \frac{GDP_{i\in r}}{GDP_r} \log(x_{i\in r}) \tag{2.7}$$

$$IC_{wr} = \sum_{r} \frac{GDP_{i\in r}}{GDP_r} \left[\sum_{i} \frac{y_i}{y_{i\in r}} \log\left(\frac{x_i}{x_{i\in r}} \right) \right] \tag{2.8}$$

taking into account that $y_{i\in r} = \dfrac{GDP_{i\in r}}{Popul_{i\in r}}$ stands for the per capita income of region i that belongs to the "r" group of regions and $y_r = \dfrac{GDP_r}{Popul_r}$ is the average per capita income of the "r" group of regions, we can express the regional share of the average per capita income in the "r" group of regions through the $x_{i\in r}$ variable defined as $x_{i\in r} = \dfrac{y_{i\in r}}{y_r}$.

IC stands for Total Inequality, IC_{br} is between-group inequality and IC_{wr} is within-group inequality. Notice that the global inequality index may be broken down into two components, a between or across-group of regions index and a weighted average of within-group of regions inequalities. It should be noticed that the weights are in form of the aggregate incomes rather than population sizes.

Taking into account the above expressions, we have calculated the Theil Index for the regions of the European Union over different time periods, using two different European accounting systems (ESA79 and ESA95) and different numbers of regions. In all of the computations of the Theil index we have classified the European regions into two groups: On the one hand we consider the less developed regions or the "objective 1 group" in the European Union. This group logically takes in the objective 1 regions[15]. On the other we consider the remaining regions in the European Union, i.e., those that fall outside the objective 1 category and that we will call "non-objective 1 group". This classification provides us with a means of measuring the dispersion in the distribution of income between those two groups and thus we are able to assess the convergence process more accurately.

The GDP variable used in the Theil formula is expressed in terms of purchasing power standards (PPS) at constant 1985 prices. The data was provided by the European statistical office (EUROSTAT). As mentioned above, however, our analysis is based on two series of data that are not perfectly homogeneous for the years they overlap: One series is for 1982-1997 (ESA79) and the other for 1995-1999 (ESA95[16]).

The first computations of the Theil Index have been made for the period (1982-1997) with ESA79. This is our longest Theil series and takes in 131 regions in the EU12. The

[15]In all our computations "objective 1 group" takes in those NUTS II regions that were objective 1 either in the first programming period (1989-1994) (Delor's I Package) or in the second programming period (1995-1999) (Delor's II Package) and "non-objective 1 group" takes in the remainder of the European Union NUTS II regions.

[16] The move to ESA95 based accounts in 1999 was planned to address a range of inconsistencies and establish a new Eurostat-compatible and consistent data set from 1995.

"objective 1 group" comprises 38 regions and the "non-objective 1 group" 93 regions[17]. The results are given in table 2.10.

For each year and for each of the two groups considered table 2.10 gives the population shares, the income shares, the logarithm of the ratio shares and the contribution to the Theil index. Finally, the last three columns give the numerical values of the Theil index for between groups, within groups and the total.

[17] Annex C lists the NUTS II regions that belongs to each group considered.

Table 2.10: Population and Income Shares for objective 1 and non-objective 1 group of regions and the Theil Index (1982-1997)

		Pop. Share	Income Share	Log R. Sh.	Cont.Theil Index	Theil Bet.	Theil Within	Theil Total
1982	obj 1 group	0.3258	0.1839	-0.5720	-0.1052			
	non-objective 1 group	0.6742	0.8161	0.1911	0.1559	0.0507	0.0137	0.0645
1983	obj 1 group	0.3274	0.1865	-0.5627	-0.1050			
	non-objective 1 group	0.6726	0.8135	0.1902	0.1547	0.0498	0.0180	0.0677
1984	obj 1 group	0.3291	0.1868	-0.5664	-0.1058			
	non-objective 1 group	0.6709	0.8132	0.1923	0.1564	0.0506	0.0185	0.0692
1985	obj 1 group	0.3302	0.1863	-0.5725	-0.1066			
	non-objective 1 group	0.6698	0.8137	0.1947	0.1584	0.0518	0.0192	0.0710
1986	obj 1 group	0.3319	0.1852	-0.5834	-0.1080			
	non-objective 1 group	0.6681	0.8148	0.1985	0.1617	0.0537	0.0182	0.0719
1987	obj 1 group	0.3321	0.1878	-0.5704	-0.1071			
	non-objective 1 group	0.6679	0.8122	0.1957	0.1590	0.0519	0.0179	0.0697
1988	obj 1 group	0.3316	0.1919	-0.5471	-0.1050			
	non-objective 1 group	0.6684	0.8081	0.1898	0.1534	0.0484	0.0174	0.0659
1989	obj 1 group	0.3306	0.1923	-0.5420	-0.1042			
	non-objective 1 group	0.6694	0.8077	0.1879	0.1517	0.0475	0.0169	0.0644
1990	obj 1 group	0.3254	0.1896	-0.5404	-0.1024			
	non-objective 1 group	0.6746	0.8104	0.1835	0.1487	0.0463	0.0186	0.0648
1991	obj 1 group	0.3258	0.1924	-0.5266	-0.1013			
	non-objective 1 group	0.6742	0.8076	0.1805	0.1458	0.0444	0.0177	0.0622
1992	obj 1 group	0.3248	0.1951	-0.5098	-0.0994			
	non-objective 1 group	0.6752	0.8049	0.1757	0.1414	0.0420	0.0181	0.0601
1993	obj 1 group	0.3230	0.1951	-0.5044	-0.0984			
	non-objective 1 group	0.6770	0.8049	0.1731	0.1393	0.0410	0.0179	0.0588
1994	obj 1 group	0.3236	0.1948	-0.5076	-0.0989			
	non-objective 1 group	0.6764	0.8052	0.1743	0.1404	0.0415	0.0183	0.0598
1995	obj 1 group	0.3203	0.1942	-0.5005	-0.0972			
	non-objective 1 group	0.6797	0.8058	0.1702	0.1372	0.0400	0.0185	0.0584
1996	obj 1 group	0.3200	0.1966	-0.4873	-0.0958			
	non-objective 1 group	0.6800	0.8034	0.1668	0.1340	0.0382	0.0191	0.0573
1997	obj 1 group	0.3198	0.1994	-0.4722	-0.0942			
	non-objective 1 group	0.6802	0.8006	0.1629	0.1304	0.0363	0.0196	0.0558

If we focus on the between-group inequality which aims to proxy the catching-up process of objective 1 regions with respect to the non-objective 1, table 2.10 reflects a change in the general tendency. Between 82 and 87 the disparity remained relatively constant rising from a value of 0.0507 in 1982 to 0.0519 in 1987. Between 1988 and 1997 however the income disparities between these two groups shrunk from 0.0484 in 1988 to 0.0363 in 1997. The within-group inequality, on the other hand tended to increase slightly. The total or overall Theil index displays almost the same pattern as the Theil index between groups. This would seem to indicate that the increase in the regional inequalities from 1982 to 1987 was driven by an increase in both the between-group component and the within-group component of the Theil Index. In 1982 the between-group contribution to European inequality was 0.0507 (as we saw in table 2.10) and by 1987 this figure had risen to 0.0519. With respect to the within-group contribution to the European inequality the figures rose from 0.0137 in 1982 to 0.0179 in 1987.

The decrease in regional inequality in the European Union from 1987 to 1997 was driven by a decrease in the between group component of total inequality. The between group contribution to total inequality was 0.0484 in 1988 and by 1997 this figure had risen to 0.0363. In this period the within-group inequality follows a relatively stable path. The graphic representation offered in figures 2.10 and 2.11 provide a vision which underline the similarities between the patterns traced by between-group inequalities and total inequality. Figure 2.12 provides a representation of the relative contributions of the between-group inequalities and the within-group inequalities to the total inequality and as such offers a graphic comparison of the three.

Figure 2.9: Theil Between Groups Comparative Performance Objective 1 Regions EU12 (1982-1997)

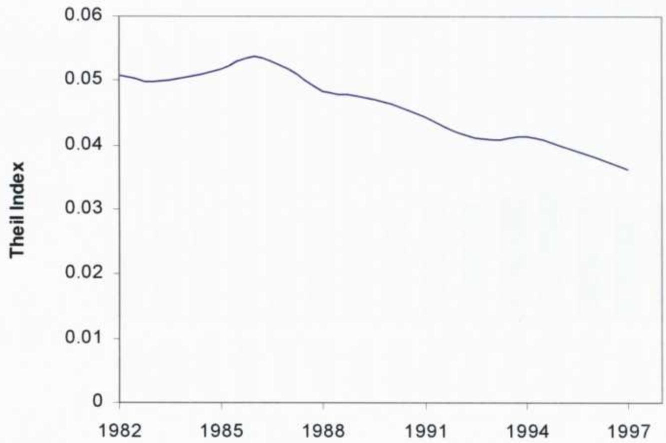
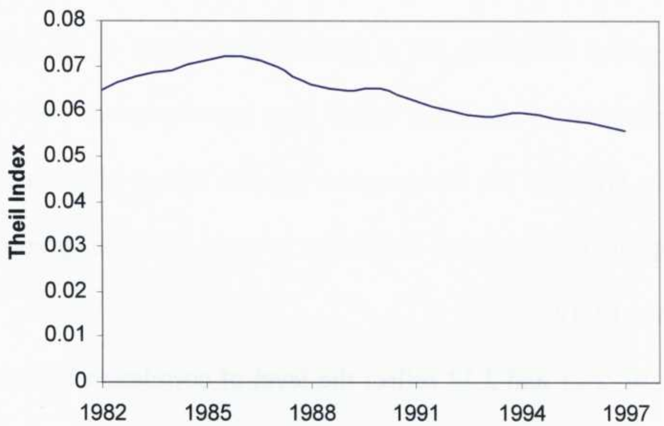
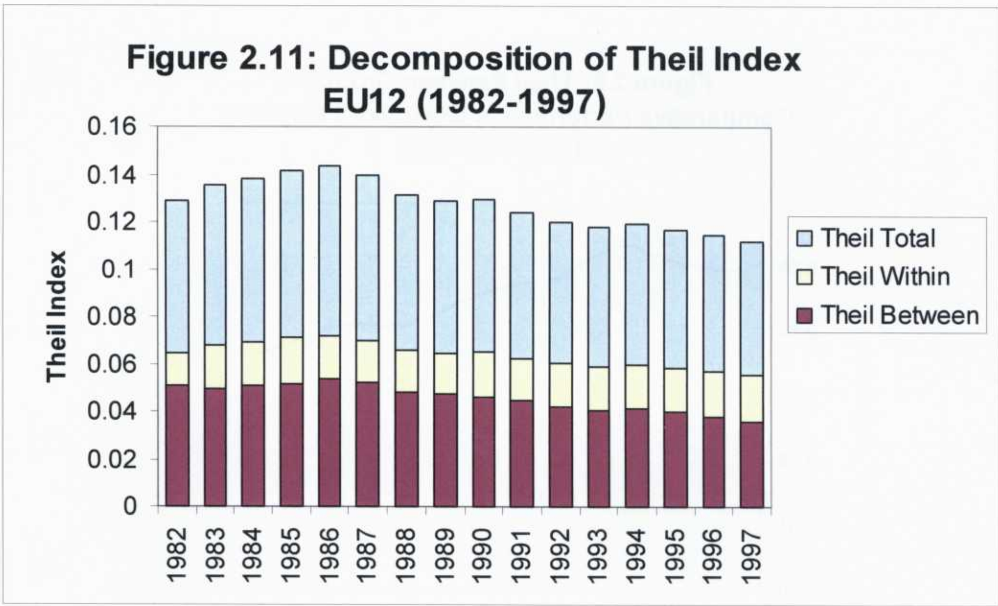


Figure 2.10: Theil Total Income Inequality among EU regions EU12 (1982-1997)





It can be seen from figure 2.12 that between-group inequality contributes proportionally more to the total inequality than within-group inequality. Moreover, there is a stable tendency of within-group inequality and a decreasing tendency of the between-group inequality. The breakdown of the Theil index into between-group and within-group components helps to highlight the convergence process taking place in the levels of income across groups and the relative stagnation in terms of within-group inequalities from 1987-1997 in the EU12.

Moreover figures 2.10, 2.11 and 2.12 reflect the level of correlation in both the phases of divergence and convergence for the period 1982-1997 with the reforms of the

European Union regional policy. The reduction in the disparities between the objective 1 and non-objective 1 groups has been taking place ever since the Delor's I (1989-1993) and Delor's II (1994-1999) packages come into effect, signalling the reform of regional policy.

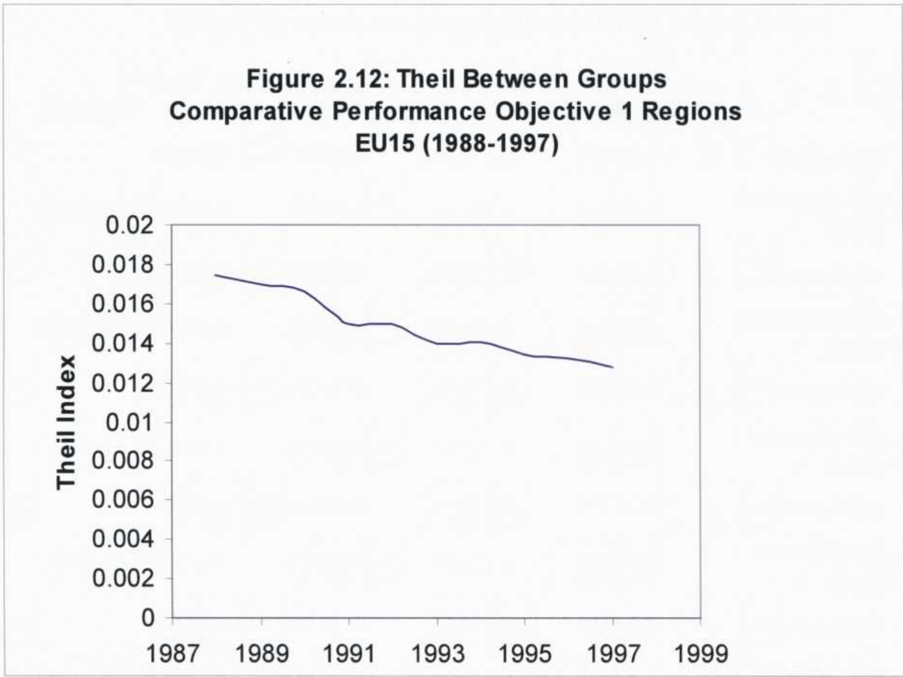
In order to enhance the sample of regions at our disposal we compute the Theil index for the period 1988-1997 (ESA79). The new sample includes 189 regions[18] all of which belong to the 15 present-day European Union countries. The general conclusions that may be drawn are similar to those given above for the smaller sample of regions. The reduction inequalities in income is due to the constant decrease in the gap in the Theil index between the two groups, which means that there is a convergence process taking place across groups of regions, in other words between objective 1 and non-objective 1 regions. Table 2.11 gives the results of the computations and can be read in similar terms to table 2.10.

[18] Annex D lists the NUTS II regions that belongs to each group considered

Table 2.11: Population and Income Shares for objective 1 and non-objective 1 group of regions and the Theil Index Between the two groups (1988-1997)

		Pop. Share	Income Share	Log R. Sh.	Cont.Theil Index	Theil Bet.
1988	obj 1 group	0.2072	0.1352	-0.4270	-0.0577	
	non-objective 1 group	0.7928	0.8648	0.0870	0.0752	0.0175
1989	obj 1 group	0.2068	0.1358	-0.4204	-0.0571	
	non-objective 1 group	0.7932	0.8642	0.0857	0.0741	0.0170
1990	obj 1 group	0.2046	0.1346	-0.4190	-0.0564	
	non-objective 1 group	0.7954	0.8654	0.0844	0.0730	0.0167
1991	obj 1 group	0.2045	0.1379	-0.3946	-0.0544	
	non-objective 1 group	0.7955	0.8621	0.0805	0.0694	0.0150
1992	obj 1 group	0.2041	0.1376	-0.3942	-0.0542	
	non-objective 1 group	0.7959	0.8624	0.0802	0.0692	0.0150
1993	obj 1 group	0.2034	0.1391	-0.3801	-0.0529	
	non-objective 1 group	0.7966	0.8609	0.0776	0.0668	0.0140
1994	obj 1 group	0.2039	0.1393	-0.3808	-0.0530	
	non-objective 1 group	0.7961	0.8607	0.0780	0.0671	0.0141
1995	obj 1 group	0.2022	0.1391	-0.3735	-0.0520	
	non-objective 1 group	0.7978	0.8609	0.0760	0.0654	0.0135
1996	obj 1 group	0.2020	0.1395	-0.3701	-0.0516	
	non-objective 1 group	0.7980	0.8605	0.0754	0.0649	0.0132
1997	obj 1 group	0.2019	0.1406	-0.3622	-0.0509	
	non-objective 1 group	0.7981	0.8594	0.0741	0.0637	0.0127

Figure 2.13 plots the evolution of the Theil index from 1988 to 1997 in the EU15 between the two groups. The value of the index falls throughout the whole period.



Finally, in order to bring the study of the regional convergence patterns in the European Union up to date using the most recent data available, we compute the numerical values for the Theil index for the period 1995-1999 based on ESA95 accounting. As before we divide the whole sample of NUTS II regions into two groups corresponding to objective 1 and non-objective 1 regions[19].

Table 2.12 provides the main results of the computations for the Theil index and reflects the reduction in income disparities between the two groups. This should be

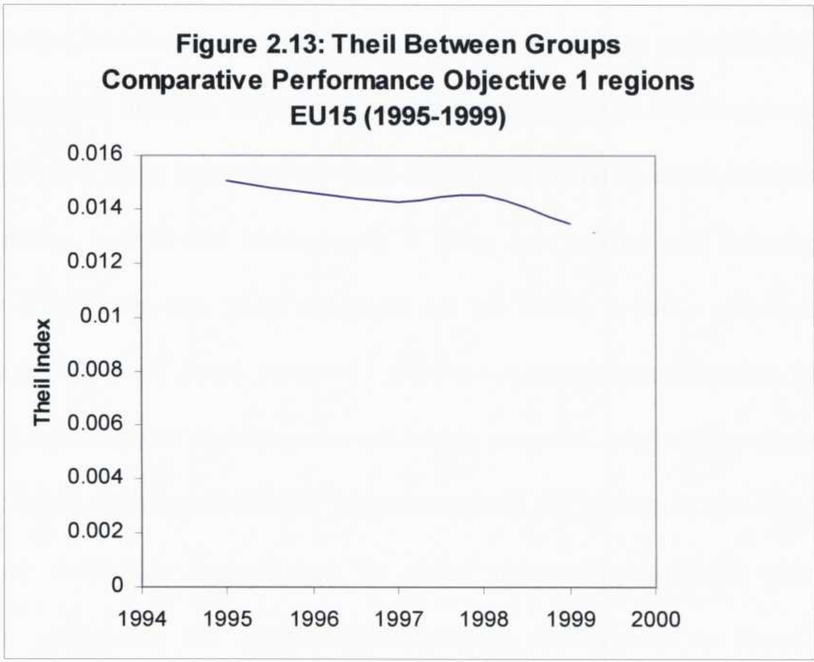
[19]Annex E lists the NUTS II regions that belongs to each group considered

viewed as a conclusive proof of the catching-up process taking place between objective 1 regions and non-objective 1 regions.

Table 2.12: Population and Income Shares for objective 1 and non-objective 1 group of regions and the Theil Index Between the two groups (1995-1999)

		Pop. Sh.	Income Share	Log R. Sh.	Cont. Theil Index	Theil Bet.
1995	obj 1 group	0.24439	0.17259	-0.34786	-0.06004	
	non-objective 1 group	0.75561	0.82741	0.09078	0.07511	0.01507
1996	obj 1 group	0.24413	0.17341	-0.34204	-0.05931	
	non-objective 1 group	0.75587	0.82659	0.08944	0.07393	0.01462
1997	obj 1 group	0.24382	0.17402	-0.33726	-0.05869	
	non-objective 1 group	0.75618	0.82598	0.08829	0.07293	0.01424
1998	obj 1 group	0.24354	0.17311	-0.34134	-0.05909	
	non-objective 1 group	0.75646	0.82689	0.08902	0.07361	0.01452
1999	obj 1 group	0.24317	0.17533	-0.32709	-0.05735	
	non-objective 1 group	0.75683	0.82467	0.08584	0.07079	0.01344

Figure 2.13 plots the values of the between-group Theil index and gives the comparative performance of objective 1 regions.



The general tendency towards a decrease in inequality between the two groups becomes evident from this figure. There is however a small increase in inequality between 1997 and 1998.

2.8 Population Potentials and Levels of Development

The following section attempts econometrically to test the explanatory power that population potentials have on the levels of development. Our goal here, is to discover whether or not the explanatory efficacy of population potentials holds constant over time or whether it decreases the further we move away from the year in which our estimates for the cross-sectional regressions began (1982). To this end we use a logarithm specification to express the relationship between population potentials and levels of development in order to estimate the regressions for different time periods.

As we mentioned above, population potential data was computed using a gravity model. This computation was carried out using a geographical information system which involves building a net of points for the European space and assigning a value of potential for each of these points (see section 2.4 for more details about the computation of the population potentials). The next step in our computations was to assign a value of population potential to each of the European Union[20] NUTS II regions in order to obtain a comparable relationship between levels of development and these population potentials based on an identical geographical coverage. We proxy the levels of development according to (NUTS II) gross domestic product per capita (PPS at 1985 prices).

Once the data had been elaborated, we estimated the posited relationship for the years, 1982, 1989, 1994 and 1997 for the EU12 regions and in 1999 for EU15 regions. Figures on income per capita are based on Eurostat data (ESA79) for the years 1982, 1989, 1994 and 1997 and Eurostat data (ESA95) for 1999.

An initial impression of the relationship between population potentials and levels of development is shown in figures 2.14 and 2.15.

[20] The value of the population potential assigned to each of the NUTS II regions in the European Union is based on a weighted aggregate of the points´ population potential that belong to a particular region.

Figure 2. 14: Population Potentials and Levels of Development (UE12 1989)

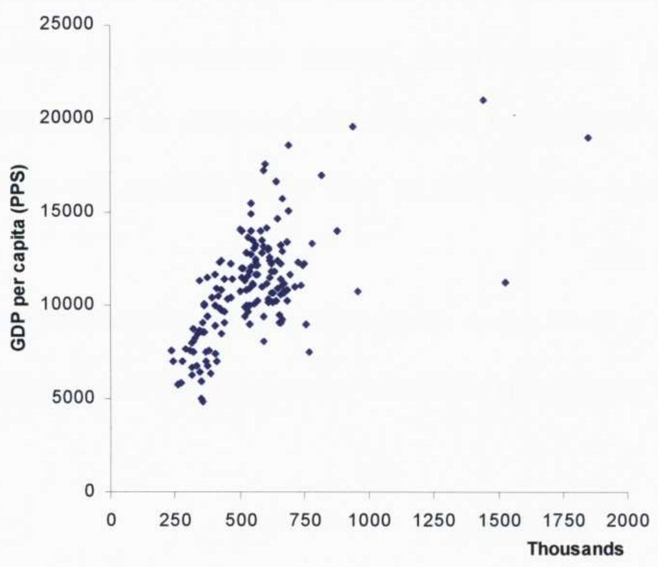
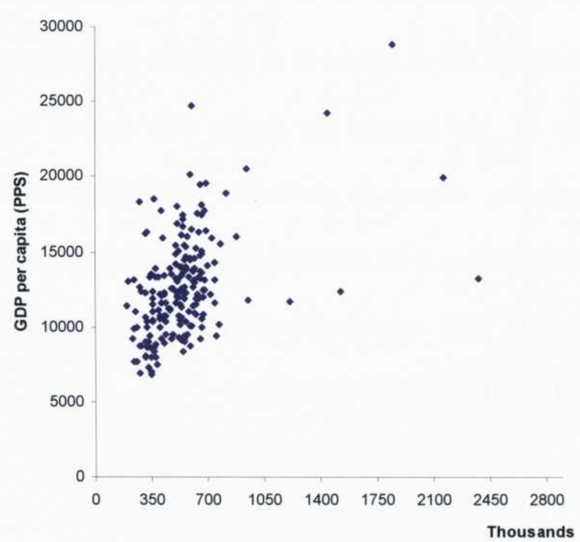


Figure 2.15: Population Potentials and Levels of Development (UE15 1999)



The above scatter graph, plots the relationship between the levels of development and population potentials for two points in time, the year 1989 (EU12) and 10 years later (1999) for EU15. On analyzing the dynamic evolution of the positive relationship between levels of development and population potentials we find that there is a higher degree of dispersion in 1999 than in 1989 which indicates that this relationship is diminishing over time.

In order to give a more robust interpretation to the relationship between levels of development and population potentials we estimate the following model:

$$LnGDPpc_{i,t} = a + cLnV_{i,t} + u_{i,t} \qquad (2.9)$$

GDPpc represents gross domestic product in purchasing power parities at 1985 prices, V stands for population potentials and u is a random disturbance. This kind of specification has the advantage that it allows us to interpret the estimated coefficient c directly as the elasticity of the income per capita with respect to the population potentials (in other words the change in per capita income expressed in percentage terms that takes place when there is a 1% increase in the population potentials).

Tables 2.13, 2.14, 2.15, 2.16, 2.17 contain the cross-section estimations of the model (2.9) for the years 1982, 1989, 1994, 1997 and 1999.

Table 2.13: Population Potential and Regional Income EU12 1982

Dependent Variable: LNY82
Method: Least Squares
Included observations: 131

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.136282	0.694993	-0.196091	0.8448
LNV	0.708395	0.052933	13.38296	0.0000

R-squared	0.581310	Mean dependent var	9.161970
Adjusted R-squared	0.578064	S.D. dependent var	0.301394
S.E. of regression	0.195775	Akaike info criterion	-0.408551
Sum squared resid	4.944296	Schwarz criterion	-0.364655
Log likelihood	28.76011	F-statistic	179.1037
		Prob(F-statistic)	0.000000

Table 2.14: Population Potential and Regional Income EU12 1989

Dependent Variable: LNY89
Method: Least Squares
Included observations: 161

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.944067	0.614355	3.164404	0.0019
LNV	0.556469	0.046651	11.92837	0.0000

R-squared	0.472262	Mean dependent var	9.270123
Adjusted R-squared	0.468943	S.D. dependent var	0.261802
S.E. of regression	0.190785	Akaike info criterion	-0.463000
Sum squared resid	5.787397	Schwarz criterion	-0.424722
Log likelihood	39.27149	F-statistic	142.2860
		Prob(F-statistic)	0.000000

Table 2.15: Population Potential and Regional Income EU12 1994

Dependent Variable: LNY94
Method: Least Squares
Included observations: 169

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.364388	0.514051	6.544848	0.0000
LNV	0.449592	0.038998	11.52861	0.0000

R-squared	0.443164	Mean dependent var	9.288080
Adjusted R-squared	0.439830	S.D. dependent var	0.264769
S.E. of regression	0.198165	Akaike info criterion	-0.387672
Sum squared resid	6.557967	Schwarz criterion	-0.350632
Log likelihood	34.75831	F-statistic	132.9089
		Prob(F-statistic)	0.000000

Table 2.16: Population Potential and Regional Income EU12 1997

Dependent Variable: LNY97
Method: Least Squares
Included observations: 169

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.502148	0.506481	6.914668	0.0000
LNV	0.444498	0.038424	11.56837	0.0000

R-squared	0.444864	Mean dependent var	9.358730
Adjusted R-squared	0.441540	S.D. dependent var	0.261268
S.E. of regression	0.195246	Akaike info criterion	-0.417345
Sum squared resid	6.366234	Schwarz criterion	-0.380305
Log likelihood	37.26565	F-statistic	133.8271
		Prob(F-statistic)	0.000000

Table 2.17: Population Potential and Regional Income EU15 1999

Dependent Variable: LNY99
Method: Least Squares
Included observations: 204

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.129120	0.477704	10.73701	0.0000
LNV	0.326139	0.036328	8.977634	0.0000
R-squared	0.285204	Mean dependent var		9.415562
Adjusted R-squared	0.281665	S.D. dependent var		0.258615
S.E. of regression	0.219188	Akaike info criterion		-0.188014
Sum squared resid	9.704801	Schwarz criterion		-0.155484
Log likelihood	21.17746	F-statistic		80.59792
		Prob(F-statistic)		0.000000

From the output of the estimations, it can be seen that the significance of the parameters is very high (t-statistic) and that the effects of population potentials on the levels of development are decreasing over time. This fact is reflected in the values that the coefficient c takes in the different periods of analysis. The coefficient c changes from 0.77 in 1982 to 0.444 in 1997 and to 0.326 in 1999. One possible interpretation of this result is as follows:

The concept of population potentials may be interpreted in terms of market potential. One spatial factor that determines regional income is the closeness to large consumer markets as it is emphasized in demand oriented models of regional growth (Kaldor 1970) and the agglomeration effects of the new economic geography models (NEG). This effect can be captured by our population potentials.

Therefore, proximity to large consumer markets, or in other words, market potential, was an important explanatory variable for regional income in the early eighties but has been decreasing in significance in determining regional income in the 1990´s. Thus dynamic income regions have also emerged on the periphery, and need not necessarily be close to rich regions. It would seem logical to assume therefore, that "new" European Union regional policy has been one of the motors of these effects since the mid eighties. European Union regional policy has had an important effect in terms of boosting the growth of peripheral regions and by extension their income levels and the results given here provide evidence to this effect.

2.9. Conclusions

The heavy "structural" lines of potentials in the European territorial space when studied through the technique of population potentials, clearly reflects a similarity with the satellite observations of night-time light emissions from cities, houses, industries, etc., captured by the Earth Viewer Satellite. This similarity highlights the usefulness of the technique of population potentials (based on an analogy with classical mechanics) for providing a graded image of the population distribution within a particular territory. Population Potentials offer a means of condensing a large quantity of information by plotting maps of population contours which expand from the main agglomeration areas, where the highest peaks of population potentials are located.

When applied to Europe this technique highlights an area in which the European population is particularly dense. This area is based around the large population centers of Manchester – London – Paris – Cologne – Düsseldorf – Ruhr Valley, around which there are further concentric population potential contours of decreasing strength. This research provides us with a clear-cut alternative to what is commonly known as the "Blue Banana"-a large growing area which includes most of the regions of Germany, Austria and the Benelux countries, as well as the more developed urban regions which form part of the UK, France and the North of Italy.

This technique provides us with an alternative vision of the European population as a nuclear structure with successive concentric lines of potentials and this vision correlates quite remarkably with nighttime light diffusion images which depict the population centered around what we define as the "Central European Triangle" (UK, Manchester, London, Paris, Cologne, Düsseldorf, Ruhr Valley). Around this area, successive population potential contours take in Berlin and the Prague and a North Italian axis.

Moreover, population potentials highlight the impact enlargement will have on the different components of the spatial structure of Europe. Potential contours indicate that "gravitational" center of Europe will be displaced towards the East.

Eastern areas of the current EU such us East and Central Germany, Austria and Western of Italy will enjoy significant competitive advantages due to the relatively strong increases in their population and market potentials which enlargement will provoke. CEECs will also enjoy important competitive advantages due to the fact that they are located centrally within a high potential contour (330.000 inh/Km)- but they are peripheral with respect to the current members of the EU- they are in the Eastern border. After enlargement they will form part of a large market area and no longer be quite so peripheral. The CEECs will also benefit from reinforced regional and local authority cooperation within the framework of new “cooperative” spaces such us these in the Central European, Adriatic, Danubian and South Eastern European Space (CADSES). They will however, probably be border regions in the Eastern frontier that will probably require special policy measures.

Enlargement will also be beneficial to the central areas of the EU and will probably not affect the strong tendency toward large-scale agglomeration at the real core of the European spatial structure: The central triangular area made up of the large metropolitan areas of Great Manchester-London/Paris/Köln-Dusseldorf-Rhur Valley that concentrates more than 40% of the EU population and more than 50% of EU GDP. The Atlantic periphery, on the other hand, will be affected by an important comparative decrease in population potentials. This decrease must be countered by the development and adoption of new European Regional Policy measures which will be carried out within the framework of the European Spatial Development Perspective. These policy measures will be needed in order to compensate for the fact that these regions are “outliers” and in order to promote a more balanced, polycentric kind of development. The policy measures will also be aimed at improving the efficiency of the small and medium size agglomerations areas, within the framework of urban networks for the Atlantic periphery, since, as the ESDP states enlargement will mean that these regions run the risk of becoming more loosely connected to more developed regions of Europe.

The last part of the chapter uses on the one hand Gini indices to analyze the spatial concentration of GDP and Population in the European Union. On the one hand we deal with the widely dealt with issue of regional convergence in the EU territory. The length of the period studied is crucial to situating and assessing the nature of convergence since it is essentially a long-term process. The methodological approach adopter in this chapter involves the use of the traditional tools of regional scientists rather than experimenting with the new tools introduced by macroeconomists (chapter three). By this means we are able to show that the results obtained using older, simpler techniques are very similar to those achieved using more sophisticated methods. Further, we address some of the factors that have, until now, been somewhat neglected, such as the problem of the weighting the contribution of different geographical areas.

Our main conclusions highlight the fact that population and GDP are highly concentrated at the "core" of the European territory. Further, the concentration of GDP in geographical space is higher than the concentration of population and this is reflected by a higher value of the Gini Index. From a dynamic point of view there has been a slight increase in the concentration of GDP and population in space over time and the increase in the concentration of population has been greater than the increase in the concentration of GDP. Finally, there is a remarkable level of stability over time with respect to the proportion of the space that corresponds to the 15-20% of the richest part of the population in the European Union. Moreover, on assigning this population to its corresponding regions we again observe the above mentioned stability. Of the 14 regions that represented the top 15% of richest population in 1984, eleven remained the same in 1994.

The regional convergence process in the European Union has seen the disparities in income between the objective 1 and non-objective 1 groups decreasing from 1987/1988 until the present for all of the samples used in our study (EU12 1982-1997, EU15 1988-1997 both samples analyzed using ESA79 accounting system and EU15 1995-1999 analyzed using the new accounting system ESA95). This indicates that there is indeed, a catching-up or convergence process underway with respect to the income levels of the two groups considered. Furthermore, this process has taken place between the years 1988-1999 and coincides with the new regional policy reforms in the Euroepan Union, the so-called Delor's I and Delor's II packages. This lends itself to the interpretation that the convergence process taking place between the two groups has been boosted by the new European Union regional policy. This issue is explored in more detail in chapter four of this dissertation.

In the last section of the chapter, we analyse the relationship between population potentials and development levels in the European Union for different periods of time, enabling us to test whether the relationship holds over time. We find clear evidence to support the positive effect of population potentials in determining levels of development.

Chapter three

The neo-classical model of growth and the convergence proccess in Europe

3.1 Introduction

The issue of convergence, both nominal and real, is very important not only from the policy perspective but also from the perspective of the theory of economic growth. From an economic policy point of view in the case of persistently large (or widening) gaps between poor and rich countries, there could be a need for economic policy measures (domestic and international) to stimulate a catch-up process. This convergence issue is also relevant in the political context of west European integration. In fact, Article 2 of the Treaty of European Union stipulates that *"The Community shall have the task……to promote…… a high degree of convergence of economic performance, ……the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among Member States.*" In a similar vein, Article 130a stipulates that "*the Community shall aim at reducing disparities between the levels of development of the various regions, including rural areas*". Significant transfers have been provided for in the framework of the Structural and Cohesion Funds to support the process of economic convergence in the peripheral regions, i.e. regions with real per capita GDP significantly below the European Union average. From the perspective of the economic growth theory, the reduction of existing gaps in developmental and income levels between countries, in other words the convergence of regional incomes is postulated by the neo-classical model of growth. The idea of a transitional growth path to a steady state income, on which growth rates decline, is the fundamental theoretical ingredient of convergence analyses.

The rest of the chapter is divided into seven sections. Section 3.2 briefly reviews the neo-classical growth model. Section 3.3 describes the concepts of convergence, how to measure it and how long it takes to reach the steady state. Section 3.4 describes the different methodological approaches in the convergence studies (cross-section analyses in the tradition of Barro/Sala-i-Martin, panel data analyses and Markov chain models). Section 3.5 reviews the main empirical findings of convergence in Europe in published studies. Section 3.6 describes the dataset we will use and on which Section 3.7 contains the results of our convergence analyses. Section 3.8 gives the conclusions.

3.2 The Neo-Classical Model of Growth and the Convergence Hypothesis

3.2.1 The Neo-Classical Model of Growth

Since the end of the Second World War the analysis of economic growth has been dominated by debates which have centred on the neo-classical growth model. The concept of convergence has had its roots in this model which is generally referred to as the Solow growth model which was derived from the works of Robert Solow (1956) and Trevor Swan (1956). This model has provided the basis for the dominant orthodoxy for most of the period, and has strongly influenced economic policy over the last 20 years. The basic neo-classical model describes a one-sector closed economy with a composite, single "Robinson Crusoe" agent (Household/producer) who owns the inputs and manages the production process.

The following discussion of this model is based on Chapter one of Barro and Sala-i-Martin's (1995) book titled *Economic Growth,* chapter one of Sala-i-Martin's (2000) book entitled *Apuntes de Crecimiento Económico,* and Romer's (1996) book entitled Advanced in Macroeconomics.

In the simplest form of the neo-classical model, output Y at time t is a function of the variables physical capital $K(t)$ and labour $L(t)$, and the level of technology which is exogenous:

$$Y(t) = F(A(t), K(t), L(t)) \tag{3.1}$$

The central characteristics of the neo-classical model are the assumptions that (i) the level of technology is exogenously determined, (ii) the production factors labour and capital each have diminishing marginal products, and (iii) the production function shows constant returns to scale.

The level of technology $A(t)$ is considered as given and is exogenously determined. In the long term, only an increase in technological development provokes a rise in the steady state output. The assumption of a given technology to which every economy has free access is an over-simplification, given that technological progress is largely the result of research activities. There is however, some justification for this assumption. On a world-wide scale, certain technological standards have been reached, which an economy can access more and more readily (for instance software that one can download from internet sites). In general, the argument of equal access to available technology, or fast technology diffusion, can be considered to be valid for highly open economies with a similar level of basic education of the population. One might expect this in the case of advanced economies in general, and is therefore the case for EU regions.

Technology is treated as labour augmenting : $Y = f(K, L * A(t))$. It raises output in the same way as it raises labour. (In this sense an innovation is Harrod neutral, i.e. the relative inputs shares $K * F_K / L * F_L$ are unchanged for a given capital/output ratio[1].

The *Cobb-Douglas production function*[2] given in Eq. (3.2) below fulfils the properties of the neo-classical production function perfectly and is therefore suitable for discussing the properties of the neo-classical production function. In addition, it has the advantage of bringing us very close to real-world comtemporary production functions (D. Romer 1996). (For convenience the subscript (t) is dropped in the following).

$$Y = F(K, A * L) = K^{\alpha}(AL)^{1-\alpha},\ 0 < \alpha < 1 \qquad (3.2)$$

[1] An alternative assumption is that technological progress is Hicks neutral

[2] The origin of this function is on the solution given by a mathematician called Charles Cobb to a question posed by his friend, the politician Paul Douglas about the existence of a production function in which if the production factors are paid by its marginal products then the proportion of the aggregate income that goes to each of them is kept constant.

As before, A is the labour technological progress, and $A*L$ is the *effective labour input*[3]. The exponents α and $(1-\alpha)$ are the output elasticities of capital and effective labour respectively.

First, $F(\bullet)$ reflects positive, diminishing marginal product with respect to each input:

$$\frac{\partial F}{\partial K} = (AL)^{1-\alpha}\alpha K^{\alpha-1} > 0 \qquad \frac{\partial^2 F}{\partial K^2} = (AL)^{\alpha-1}\alpha(\alpha-1)K^{\alpha-2} < 0$$

(3.3)

$$\frac{\partial F}{\partial L} = A^{1-\alpha}K^{\alpha}(1-\alpha)L^{-\alpha} > 0 \qquad \frac{\partial^2 F}{\partial L^2} = (1-\alpha)(-\alpha)A^{1-\alpha}K^{\alpha}L^{-\alpha-1} < 0$$

Second, $F(\bullet)$ exhibits constant returns to scale:

$$F(\lambda K, \lambda AL) = (\lambda K)^{\alpha} * (\lambda AL)^{1-\alpha} = \lambda^{\alpha+(1-\alpha)} * K^{\alpha} * AL^{1-\alpha} = \lambda * F(K, A*L) \text{ for all } \lambda > 0$$

(3.4)

Third, the marginal product of capital (or labour) approaches infinity as capital (or labour) approaches to 0 and approaches 0 as capital (or labour) goes to infinity.

$$\lim_{K\to 0}(F_K) = \lim_{L\to 0}(F_L) = \infty$$

(3.5)

$$\lim_{K\to \infty}(F_K) = \lim_{L\to \infty}(F_L) = 0$$

[3] Effective labour input is employment times its efficiency determined by the level of technology.

The above properties are known as *Inada Conditions*, Inada (1963). This means that the marginal product of capital is positive, but declines when capital increases. Hence, all other factors being equal, any additional amount of capital yields a decreasing rate of return in the production function. This assumption is central to the neo-classical model of growth. Under this condition, capital accumulation does not make a constant contribution to income growth. The assumption of diminishing returns has been heavily challenged by recent growth theory, which believes for instance that, human capital accumulation to yield constant returns, if not increasing ones- a possibility when considering knowledge spill-overs.

The condition of constant returns to scale implies that we can rewrite the production function in per capita terms, in its intensive form as it is also called:

$$y = f(k) \equiv F\left(\frac{K}{AL},1\right) = k^{\alpha} \tag{3.6}$$

This is a per unit capital function for effective labour.

3.2.2 Transitional Dynamics

3.2.2.1 Capital Accumulation

If is assumed that capital depreciates at the constant rate $\delta > 0$; that is at each point in time, a constant proportion of the capital stock is used up and can no longer be used for production and that the economy saves a constant fraction of output $s > 0$ which is in turn invested in new capital, the net increase in the stock of physical capital at a point in time equals gross investment less depreciation:

$$\dot{K}(t) = sY(t) - \delta K(t) \quad (3.7)$$

$$\dot{K}(t) = sF[K(t), L * A(t)] - \delta K(t) \quad (3.8)$$

The change in the aggregate capital stock with respect to time $\dot{K}(t)$ equals investment minus depreciation of existing capital stock.

Let $k(t) = K(t) / L * A(t)$ be the quantity of capital per unit of effective labour and assume that $A(t)$ is given, then one gets capital accumulation in per capita terms (for convenience we drop the subscript (t)):

$$\dot{K} = s * f(k) - (n + \delta) * k \quad (3.9)$$

$$\dot{K} = s * f(k) - (n + x + \delta) * k \quad (3.10)$$

where $n = \frac{\dot{L}}{L}$ and $x = \frac{\dot{A}}{A}$, $\dot{L}$ is the derivative $d[L(t)]/dt$ with respect to time.

The augmentation of the capital stock per capita equals investment adjusted by the rate of population growth and the depreciation rate given in (3.9). If technological growth x

is included, effective depreciation is $(n+x+\delta)$ and the equation for capital accumulation is as in (3.10).

This equation is the fundamental differential equation of the Solow-Swan model.

Figure 3.1 shows the workings of Eq. (3.10). The upper curve is the production function, $f(k)$. The term $s*f(k)$ which appears in Eq. (3.10) is the fraction of the per capita output which is saved, we will call this the *savings curve.* Note from the figure that the $s*f(k)$ curve starts from the origin because $f(0)=0$, has a positive slope because $f'(k)>0$ and gets flatter as k rises because $f''(k)<0$. The Inada conditions imply that the $s*f(k)$ curve is vertical at $k=0$ and becomes flat as k approaches infinity. The other term in the equation (3.10), $(n+x+\delta)*k$ that it is called *depreciation curve* appears in figure 3.1 as a straight line from the origin with the positive slope $(n+x+\delta)$

Due to the diminishing marginal product of capital, the per capita output available for savings will become smaller with additional capital. Therefore, investment per effective labour is non-linear. This decreases with rising capital accumulation. Initially, investment exceeds the term $(n+x+\delta)$ and thus the capital share per effective labour increases. As the share of capital approaches infinity, investment becomes lower than the term $(n+x+\delta)$. Hence there is a point k^* where investment is just enough to balance the second term. At k^* the amount of capital per capita is constant, $\dot{k}=0$.

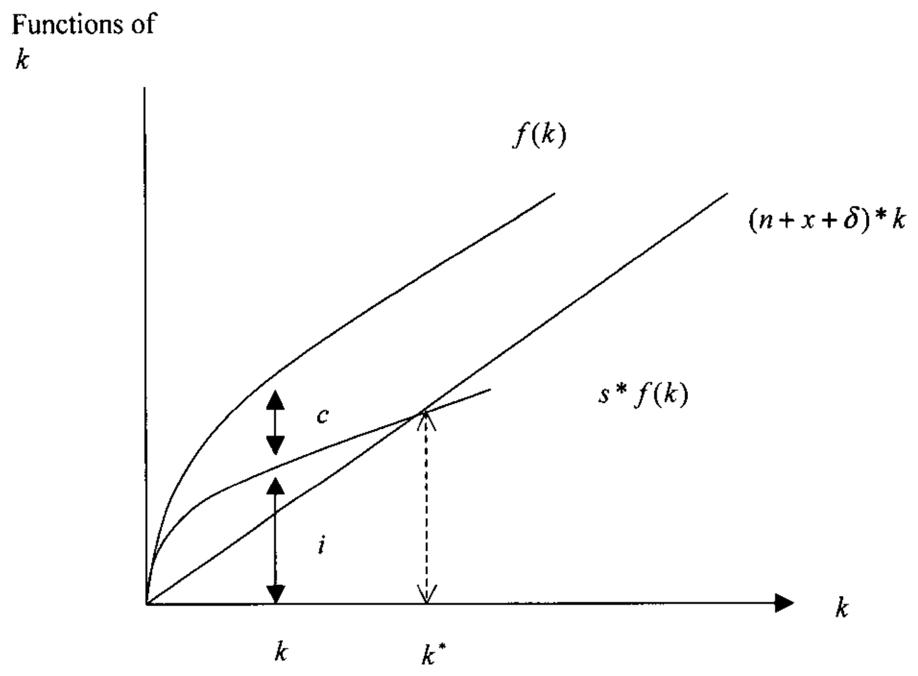


Figure 3.1. The steady state in the neo-classical model of Solow-Swan (Adapted from Sala-i-Martin (2000))

3.2.2.2 The Steady State

In the Solow-Swan model the *steady state* corresponds to $\dot{k}=0$ in equation (3.10), that is, to an intersection of the savings curve, $s*f(k)$,with the depreciation curve, $(n+x+\delta)*k$, in figure 3.1[4]. The stock of capital k^* which satisfies $\dot{k}=0$ is called *the steady state capital stock.* Algebraically, k^* satisfies the condition:

$$s*f(k^*)=(n+x+\delta)*k^* \qquad (3.11)$$

If the production function is of Cobb- Douglas type with technology being labour augmenting (Eq. 3.6) the expression for the steady state capital stock is:

$$k^*=\left[\frac{s}{n+x+\delta}\right]^{1/(1-\alpha)} \qquad (3.12)$$

Due to the steady state capital stock is constant, per capita income (which is a function of k) is also constant so its growth rate in the steady state is $0, \gamma_y^*=0$. In the steady

[4] The intersection in the range of positive k exists and is unique because $f(0)=0$, $n+x+\delta<\lim_{k\to 0}[s*f'(k)]=\infty$, $n+x+\delta>\lim_{k\to\infty}[s*f'(k)]=0$, and $f''(k)<0$

state all the variables expressed in per capita terms are constants and therefore their steady state growth rates must be 0[5].

What one is now interested in, is how income growth behaves on the way to the steady state. A convenient way to answer this question is to focus on the growth rate of capital γ_k[6].

If we divide the Eq. (3.10) by k we obtain the growth rate of the per capita capital stock:

$$\gamma_k = s * f(k)/k - (n + x + \delta) \tag{3.13}$$

Equation (3.13) says that γ_k equals the difference between two terms, $s * f(k)/k$ and $(n + x + \delta)$. We can use the figure 3.2 to show the dynamics of the growth rate over the time in the Solow-Swan model. In order to plot figure 3.2 we will give some features of Eq. (3.13). The first term in the equation is the savings rate multiplied by the average product of capital $f(k)/k$. In the case of our Cobb- Douglas function this average

[5] Note that, at all points in time, the growth rate of the level of a variable equals the per capita growth rate plus $n + x$, so in the steady state capital and output grow at the same rhythm than population plus technological change.

[6] If the production function is of Cobb-Douglas type, studying the behaviour of the growth rate of per capita capital will allow us to know both the growth rates of per capita output and per capita consumption. This means that the growth rate of per capita output is proportional to the growth rate of per capita capital. Moreover, per capita consumption is proportional to per capita output so the growth rate of consumption equals the growth rate of output.

product equals $f(k)/k = k^{\alpha-1}$ and therefore the per capita capital growth rate can be rewritten as:

$$\gamma_k = s * k^{-(1-\alpha)} - (n + x + \delta) \qquad (3.14)$$

In order to plot the savings curve, $s * k^{-(1-\alpha)}$, against k we have to take into account that:

i) It is a decreasing function for all of k

ii) Tends to infinity when k tends to cero

iii) Tends to zero when k tends to infinity

i.e, the *savings curve* take on infinity values when k is cero, it decreases all over the time and it approaches to cero for high values of k. In figure 3.2 we plot the savings curve and we label it by the initials SC.

The *depreciation curve*, $(n + x + \delta)$, is independent of k and it is represented by a horizontal line in the figure 3.2. This curve is label by the initials DC.

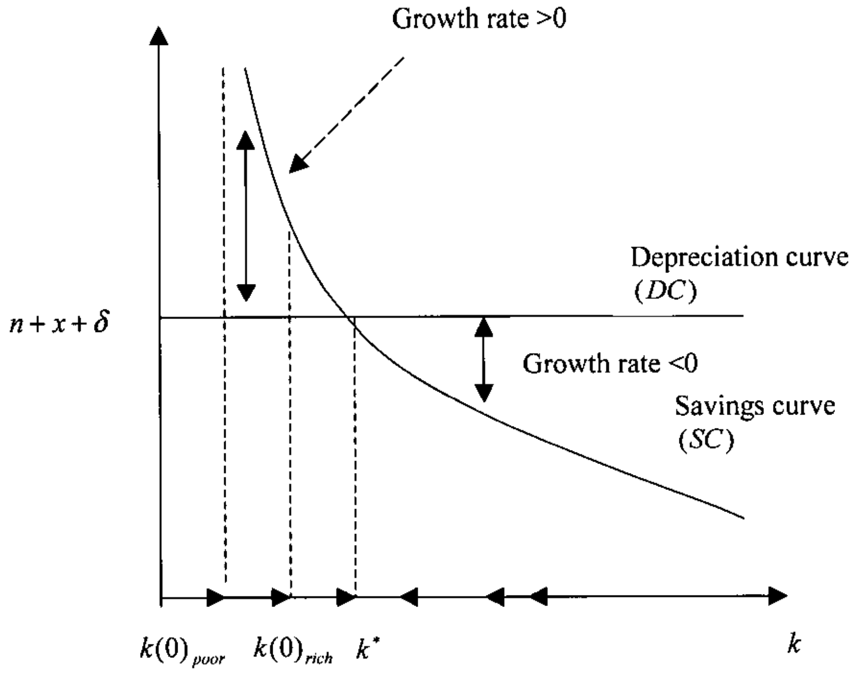


Figure 3.2 Dynamics transition in the neo-classical model of Solow-Swan (Adapted from Sala-i-Martin (2000))

Figure 3.2 shows that to the left of the steady state, the $s * f(k)/k$ curve lies above $(n + x + \delta)$. Hence, the growth rate of k is positive, and k rises over time. As k

increases, γ_k declines and approaches 0 as k approaches k^*. The $s * {f(k)}/{k}$ curve gets closer to the $(n+x+\delta)$ curve as k gets closer to k^*; hence, γ_k falls. The economy tends asymptotically toward the steady state in which k do not change. An analogous argument demonstrates that if the economy starts with $k(0) > k^*$, then the growth rate of k is negative, and k falls over time. Note from figure 3.2 that for $k(0) > k^*$, the $(n+x+\delta)$ curve lies above the $s * {f(k)}/{k}$ and hence $\gamma_k < 0$. Thus the steady state capital per person , k^*, is stable.

We can study the behaviour of output throughout the transition. The growth rate of output per capita is given by:

$$\gamma_y = \left[k * {f'(k)}/{f(k)}\right] * \gamma_k \qquad (3.15)$$

where $\left[k * {f'(k)}/{f(k)}\right]$ is the share of capital, i.e. the share of rental income on capital $[k * f'(k)]$ in total income $y = f(k)$.

Equation 3.15 shows that the relation between γ_y and γ_k depends on the behaviour of the share of capital. In the case of the Cobb-Douglas function, the share of capital is the constant α, and γ_y is the fraction α of γ_k. Hence, the growth rate of per capita output is given by:

$$\gamma_y = \alpha * \gamma_k \tag{3.16}$$

so that

$$\gamma_y = \alpha * \left[s * k^{-(1-\alpha)} - (n + x + \delta) \right] \tag{3.17}$$

and therefore the prediction made by the Solow-Swan growth model is that the growth rate of per capita income declines when the economy moves from a low per capita income level, with a low stock of capital per person, to a higher income level and a higher stock of capital before reaching its steady state income.

3.3 Convergence in the Neo-Classical Model of Growth

3.3.1 Theoretical concept

The neo-classical model of growth postulates the convergence of regional incomes. Given the dynamics of this model of growth discussed in the previous section, one may expect that in a set of economies, which have the same steady state per capita income, and which differ only in their initial capital endowment per person and per capita income, initially poor economies will grow faster than rich economies to converge finally to the same per capita income. In the literature, the phenomenon that poorer economies on average will grow faster than richer ones (over the long term) has been termed as β - *convergence*. Such differential growth is necessary to reduce the intercountry variation of per capita income levels. A tendency for the dispersion of per capita incomes (as measured by their standard deviation) across a group of countries to fall over time has been labelled σ - convergence. Clearly, progress in σ *-convergence* is not only a function of the differential rates of growth between poorer and richer countries but also of the size of the initial income gap.

β *-convergence* is a necessary but not a sufficient condition for σ *-convergence*[7]. β - convergence implies the existence of a longer-term catch-up mechanism, i.e forces which work towards the narrowing of income differences across countries. These forces, however, can be offset by temporary shocks which adversely (or, positively) affect short-run growth performance. This is why the existence of β *-convergence* may not be fully reflected in changes of the dispersion of income levels[8].

The basic kind of convergence to a common steady state is referred to *as absolute convergence* (Barro and Sala-i-Martin, 1991, 1995; Sala-i-Martin 1996, de la Fuente 1995,Galor 1996, Seidel 1995). The assumption of a unique steady state will be only satisfied if all economies have the same fundamental parameters with respect to the saving rate s, population growth n, capital depreciation δ, and above all the same

[7] For a discussion of these convergence concepts see X. Sala-i-Martin (1996).
[8] See R.Barro (1997) and P.Henin and Y.Le Pen (1995).

level of technology A[9], i.e if they all have the same production function. The only difference is in the endowment of capital.

The view that economic growth is a complex function of a wide range of interrelated factors, over and above traditional factor inputs, has led some analysts to develop the idea of *conditional convergence.* This remains within the neo-classical framework but describes the tendency of countries to converge on their own long run equilibrium paths as a function of a number of preconditions or "conditioning variables", i.e richer economies converge towards a high level of income, whereas poor economies converge towards a lower level income level (Ben-David 1994). Differential growth rates then reflect the distance of countries from their own steady states[10]. This of course is a concept of convergence which has a completely different meaning from that of (absolute) β *-convergence.* In the case of groups of countries with broadly similar long-run equilibrium positions, there may be a tendency for (absolute) convergence within such groups (Convergence clubs) but not between them[11].

[9] It should be remembered that $A(t)$ the level of technology in the neo-classical production function is often interpreted in the sense of comprising institutional infrastructure and hence the effectiveness of institutions and government systems as well.

[10] G.Mankiw (1995), p.284.

[11] W. Baumol, (1986) comparing income levels in 1870 and 1979, identified a group of 16 advanced economies in such a convergence club. It is noteworthy that he found also some tentative evidence for club convergence among a group of the former centrally planned economies. A more restrictive form of the "club convergence" hypothesis is the requirement that countries are broadly similar both as regards their fundamental structural characteristics and their initial conditions. O. Galor (1996).

3.3.2 A Measure of the Speed of Convergence

If an economy revels β *-convergence,* it is important to know how fast the economy converges to its steady state. This will be given by the rate of convergence β that can be defined as the change in the growth rate when capital increases by one per cent. Mathematically we can express this speed of convergence in the following way:

$$\beta = -\frac{\partial \gamma_k}{\partial \log(k)} \qquad (3.18)$$

To derive the convergence coefficient β, the procedure suggested by Barro and Sala-i-Martin (1991,1992, 1995)[12] and Sala-i-Martin (2000) is to consider a Taylor first order log-linear approximation of the growth rate γ_k (Eq.3.14) in the neighbourhood of the steady state k^* (Barro and Sala-i-Martin 1995: 36-37 and Sala-i-Martin 2000: 44-45). The Taylor approximation to Eq. (3.14) (expressing before γ_k as a function of $\log(k)$) yield to:

$$\gamma_k = -(1-\alpha) * s * e^{-(1-\alpha)\log(k^*)} * \left[\log(k) - Log(k^*)\right] \qquad (3.19)$$

[12] For a presentation see also D. Romer (1996), Durlauf and Quah (1998).

Note that the value of $s * e^{-(1-\alpha)\log(k^*)}$ in the steady state is $(n+x+\delta)$ so substituting we get:

$$\gamma_k = -(1-\alpha)*(n+x+\delta)*[\log(k) - Log(k^*)] \tag{3.20}$$

i.e the capital growth rate in the economy is inversely related with the initial level of capital. As we have the growth rate γ_k expressed as a lineal function of $\log(k)$ it is very easy to take the derivative to compute the speed of convergence β :

$$\beta = (1-\alpha)*(n+x+\delta) \tag{3.21}$$

One can directly derive the corresponding growth rate of output per capita using the simple relationship between both growth rates in the case of Cobb-Douglas function:

$$\gamma_y = \alpha * \gamma_k \tag{3.22}$$

$$\log\left(y/_{y^*}\right) = \alpha * \log\left(k/_{k^*}\right) \tag{3.23}$$

substituting in (3.22) yields:

$$\gamma_y \cong -(1-\alpha)*(n+x+\delta)*\left[\log\left(y/_{y^*}\right)\right] \tag{3.24}$$

$$\gamma_y \cong -\beta * \left[\log\left(y/_{y^*}\right)\right] \tag{3.25}$$

This means that the convergence coefficient for per capita output y is the same as for capital per person k. The convergence coefficient indicates how rapidly, at the given growth rate and the existing income gap, an economy will reach its steady state with k^* and y^*.

3.3.3 Convergence Time

To derive the convergence time for a given convergence rate β, one has to consider that Eq. (3.20) is a differential equation in $\log(k)$ with the solution:

$$\log(k_t) = (1 - e^{-\beta * t}) \log(k^*) + e^{-\beta * t} \log(k_0) \tag{3.26}$$

where k_0 denotes per capita capital at the beginning of a time period, k^* is the steady state capital and k_t is an observation in between at time t.

The time t where k_t is halfway between k_0 and k^* satisfies the condition:

$$e^{-\beta * t} = \frac{1}{2} \tag{3.27}$$

Taking logs and solving with respect to t, the half life[13] H is:

$$H = {\log(2)}/{\beta} = 0.69\beta \tag{3.28}$$

3.4 Methodologies of Convergence Analysis

Convergence studies can be pigeon-holed into three broad categories: Cross-Section studies for absolute and conditional convergence, panel data analyses and Markov chain analyses. The characteristics of each are sketched out here.

3.4.1 Cross-section estimation of convergence

3.4.1.1 Cross-section estimation of absolute convergence

Barro and Sala-i-Martin in their prominent paper entitled "Convergence" (Journal of Political Economy, Vol. 100(2), April 1992, pp.223-249) estimate the absolute β convergence on the basis of a univariate cross-country regression of per capita income growth between year t and $t+T$ (${1}/{T}\log\left({y_{i,t+T}}/{y_{i,t}}\right)$) on the initial level of per capita

[13] This is a standard result from elementary physics, that the half-life (H) of a radioactive substance decaying at the constant rate β is $H = \frac{Log(2)}{\beta}$ (this is useful because it is often difficult to establish when a substance has lost practically all of its activity and more easy to ascertain when half the active material has disappeared).

income ($y_{i,t}$). The steady state income per capita of an economy is y_i^*, and x_i^* is the steady state growth rate of output, corresponding to the labour augmenting technological progress. So the specified equation to test β convergence would be:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = x + \frac{(1-e^{-\beta * T})}{T} * \log\left[\frac{y_i^*}{y_{i,t}}\right] + u_{it,t+T} \qquad (3.29)$$

In practice, estimation is effected with the reduced form (Barro and Sala-i-Martin 1995:387, Sala-i-Martin 2000:202):

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + u_{it,t+T} \qquad (3.30)$$

In this specification one does not find the steady state y^* or the steady state growth rate x. Both are contained in the intercept a:

$$a = x + \frac{(1-e^{-\beta * T})}{T} * \log(y_i^*) \qquad (3.31)$$

We work with this reduced form because neither the steady state of an economy nor its steady state growth rate are known.

This specification states absolute convergence as it considers a common intercept a for the set of economies that represents the steady state according to Eq.(3.31).

3.4.1.2 Cross-section estimation of conditional convergence

The available empirical evidence does not support the universal convergence hypothesis: there is no systematic tendency for poor economies to grow faster than richer ones. In fact, the dominant feature has been for diverging productivity levels and real per capita incomes between the group of advanced industrialized economies on the one hand and the developing countries on the other[14]. There are, of course, some significant exceptions, such as the east Asian growth rates. The general conclusion, however, is that countries do not tend to converge to the same balanced growth path, but rather settle on different ones. Such differences would lead to steady state differences. Conditional convergence is estimated on the basis of a multivariate regression analysis, with initial income and a set of "conditioning variables" X_i as proxies for the determinants of the long-term balanced growth path of the individual economies.

The equation to estimate is the following one:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T} \tag{3.32}$$

Conditional convergence exists if the coefficient on the initial income is negative. In other words, in case of conditional convergence there is a negative partial correlation between initial income per capita and subsequent growth.

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[14] For this empirical evidence see L.Pritchett (1997), C.Jones (1997), UNCTAD, Trade and Development Report, (1997), Sala-i-Martin (2000).

3.4.2 Panel data estimation of convergence

Region-specific effects can be modelled by employing panel data estimation techniques. As a panel data estimation technique uses observations for several points in time, it builds on a richer information set[15].

The general econometric specification of a panel data model is the following one:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a_i - \frac{1}{T}(1 - e^{-\beta * t}) * \log[y_{i,t}] + \psi_{t,t+T} + u_{it,t+T} \tag{3.33}$$

However in order to use OLS in the estimation, the coefficient $\frac{1}{T}(1 - e^{-\beta * t})$ is changed by a general coefficient b and the equation can be rewriten in the following way.

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a_i - b * \log[y_{i,t}] + \psi_{t,t+T} + u_{it,t+T} \tag{3.34}$$

where the expression for the error is made up of a_i, an unobserved individual effect which is constant over time, a time-specific factor $\psi_{t,t+T}$ which equally effects all individuals, and a random error $u_{it,t+T}$.

[15] Islam (1995) and Canova and Marcet (1995) show that cross-section analysis lead to a systematic downward bias of the convergence coefficient due this technique neglects unobservable factors and hence suffers an omitted variable bias.

The average growth rate between t and $t+T$ should be negatively related to the initial logarithm of the per capita income level $\log(y_{i,t})$. This relationship is represented by the common coefficient b. The region-specific fixed effect present over the whole sample period, is captured by the term a_i. The term $\psi_{t,t+T}$ represents the time-specific effect affecting all individuals in period $t, t+T$. This specification of the model means that we estimate convergence by using a two-way fixed effects model (see Hsiao 1986 and Baltagi 1995).

The speed of convergence β can be obtained from the following relationship between the coefficients of $\log(y_{i,t})$ in Eq. (3.33) and (3.34):

$$\beta = -\frac{1}{T}\ln(1 - Tb) \tag{3.35}$$

The region-specific fixed effect a_i determines the region's steady state income. This fixed effect is a concept which is similar to using explanatory variables or country dummy variables in the conditional convergence analysis. The difference between this method and the conditional convergence analysis is that panel data estimation allows for continuous individual conditional effects while the former assumes to identify groups of individual units.

With the time-specific effect ψ_t global shocks are captured.

3.4.3 Markov Chain Models

Markov Chain models constitute a different approach to model convergence issues and growth dynamics. They have been employed recently by Quah (1993) Magrini (1995), Fingleton (1997, 1999) Durlauf and Quah (1998). The basic Markov Chain assumes that, given I income-level states, each region has a probability $p_i(t)$ of being in state i at time t, and given state i at time t, a transition probability $m_{ij}(t)$ of being in state j at time $t+1$. By making the simplifying assumption that all transition probabilities are unchanging over time, that is, that $m_{ij}(t) = m_{ij}$ for all t, ordering these stationary probabilities as the $I-by-I$ transition matrix M and denoting $p_i(t)$ as the time-dependent elements of the $1-by-I$ row vector $p(t)$ then

$$p(t+1) = p(t) * M = P(0) * M^t \qquad (3.36)$$

where M^t denotes the product of t identical M matrices. A consequence of Eq. (3.36) is the existence of an equilibrium probability $I-by-I$ row vector s where

$$s = s * M \qquad (3.37)$$

This vector s is the ergodic probability vector[16] to which each of the rows of M^t tends as t tends to infinity and thus describes the stochastic equilibrium- in other words, the different output per capita level (state) probabilities to which the system converges under a single model for the transition probabilities.

The use of Markov model implies that permanent interregional output per capita differences may characterize the system of EU regions at equilibrium which is quite unlike the equilibrium envisaged by basic neo-classical theory.

3.5 A Literature Review of the Convergence in Europe

In this section we summarize the main findings in the empirical income convergence literature that looks at the European regions and is organized according to the different methodologies employed in these studies (cross-section regressions, panel data regressions and Markov chain models).

[16] Ergodicity is a property of a Markov Chain in which there is a finite mean recurrence time for each state, where the recurrence time is the time required for a first return to a state, and return is possible at any time. The ergodic probability vector is often referred to as the equilibrium distribution for the Markov chain but is preferred so as to distinguish it from the equilibrium of an economic system

3.5.1 Cross-Section Studies

The convergence of the European Union regions, in the sense of β-convergence was first studied by Barro and Sala-i-Martin (1991). These authors investigated convergence since 1950 within seven EU countries, the founding countries and the UK. The authors found that convergence in EC member states took place at a rate of $\beta = 1.78$ per cent per annum from 1950 to 1985. Dividing the whole sample in sub periods they compute a convergence rate of 2 per cent in the 1950s and 2.4 per cent in the 1960s and since then a fall to 1.3 per cent in the 1970s and 1.1 per cent in the first half of the 1980s. These convergence figures are computations of average speeds of convergence in all European countries, however Barro and Sala-i-Martin (1991) and Sala-i-Martin (1996) found that UK and Spain were the countries with the highest speed of convergence (3 per cent and 2.3 per cent respectively) while in France, Germany and Italy the figures were much lower (between 1 and 1.6 per cent).

In the above studies there are two points of particular interest:

First, the European countries have experienced β-convergence which slowed down considerably in the 1980s compared to the 1960s.

Second, the evidence from selected EU countries suggests that there are different convergence rates across countries.

The above studies have also show some drawbacks. These studies were confined to the Northern EU-member states and of the cohesion countries was included only Spain.

Further, convergence within member states was considered rather than convergence to a common EU level.

These drawbacks, have been assimilated and a set of studies on regional convergence in the EU have followed.

Neven and Gouyette (1994, 1995) investigate β-convergence for all NUTS II level EU-regions for the period 1980-89, regarding the development of the relative per capita income (income in terms of the EU-average) from the Eurostat-Regio database. They find a convergence rate for all EU regions for the 1980s of 1.1 per cent. Moreover these authors observe that there are strong differences in the pattern of convergence across sub periods ($\beta = 2$ per cent in the first half of eighties and $\beta = 0.42$ per cent in the second half of eighties) and across subsets of regions (The South of Europe seems to catch up in the early eighties and it stagnates, at best, in the second part of the eighties. The regions in the North of Europe on the other hand tend to stagnate or diverge in the first part of the eighties but converge strongly thereafter). This pattern is consistent with the view that Northern European countries have adjusted better to the main change in the policy regime which occured in the mid eighties, namely the implementation of the internal market programme and the entry of Spain in the Community in 1985. In these authors'view this evidence also lends support to the view that trade liberalization can exacerbate disparities. They also point out that the distinction between the North and South of the European Community is likely to be more relevant in the analysis of growth patterns than the distinction between the centre and the periphery. Moreover, one of the possible reasons for the lack of convergence after 1985 in Southern regions could be that the population in these regions responds much more slowly to wage and unemployment differences.

Button and Pentecost (1995) analyse the degree of convergence of Western European regional economies (NUTS I level regions from the former 9 EC member states) since the mid-1970s when the larger European Union was established. They found that with simple model specifications β-convergence had occurred (more in the 1970s than in the 1980s). They further showed that, using a more complete model, which included structural variables, country dummies and an ERM dummy, no significant convergence had occurred across European Union's regions in the 1980s.

Fagerberg and Verspagen (1996) investigate β-convergence of per capita GDP for a sample of 70 NUTS I/NUTS II regions covering the six original EU Member States. They found that there was a slow but steady reduction of differences in GDP per capita across European Union regions during most of the post-war period (1950-1970 with $\beta = 1.8$ per cent) but, they found that there had been a dramatic slowing down in this trend in the seventies, eighties and nineties ($\beta = 0.5$ per cent from 1970 to 1990). Their findings support the idea of a "Europe at different speeds" with at lest three different "Growth clubs" characterized by different dynamics, productivity and unemployment levels.

However we have to interpret their findings very cautiously because of the various data sets employed in their study.

Fingleton et al. (1996) analyse unconditional and conditional convergence rates between two sub periods 1975-1987 and 1987-1993 for the former EU12 regions at level NUTS II. Their unconditional convergence model shows that there has been faster convergence taking place since 1987 (coinciding with the advent of the Single Market Programme) with a convergence rate of about 0.5 per cent per annum compared with about 0.3 per cent per annum prior to 1987 but this rate does not differ significantly from 0.

In their conditional convergence estimates they use a full set of control and state variables for which data are available (see pages 107 and 108) and found that the conditional rate of convergence is slower post-1987 (more precisely $\beta = 1$ per cent per annum in 1975-1987 and $\beta = 0.5$ per cent per annum in 1987-1993).

Tondl (1997, 1999) provides an assessment of the regional convergence process between the Western European regions since the 1950s. In particular she studies whether or not there is sufficient evidence of regional convergence and whether convergence is a phenomenon which is limited to the core EC regions or rather, if it encompasses Europe's Southern and Northern regions as well. Her findings showed that the speed of convergence among the core EC regions was of about 2 per cent per annum and was particularly pronounced between them from the early 1960s to 1973. From the mid sixties until 1973, non EC regions converged strongly with EC member regions. Since the mid-seventies convergence has slowed down to 1 per cent per annum and between 1980 and 1986, for the whole group of European regions there has been more divergence than convergence. During the latter period, club-convergence appeared and differences in individual steady state income became more pronounced. From 1986, regional convergence again reappeared on a global scale as the prevalent dynamic and weakened the evidence for club-convergence. She also found that from 1975 regional convergence was higher between the Northern EC regions and EFTA regions than between the Northern EC regions and the Southern regions.

Button and Pentecost (1999) study convergence across EU regions focusing on why some slower regions within EU countries are catching up with the pace setters while others are not.

Maurseth (2001) analyses the convergence process in the eighties and nineties showing that convergence re-emerged at the end on the 1980s and in the 1990s being a combination of poor regions catching up with richer ones, peripheral regions growing faster than central ones combined with innovation and technological spillovers. Moreover convergence was most pronounced between the regions that were localized at a significant distance from each other and that were dissimilar in terms of innovative activity, technological specialization and the amount of spillovers received.

Boldrin and Canova (2001), using data for NUTS2 regions for EU15 whenever it was available and by resorting to the NUTS I level only when carrying out the analysis at the lower levels was impossible, look for evidence of either divergence or a convergence process in per capita income, labour productivity and unemployment rates over the period 1980-1996. Their results are not supportive of β-convergence for regional per capita income. They have estimated different specifications for the equation $\Delta \log(y_t^i) = \alpha_i + \beta \log(y_{t-T}^i) + \varepsilon^i$ along different sub samples and sub periods, using both per capita GDP (185 regions) and Labour productivity (101 regions), in absolute value, in logs and scaled by national or European averages with and without national dummies. When y_t^i is per capita GDP, the point estimate β is always either positive or statistically insignificant, or both. When, instead, y_t^i is labour productivity, the point estimate of β is both negative and statistically significant.

Giannetti (2002) carries out several cross-section analysis over the period 1980-1992 testing for conditional convergence[17]. The author's sample covers 108 regions, NUTS 0 are represented by Denmark and Ireland, Nuts I by Belgium, Germany, Great Britain and the Netherlands and NUTS II by Greece, Portugal, Spain and France.

The author estimates conditional convergence first for all of the regions and then for sub samples of industrialized regions, regions specialized in traditional sectors, objective 1

[17]This paper is mainly theoretical in which the author explores the effect of integration between two symmetric countries characterized by strong regional disparities that originate from a lower productivity in the high-tech sector.

regions and regions that are not objective 1 finding results supportive of the existence of convergence clubs based on regional specialization.

With respect to regional convergence within countries, a number of studies testing for convergence have appeared recently. In Spain, Dolado et al. (1994), Mas et al. (1994) García-Greciano et al. (1995), Mas et al. (1995), Sala-i-Martín (1996), Cuadrado-Roura et al. (1998), García-Greciano and Raymond Bara (1999), Lamo (2000), for Italy Paci and Pigliaru (1995) , Fabiani and Pellegrini (1997), Casini-Benvenuti et al. (1999), Bianchi and Menegatti (1999),Terrasi (1999)[18], for Germany Herz and Röger (1995), Seitz (1995), Funke and Strulik (1999), Niebuhr (2001)[19] for Austria Hofer and Wörgötter (1997), for Great Britain Chaterij and Dewhurst (1996), for Greece Siriopoulos and Asteriou (1998), Petrakos and Saratsis (2000), Asteriou et al. (2002)[20]and for Sewden, Persson (1997).

3.5.2 Panel Data Studies

A number of studies have estimated convergence equations in which conditioning for the existence of different steady states is taken care of.

[18]In this paper regional convergence of per capita GDP is analysed using the Theil coefficient of concentration.

[19]In this paper the approach to the study of regional income convergence is using spatial econometric methods

[20] In this paper the convergence hypothesis was tested using time series techniques

Canova and Marcet (1995) studied the issue of income convergence along NUTS II level regions from 9 member states over the period 1980-1992. For each country and region and using a Bayesian model a steady state is estimated. The collection of steady states is regressed against the initial conditions of each country/region. The estimated value of the slope $\|\beta\|$ in this second regression should tell us whether inequality will be reduced or eliminated ($\|\beta\| < 1$) or if, instead, it will increase ($\|\beta\| > 1$). Using this method they found convergence to its own steady-state income level is much faster than previously estimated (for instance convergence happens at a rate as high as 80 per cent in the North of Portugal and some Greek regions), but that cross-sectional differences persist: inequalities will only be reduced to very small degree over time. The cross-country distribution of the steady state is largely explained by the cross-sectional distribution of initial incomes, so poor regions have lower steady state incomes than rich regions.

Fingleton et at. (1996) used a panel data to analyse $\beta-$convergence at the level of member states for EU12 over the period 1975-1987 and 1987-1993. In the simple regressions for unconditional $\beta-$convergence they found a positive β coefficient for the first period (1975-1987) and negative coefficient for the second (1987-1993) but neither was significant. Fingleton et al. also made variations of the basic regression equation introducing more explanatory variables (dummies for countries, dummy for the introduction of the Single Market Programme, intensity of R&D, investment ratios, etc) finding a negative coefficient on the starting level of GVA per capita which is consistent with the view that a general process of convergence, conditional on other elements has been proceeding in the last twenty years among European countries.

Tondl (1997) analysed convergence for the regions of EU15 in subsequent intervals in the period 1975-1994. Tondl found a convergence rate β of 21 per cent for the whole period implying that regions would be halfway from their steady income in 3.3 years. Tondl also investigated convergence in different sub periods on the ground of the business cycle argument. For the period 1975-1980, estimation showed a convergence rate β of 21 per cent. Thereafter, in the period 1980-1986 the convergence coefficient soared to 82 per cent. However as region-specific effects are much more disperse in this period than before (the standard deviation of steady state incomes triples vis-à-vis its value in 1975-1980), this indicates that regions showed strong convergence towards now more dispersed, individual steady state incomes and regions converge very fast to those different levels. In the period 1986-1992, she showed that convergence dropped to a still lower level of 60 per cent and the deviation of steady states narrowed again. Her interpretation was that the structural parameters determining long-term income have improved with many poorer regions, and general structural changes raised the common level of long-run income.

Gaulier et al. (1999) applied a modified Evans and Karras (1996) testing procedure to three samples (Europe, OECD and World). Gaulier et al. proposed a nested test procedure to characterize various convergence processes absolute or conditional, with or without a common speed of convergence. They found evidence supporting the existence of an absolute and common convergence process for per capita GDP in the European Union for the period 1960-1990.

Philippe (1999) in his paper revealed the slow convergence process and the disparities of the catching-up through European space.

Beine et al. (1999) also applied Evans and Karras (1996) testing procedure and the variant proposed by Gaulier et al. (1999). Their empirical results do not support the club convergence hypothesis. They suggested that the specialization process induced by the setting up of the European economic and monetary integration takes place more at the regional rather at the national level.

Björkstén (2000) analysed convergence using a panel data for a sample of 18 European Countries (EU15 plus Iceland, Norway and Switzerland) over the period 1971-1997. The regression was estimated including fixed effects´coefficients that allowed him to test for the existence of systematic differences across countries. When the countries are listed according to the sizes of the fixed effects coefficients, they appeared to break into three groupings which represent three convergence clubs within Europe. However the author´s conclusion is cautionary, warning against over-interpreting the fixed coefficients. Fixed effects include institutional factors and there is a trend toward convergence in these as well as Europe becomes an ever closer group of nations.

Boldrin and Canova (2001), using data of NUTS I/ NUTS2 regions for EU15 and applying the same procedure than Canova and Marcet (1995) found a value of β of 0.98 when per capita GDP is the variable of interest. Their estimations showed that the β value varied significantly from zero, but was indistinguishable from one (estimated standard deviation of β was 0.02). These results showed little or no convergence in per capita income.

Giannetti (2002) carried out a panel data analysis over the period 1980-1992 and tested for conditional convergence. The author's sample covers 108 regions among the NUTS 0, Nuts I and NUTS II levels chosen for her study.

The author estimates conditional convergence for all regions and for sub samples of industrialized regions, regions specialized in traditional sectors, objective 1 regions and regions that are not objective 1 finding results supportive of the existence of convergence clubs based on regional specialization

Studies of convergence using panel data for single countries are those of De la Fuente (2002) for Spain, Funke and Strulik (1999) for Germany, Button and Pentecost (1999) for UK.

3.5.3 Studies based on Markov Chains

Some authors addressed the issue of convergence using a different econometric methodology, i.e. by applying Markov chain analysis to study intra-distribution dynamics of income and its long-term distribution. Quah (1996), Fingleton (1997, 1999), Magrini (1999), Cheshire and Magrini (2000), applied this concept to investigate convergence of European regions.

Quah (1996) investigated regional income distribution dynamics of NUTS II level regions in the 1980s for 6 member states. Looking at the density functions of the per capita income (relative to the EU average) he shows that the regional income distributions fluctuate over time becoming more concentrated around the mean in the second half of the eighties. The standard deviation of income fell from 0.27 in 1980 to 0.25 in 1989. Quah fitted a Markov chain model to the observed sequence of income distribution, dividing income into 5 levels. The resulting ergodic probability vector, i.e. the limiting income distribution is uni-modal around the mean, indicating that regional incomes would converge towards a tighter income distribution. The transition probability matrix estimated by Quah suggested that a number of regions changed their relative income rank. Poor regions moved to a higher income classes and vice versa (probability to move out of the income class stood at about 10 per cent)

Fingleton (1996, 1997, 1999) looked at the evidence of convergence and the nature of that convergence for NUTS II regions in the EU15 over the period 1975-1995 using the Cambridge Econometrics'European regional databank. Income-level states are divided into four categories (poor, below mean, above mean and rich).The main focus of his paper is on the estimation and diagnostic testing of various Markov chain models, and on the alternative methods for the Markov transition matrix.

Fingleton applies a pure-symmetric model[21] and a quasi-symmetric model[22] for the European regions testing if they fit the distribution dynamics. In the case of the pure-symmetric model, the ergodic probability vector of this model suggests that the EU regions would always include a share of 20 per cent of poor regions which have a relative income of below 75 per cent of the average, 25 per cent would have an income level of below the mean, 37 per cent would have an income level above the mean and 16 per cent would have an income level above 125 per cent of EU average (Fingleton 1999: 29, Table 5). Moreover, in this model the estimated transition probability matrix indicates that a region has a 9 per cent chance of becoming rich, and a rich region has a 31 per cent chance of losing income (Fingleton 1997: 397, Table 6). In the case of the quasi-symmetric model, the equilibrium income distribution has a lower proportion of poor regions of 4 per cent, and the highest frequency is in the above average income

[21] Pure symmetric model implies that the transition probability $p_{i,j} = p_{j,i}$ and the frequencies in income classes remain constant over time, although switching income classes occurs.

[22] Quasi-symmetric model implies that $p_{i,j} = p_{j,i}$, but no constant income distribution

class at 48 per cent (Fingleton 1999: 29, Table 5). However, it would take more than 300 years until to reach this limiting distribution.

Magrini (1999) Cheshire and Magrini (2000), focussed on the cross-sectional distribution of per capita income modelling the growth process as a time homogeneous Markov chain and applying it to the per capita income data for 122 EU functional regions (FURs) in EU12 over the period 1979-1990. Magrini uses 11 income states to model the transition behaviour. He derives those number of income states from a statistical test procedure which aims to determine the appropriate size of an income class. The results of his analysis suggested that the process of economic growth at work in the European Union during the 1980s was characterised by a tendency towards divergence. In particular, six of the FURs, Düsseldorf, Hamburg, Stuttgard, München, Paris and Frankfurt showed a tendency to grow away from the rest of the European regions, with the stationary distribution corresponding to these other regions polarised into two large groups (with two classes below the mean income class and two classes above)

Application of Markov chain models to study convergence for single countries are those of Pekkala (1999) and Kangasharju (1999) for Finland.

Finally, Tables (3.1), (3.2) and (3.3) summarizes the main studies on the convergence of EU regions taking into account the three methodologies discussed above.

Table 3.1: Cross-Section Studies of EU regions

Author/s	Year	Region's sample	Period	β	Remarks
Barro/Sala-i-Martin	1991	EC-6 +UK NUTS I/II	1950-1985	1.8	Convergence Within countries
Neven/Gouyette	1994	EU-12 NUTS II	1980-1989	1.1	Conditional Convergence
Button/Pentecost	1994	EU-9 NUTS I	1975-1990	2.8	Conditional Convergence
Fagerberg/Verspagen	1996	EC-6 NUTS I/NUTS II	1950-1970 1970-1990	1.8 0.5	Conditional Convergence
Fingleton et al.	1996	EU-12 NUTS II	1975-1987 1987-1993	1.8 0.5	Considers spatial autocorrelation
Tondl	1997	EU-9 NUTS I / NUTS II	1950-1973	2.7	Conditional Convergence
Tondl	1999	EU-15 NUTS II	1975-1980 1980-1986 1986-1992	1.3 0.5 1.2	EC core vs. periphery, Europe Total
Boldrin and Canova	2001	EU-15 NUTS II	1980-1996		No convergence
Giannetti	2002	EU-10 NUTS 0/NUTS I/NUTS II	1980-1992		Conditional Convergence

Table 3.2: Panel data Studies of EU regions

Author/s	Year	Region's sample	Period	β	Remarks
Canova and Marcet	1995	EU-9 NUTS II	1980-1992		Individual convergence coefficient
Fingleton et al.	1996	EU-12 NUTS II	1975-1987 1987-1993		Conditional Convergence
Tondl	1997 1994	EU-15 NUTS II	1975-1994		Average convergence coefficient
Gaulier et al.	1999				Absolute Convergence
Björkstén	2000	EU-15 +3 NUTS II	1971-1997		Convergence clubs
Boldrin and Canova	2001	EU-15 NUTS I/NUTS II	1980-1996		No convergence
Giannetti	2002	EU-10 NUTS 0/NUTS I/NUTS II	1980-1992		Convergence Clubs

Table 3.3: Markov Chain Studies of EU regions

Author/s	Year	Region's sample	Period	Limiting distribution
Quah	1986	EU-6 NUTS II	1980-1990	Uni-modal
Fingleton et al.	1997 1999	EU-15 NUTSII	1975-1995	Highest frequency equilibrium in middle income
Magrini	1999	EU-12 FURs	1979-1990	Distribution divides: rich club, rest bi-modal

3.6 The Data Set

We analyse regional convergence in Western Europe by using two different series of data. These data sets are used separately in order to avoid biases stemming from differences in the accounting systems employed in each of them (ESA79 and ESA95)[23]. Some studies (e.g Barro and Sala-i-Martín 1991,1995; Leonardi 1995) sometimes mix data from different data sets, which leads to a problem of data inconsistency.

For the investigation of the regional convergence in the period 1980-1997 we use data provided by the statistical office of the European Commission (EUROSTAT- REGIO) data base, which gives gross domestic product per capita (GDP p.c.) in different units (ECUS, EURO and PPS) and at different levels of desegregation (NUTS I, NUTS II, NUTS III) for the fifteen European Union member states. This data set is based on the European System of Accounts ESA79. In reference to the availability of data for the NUTS II regions, commonly used in the studies of European regional convergence, there is no information for East Germany until 1991 and for some regions such as Chemnitz, Dresden and Leipzig until 1993. In the case of non-mainland France (Guadeloupe, Martinique, Guiana and Reunion) the data provides observations for a single point in time: 1994. In the case of the Netherlands the data does not provide

[23] The main differences between ESA95 and ESA79 are the following: the inclusion of balance sheets; the introduction of a subsectoring of households; the introduction of a new concept of final consumption: actual final consumption; the introduction of the concepts of economically active population and unemployment; the clear choice in favour of valuing output at basic prices

observations at NUTS II level for Overijssel, Gelderland and Flevoland. In the case of Austria, Finland and the Portuguese islands the data provides observations for 1987 onwards. There are data for observations for Sweden from 1985. Finally, in the case of the United Kingdom, data became available in 1981. As it stated above there are some missing values, so some changes were necessary in order to have a larger time-series sample for the regions. In some cases we have to use the data available for a higher aggregate level as is the case of the data for United Kingdom.

For the convergence analysis for the period 1995-1999 we use data of all the NUTS II regions in the EU15, data which is also provided by the Eurostat-Regio database but in this case figures for the GDP are based on the new accounting system (ESA95).

The data sets are only used separately as they are based on different accounting systems. We checked the comparison of the GDP figures based on ESA79 and ESA95 in the time periods where the dataset overlap (1995,1996,1997) and for several regions the changes were very important. In some cases we found values of the GDP based on ESA95 that were 14.84% lower than the same values based on ESA79 as was the case of Luxembourg for the year 1995. In other cases the GDP values based on ESA95 were over 30% higher than these values computed under ESA 79 for Sterea Ellada, the region of Brussels, for example. This prevents us from forming an aggregate data set in order to create a larger time series for the regions.

In our analysis we use the GDP data standardized by purchasing power parities at constant 1985 prices (The use of PPPs, common in international comparison has the effect that poorer countries' per capita incomes becomes higher than with current exchange rates).

In order to find an appropriate division of the 1980-1997 period covered by the Eurostat regio database based on ESA79 for the convergence analysis, the time series of growth rates were examined for turning points. It turned out that the selection of the periods 1980-1988, 1989-1992 and 1994-1997 would best satisfy the criteria to cover a similar cyclical path across regions in a subperiod. As regional growth rates slipped globally back in 1993 and during the following period due to a deceleration in the business cycle, the second subperiod only goes up to 1992. Moreover this division is compatible with the analysis of the impact that the new European Union regional policy has on the speed of convergence and the catch up process of the objective 1 regions to the average levels of European Union. The programming periods[24] of the structural funds after their reform, takes in the years 1989-1994 for the first Delors package and 1995-1999 for the second Delors package. Due to the goals that the structural funds and the regional policy pursue in the objective 1 regions the results of our convergence regressions should be related to this structural policy.

[24] The most recent programming period takes in the years 2000-2006 and is the so called agenda 2000.

3.7 European Regional Convergence Process, 1982-1999

3.7.1 Results from cross-section regression analysis of European Regional Convergence

For the period 1982-1997 we can find evidence for β-convergence among both the regions of EU9[25] and the regions of EU12[26]. The estimation of the cross-section regression analysis yielded a speed of convergence, β, for the EU9 regions of 1.15% and 1.04 % for EU12. The parameters of the regression are highly significant. The results of the estimation are reported in table 3.4 for EU9 and 3.5 for EU12. Both estimates fully explain the relationship reflected by R^2 of 0.46 and 0.45. In this period the relationship between initial per capita income of a region and its growth rate is negative (figures 3.3 and 3.4).

Figures 3.3 and 3.4 show the rather negative performance of the French regions throughout the period 1982-1997. This fact leads us to include a dummy variable for the French regions in order to provide a control for differences in steady states. The negative and highly significant "t" statistic for this dummy variable coefficient indicates a lower than average steady state income for those regions.

[25] EU9 comprises all regions in the first nine EC member states, i.e. the formation of 1973

[26] EU12 refers to all regions in the EU9 plus the regions from Greece (EC accession in 1981), Spain and Portugal (EC accession 1986)

Table 3.4 Convergence of EU9 regions 1982-1997

Dependent Variable: Average Growth Rate 1982-1997
Method: Least Squares
Included observations: 97
Estimated Equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.112327	0.029543	3.802149	0.0003
LNY82	-0.010603	0.003182	-3.331831	0.0012
DFR	-0.013632	0.001672	-8.154059	0.0000

R-squared	0.457830	Mean dependent var	0.010799
Adjusted R-squared	0.446295	S.D. dependent var	0.009262
S.E. of regression	0.006892	Akaike info criterion	-7.086535
Sum squared resid	0.004465	Schwarz criterion	-7.006905
Log likelihood	346.6969	F-statistic	39.68870
Durbin-Watson stat	1.834859	Prob(F-statistic)	0.000000

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Figure 3.3: Regional Convergence in EU9 1982-1997

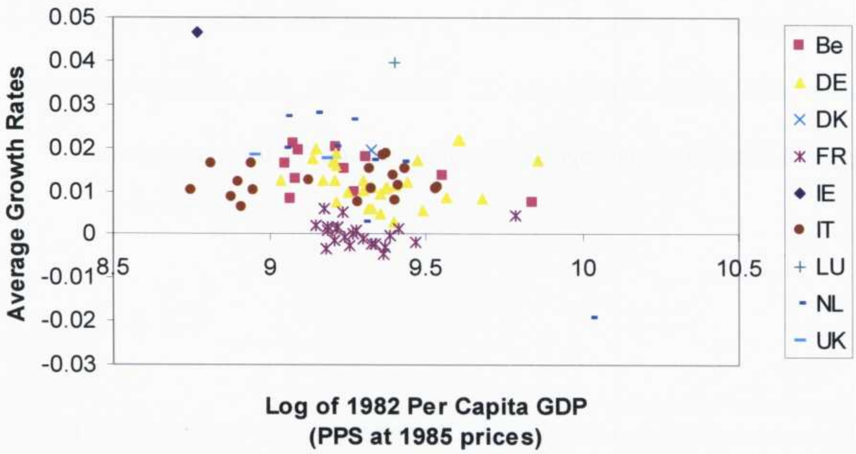


Table 3.5 Convergence of EU12 regions 1982-1997

Dependent Variable: Average Growth Rate 1982-1997
Method: Least Squares
Included observations: 133
Estimated Equation:

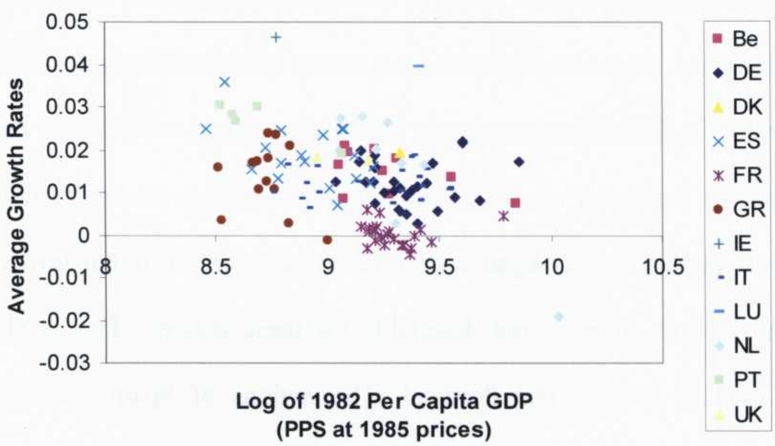
$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.103407	0.019008	5.440311	0.0000
LNY82	-0.009662	0.002081	-4.643286	0.0000
DFR	-0.013454	0.001689	-7.966336	0.0000

R-squared	0.446568	Mean dependent var	0.012710
Adjusted R-squared	0.438054	S.D. dependent var	0.009443
S.E. of regression	0.007079	Akaike info criterion	-7.041052
Sum squared resid	0.006515	Schwarz criterion	-6.975857
Log likelihood	471.2300	F-statistic	52.44898
Durbin-Watson stat	1.670294	Prob(F-statistic)	0.000000

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Figure 3.4: Regional Convergence in EU12 1982-1997

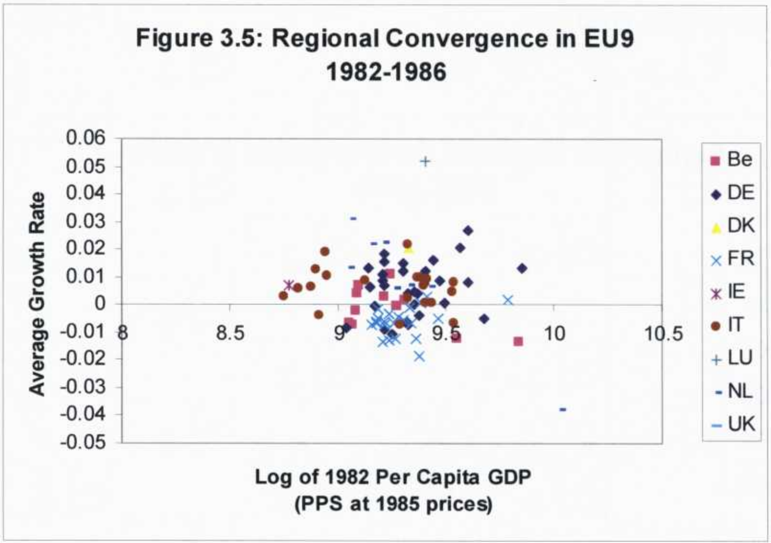


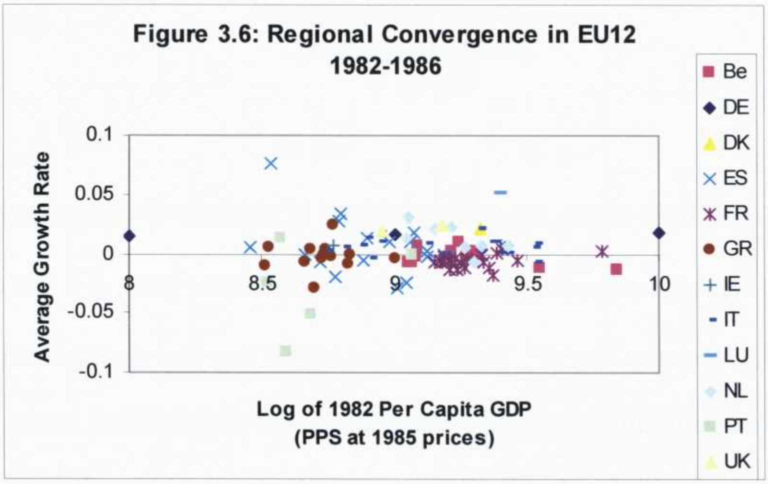
On analysing the output of the estimation, we find that the group of EU9 regions has on average a growth rate of around 1% throughout the entire period. However, on comparing these regions with those of Spain, Greece and Portugal, one notes that the average growth rates of this group was higher, almost 1.3%. Hence the catching-up of the Southern European regions, may be deemed to be positive during this period.

The following set of analyses allows us to widen the investigation for regional convergence in the European Union for the period 1982-1997. First, we divided the entire period into the following subperiods 1982-1986, 1986-1992 and 1992-1997. This subdivision facilitates several objectives. On the one hand it best satisfies a similar cyclical path across regions in a subperiod, while on the other, allow us to analyse whether or not the "new" European Union regional policy has boosted the convergence process in the European Union.

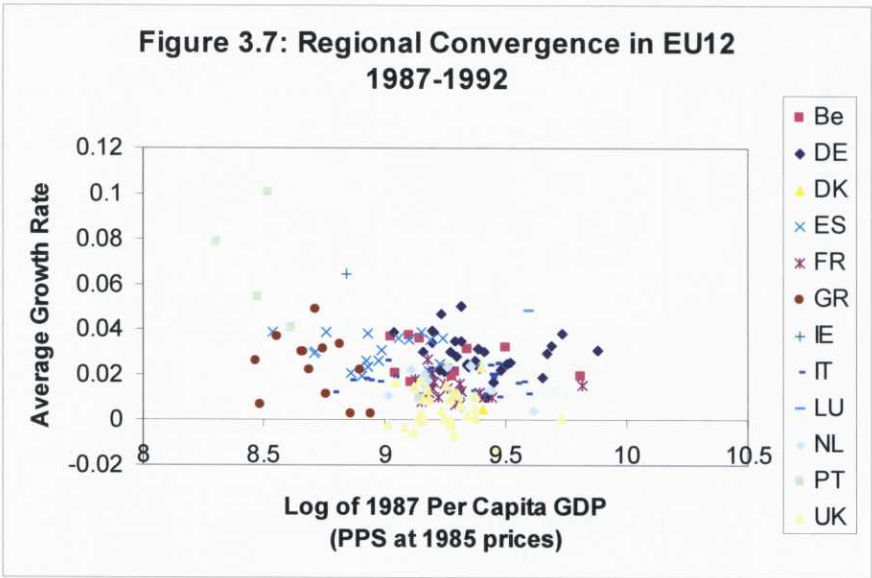
A view on figures 3.5 and 3.6 reveals that in the period 1982-1986 the negative relationship between initial income and growth rates does not hold, thus indicating a clear non-convergence pattern for all of the regions both in EU9 and EU12 from 1982 to 1986. Moreover, the average growth rates reflect almost total stagnation (close to 0% in 1982-1986). On focusing more closely on certain regions, we find that there are several points that are worthy of mention: First the French regions are clearly under performers during this period, and a negative correlation between the initial levels of per capita GDP and growth rates is not detectable for these regions. This is also true of the regions of Italy Greece and Portugal. The regions of Spain, the Netherlands and

Belgium however reflect a clearly negative correlation between the initial levels of per capita GDP and subsequent growth rates.





In our period of regional convergence analysis, the period 1987-1992 is when regional convergence began. Figure 3.7 reflects this negative relationship between initial income and growth rates. This figure suggests that Portugal has set off with high growth rates. At the same time, the "fit" of the regions of the cohesion countries into the common convergence path is quite good.



The results of the cross-section regression estimate of absolute β convergence (table 3.6) show that convergence among the EU12 regions has taken place at a rate of 1.8% per annum. However the low R^2 could be due to the fact that the European Union economies converge to different steady states, associated with different levels of initial income. The regions with low levels of income may be converging to their own steady states, whereas those regions with high levels of initial income are doing the same but to a high steady state position.

Table 3.6: Convergence of EU12 regions 1987-1992

Dependent Variable: Average Growth Rate 1987-1992
Method: Least Squares
Included observations: 166
Estimated equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1 - e^{-\beta * T})}{T} * \log[y_{i,t}] + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.184763	0.036079	5.121096	0.0000
LNY87	-0.017840	0.003925	-4.545858	0.0000

R-squared	0.111905	Mean dependent var	0.020831
Adjusted R-squared	0.106489	S.D. dependent var	0.015041
S.E. of regression	0.014217	Akaike info criterion	-5.656751
Sum squared resid	0.033149	Schwarz criterion	-5.619257
Log likelihood	471.5103	F-statistic	20.66483
Durbin-Watson stat	0.842246	Prob(F-statistic)	0.000011

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Taking into account the possibility of different steady states among the European Union economies, we re-estimate our initial specification by including dummy variables for the countries of the European Union. Another important reason to use dummy variables in regional growth analyses is derived from the possibility of spatial correlation patterns. It is very likely that a region's growth is influenced by that of neighbouring regions. Fingleton (1995) suggests using a spatially auto correlated errors model in order to cope with this obstacle. The use of dummy variables is an alternative approximation method for absorbing spatial correlation. To this new specification we add eleven dummy variables[27] for the regression of absolute β-convergence. The dummy variables take the value of 1 for all the regions in the country for which we are

[27] Obviously, we exclude one country dummy to avoid multicolineality problems.

defining the dummy and the value 0 for the remaining regions of the remaining countries. This specification provides the same results as those derived from the Geographical conditioning a la Quah[28].

The results of this conditional β-convergence cross-section regression for EU12 are shown in table 3.7. By comparing this estimation with the previous one, we find that the speed of convergence is almost the same with β reaching 1.77% in the case of the latter. The estimate of β shows that there is convergence among the EU12 regions. Ireland and Spanish regions towards the bottom of the income scale performed above average. So did German and Portuguese regions, but Greece, French and UK regions fell behind. The coefficients of the country dummy variables show the differences in steady states of these countries´regions.

[28] In the Geographical conditioning a la Quah the dummy variables take the value 1 for each region that geographically borders with other regions and the value 0 for the remaining ones.

Table 3.7: Conditional Convergence of EU12 regions 1987-1992

Dependent Variable: Average Growth Rate 1987-1992
Method: Least Squares
Included observations: 166
Estimated equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.181175	0.040735	4.447668	0.0000
LNY87	-0.016996	0.004346	-3.910842	0.0001
DDE	0.007823	0.002606	3.001615	0.0031
DES	0.001839	0.003422	0.537378	0.5918
DFR	-0.009808	0.002827	-3.469862	0.0007
DGR	-0.009512	0.004311	-2.206289	0.0289
DIE	0.033548	0.009861	3.402187	0.0009
DSIT	-0.010120	0.004230	-2.392464	0.0179
DLU	0.029982	0.009652	3.106119	0.0023
DNL	-0.008739	0.003373	-2.590964	0.0105
DP	0.021886	0.005669	3.860460	0.0002
DDK	-0.016302	0.009600	-1.698151	0.0915
DUK	-0.018477	0.002617	-7.059241	0.0000

R-squared	0.638086	Mean dependent var	0.020831
Adjusted R-squared	0.609701	S.D. dependent var	0.015041
S.E. of regression	0.009396	Akaike info criterion	-6.421894
Sum squared resid	0.013509	Schwarz criterion	-6.178184
Log likelihood	546.0172	F-statistic	22.47939
Durbin-Watson stat	1.742182	Prob(F-statistic)	0.000000

Dataset: EUROSTAT ESA79
Estimation in Eviews

Our final sample period of analysis using the EUROSTAT-REGIO database (ESA79) was 1993-1997. This period corresponds to the economic recovery, with average growth rates in the EU12 which were higher than 2.5% per annum. The analysis carried out is similar to that which was carried out for the period 1987-1992. First we estimated absolute β convergence (Table 3.8) and then re-estimate our initial specification while conditioning for the differences in the steady states of the European countries by including dummy variables (Table 3.9). The results obtained for absolute β convergence are fairly similar to those obtained for the previous period and reflect a convergence speed of about 1.9% per annum. On conditioning for differences in the steady states the speed of convergence is about 2.3%.

Table 3.8: Convergence of EU12 regions 1993-1997

Dependent Variable: Average Growth Rate 1993-1997
Method: Least Squares
Included observations: 178
Estimated equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log\left[y_{i,t}\right] + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.193355	0.043931	4.401362	0.0000
LNY94	-0.018142	0.004744	-3.824404	0.0002

R-squared	0.076726	Mean dependent var	0.025419
Adjusted R-squared	0.071481	S.D. dependent var	0.017881
S.E. of regression	0.017230	Akaike info criterion	-5.273163
Sum squared resid	0.052249	Schwarz criterion	-5.237413
Log likelihood	471.3115	F-statistic	14.62607
Durbin-Watson Stat	0.822902	Prob(F-statistic)	0.000182

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Table 3.9: Conditional Convergence of EU12 regions 1993-1997

Dependent Variable: Average Growth Rates 1993-1997
Method: Least Squares
Included observations: 178
Estimated equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T}$$

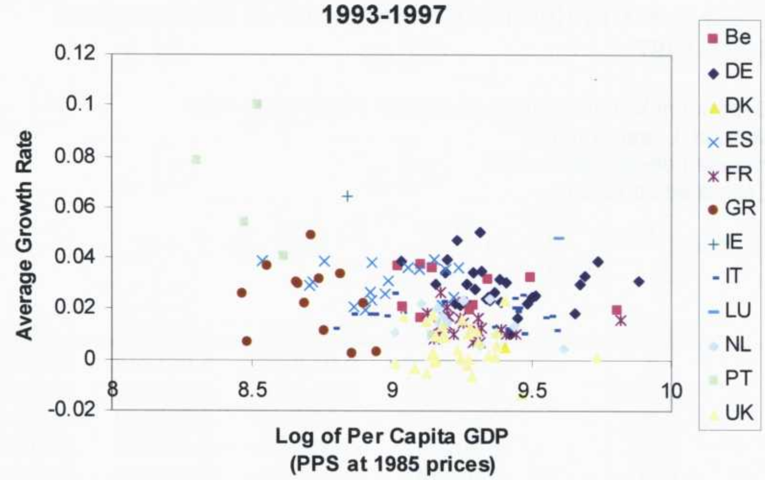
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.247960	0.042085	5.891846	0.0000
LNY94	-0.023765	0.004436	-5.357760	0.0000
DDE	-0.006087	0.003110	-1.957012	0.0520
DES	-0.002347	0.004048	-0.579923	0.5628
DFR	-0.026141	0.003586	-7.289129	0.0000
DGR	-0.012311	0.004910	-2.507258	0.0131
DIE	0.035262	0.012026	2.932025	0.0038
DSIT	-0.013609	0.005218	-2.608048	0.0099
DLU	0.015633	0.012139	1.287772	0.1996
DNL	0.023109	0.004214	5.483995	0.0000
DP	0.007917	0.005730	1.381698	0.1689
DDK	0.019335	0.011991	1.612563	0.1088
DUK	0.008510	0.003322	2.561823	0.0113

R-squared	0.598294	Mean dependent var	0.025419
Adjusted R-squared	0.569079	S.D. dependent var	0.017881
S.E. of regression	0.011738	Akaike info criterion	-5.981772
Sum squared resid	0.022733	Schwarz criterion	-5.749395
Log likelihood	545.3777	F-statistic	20.47900
Durbin-Watson stat	1.655734	Prob(F-statistic)	0.000000

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Finally, figure 3.8 illustrates the convergence process in the EU12 for 1993-1997.

Figure 3.8: Regional Convergence in the EU12 1993-1997



Among the EU15 regions, convergence was slightly higher than in the EU12 with absolute β convergence reaching 2% in the period 1987-1992 and 1.9% in the period 1993-1997. The results of these estimations are shown in tables 3.10 and 3.11.

Table 3.10: Convergence of EU15 regions 1987-1992

Dependent Variable: Average Growth Rate 1987-1992
Method: Least Squares
Included observations: 184
Estimated equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log\left[y_{i,t}\right] + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.205730	0.038724	5.312656	0.0000
LNY87	-0.020332	0.004206	-4.833561	0.0000

R-squared	0.113766	Mean dependent var	0.018637
Adjusted R-squared	0.108896	S.D. dependent var	0.016731
S.E. of regression	0.015794	Akaike info criterion	-5.447539
Sum squared resid	0.045401	Schwarz criterion	-5.412594
Log likelihood	503.1736	F-statistic	23.36332
Durbin-Watson stat	0.692029	Prob(F-statistic)	0.000003

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Table 3.11: Convergence of EU15 regions 1993-1997

Dependent Variable: G9397
Method: Least Squares
Included observations: 193
Estimated Equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.195970	0.037576	5.215271	0.0000
LNY93	-0.018535	0.004062	-4.563082	0.0000

R-squared	0.098298	Mean dependent var	0.024580
Adjusted R-squared	0.093577	S.D. dependent var	0.015972
S.E. of regression	0.015206	Akaike info criterion	-5.523904
Sum squared resid	0.044165	Schwarz criterion	-5.490094
Log likelihood	535.0568	F-statistic	20.82172
Durbin-Watson stat	0.947112	Prob(F-statistic)	0.000009

Dataset: EUROSTAT
ESA79
Estimation in Eviews

For the time periods 1987-1992 and 1993-1997 we also estimate conditional β-convergence adding to our cross section regression a dummy variable for each of the European countries in order to control for differences in the steady state incomes. The results of these estimations are shown in tables 3.12 and 3.13.

Figures 3.9 and 3.10 illustrate the convergence process in the EU15 for 1987-1992 and 1993-1997.

Table 3.12: Conditional Convergence of EU15 regions 1987-1992

Dependent Variable: Average Growth Rate 1987-1992
Method: Least Squares
Included observations: 184
Estimated equation:

$$\frac{1}{T}*\log\left[\frac{y_{i,t+T}}{y_{i,t}}\right]=a+\frac{(1-e^{-\beta * T})}{T}*\log[y_{i,t}]+X_i+u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.171156	0.036905	4.637731	0.0000
LNY87	-0.015926	0.003937	-4.045488	0.0001
DDE	0.007797	0.002509	3.108377	0.0022
DES	0.002263	0.003246	0.697150	0.4867
DFR	-0.009717	0.002718	-3.574746	0.0005
DGR	-0.008817	0.004047	-2.178710	0.0307
DIE	0.034104	0.009463	3.603876	0.0004
DSIT	-0.009692	0.004032	-2.403744	0.0173
DLU	0.029731	0.009285	3.201918	0.0016
DNL	-0.008635	0.003244	-2.662049	0.0085
DP	0.022689	0.005353	4.238818	0.0000
DDK	-0.016345	0.009241	-1.768849	0.0787
DUK	-0.018353	0.002514	-7.299981	0.0000
DAT	-0.008561	0.003565	-2.401551	0.0174
DSE	-0.032044	0.004150	-7.721191	0.0000
DFI	-0.055814	0.005579	-10.00396	0.0000

R-squared	0.731720	Mean dependent var	0.018637
Adjusted R-squared	0.707767	S.D. dependent var	0.016731
S.E. of regression	0.009045	Akaike info criterion	-6.490316
Sum squared resid	0.013744	Schwarz criterion	-6.210756
Log likelihood	613.1091	F-statistic	30.54746
Durbin-Watson stat	1.761313	Prob(F-statistic)	0.000000

Dataset: EUROSTAT
ESA79
Estimation in Eviews

Figure 3.9: Regional Convergence in the EU15 1987-1992

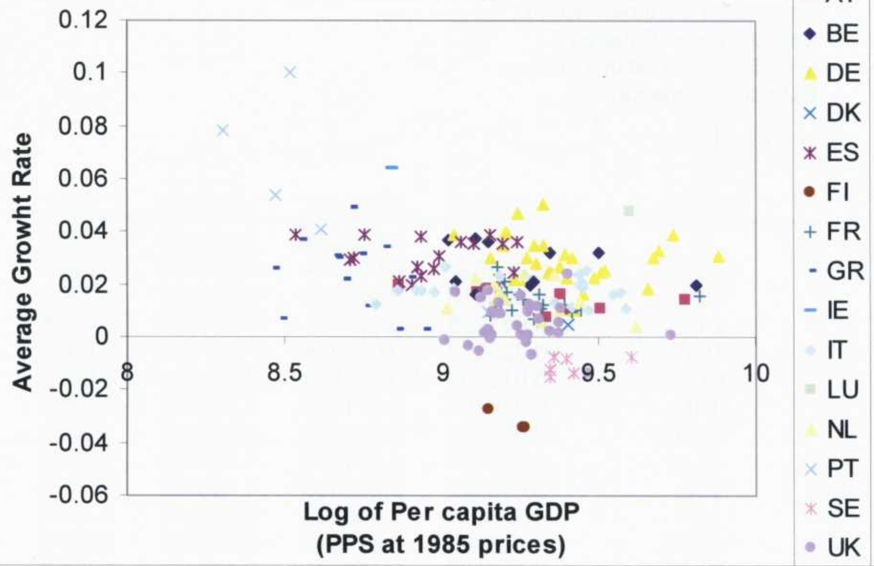


Figure 3.10: Regional Convergence in the EU15 1993-1997

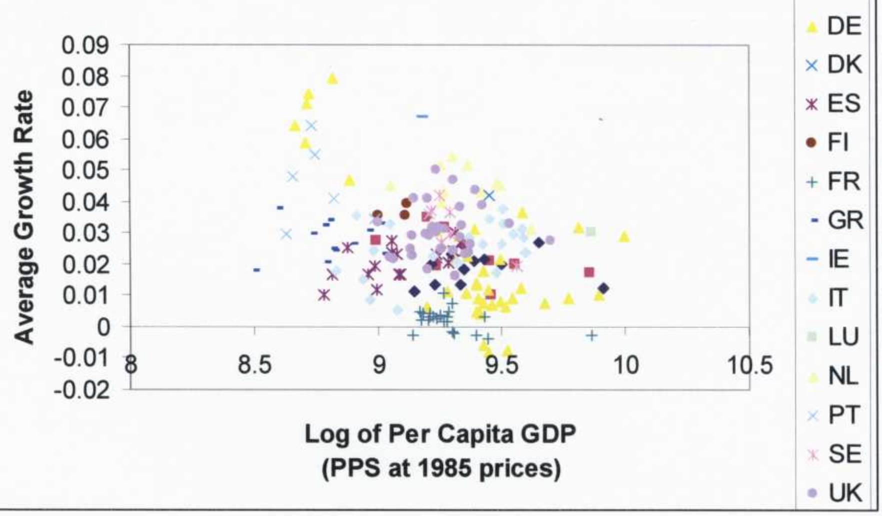


Table 3.13: Conditional Convergence of EU15 regions 1993-1997

Dependent Variable: G9397
Method: Least Squares
Included observations: 193
Estimated equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.266600	0.038271	6.966120	0.0000
LNY93	-0.025739	0.004044	-6.364845	0.0000
DDE	-0.003819	0.002935	-1.301372	0.1948
DES	-0.011295	0.003724	-3.033343	0.0028
DFR	-0.025362	0.003334	-7.607458	0.0000
DGR	-0.012667	0.004570	-2.771524	0.0062
DIE	0.036464	0.011262	3.237787	0.0014
DSIT	-0.014736	0.004855	-3.035181	0.0028
DLU	0.017485	0.011338	1.542120	0.1248
DNL	0.016486	0.003939	4.185287	0.0000
DP	0.004653	0.005358	0.868467	0.3863
DDK	0.018690	0.011212	1.666941	0.0973
DUK	0.002669	0.003091	0.863478	0.3890
DAT	-0.002196	0.004326	-0.507662	0.6123
DSE	0.005035	0.005062	0.994760	0.3212
DFI	0.003918	0.006900	0.567870	0.5708

R-squared	0.564654	Mean dependent var	0.024580
Adjusted R-squared	0.527760	S.D. dependent var	0.015972
S.E. of regression	0.010976	Akaike info criterion	-6.106969
Sum squared resid	0.021323	Schwarz criterion	-5.836487
Log likelihood	605.3225	F-statistic	15.30488
Durbin-Watson stat	1.700835	Prob(F-statistic)	0.000000

Dataset: EUROSTAT
ESA79
Estimation in Eviews

The regional convergence process that has been taking place since 1986 within the group of objective 1 regions, and which had become the main focus of the European Union regional policy is worth investigating separately and this we will do in the following chapter where we deal with the economic development of these regions and their experience with the European Union regional programmes.

3.7.2 Results from panel data regression analysis of European Regional Convergence

Only recently, have panel data estimation techniques (see Hsiao 1986, Baltagi 1995) become influential in growth estimation. The main reasoning behind the use of this estimation technique is the desire to exploit panel data in order to control unobserved time-invariant heterogeneity in cross-sectional models. This methodology is loosely linked to one strand of panel data literature known as *fixed effects models*.

The assumption that economic-specific, time-invariant fixed effects exist, and which are responsible for individual steady state income positions, was adopted in several growth analyses (Islam, 1995, Canova and Marcet 1995).

Differences in regional steady state incomes obviously has become increasingly important since the 1980s. These differences no longer appear to be linked to the characteristics of the country where the region is located. The cross-section regression analysis however does not allow us to estimate individual regional effects in conditional convergence to their full extent. We thus aimed to employ an alternative framework for the estimation, one which was able to provide a direct estimate for individual regional factors, reflecting region-specific steady state differences. We again estimated convergence again for the period 1983-1999, but this time exploiting the whole time series information for each region. Within the framework of the panel data, the individual regional effects that condition the regions specific steady state income, can be estimated. The results show that the regions' steady state incomes did indeed, drift apart. When regions are bound to very different steady state positions, convergence to a common income level appears to be impossible.

In this particular analysis the concept of convergence is somewhat different in the sense that it is now regarded as convergence towards the region's own steady state income. Consequently, as a region is closer to its own steady state than to the average steady state of a total group, the convergence coefficient is higher than in the cross-section analysis.

This alternative estimation leads to striking results, summarized in tables 3.14, 3.15, 3.16, 3.17 and 3.18. Overall, growth rates are significantly negatively related to income levels and show that the convergence relationship holds. We only report minimum and maximum values of the region-specific fixed effects, as 206 fixed effects would have to be listed.

The estimated coefficient b for the whole period 1982-1997 is 0.17, which corresponds to a convergence rate β of 8.7 per cent per annum implying that regions would be halfway from their steady state income in 7.96 years (the half-period for the complete closure of the income gap is calculated from the formula, $H = {}^{\log(2)}\!/_{\beta} = 0.69\beta$. Other studies with similar specifications, reported a rise in β using panel data estimations. De la Fuente (1996) found a rate of convergence of 12.7 per cent for the Spanish regions for 1955-91 when using a fixed effects model. Canova and Marcet (1995) showed that the convergence coefficient increases to 23 per cent when each region converges to its own steady state.

From the basic results for 1983-1997 it is clear that steady state incomes must have changed during this period of time, since if this was not the case then zero growth would soon have been observed. Therefore, convergence in the particular periods used previously in the cross-section analysis need to be investigated on the grounds of the business cycle argument. For the period 1983-1986, the estimation shows a convergence rate β of 40.49 per cent. The convergence coefficient implies that, on average, regions would have reached half of their steady state in about 1.71 years in 1982-1986. These results are consistent with those of the previous section, where hardly any convergence was detected particularly for the period 1982-1986. The low speed of convergence, highlighted in the cross-section regression, simply reflects the fact that conditional factors had become very pronounced, but it was impossible to take this fully into account. The estimated coefficient for the period 1986-1992 (1992-1997) is somewhat lower, implying a convergence rate of 20.85 (17.08 per cent) per cent, and the fixed effects are now less disperse than in the previous period. These results are again in line with the results from the cross-section analysis, where convergence sped up after 1986 and where the convergence rate was higher in 1986-1992 than in1992-1997.

We also estimated our fixed effects panel data model (table 3.18) for the period 1995-1999 using the figures based on the EUROSTAT (ESA95). The results show a convergence rate of about 11.11 per cent per annum.

Table 3.14: Panel data estimation of convergence 1982-1997

Dependent Variable: $LnY_{i,t} - LnY_{i,t-1}$

Method: Pooled Least Squares
Number of cross-sections used: 206
Total panel (unbalanced) observations: 2592
Estimated equation:

$LnY_{i,t} - LnY_{i,t-1} = a_i - b * LnY_{i,t-1} + u_{i,t}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YA?	-0.174864	0.012206	-14.32592	0.0000
Fixed Effects				
Min a_i		1.492127	s.d 0.04709	
Max a_i		1.820381		

R-squared	0.148181	Mean dependent var	0.016356
S.E. of regression	0.054640	S.D. dependent var	0.056800
F-statistic	2.014026	Sum squared resid	7.120567
Prob(F-statistic)	0.000000	Durbin-Watson stat	2.243721

Table 3.15: Panel data estimation of convergence 1982-1986

Dependent Variable: $LnY_{i,t} - LnY_{i,t-1}$

Method: Pooled Least Squares
Number of cross-sections used: 139
Total panel (unbalanced) observations: 538
Estimated equation:

$LnY_{i,t} - LnY_{i,t-1} = a_i - b * LnY_{i,t-1} + u_{i,t}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YA?	-0.792775	0.061944	-12.79834	0.0000
Fixed Effects				
Min a_i		6.683014	s.d 0.24318	
Max a_i		7.951403		

R-squared	0.404727	Mean dependent var	0.002926
S.E. of regression	0.037752	S.D. dependent var	0.042124
F-statistic	1.946766	Sum squared resid	0.567227
Prob(F-statistic)	0.000000	Durbin-Watson stat	2.145309

Table 3.16: Panel data estimation of convergence 1986-1992

Dependent Variable: $LnY_{i,t} - LnY_{i,t-1}$

Method: Pooled Least Squares
Number of cross-sections used: 191
Total panel (unbalanced) observations: 1193
Estimated equation:

$LnY_{i,t} - LnY_{i,t-1} = a_i - b * LnY_{i,t-1} + u_{i,t}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YA?	-0.415950	0.024732	-16.81816	0.0000
Fixed Effects				
Min a_i		3.545936	s.d 0.1147	
Max a_i		4.179079		
R-squared	0.300802	Mean dependent var		0.021081
S.E. of regression	0.065949	S.D. dependent var		0.072275
F-statistic	2.254656	Sum squared resid		4.353631
Prob(F-statistic)	0.000000	Durbin-Watson stat		2.560657

Table 3.17: Panel data estimation of convergence 1992-1997

Dependent Variable: $LnY_{i,t} - LnY_{i,t-1}$

Method: Pooled Least Squares
Number of cross-sections used: 206
Total panel (unbalanced) observations: 1191
Estimated equation:

$LnY_{i,t} - LnY_{i,t-1} = a_i - b * LnY_{i,t-1} + u_{i,t}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YA?	-0.270969	0.019397	-13.96958	0.0000
Fixed Effects				
Min a_i		2.324076	s.d 0.0699	
Max a_i		2.800542		
R-squared	0.434750	Mean dependent var		0.015195
S.E. of regression	0.033304	S.D. dependent var		0.040281
F-statistic	3.673900	Sum squared resid		1.091411
Prob(F-statistic)	0.000000	Durbin-Watson stat		1.674568

Table 3.18: Panel data estimation of convergence 1995-1999

Dependent Variable: $LnY_{i,t} - LnY_{i,t-1}$

Method: Pooled Least Squares
Number of cross-sections used: 211
Total panel (balanced) observations: 844
Estimated equation:

$LnY_{i,t} - LnY_{i,t-1} = a_i - b * LnY_{i,t-1} + u_{i,t}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YA?	-0.143666	0.021954	-6.543894	0.0000
Fixed Effects				
Min a_i	1.256151	s.d 0.03985		
Max a_i	1.519423			
R-squared	0.317509	Mean dependent var		0.028615
S.E. of regression	0.024584	S.D. dependent var		0.025766
F-statistic	1.393458	Sum squared resid		0.381955
Prob(F-statistic)	0.001161	Durbin-Watson stat		2.319766

3.8 Conclusions

In this chapter we have studied the regional convergence of the regions in the European Union since 1982 using cross-section and panel data regressions. The cross-section estimations indicate that from 1982 to 1986 there is a clear non-convergence pattern for all of the regions both in EU9 and EU12. Absolute β-convergence has been the norm since 1987. That is, the poor regions in these countries tend to experience faster per capita growth than rich regions. The values found for absolute β-convergence in the period 1987-1992 are higher in the EU15 than in the EU12 (speed of convergence of about 2% in EU15 and 1.77% in EU12). However, in 1993-1997 the speed of convergence reached similar values both for the EU12 and EU15, a value of around

1.9%. Although the coefficient estimate for the speed of convergence is highly significant in all our estimations, the explanatory power of the cross section estimates of absolute β-convergence are rather low, suggesting that country-specific steady states could be behind these results. In order to check for these differences in steady states we estimate conditional β-convergence for our periods of analysis while including dummy variables for each of the countries in the European Union. The explanatory potential of the is much improved, and this is reflected by higher R^2 value and the β coefficients are highly significant.

We estimated convergence rates again for the period 1982-1999, using a fixed effects panel data model capable of providing a direct estimate for individual regional factors reflecting region-specific steady state differences. The results show that the regions steady state incomes drifted apart. When regions are bound to very different steady state positions, convergence to a common income level is therefore impossible.

The figures obtained for the convergence rates are much higher than in the cross-section regressions, since the specifications of the model implies convergence to each region's own particular steady state income.

Chapter four

European Union Regional Policy and its effects on Objective 1 regions

4.1 Introduction

This chapter[1] analyses regional growth, and the impact that European Union structural policy has had on the objective 1 regions since 1989 against the backdrop of talks on EU regional policy after 2000. Before developing this analysis, we will trace the evolution of regional disparities in the European Union during the period 1986-1999 in order to provide a frame of reference for the developments in the growth rates in the objective 1 regions. The analysis of the growth process in the objective 1 regions is carried out in section 4.4. It is shown that objective 1 regions have been one of the most energetic groups in terms of growth during the period 1989-1993 and 1995-1999. This result becomes even more striking when we take into account that it took place during a period in which markets and populations were becoming more "globalized" and competition was becoming more intense through the completion of the internal market.

We also provide evidence of the catching-up process experienced by objective 1 regions which was set in motion when the regional development programmes were initiated. The analysis of this catching-up process was carried out by regressing the gap between the per capita income of the objective 1 regions and the average per capita income of the EU15 on a trend variable using a panel data model with fixed effects.

[1] We wish to thank seminar participants at ECSA conference (Brussels 2000) and UACES 31st Annual conference and 6th Research Conference (2001) where earlier versions of this chapter have benefited from constructive suggestions (http://www.ecsanet.org/fifth_ecsaworld/index.htm.). I also want to thank the staff of the Economics Department at Exeter University and especially Prof. Marco Mariotti for the research-invitation and all the facilities and help given for finishing this chapter. A preliminary version of the chapter has been published as a working paper at Exeter University. Discussion paper in Economics 01/07, University of Exeter, pags 23, http://www.ex.ac.uk/sobe/.

Nowadays EU Regional Policy is facing new challenges: On the one hand, the implications of the European Spatial Development Perspective (ESDP) need to be taken on board and the measures that have been adopted in order to foster competitiveness in the EU need to be fully assimilated. Further, resources and institutional bureaucracy must be adapted in order to cope with the enlargement process. The search for global competition implicit in the ESDP framework mean that the Regional Policy must become broader in outlook. The accession of the CEECs will mean that the statistical threshold of the objective 1 regions will fall by several percentage points. These two factors seems to suggest that it is not wise to concentrate assistance in the least-favoured regions. However, it should be remembered that Regional Policy is a highly selective tool which cannot be used as a blanket measure for improving competitiveness throughout the European territory. In spite of these obstacles it is still possible to maintain a certain emphasis on the present objective 1 regions by introducing some kind of balance in order to compensate for the "contraction effect on the statistical threshold subsequent to the accession of the CEECs.

Sections 4.5 and 4.6, which constitute the last part of this chapter, deal with the challenges thrown up by recent debates on European Union regional policy by providing a simulation which utilises the figures foreseen for structural actions in the financial framework for an enlarged EU-21, a proposal that was sketched out at the Berlin European Council in March 1999. The results of the simulation show that the financial perspectives approved in the Berlin Summit (March 1999) suggest that there is enough financial leeway to assist 90% of population in CEECs and 75% of the current objective 1 population. Section 4.7 concludes with the main findings.

4.2 The need of a Regional Policy in the European Union

Following a decade of rather limited initiatives, in 1986, within the context of the Single Market project, the European Community assumed the task of a common regional policy. The main aim of this policy was to support the development of the weakest regions, which, in addition to Ireland and the Mezzogiorno, included the new entrants, Greece, Spain and Portugal. Article 130a-e of the Single European Act, firmly established EC regional policy and the objectives of economic and social cohesion as corner-stones of the Community's constitutional framework. The main reasoning behind the creation of EC regional policy was the potential threat of problems arising from the economic restructuring of the weaker, peripheral parts of the Community, linked to 1992 project. In order to speed up the restructuring process, and to improve the conditions for economic development, Community financial assistance was deemed necessary. Further reasons that make regional policy necessary for the European Union are:

First, there is no natural tendency toward a spatial balance in the development of the regions.

Secondly, the concentration of population and economic activities is a well-established feature of EU territory. It is perhaps worth reiterating, what is frequently cited in relevant literature, namely that London, Paris, Milan, Munich and Hamburg together form a pentagonal area that represents 20% of the total area and contains 40% of the EU citizens who produce about 50% of the EU's total GDP. This gives rise to major imbalances.

Thirdly, Unconditional convergence in GDP ph levels is not a natural tendency. If there exists a certain level of convergence it would appear to be a very long term process and spontaneous speeds of catching up are too low.

With the institutionalisation of regional policy and the Delors I and II packages peripheral economies received substantial financial support which aimed to accelerate growth in these areas.

4.3 Economic and Social Cohesion: New European Union Regional Policy and its programming periods

According to the Treaty, the Community must act "*to promote overall harmonious development*" and "to *reduce disparities between the levels of development of the various regions and the backwardness of the least favoured regions*" (Art 158). The Single European Act (SEA)(1987) was conceived with the aim of fostering the integration process in the European Community. Integration was to be characterized by the twin dynamic of monetary union and regional expansion. The former process came about through the unification of European markets and the bases for monetary union which were set out in the EU Treaty, Maastricht (1992), and had the effect of intensifying integration and giving rise to economic and monetary union (EMU). The latter process, that of regional expansion resulted in a EU made up of 15 member countries and a population more than 370 million people.

The deepening of economic integration was followed by a wide-scale reform in Regional Policy. Present Regional Policy has been shaped by the introduction of the Economic and Social Cohesion principle in the EEC Treaty by the Single European Act (SEA) in 1987. It was reinforced after the ratification of the EU Treaty and the creation of the new Cohesion Fund.

The provisions of the SEA foresaw Economic and Social Cohesion as the back bone of European Union Regional Policy (old Article 130a EEC Treaty). The objective of strengthening Economic and Social Cohesion implies the promotion of an overall harmonious development of the EU by reducing regional disparities and, in particular, the backwardness of least-favoured regions. The ERDF along with the other structural funds operating within a coordination framework are intended to help redress the main regional imbalances in the EU by participating in the development and structural adjustment of less developed regions and in the conversion of declining industrial regions and other areas with structural and/or employment problems.

After these changes in the Primary Community Law, both reforms of the Regional Policy were implemented. In 1988 legislative tasks were completed and the funding for the new programming period 1989-1993 was approved (European Commission, 1989). Both, the general procedures and the financial amounts assigned to European Regional Policy were reformed providing it with its contemporary structure. With respect to general procedures, a new scheme of planning and programming via negotiation throughout the various strata public authorities was set up by means of the "Community Support Frameworks" (CSF). The reform affecting financial amounts, involved doubling the real value of funding allocated to Regional Policy in this first programming period 1989-1993 (Delors I package).

After the EU Treaty, (Maastricht 1992), the coordination and programming of structural funds were reinforced and their funding was again doubled in terms of real value. Legislative reform was completed during the year 1993 (European Commission,1993, 1994a) and the new programming period 1994-1999 (Delors II package) was on the point of coming into effect (European Commission, 1994b).

At present, the EU is facing some important challenges. On the one hand, the European Union must foster growth and competitiveness and find its way in a global economy while meeting the requirements of the World Trade Organization (WTO). On the other, the consolidation of European Monetary Union (EMU) and the initiation of the enlargement process towards Central and Eastern European Countries (CEEC) are fundamental aims of the EU. The strategic framework for meeting these challenges has been put forward by the European Commission in the "Agenda 2000", where the financial guidelines for the next programming period 2000-2006 were also drawn up (European Council, 1999b, 1999c, 1999d, 1999e).

These guidelines for the medium-term implementation and funding of the main EU policies were agreed to at the Berlin Summit (European Council 1999a), where a coherent framework designed to link expenditure commitments and foreseen resources was set out by the European Council. European Union expenditure must respect the imperative of budgetary discipline needed to maintain EMU stability whilst simultaneously ensuring the orderly development of EU policies and coping effectively with the process of enlargement.

The figures given in the following table show the main structural features of the new European Regional Policy through its three programming periods from 1989 to 2006. The table reflects the increases in the real value of funds allocated to structural interventions, both in terms of total amounts and in terms of annual averages.

Table 4.1: Economic and Social Cohesion: Regional Policy Figures

PROGRAMMING PERIODS STRUCTURAL OPERATIONS Billions Ecus 1999		1989-93		1994-99			2000-06	
		Total	Annual Average	Total	Annual Average	Year 1999	Total	Annual Average
Structural Funds		74.821	14.964	166.911	27.818	32.119	195.000	27.857
OBJ 1	Amount	48.046	9.609	103.061	17.177	19.818	135.900	19.414
	% Objectives	69,6%	---	68.0%	---	---	74.5%	---
	% Total Stral. Funds	64.2%	---	61.7%	---	---	69.7%[a]	---
Cohesion Funds		1.746[b]	---	17.364	2.894	2.894	18.000	2.571
Future Acceding and New Member Sates		---	----	---	---	---	47.780[c]	8.254
Total Funding		76.567	15.313	184.275	30.712	35.013	260.780	38.682

[a] Only 1993, [b] 65,4% without transitional support , [c] New MS increasing amounts starting from 2002
Source: Annual Reports on Structural Funds (European Commission) and Conclusions of the Presidency from the Berlin European Council (March 1999).

In accordance with the Economic and Social Cohesion principle, a concentration process with respect to structural funds in the most needy areas and particularly in those regions whose development is lagging behind, the main thrust of EU development, that is, the objective 1 regions is already underway. The concentration process in the structural funds is implemented by means of a reduction in the total percentage of population receiving assistance, with the exception of the objective 1 regions. It should be remembered however, that the amount of the population receiving assistance according to the different objectives, is not, and must not be independent of the distribution of developmental disparities and structural imbalances throughout the European Union.

This concentration principle has meant that the perspectives for the new period 2000-2006 give rise to a certain optimism. The percentage of the structural funds being assigned to objective 1 regions has increased up to a figure of 65.4 (69,7% if the regions with transitional assistance are included). By this means, sufficient support has been maintained for the objective 1 regions, while creating enough financial space to facilitate the enlargement process both for the pre-accession, financial instrument and PHARE program as well as for structural interventions in the new member States, (future acceding countries after 2002).

Concentrating support within the most needy areas is at the core of the arrangements drawn up by the European Council at the Berlin Summit in order to address the problems of financial stability, assistance to those regions with structural problems and the process of enlargement to include CEE countries. This is clearly emphasized in the conclusions of the Berlin Summit:

"Improving the effectiveness of the structural and Cohesion funds in achieving the goal of economic and social cohesion enshrined in the Treaty is a central plank of the Agenda 2000 reforms. This goal has to be maintained in the future as priorities continue to evolve in a more diverse Union, taking account of the aim of achieving greater concentration of structural assistance, improving the financial management of the structural funds as well as simplifying their operation and administration" (Presidency conclusions - Berlin European Council 24 and 25 March 1999)

4.4 Structural Actions, convergence and growth in Objective 1 regions

Since the expansion of the industrial revolution last century, Western European economies have grown on average by 2-2½% a year, although there have been periods of market fluctuations such us the prolonged boom period in the 1950s and 1960s. This boom ended with the oil crises of the 1970s. From 1973 onwards, growth in the EU has once again averaged 2-2½%. This figure is slightly lower than the figure for growth in the US, whereas previously it had been substantially higher. This statistic implies that both output - and real income- have doubled every 30 years or so. In the 10 years from 1986 to 1996, GDP in the EU grew on average by just over 2% a year , though this growth was much more intense in the first half of the period-1986 to 1991- when growth, buoyed by expansion of the global economy and closer European integration, averaged over 3% a year. In the second half of the period, from 1991 to 1996, and partly as a result of the downturn in the world economy, growth in the EU averaged just 1½% a year and GDP fell by ½% in 1993 for the first time since the oil crisis in 1975. Despite the worsening of the global economic situation the average growth rate over the period 1995 to 1999 reached 2.8%.

4.4.1 Regional disparities in the EU 1986-1999

The scale of regional disparities throughout the Union, the variation in performance between different types of region and the specific problems in particular countries go beyond the simple core/periphery and rich/poor distinctions. Nevertheless, the disparities between rich and poor regions and the way that these have changed over recent years, is perhaps the defining characteristic of European imbalance.

The regions whose development is lagging behind have, on the whole, achieved improved performance during a period of deepening and intensified competition which has came about through the completion of the internal market, the liberalization of monetary and capital movements in the EU and within the context of more global competition in the world economy. The reform of EU Regional Policy has certainly played a key role in obtaining these results since it has facilitated:1) the coordination of planning and programming of Structural Funds within the Community Support Frameworks (CSF) 2) the intensification of the concentration of its efforts within the objective 1 regions, i.e. those regions whose development is lagging behind and 3) an increase in the funding allocated to regional structural interventions.

Closer integration in the EU, together with a strengthening of Regional Policy and the competitive advantages intrinsic to the poorer regions, has favoured the convergence of objective 1 regions over the period 1986 to 1999. The result was that the disparities became polarized at the bottom end of the distribution pattern. A typical "poor" region (ie one with below-average output) experienced an increase in per capita GDP of some 3 percentage points relative to the EU average.

As is shown in the 6th Periodic Report on the Social and Economic situation and Development of the Regions of the European Union, the poorest regions achieved a level of convergence, which was remarkable for its intensity and for the historical perspective in which it took place:

"There is clear evidence that GDP per head, and therefore the output and income of poorer regions, is converging towards the EU average. Over the 10 years, 1986 to 1996, the level in regions with below average GDP per head typically increased by around 3 percentage points relative to the EU average. Convergence, moreover, seems to have been more pronounced in the poorest regions, the 25 with the lowest GDP per head in 1986 narrowing the gap with the EU average by 5½ percentage points and the 10 lowest by 7½ percentage points". (6th Periodic Report on the Social an Economic situation and Development of the Regions of the European Union).

However there was a small reduction in the overall regional disparity in the EU, due to the confluence of a sharp decline in disparities below average GDP per head and an increase above the average. As noted above, the relative prosperity of both the richest and the poorest regions increased over the period. The summary measure reflects that these disparities are compressed at the bottom end of the distribution pattern and expanded at the top. However, there has been very little change in the regional ranking in terms of GDP per head, which remains just the same as 10 years earlier.

4.4.2 Regional Growth in objective 1 regions

The following dispersion graphs (Figure 4.1 and 4.2) show the distribution of European Union regional growth (NUTS 2) according to levels of development and growth rates in the EU15 for the periods 1989-1993[2] and 1995-1999. We have chosen these time periods because they represent the span in which the two regional development programmes have been operational[3]. The first Community Support Framework (CSF I) was in place from 1989-1993, and the second (CSF II) from 1994 until 1999. The regions for each of the EU15 countries have been plotted using different colours. In this sense it is easier to compare the relative performance of those countries that are subject to objective 1 regional Policy[4] (mainly Greece, Spain, Portugal, Italy and Ireland) with the performance of the non-objective 1 regions.

[2] Computations for 1989-1993 were carried out using the EUROSTA-REGIO database (ESA79) while for 1995-1999 they were carried out using the EUROSTAT-REGIO database (ESA95)

[3] Although the second CSF was in place in 1994, we chose the interval 1995-1999 in order to be able to use the new EUROSTAT (ESA 95) figures.

[4] There are other countries which have objective 1 regional policies such as the new German Laender, French dominions.

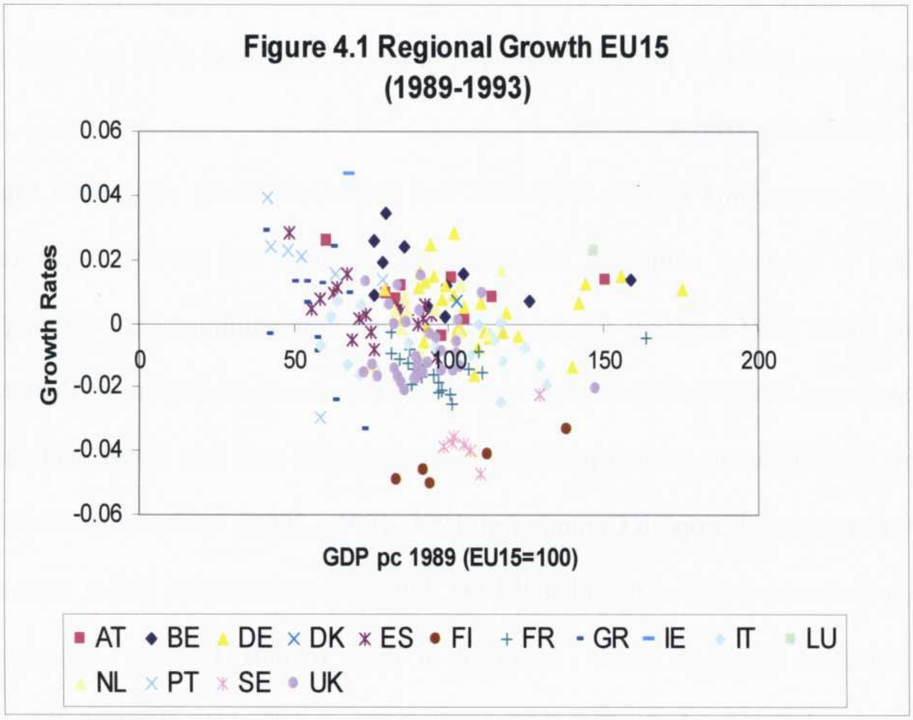


Figure 4.1 Regional Growth EU15
(1989-1993)
Growth Rates
GDP pc 1989 (EU15=100)
AT BE DE DK ES FI FR GR IE IT LU
NL PT SE UK

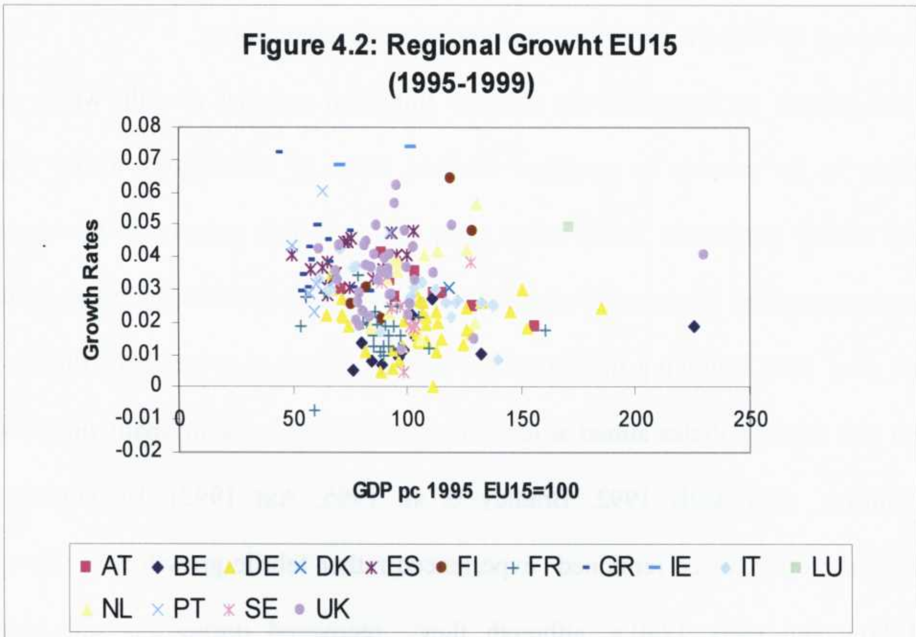


Figure 4.2: Regional Growht EU15
(1995-1999)
Growth Rates
GDP pc 1995 EU15=100
AT BE DE DK ES FI FR GR IE IT LU
NL PT SE UK

A visual inspection of these graphs indicates the performance of the EU periphery (Spain, Greece, Portugal, Ireland) in terms of growth during 1989-1993 and 1995-1999 was unequivocally positive.

During the programme periods 1989-1993 and 1994-1999, many objective 1 regions benefited in terms of additional investment, job creation and growth of per capita income. Since 1989 Regional strategic planning and programming along with support from Structural Funds have facilitated supply-side improvements in many of the weaker regions, a strengthening of their productive potential and a shift into higher value-added sectors (see reports European Commission, 1991, 1996a, 2000). Income disparities have been on the increase since 1975 (Tondl 1997, European Commission 1996b, Armstrong 1995, Dunford 1993). A closer appraisal of these regions, i.e., the regions with sluggish development, shows that their performance and the rate at which they have been catching up with the rest of the regions has not been uniform.

Regional growth performance was strongly linked to national growth, which varied according to the country in question. Further, some of the regions within a given country clearly performed much better than others, which seemed to be cursed by persistent stagnation. Spain and Portugal both enjoyed an impressively intense period of growth after 1987 following the stagnation they experienced in the early 1980's. This growth was due to policies aimed at fomenting stabilization and, in Spain, on economic restructuring (Tsoukalis 1992, Bradley et al. 1995, Axt 1992). By contrast, the Mezzogiorno and Greece remained experienced rather febrile growth path throughout the 1980's and early 1990's, although they recovered during the mid nineties, particularly Greece. The Mezzogiorno, which, to a certain extent caught-up with the North of Italy in the 1960's, suffered an about-turn in this trend in 1975 (Baussola and Fiorito 1994, Terrasi, 1999). The Greek economy suffered from a postponing of economic restructuring and a lack of clear macroeconomic policy commitments, as a result of which economic growth failed to gain momentum (Alogoskoufis 1995, Tsoukalis, 1992). However, since the change of government in 1996, Greece has adopted a more consistent economic policy, which seems to be encouraging growth.

In Spain, regional disparities have been increasing since 1986 and certain regions in the North East and Madrid are now nearly twice as rich as the poorest region which is Extremadura, while the economic position and income generated by the country as a whole has improved significantly (Villaverde Castro, 1993, Mas et al. 1995). Since 1980, it is mainly the rich regions such as Madrid, Catalunya, Aragon and Baleares which have improved their income position substantially. The poorer, less developed regions, located in the centre, the North West and the South also improved.

The richest regions of Portugal are those which absorb the country's capital, Lisbon, the Algarve with its buoyant tourism-based economy and the industrial North of the country, which is the regions of Norte. During Portugal's macroeconomic stabilization period, only the area of Lisbon and the Norte managed to augment their incomes substantially, while the agricultural Centro and the Alentejo regions experienced declines sin income. The Algarve was in fact the regions in which growth was most impressive while the convergence of Portugal as a whole has become relatively balanced.

The general stagnation of income convergence in the Mezzogiorno is one of the few exceptions. The richest provinces of Abruzzo and Sardegna, have improving in terms of income since 1980 although this improvement has been modest. In contrast, the other richer provinces of the Mezzogiorno on the Adriatic side, Molise and Puglia, were in decline in relative terms until 1994. The poorer provinces in the West and Sicily maintained roughly the same position in 1994 as in 1980, or fell behind (Basilicata). Since 1995 however, these regions have experienced high growth rates, which in the case of Basilicata reached 4.2%, Sicilia 3%, Molise 3.7%, Puglia 3%, in the period 1995-1999.

In Greece the regions'ranking in per capita GDP underwent some important changes. Of those regions which had the highest per capita index scores in 1980, only the Athens area and Central Macedonia (Thessaloniki) managed to maintain this status by 1994, while Central Greece and the Peloponnese lost considerable ground. However, during the most recent programming period they performed most encouragingly with growth rates which were well above 3% for all the Greece regions.

A Closer look at the growth rates of the objective 1 regions in the period 1989-1993 and 1995-1999 can be seen figures 4.3 and 4.4.

Figure 4.3: Objective 1 Regions EU15 (1989-1993)

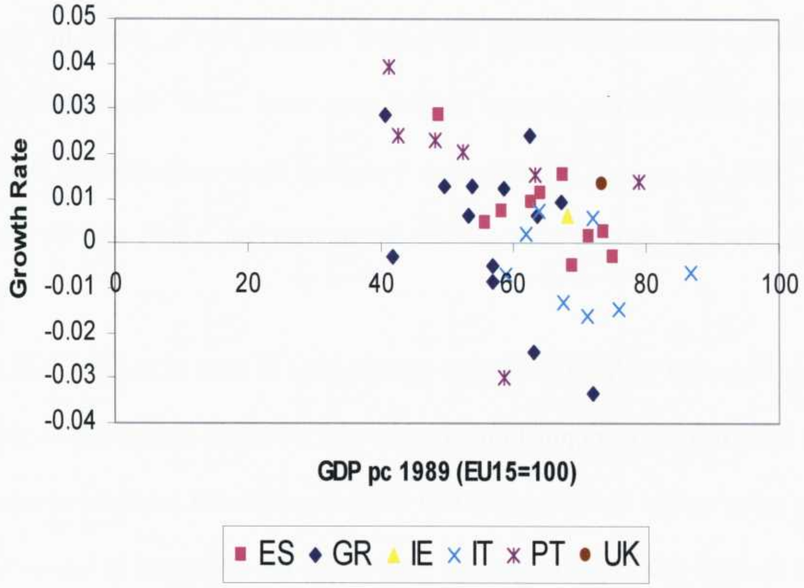
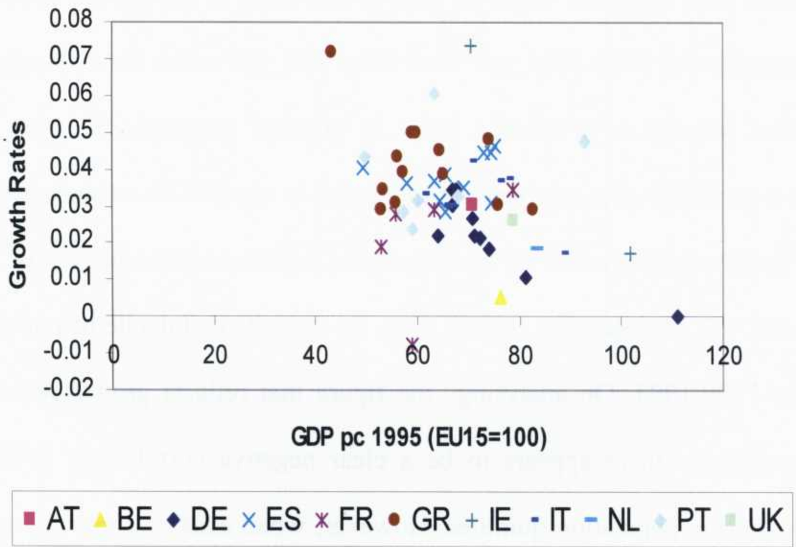


Figure 4.4: Objective 1 Regions EU15 (1995-1999)



Although there are some notable exceptions in the case of some of the Italian and Greek regions, it can be seen that the objective 1 regions performed very well during 1989-1993 (their average growth rates during this period reached 0.04%, while for the EU15 during the same period of time average growth rates were –1%). Similarly during the period 1995-1999, on average, the objective 1 regions again outperformed the rest of EU15 regions. Average growth rates for the former reached 3.36% and for the latter 2.8%.

It would seem logical to weight the average growth rates of each of the NUTS II regions according to their respective populations. In this way we avoid biases that might occur by giving the same weight to two regions that have very different amounts of population (It should be obvious that negative growth rates in Ille the France or in London do not have the same impact in economic terms as the same negative growth rates when hypothetically linked to Cantabria or any other less populous regions).

To this end, we have analysed regional growth according to population decile and to population quintile for 1989-1993 and for 1995-1999. We make the assumption that each individual belongs to a specific point in physical geographical space and by extension to a particular area surrounding that point in space. This analysis sheds new light on the positive performance of the objective 1 regions in terms of growth.

Figures 4.5 and 4.6 represent the growth rates by quintile and decile of population in the EU15 for 1989-1993. On analysing the figure that reflects growth according to population quintiles, there appears to be a clear negative correlation between the growth rates and the population quintiles. However, when analysing growth according to deciles of population we find that the negative relationship no longer holds true. Rather, the figure that breaks population down into deciles projects a "U"-shaped profile in the EU-15 for the period 1989-1993. This pattern indicates a process in which regional growth is becoming polarized. This model of polarized growth is known as the so-called "twin peaks" model (Chaterij, 1993, Quah, 1996a, 1996b, 1997). It has created what Baumol called convergence "clubs", polarized either at the highest or lowest levels of income (Ben-David 1994, Quah, 1996a, 1996b, Fagerberg and Verspagen, 1996).

Figure 4.5: Average Growth Rate by Population Quintile (1989-1993)

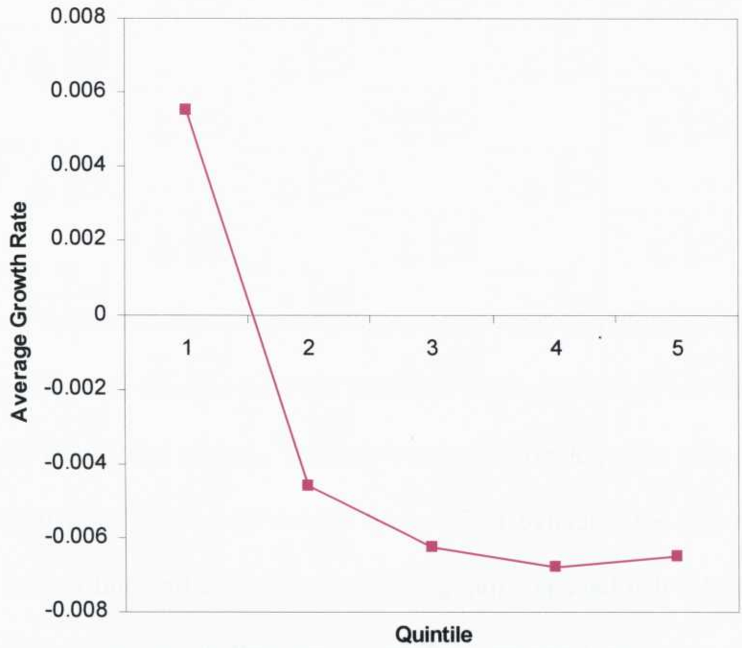
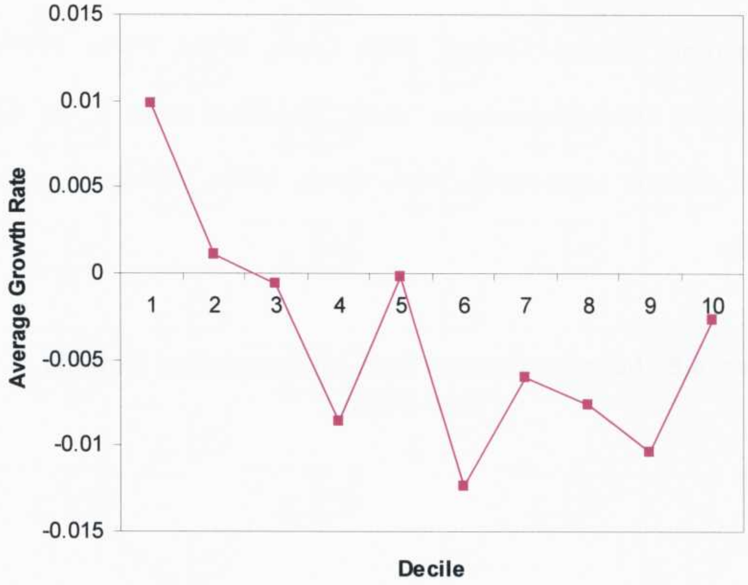


Figure 4.6: Average Growth Rate by Population decile (1989-1993)



On associating the population deciles (or population quintiles), classified in order of growth rates, with the population of the different NUTS II regions in the EU we found that the first quintile of population (first two deciles), contain individuals that live in NUTS II regions that are objective 1. Moreover figures 4.5 and 4.6 show that in 1989-1993 the only deciles that have positive growth rates were the first and second. We can conclude that the objective 1 regions performed very well during this period of time.

They, experienced positive growth rates while the remaining regions lost momentum during this period.

The profile of regional growth by population quintile and decile in EU15 for 1995-1999 is shown in figures 4.7 and 4.8.

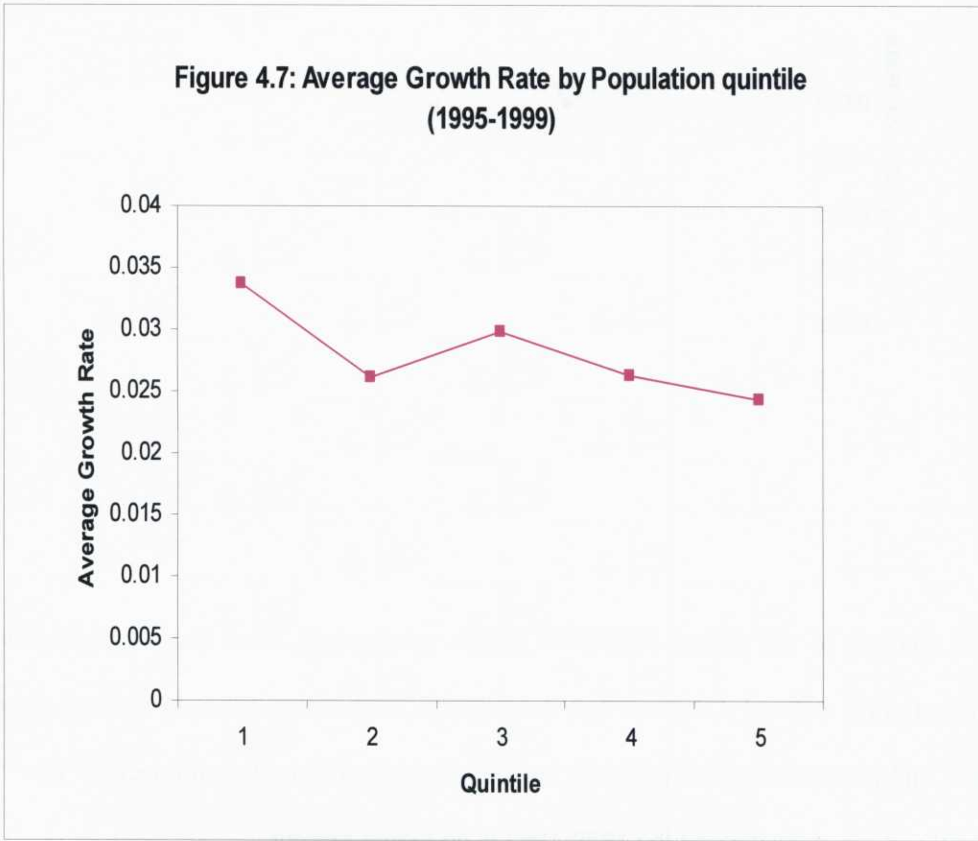
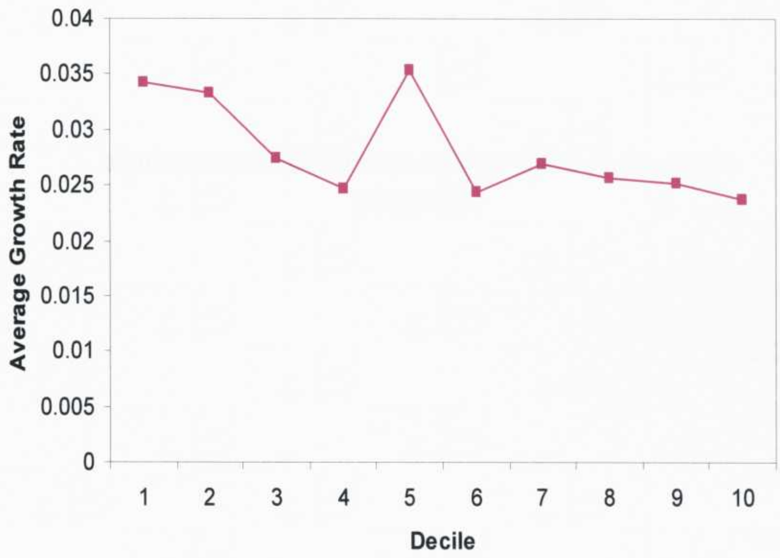


Figure 4.8: Average Growth Rate by Population decile (1995-1999)

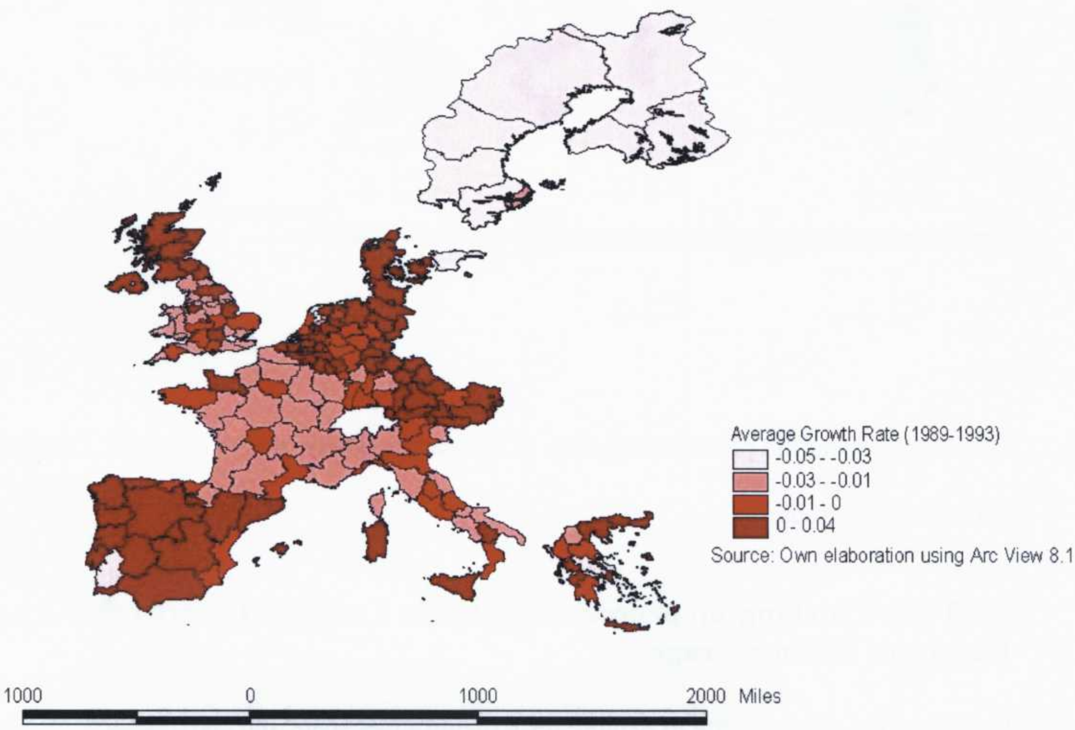


The analysis of the period 1995-1999 differs substantially from the previous period. Here, figures 4.8 and 4.9 show that the negative relationship between average growth rates and population quintiles holds, both in the case of quintiles and deciles. The "U" profile which characterized the 1989-1993 is no longer present.

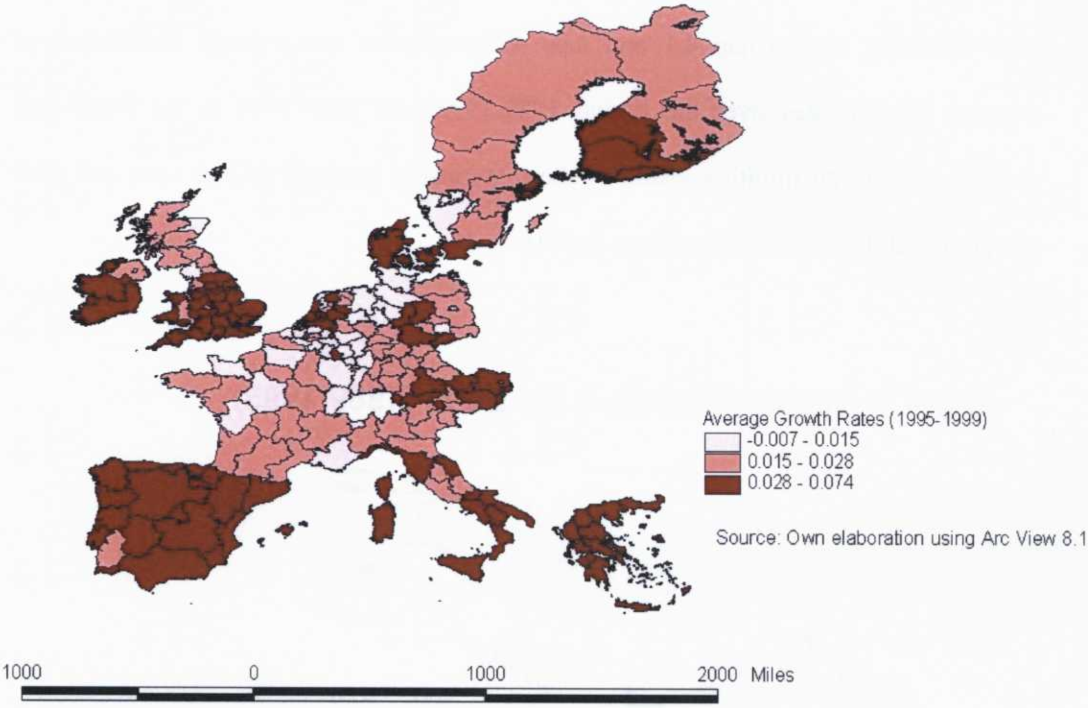
The regions that make up the first and second deciles are once again, mainly objective 1, and are these are the deciles whose growth rates are highest. The fact that the performance of objective 1 regions outstrips the rest of the regions, is once again highlighted.

The following maps (map 4.1 and map 4.2) represent the regional distribution of average growth rates over the period 1989-1993 and 1995-1999 in the EU15 and provide us with an intuitive vision of the relationship between growth rates and their geographical distribution throughout the EU.

Map 4.1: Regional Growth in the EU15 (1989-1993)



Map 4.2: Regional Growth in the EU15 (1995-1999)



This maps reflect the positive trajectory of the vast majority of the objective 1 regions during both periods.

4.4.3 The Catching-up process of objective 1 regions towards the European Union average

In this section we are going to explore the dynamics that shape the convergence process, that is, the mechanisms that allow the objective 1 regions to catch up with the European Union benchmark average and have been doing so since 1983. To this end we divide the entire period of analysis into three subperiods. First, we assess the trajectory of the objective 1 regions prior to implementation of the two regional development programmes, that is before so-called Community Support Framework Programmes (CSF). Second, we analyse how this catching-up process evolves during the first Community Support Framework (CSF I, 1989-1993), and third we repeat this procedure for the second Community Support Framework (CSF II, 1994-1999).

Using the temporal divisions of our periods of analysis we attempt to ascertain whether or not the objective 1 regions have been catching-up with the rest of the EU regions as a direct result of EU regional policy, or whether this tendency began prior to its inception.

The methodology adopted in order to achieve our goals, involved the estimation a panel data model with fixed effects by pooled least squares.

The model took the following form:

$$x_{i,t} = a_i + bt + u_{i,t} \qquad (1)$$

$x_{i,t} = \frac{GDPpc_{i,t}}{GDPpc_{t,UE}}$ represents the gap between the per capita income of the i-objective 1 region and the average per capita income of the European Union in t. t is the trend variable and $u_{i,t}$ represents a random disturbance.

A positive and statistically significant value for b for a particular period suggests that, in the period in question, the objective 1 regions did indeed catch-up towards the average European Union income. In other words there is a convergence process under way which involves the objective 1 regions closing the gap between themselves and the rest of the European Union regions.

Equation (1) was estimated for different sub samples of objective 1 regions, and covers the programming periods, in which they were status objective 1 regions. First, we estimated equation (1) for those regions that were objective 1 in the first programming period (1989-1993). The results of the estimation are shown in table 4.2, 4.3 and 4.4.

Table 4.2: Catching-up Objective 1 regions during CSF I (1983-1988)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1983 1988
Number of cross-sections used: 41
Total panel (unbalanced) observations: 236

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.002010	0.001231	1.632822	0.1041
Fixed Effects				
ES11--C	0.569445	GR41--C	0.428545	
ES12--C	0.720209	GR42--C	0.633133	
ES41--C	0.672471	GR43--C	0.556270	
ES42--C	0.565218	IE--C	0.611149	
ES43--C	0.459632	IT71--C	0.870998	
ES52--C	0.713442	IT72--C	0.752567	
ES61--C	0.537263	IT8--C	0.681122	
ES62--C	0.651650	IT91--C	0.710451	
ES63--C	0.582803	IT92--C	0.650309	
ES7--C	0.678945	IT93--C	0.590904	
FR83--C	0.866146	ITA--C	0.676067	
GR11--C	0.574691	ITB--C	0.738186	
GR12--C	0.576029	PT11--C	0.487369	
GR13--C	0.577535	PT12--C	0.454810	
GR14--C	0.541035	PT13--C	0.783801	
GR21--C	0.448597	PT14--C	0.446232	
GR22--C	0.528875	PT15--C	0.499213	
GR23--C	0.497938	PT2--C	0.396335	
GR24--C	0.726968	PT3--C	0.386969	
GR25--C	0.597202	UKN--C	0.753083	
GR3—C	0.626041			

R-squared	0.937934	Mean dependent var	0.621489
Adjusted R-squared	0.924817	S.D. dependent var	0.117261
S.E. of regression	0.032152	Sum squared resid	0.200553
F-statistic	71.50489	Durbin-Watson stat	1.510642
Prob(F-statistic)	0.000000		

Table 4.3: Catching-up Objective 1 regions during CSF I (1989-1993)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1989 1993
Number of cross-sections used: 41
Total panel (balanced) observations: 205

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.011548	0.001078	10.71565	0.0000
Fixed Effects				
ES11--C	0.494116	GR41--C	0.332973	
ES12--C	0.617139	GR42--C	0.578775	
ES41--C	0.589483	GR43--C	0.538681	
ES42--C	0.546332	IE--C	0.661503	
ES43--C	0.416019	IT71--C	0.787658	
ES52--C	0.671267	IT72--C	0.657863	
ES61--C	0.481454	IT8--C	0.578566	
ES62--C	0.610706	IT91--C	0.608943	
ES63--C	0.561783	IT92--C	0.532497	
ES7--C	0.646382	IT93--C	0.482601	
FR83--C	0.740665	ITA--C	0.574346	
GR11--C	0.441245	ITB--C	0.649379	
GR12--C	0.496316	PT11--C	0.445539	
GR13--C	0.507540	PT12--C	0.402739	
GR14--C	0.461551	PT13--C	0.716457	
GR21--C	0.310034	PT14--C	0.435649	
GR22--C	0.447980	PT15--C	0.561030	
GR23--C	0.407272	PT2--C	0.350171	
GR24--C	0.577195	PT3--C	0.350101	
GR25--C	0.462045	UKN--C	0.658904	
GR3--C	0.548418			

R-squared	0.971674	Mean dependent var	0.6390
Adjusted R-squared	0.964549	S.D. dependent var	0.1158
S.E. of regression	0.021822	Sum squared resid	0.0776
F-statistic	136.3769	Durbin-Watson stat	1.5849
Prob(F-statistic)	0.000000		

Table 4.4: Catching-up Objective 1 regions during CSF I (1994-1997)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1994 1997
Number of cross-sections used: 45

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.003643	0.000970	3.757714	0.0003
Fixed Effects				
ES11--C	0.576512	GR24--C	0.598526	
ES12--C	0.692778	GR25--C	0.526083	
ES41--C	0.700007	GR3--C	0.698274	
ES42--C	0.610820	GR41--C	0.453398	
ES43--C	0.497661	GR42--C	0.690841	
ES52--C	0.704549	GR43--C	0.662103	
ES61--C	0.529017	IE--C	0.897466	
ES62--C	0.632425	IT71--C	0.848914	
ES63--C	0.645876	IT72--C	0.730583	
ES7--C	0.709821	IT8--C	0.614478	
FR83--C	0.758873	IT91--C	0.665109	
FR91--C	0.357071	IT92--C	0.637541	
FR92--C	0.496696	IT93--C	0.544526	
FR93--C	0.436637	ITA--C	0.615172	
FR94--C	0.413551	ITB--C	0.690544	
GR11--C	0.546767	PT11--C	0.575774	
GR12--C	0.610624	PT12--C	0.556169	
GR13--C	0.554026	PT13--C	0.844175	
GR14--C	0.562902	PT14--C	0.548713	
GR21--C	0.381047	PT15--C	0.660990	
GR22--C	0.556687	PT2--C	0.449111	
GR23--C	0.515843	PT3--C	0.492634	
		UKN--C	0.747628	
R-squared	0.989020	Mean dependent var		0.667175
Adjusted R-squared	0.984970	S.D. dependent var		0.113238
S.E. of regression	0.013883	Sum squared resid		0.023512
F-statistic	244.2053	Durbin-Watson stat		1.553917
Prob(F-statistic)	0.000000			

The results of the estimation show that the gap between the objective 1 regions and the EU begins to close only after the regional development programmes got underway. The positive value of the parameter b in the first estimation does not diverge statistically from zero (see t-statistic value). However, from 1989 onwards the objective 1 regions began to move towards the European Union income average and this is reflected in the b parameter. Moreover, the catching-up process was faster during the first programming period. On comparing the different values estimated for the parameter we find that b (b(1989-1993)= 0.011548 and b(1994-1997)= 0.003643).

We also estimated equation (1) for the objective 1 regions in the period 1995-1999 using the figures provided by the new European accounting system (ESA95). The results show that the catching-up process is faster than that which took place in the period 1994-1997. This acceleration in terms of convergence was due principally to the positive performance of the objective 1 regions in 1998 and 1999. Table 4.5 shows the output of the estimation.

Finally, equation (1) has been estimated for the regions that were objective 1, either in the first programming period or in the second. The results of these estimations are shown in tables 4.6, 4.7 and 4.8.

Table 4.5: Catching-up Objective 1 regions during CSF I (1995-1999)

Dependent Variable: $x_{i,t}$
Method: Pooled Least Squares
Sample: 1995 1999
Number of cross-sections used: 46
Total panel (balanced) observations: 230

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.006440	0.000961	6.702004	0.0000
Fixed Effects				
ES11--C	0.619282	GR3--C	0.727718	
ES12--C	0.677989	GR41--C	0.603185	
ES41--C	0.723911	GR42--C	0.768709	
ES42--C	0.628252	GR43--C	0.646763	
ES43--C	0.481298	IE01--C	0.737682	
ES52--C	0.744747	IE02--C	1.091090	
ES61--C	0.566685	IT71--C	0.842638	
ES62--C	0.646130	IT72--C	0.774999	
ES63--C	0.636584	IT8--C	0.634355	
ES7--C	0.752737	IT91--C	0.646109	
FR83--C	0.760512	IT92--C	0.706378	
FR91--C	0.537069	IT93--C	0.596100	
FR92--C	0.615432	ITA--C	0.641950	
FR93--C	0.511725	ITB--C	0.749669	
FR94--C	0.496148	PT11--C	0.588559	
GR11--C	0.533434	PT12--C	0.556448	
GR12--C	0.658440	PT13--C	0.954226	
GR13--C	0.616714	PT14--C	0.571527	
GR14--C	0.563625	PT15--C	0.667161	
GR21--C	0.435948	PT2--C	0.491039	
GR22--C	0.567421	PT3--C	0.656778	
GR23--C	0.501993	UKN--C	0.777875	
GR24--C	0.804898			
GR25--C	0.521879			

R-squared	0.978842	Mean dependent var	0.672229
Adjusted R-squared	0.973523	S.D. dependent var	0.126660
S.E. of regression	0.020610	Sum squared resid	0.077731
F-statistic	184.0454	Durbin-Watson stat	1.088385
Prob(F-statistic)	0.000000		

Table 4.6: Catching-up Objective 1 regions during CSF I or CSF II (1983-1988)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1983 1988
Number of cross-sections used: 45
Total panel (unbalanced) observations: 252

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.001525	0.001198	1.273408	0.2043
Fixed Effects				
AT11--C	0.601911	GR41--C	0.430240	
BE32--C	0.779781	GR42--C	0.634827	
ES11--C	0.571139	GR43--C	0.557965	
ES12--C	0.721904	IE--C	0.612844	
ES13--C	0.723134	IT71--C	0.872693	
ES41--C	0.674165	IT72--C	0.754261	
ES42--C	0.566913	IT8--C	0.682817	
ES43--C	0.461327	IT91--C	0.712145	
ES52--C	0.715136	IT92--C	0.652004	
ES61--C	0.538957	IT93--C	0.592599	
ES62--C	0.653345	ITA--C	0.677762	
ES63--C	0.584497	ITB--C	0.739880	
ES7--C	0.680639	NL23--C	0.710082	
FR83--C	0.867840	PT11--C	0.489064	
GR11--C	0.576386	PT12--C	0.456505	
GR12--C	0.577724	PT13--C	0.785496	
GR13--C	0.579230	PT14--C	0.447927	
GR14--C	0.542729	PT15--C	0.500907	
GR21--C	0.450291	PT2--C	0.399240	
GR22--C	0.530570	PT3--C	0.389874	
GR23--C	0.499633	UKN--C	0.754777	
GR24--C	0.728662			
GR25--C	0.598896			
GR3—C	0.627736			

R-squared	0.938972	Mean dependent var	0.629036
Adjusted R-squared	0.925641	S.D. dependent var	0.117836
S.E. of regression	0.032132	Sum squared resid	0.212694
F-statistic	70.43351	Durbin-Watson stat	1.513729
Prob(F-statistic)	0.000000		

Table 4.7: Catching-up Objective 1 regions during CSF I or CSF II (1989-1993)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1989 1993
Number of cross-sections used: 52
Total panel (unbalanced) observations: 246
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.013668	0.001352	10.11141	0.0000
Fixed Effects				
AT11--C	0.526227	GR23--C	0.388195	
BE32--C	0.657616	GR24--C	0.558118	
DE3--C	0.851226	GR25--C	0.442967	
DE4--C	0.363251	GR3--C	0.529341	
DE8--C	0.324372	GR41--C	0.313896	
DEE1--C	0.288800	GR42--C	0.559698	
DEE2--C	0.372257	GR43--C	0.519604	
DEE3--C	0.317170	IE--C	0.642426	
DEG--C	0.301773	IT71--C	0.768581	
ES11--C	0.475039	IT72--C	0.638786	
ES12--C	0.598062	IT8--C	0.559489	
ES13--C	0.640366	IT91--C	0.589866	
ES41--C	0.570406	IT92--C	0.513420	
ES42--C	0.527255	IT93--C	0.463524	
ES43--C	0.396942	ITA--C	0.555269	
ES52--C	0.652190	ITB--C	0.630301	
ES61--C	0.462377	NL23--C	0.624038	
ES62--C	0.591629	PT11--C	0.426462	
ES63--C	0.542706	PT12--C	0.383662	
ES7--C	0.627305	PT13--C	0.697380	
FR83--C	0.721588	PT14--C	0.416572	
GR11--C	0.422167	PT15--C	0.541953	
GR12--C	0.477239	PT2--C	0.331094	
GR13--C	0.488463	PT3--C	0.331024	
GR14--C	0.442474	UKN--C	0.639827	
GR21--C	0.290957	GR22--C	0.428903	

R-squared	0.959336	Mean dependent var	0.638338
Adjusted R-squared	0.948380	S.D. dependent var	0.128156
S.E. of regression	0.029117	Sum squared resid	0.163626
F-statistic	87.56196	Durbin-Watson stat	1.432507
Prob(F-statistic)	0.000000		

Table 4.8: Catching-up Objective 1 regions during CSF I or CSF II (1994-1997)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1994 1997
Number of cross-sections used: 59
Total panel (unbalanced) observations: 224

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.005929	0.001070	5.543754	0.0000
Fixed Effects				
AT11--C	0.635027	GR13--C	0.523165	
BE32--C	0.725091	GR14--C	0.532041	
DE3--C	1.024423	GR21--C	0.350186	
DE4--C	0.636572	GR22--C	0.525826	
DE8--C	0.568508	GR23--C	0.484982	
DED1--C	0.512691	GR24--C	0.567665	
DED2--C	0.609825	GR25--C	0.495222	
DED3--C	0.665864	GR3--C	0.667413	
DEE1--C	0.512094	GR41--C	0.422537	
DEE2--C	0.623764	GR42--C	0.659980	
DEE3--C	0.532057	GR43--C	0.631242	
DEG--C	0.557090	IE--C	0.866605	
ES11--C	0.545651	IT71--C	0.818053	
ES12--C	0.661917	IT72--C	0.699722	
ES13--C	0.686756	IT8--C	0.583617	
ES41--C	0.669146	IT91--C	0.634248	
ES42--C	0.579959	IT92--C	0.606680	
ES43--C	0.466800	IT93--C	0.513665	
ES52--C	0.673688	ITA--C	0.584311	
ES61--C	0.498156	ITB--C	0.659683	
ES62--C	0.601564	NL23--C	0.701370	
ES63--C	0.615015	PT11--C	0.544913	
ES7--C	0.678960	PT12--C	0.525308	
FR83--C	0.728012	PT13--C	0.813314	
FR91--C	0.329639	PT14--C	0.517852	
FR92--C	0.469264	PT15--C	0.630129	
FR93--C	0.409205	PT2--C	0.418250	
FR94--C	0.386119	PT3--C	0.461773	
GR11--C	0.515906	UKN--C	0.716767	
GR12—C	0.579763			
R-squared	0.983775	Mean dependent var	0.680949	
Adjusted R-squared	0.977938	S.D. dependent var	0.119413	
S.E. of regression	0.017737	Sum squared resid	0.051594	
F-statistic	168.5383	Durbin-Watson stat	1.785120	
Prob(F-statistic)	0.000000			

If we pool together the regions that were objective 1 either in the first or in the second Community Support Framework, the trend does not differ when we only take into account those regions that were objective 1 during CSF I. We can state quite categorically that these regions were not "catching up" in terms of average European Union Per Capita GDP prior to the implementation of the EU regional policy. Moreover the catching-up process is faster during the period 1989-1993 than during 1994-1997.

On Comparing the values for the *b* parameter estimated for the two samples of objective 1 regions (regions that were objective 1 during CSF I and regions that were objective 1 during CSF I or CSF II), it may be observed that in 1989-1993 the *b* values are very close to each other (0.011548 and 0.013668), but in 1994-1997, the *b* value for the sample that takes in the objective 1 regions for both periods is over 1.5 times greater (0.003643 versus 0.005929). The reason for this result is basically due to the exceptional performance experienced by the German objective 1 regions, particularly during the period 1994-1996.

A Re-estimation of equation (1) utilizing the most recent EUROSTAT (ESA95) data, provides a *b* value of 0.003517 which, compared with the value obtained in table 4.5 (0.006440), indicates that the same German regions that were out performers in 1994-1996, were under performers in 1997-1999. Table 4.9 gives the results of the estimation

Table 4.9: Catching-up Objective 1 regions during CSF I or CSF II (1995-1999)

Dependent Variable: $x_{i,t}$

Method: Pooled Least Squares
Sample: 1995 1999
Number of cross-sections used: 60
Total panel (balanced) observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T?	0.003517	0.000899	3.910760	0.0001
Fixed Effects				
AT11--C	0.699897	GR13--C	0.625483	
BE32--C	0.721626			
DE3--C	1.031108	GR21--C	0.444717	
DE4--C	0.707661	GR22--C	0.576190	
DE8--C	0.699821	GR23--C	0.510762	
DED1--C	0.665092	GR24--C	0.813667	
DED2--C	0.719052	GR25--C	0.530649	
DED3--C	0.779086	GR3--C	0.736488	
DEE1--C	0.628728	GR41--C	0.611954	
DEE2--C	0.702838	GR42--C	0.777479	
DEE3--C	0.672168	GR43--C	0.655532	
DEG--C	0.679096	IE01--C	0.746451	
ES11--C	0.628052	IE02--C	1.099859	
ES12--C	0.686759	IT71--C	0.851407	
ES13--C	0.732270	IT72--C	0.783768	
ES41--C	0.732681	IT8--C	0.643125	
ES42--C	0.637022	IT91--C	0.654879	
ES43--C	0.490067	IT92--C	0.715148	
ES52--C	0.753516	IT93--C	0.604869	
ES61--C	0.575455	ITA--C	0.650719	
ES62--C	0.654899	ITB--C	0.758439	
ES63--C	0.645354	NL23--C	0.799373	
ES7--C	0.761507	PT11--C	0.597328	
FR83--C	0.769281	PT12--C	0.565217	
FR91--C	0.545838	PT13--C	0.962996	
FR92--C	0.624201	PT14--C	0.580297	
FR93--C	0.520494	PT15--C	0.675930	
FR94--C	0.504917	PT2--C	0.499808	
GR11--C	0.542204	PT3--C	0.665548	
GR12--C	0.667210	UKN--C	0.786645	

R-squared	0.974610	Mean dependent var	0.688468
Adjusted R-squared	0.968236	S.D. dependent var	0.123601
S.E. of regression	0.022029	Sum squared resid	0.115979
F-statistic	152.9026	Durbin-Watson stat	1.027632
Prob(F-statistic)	0.000000		

4.4.4 Income Convergence in objective 1 regions

Figures 4.3 and 4.4 in page 177 reflected a negative relationship between average growth rates and initial income. With the objective of obataining a more robust interpretation of this relationship we estimate the convergence rate within the group of objective 1 regions for 1989-1993 (table 4.10) and 1995-1999 (table 4.11).

Table 4.10: Convergence of objective 1 regions 1989-1993

Dependent Variable: Average Growth Rate 1989-1993
Method: Least Squares
Included observations: 39
Estimated Equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.493003	0.112626	4.377365	0.0001
LNY87	-0.052742	0.012788	-4.124458	0.0002

R-squared	0.314956	Mean dependent var	0.028611
Adjusted R-squared	0.296442	S.D. dependent var	0.019599
S.E. of regression	0.016439	Akaike info criterion	-5.328345
Sum squared resid	0.009999	Schwarz criterion	-5.243034
Log likelihood	105.9027	F-statistic	17.01115
Durbin-Watson stat	1.051123	Prob(F-statistic)	0.000202

Dataset: EUROSTAT
ESA79

Table 4.11: Convergence of objective 1 regions 1995-1999

Dependent Variable: Average Growth Rate 1995-1999
Method: Least Squares
Sample(adjusted): 1 60
Estimated Equation:

$$\frac{1}{T} * \log\left[\frac{y_{i,t+T}}{y_{i,t}}\right] = a + \frac{(1-e^{-\beta * T})}{T} * \log[y_{i,t}] + X_i + u_{it,t+T}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.311279	0.082569	3.769942	0.0004
LNY95	-0.030917	0.009189	-3.364538	0.0014
DFR	-0.015771	0.005520	-2.857389	0.0060
DIE	0.044506	0.008671	5.133013	0.0000

R-squared	0.404247	Mean dependent var	0.033686
Adjusted R-squared	0.372331	S.D. dependent var	0.014726
S.E. of regression	0.011667	Akaike info criterion	-5.999791
Sum squared resid	0.007622	Schwarz criterion	-5.860168
Log likelihood	183.9937	F-statistic	12.66620
Durbin-Watson stat	1.724001	Prob(F-statistic)	0.000002

Dataset: EUROSTAT ESA79

As we can see from table 4.10 and 4.11, the rate at which the objective 1 regions are converging is high. The highest rate of convergence among the group of objective 1 regions was registered in the period 1989-1992 and was 6.12%. However, the rate for the period 1995-1999 remains high (3.3%). In the previous estimation we can see that the Greek and Irish regions have diverged from the groups' average steady state income. Ireland actually outstripped the group average while the Greek regions fell back sharply. We can conclude that the catching-up process among the objective 1 regions is much faster than that which is taking place among the regions of the European Union as a whole.

4.5 Central and Eastern European Countries, regional policy and the European Market

Accession to the European Union will provide an important opportunity for Central and Eastern European Countries (CEECs). The EU is offering these countries a powerful development strategy which is based on a combination of market competition and development policy:

- Competition in a large market within the framework of European Economic and Monetary Union will foster competitiveness in domestic sectors and attract foreign direct investment aimed at taking advantage of new business opportunities.
- The EU also offers a structural development policy focused on those regions whose development is lagging behind. This development policy is not a price support policy but an investment policy that aims to take advantage of the competitive forces derived from integration in a larger market.

It is hoped therefore, that the competition generated from an enlarged market, in combination with EU regional development policy will boost the growth of CEECs within the framework of an open market economy.

Regional development policy is drawn up within a planning and programming framework based on a partnership system. Planning and programming documents are elaborated through consultation with social and economic agents. Community Support Frameworks (CSFs) are elaborated through processes of consensus conducted throughout different governmental levels (Regional, Member States´s Central Governments, European Commission) and are formally approved by a Decision of the European Commission. Operational Programmes, principally regional integrated operational programmes, are the policy tools used to implement the regional development strategies and investments which are also contained in the CSFs. They are also submitted for approval to the European Commission by Member States, and are managed under the auspices of steering and monitoring committees.

The management of structural funds is a complex task which must be carried out by competent administrations at central and regional levels. This management process must be compatible with the legal and policy frameworks of the EU, i.e., with the rules that govern competition, especially with respect to state support. The EU must guarantee not only the entire investment of resource funding, but also the adequate and most efficient way of addressing expenditure allocation. Management plays a key factor in the successful outcome of EU regional development policy. The CEECs will have to make a great effort to ascertain and maintain the requisite of management capabilities. Extraordinary administrative reforms will be needed together with the training of human resources both within the civil service and in other pertinent managerial sectors.

In order to help to prepare the market economy and administrative structures for accession, EU Regional Policy has been extended to the CEECs through new instruments such us the Phare programme and Pre-accession instruments. These procedures require much technical assistance, training and administrative cooperation.

The changing face of the world economy, characterized by intensified competition globalisation and the growing importance of the information society, mean that regional economic growth is now determined by a plethora of factors which combine in evermore subtle ways. Emphasis must be placed not simply on those regions whose development is lagging behind the rest of regions, but also on all the factors that affect competitiveness as a whole. These factors include territorial accessibility and transport, research and innovation, education and vocational training, productive structure and so on.

These new criteria may be addressed via the ESDP that aims to foment a polycentric type of development which is both harmonic and balanced throughout the whole of the European territory. The range of the dimensions and criteria involved however, a great deal of risk due to the dispersion and enlargement of the areas that are to be assisted. This will damage the effectiveness that the European Regional Policy has fomented through the concentration of its efforts, both in the personal and financial sphere, on those regions whose development is slower than the rest.

The main challenge for the ESDP is to achieve its goals under the conditions of enlargement. The peculiarities of the acceding countries will mean that it is important to clarify certain factors such as the investment carried out by the public sector, reducing the foreseeable conflicts between different policy fields, and the best way of stimulating latent economic potential. All these factors mean that spatial coordination will play a greater role in the Acceding Countries than in the current Member States. This has particular ramifications for:

a) The planning of the expansion of the trans-European transport infrastructure and the Community's transport policy.

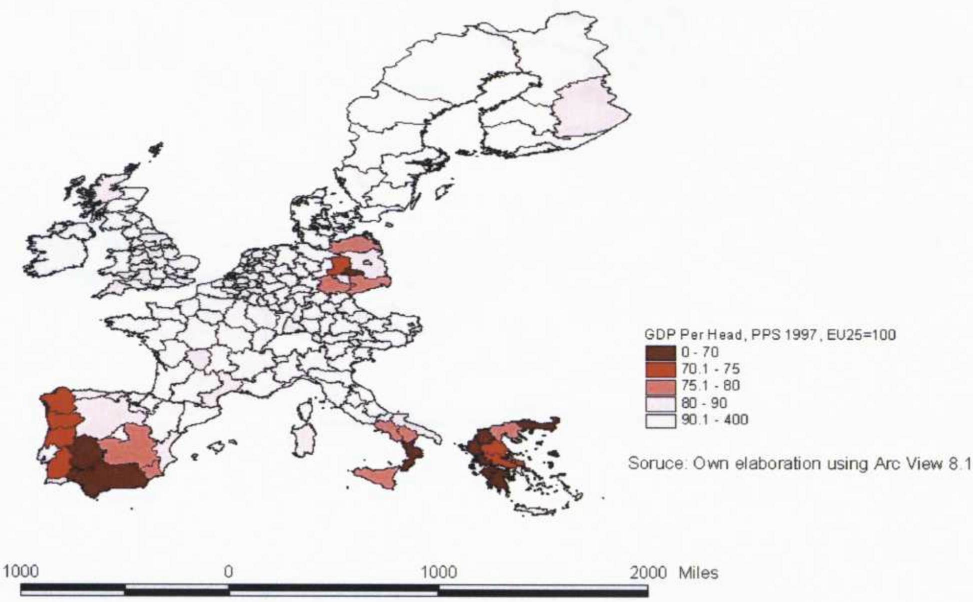
b) Certain environmental measures, in particular, the rehabilitation and renovation of old industrial zones.

c) Measures for structural adjustments in rural regions.

More intensive cross-border co-operation and trans-national cooperation in spatial development will aid the integration process in the enlargement area.
Moreover, EU enlargement to include the Central and Eastern European Countries (CEEC) affects Regional Policy, because of its current focus on those regions that are presently considered to be objective 1 regions. The accession of the CEE countries will provoke a contraction effect in the statistical GDP ph threshold that defines the objective 1 regions (see map EU-25), because the CEE countries have the lowest levels of development. There are, of course regions that are objective 1 for reasons of low population density –northern areas in Scandinavian countries- and regions that are right on the periphery –oceanic isles: The Canary Islands, The Azores, Madeira, and French dominions. A very important group of regions, which are, at present, considered to be objective 1, will probably lose this status because of the contraction effect acting on the statistical threshold of reference. A second group of regions might lose their

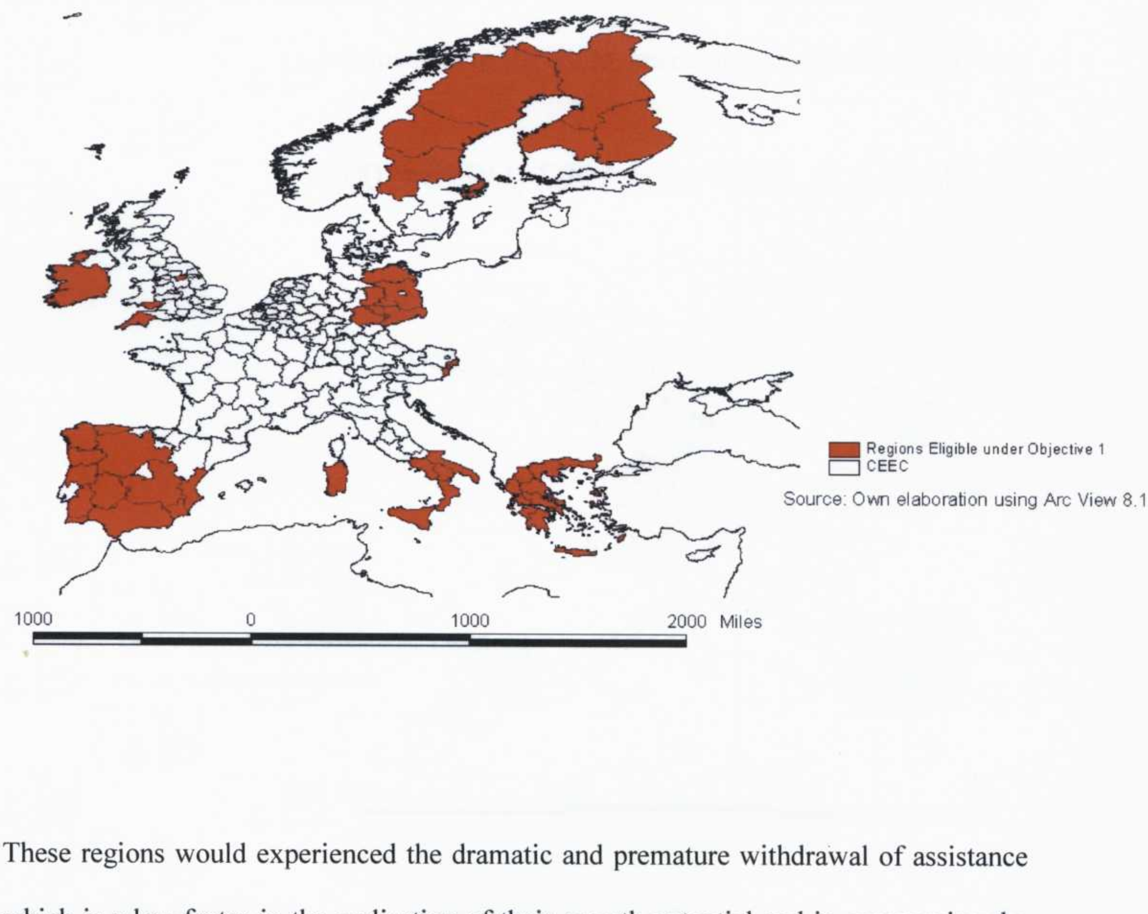
objective 1 status because of the growth dynamic that has succeeded in boosting their development and accelerating the Per capita GDP convergence process already underway in European Union. A much higher proportion of the present objective 1 regions risk losing this status because of the contraction of the statistical threshold than those that will lose their objective 1 status due to their positive performance in terms of growth. Map 4.3 shows GDPph levels for the current European Union´s regions in the case of a hypothetical enlargement of the EU to 25 members.

Map 4.3: GDP pc in 1997 (UE25=100)



There are very few regions that are in a position to enjoy the positive effects of the convergence while remaining objective 1 regions. The remaining regions, simply because of the contraction effect on the statistical threshold of reference, would be situated in upper levels, i.e. levels of above the 70% average GDPph EU-25. A minor boost towards convergence therefore, would mean that these regions would lose their objective 1 status.

Map 4.4: Regions eligible under structural funds (2000-2006)



These regions would experienced the dramatic and premature withdrawal of assistance which is a key factor in the realisation of their growth potential and in overcoming the handicaps and vicious circles of the structural lag. The withdrawal of funds from these areas therefore, would harm the regions where the Structural Funds are most effective in contributing to European growth.

It is important to maintain the concentration and effectiveness of the Community Regional Policy and the contribution of the structural funds themselves, focused on the most deserving regions since they combine the lowest levels of development together with the highest levels of potential growth. The crux of the solution to the problem of balanced development throughout Europe, therefore, is to provide the poorer regions with the means whereby they can compete unaided.

There are several means by which this compensation might be applied. The common denominator might be: To clasify those regions in the present European Union whose GDPph is below 75% of the EU-15average GDPph immediately after the accession as objective 1 regions.

A comparison of this map with the others in this section reveals that the situation is not as dramatic in less developed regions as one might have expected. A significant proportion of the current objective 1 regions will no longer be objective 1 due to the dynamism of their growth. In fact some of these regions would not have fallen below the 75% of the average GDPph threshold in 1997.

By the end of the current programming period the population in those regions in the current UE–15 whose Per Capita GDP is below 75% of the average should have fallen by just under 25% will facilitate an increase in concentration of the assisted population and will allow policy to focus on other objectives, such as restructuring and unemployment. However, in a hypothetical UE-25, due to low levels of development and GDP ph, the vast majority of the regions in the future acceding countries, would be objective 1. One of the effects of enlargement therefore, will be an increase in the percentage of the EU population which fall into the objective 1 regions.

At present, if we discount those objective 1 regions that will surpass the 1997 threshold of 75% average GDP ph for the EU-15, over the following years, then the assisted population under objective 1 could be placed within the range of 15.6%-16.6%. If we add the 90% of the population of the acceding CEECs (EU-25) the percentage of population receiving assistance under objective 1 in the future EU-25 will rise to 31%. That it is to say, a total of 47% of the population will be assisted, if the assistance objective 2 regions is maintained.

The dynamism of a significant number of the present objective 1 regions, effectively requalifying them as non-objective 1 regions by the end of the 2000-2006 programming period, will provide sufficient financial "space" to assist the future CEE acceding countries. The financial framework of Agenda 2000 and the Berlin European Council provides the mechanisms to utilise the funding space for structural interventions in the future acceding countries in a hypothetical EU25.

4.6 The Agenda 2000 and the Berlin European Council

The guidelines for the medium-term implementation and funding of the main EU policies were agreed upon at the Berlin Summit (March 1999), where a coherent framework to marry expenditure commitments and foreseen resources was set out by the European Council. The European Union's expenditure must respect the imperative of budgetary discipline required for stability in the EMU, and an efficient pattern of spending must be established and maintained among the various headings (Agriculture, Structural actions and Regional Policy, Internal Policies, External Action, Pre-Accession Aid and Enlargement). This pattern of spending must also ensure the orderly development of EU policies and to cope effectively with the process of enlargement.

During the meeting of the Berlin European Council, the "Agenda 2000" set out the guidelines for policy reforms and drew up the framework for funding these reforms in the medium-term, as a means of ensuring that the Union will be in a position to face the challenges which enlargement will create. Both the financial perspectives for the current EU-15 and the financial framework for an EU with six future acceding countries (EU-21) were set out on the basis of the working assumption that the accession of new Member States would begin in 2002. Table 4.4 defines the framework for action in terms of the main EU policies both for the current members of the EU and for the foreseeable framework of a Union enlarged up to 21 members States.

TABLE 4.12: FINANCIAL PERSPECTIVES (EU15) AND FINANCIAL FRAMEWORK (EU21)

EUR Million 1999 prices-Appropriations for commitments	A: FINANCIAL PERSPECTIVE EU15		B: FINANCIAL FRAMEWORK EU21	
	2000-2006	Year 2006	2000-2006	Year 2006
1 .AGRICULTURE	297.740	41.660	297.740	41.660
CAP expenditure (excluding rural development)	267.370	37.290	267.370	37.290
Rural development and accompanying measures	30.370	4.370	30.370	4.370
2. STRUCTURAL OPERATIONS	213.010	29.170	213.010	29.170
Structural Funds	195.010	26.660	195.010	26.660
Cohesion Fund	18.000	2.510	18.000	2.510
3. INTERNAL POLICIES	42.350	6.200	42.350	6.200
4. EXTERNAL ACTION	32.060	4.610	32.060	4.610
5. ADMINISTRATION	33.660	5.100	33.660	5.100
6. RESERVES	4.050	400	4.050	400
Monetary reserve	1.250	0	1.250	0
Emergence aid reserve	1.400	200	1.400	200
Guarantee reserve	1.400	200	1.400	200
7. PRE-ACCESSION AID	21.840	3.120	21.840	3.120
Agriculture	3.640	520	3.640	520
Pre-Accession structural instrument	7.280	1.040	7.280	1.040
PHARE (applicant countries)	10.920	1.560	10.920	1.560
8. ENLARGEMENT			58.070	16.780
Agriculture			12.410	3.400
Structural operations			39.580	12.080
Internal policies			3.950	850
Administration			2.130	450
TOTAL APROPRIATIONS FOR COMMITMENTS	640.470	90.260	702.780	107.040
CEILING ON APROPRIATIONS FOR PAYMENTS	685.870	103.530	685.870	103.530
Appropriations for payments as % of GNP	1.15%	1.13%	1.12%	1.09%
Margin	0.12%	0.14%	0.14%	0.18%
Own resources ceiling	1.27%	1.27%	1.27%	1.27%

SOURCE: Conclusions of the Presidency, Berlin European Council 24-25 March 1999.

The previous table reflects the total amounts of expenditure that corresponding to the different headings for the present EU-15 (financial framework) and for an EU-21 under the hypothesis of enlargement (financial framework) during the period 2000-2006.

The foreseeable amount of resources and the Community financial rules with respect to the own resources ceiling are reflected in these frameworks. The reserve margin which arises as a direct consequence is also given in the last row of the table.

In the financial framework for the EU-21, the total number of headings is enlarged to 8, and the last of these is reflects the interventions in the new member States. The table also reflects the annual appropriations for the commitments foreseen for the year 2006.

4.7 European Union regional policy: The 2007 Financial envelope for the objective 1 regions

In this section, we use the figures for 2006 for structural interventions and carry out a simple simulation exercise in order to discover the financial space available for extending objective 1 aid to CEECs[5]. The simulation is based on the GDPph data for 97, the expected reduction in the number of EU-15 objective 1 regions, and the hypothesis of the provision of objective 1 assistance to 90% of the CEEC population. The simulation is carried out by computing the amounts required in order to provide the average per head aid to 75% of the currently assisted population in EU-15 and to 90% of CEEC population and marrying the percentages to the amount of resources foreseen

[5]A specific paper dealing with growth rates in the objective 1 regions and the stagnation of rich regions with medium levels of development and the study of the financial possibilities for enlarging the European Union Regional Policy to Central and Eastern European Countries has been presented at UACES 31st Annual conference (Bristol 2001) and has been published as a working paper at Exeter University.

for objective 1 and allied structural interventions for the year 2006 (Objective 1 foreseen resources) in the EU-21 financial framework sed out by the Berlin European Council.

The results achieved using these hypotheses are given in the following tables (table 1 and table 2):

The total amount of foreseen resources for the year 2006 in the Financial Framework for structural actions in objective 1 regions, can be obtained by adding the amounts (already foreseen) in the 2006 annuity and those that correspond to the future Member States under the headings of Structural Operations and Pre-adhesion Aid. The result is a total of 32.115 Meuros at 1999 prices. On adding the projection of the increase in resources that arises as a result of GNP growth for 2007 under the assumptions given in the financial framework (0.45% of GNP devoted to Structural Actions), in so doing we obtain an additional figure of 919 Meuros. As a result, the total resources for structural interventions in objective 1 regions for the year 2007 is 33.034 Meuros.

TABLE 4.13: RESOURCES FOR OBJECTIVE 1

RESOURCES FOR OBJECTIVE 1	Thousands Meuros 1999
Objective 1 EU-15 (65.4% of 26.660 2006 Annuity)	17.435
Structural Operations Acceding Countries	12.080
Preaccesion Aid	2.600
Subtotal in EU 21 Financial Framework	32.115
2007 Increase. (0.45% from 2.15% GDP	919
TOTAL RESOURCES 2007	33.034

On the needs′ side, if we adopt the assumption that 75% of the assisted population will belong to objective 1 regions in the current programming period 2000-2006, thus allowing for the effects of statistical convergence we obtain a figure of 13.077 Meuros for the total needs for 2007, if we use the 2006 figures for average aid per head. On using the 2000-2006 figures for average aid per head we obtain a figure of 13.664 Meuros.

Moreover, if we take into account that 90% of the population of the 12 acceding countries of Central and Eastern Europe will have a GDP per head which is lower than 75% of the EU average, needs for the year 2007 will be either 19.884 Meuros if we use the average aid per head for the year 2006 in objective 1 regions or a slightly higher figure of 20.777 Meuros if we use the average aid per head for 2000-2006 in objective 1 regions.

As a result of these computations on the needs′side, it can be shown that under the assumption of the average aid per head for the year 2006 in objective 1 regions, the projection for resources for the year 2007 in objective 1 regions under the assumptions of the current financial framework of the EU for 2000-2006 would be sufficient both to meet the amounts required for the enlargement and to counter balance the statistical effect of accession in order to maintain funding for ¾ of the objective 1 population in the current EU15.

If we use the average aid per head for 2000-2006 in objective 1 regions as the criteria for aid per head in those regions where there is developmental lag, we find that the total required would be 34.441 Meuros. The latter hypothesis therefore generates a financial gap of 1.407 Meuros.

TABLE 4.14: NEEDS FOR REGIONS LAGGING BEHIND IN 2007

AID FOR 2007 OBJ 1 EU-25 (*) Thousands of Meuros 99	Average Aid 2006	Average Aid 00-06
75% Current EU15 Obj 1	13.077	13.664
90% Population CEEAC	19.884	20.777
Total Amount Obj 1 EU-25 (*)	32.961	34.441
Difference with respect to Total Resources	73	-1.407

(*) Cyprus and Malta are not included

The funding needs of the objective 1 regions can be compared with the amounts devoted to other objectives (table 3): 8.379 Meuros, for objectives 2 and 3 and 2.510 for the Cohesion Fund. The non-objective one regions that receive support however, may be bolstered without resource to the support, which is at present dedicated to the objective 1 regions. The amount of 1.407 Meuros may be found through an increase in the GNP destined for structural interventions and thus European Union Regional Policy will be fulfilled.

TABLE 4.15: COMPARATIVE VALUE OBJECTIVE 1 FINANCIAL GAP

COMPARATIVE VALUE OBJECTIVE 1 FINANCIAL GAP	Meuros 99	%
Objective 2 and 3	8.379	16.8
Cohesion Fund	2.510	56.0
0.05% over GDP	4.750	29.6
Financial gap for Objective 1 Keeping real value aid per head	1.407	100.0

These computations are not intended as a vehicle for suggesting the amounts that should be assigned to the EU Regional Policy in the future programming period 200-2006. Rather, these amounts must arise out of the political debate surrounding the objectives of future regional policy in the EU. These objectives must take on board a radical increase in the disparities in levels of development whilst assimilating the effects of a reformulation of the criteria for objective 2 (regions with structural problems) and objective 3 (human resources and employment). Further, the problems of coordinating policies and balancing territorial development from the European Spatial Development Perspective will have to be addressed . These objectives are far-reaching in their outlook, and as a consequence will require a financial framework which is ambitious enough to take advantage of the benefits derived from development and cohesion, in order to provide the basis of enlarged, strengthened EU.

4.8 Conclusions

In the first part of this chapter we analysed growth and the catching-up process of the less developed regions which has been in progress since 1989. As a way of analysing the growth process we split the period into two subperiods 1989-1993 and 1995-1999 as a means of making them to coincide with the years in which the Community Support Frameworks have been operational. The analysis was carried out by studying the growth rates in units of population decile and population quintile. This methodology helps us to avoid biases that might arise from giving the same weight to two regions that have very different levels of population. The results of this analysis shed new light on the positive performance of the objective 1 regions, indicating that they have experienced positive growth rates in the two subperiods and, on average, have outperformed EU15.

For the analysis of the catching-up process we regress the gap between the per capita income of the objective 1 regions and the average per capita income of the EU15 on a trend variable using a panel data model with fixed effects. Estimations of the model proposed for the time periods 1983-1988, 1989-1994, 1994-1997 and 1995-1999 show that the catching-up process of the objective 1 regions did not take place until the implementation of the objective 1 regional economic development policy. Moreover, the catching-up process was faster during the first Community Support Framework. These findings provide evidence that proves the effectiveness of EU regional policy in fomenting the growth of the objective 1 regions.

In the final part of the chapter, we focus on the effects that the enlargement of the European Union to incorporate the Central and Eastern European Countries (CEECs) will cause in the current objective 1 regions. The simple calculations carried out above using the resources foreseen for the objective 1 regions, the future acceding countries and the Cohesion Fund have shown that maintaining the concentration in the objective 1 regions and providing the average level of assistance to 90% of the population in the 10 CEEC is compatible with financial balance and the “own resources” ceiling.

This is not a reasonable political target, because there will be an increased need for a cohesion policy in an enlarged Union and a successful policy of economic development is one of the most dynamic and essential tools that the EU can provide for the future CEE acceding countries. There are several potential ways of adjusting Economic and Social Cohesion Policy in order to cope efficiently with EU enlargement. Structural Funds and Cohesion Policy however, must remain focused on economic development policies, allowing the objective 1 regions in the current EU-15 to continue to close the gap that exists between themselves and the rest of the EU, thus fomenting the growth potential of the CEECs. This implies that the less developed regions should continue to receive support while at the same time extending this aid to the future acceding Countries. The debate is being aired, there are not utopian solutions, but European “dynamic” would seem to imbue optimism.

Fundamental to the successful implantation of the accession mechanisms will be the competent, efficient management of structural funds. The weaknesses inherent in the administrative system constrained the effects of the first Greek CSF (Georgiou, 1993, European Commission 1996c, 1997a) while the first and perhaps even the second CSF in Italian Mezzogiorno were similarly constrained (Leonardi 1995, European

Commission, 1995b, 1996c, Roeger 1996, Svimez 1996b). If the CEECs are not to follow suit they must make an effort to acquire relevant managerial capabilities.

A further crucial line of reform deals with the territorial coordination of sectorial policies and investments in infrastructure. A Suitable policy framework must be built in order to guarantee the spatial coherence of measures adopted within the guidelines of the European Spatial Development Perspective. The main challenge for the ESDP is to achieve its goals whilst minimizing the constraints of enlargement and maximizing the global benefits.

Chapter five

Conclusions

5.1 Conclusions

This thesis has studied the spatial structure, regional growth and regional convergence in the European Union from 1982 to 1999.

First, in analysing the spatial structure of the European Union, we use both the technique of population potentials and the Gini concentration index.

Population Potentials offer a means of condensing a large quantity of information by plotting maps of population contours which expand from the main agglomeration areas, where the highest peaks of population potentials lie.

When applied to Europe this technique emphasizes an area in which the European population is particularly concentrated. This area is based around the large population centres of Manchester – London – Paris – Köln – Düsseldorf – Ruhr Valley, around which there are further concentric population potential contours of decreasing strength. This research provides us with a clear-cut alternative to what is commonly known as the "Blue Banana"-a large growing area which includes most of the regions of Germany, Austria and Benelux, as well as the more developed urban regions which form part of the UK, France and the North of Italy.

This alternative concept of the European population as a nuclear structure with successive concentric lines of potentials, correlates quite remarkably with nighttime light diffusion images which depict the population centered around what we define as the "Central European Triangle" (UK, Manchester, London, Paris, Cologne, Düsseldorf, Ruhr Valley). Around this area, successive population potential contours take in Berlin, Prague and the North Italian axis.

Using the Gini concentration index the main conclusions with respect to the spatial concentration of GDP and population are: First, population and GDP are concentrated at the "core" of the European territory. Second, the concentration of GDP in this space is higher than the concentration of the population. Third, from a dynamic point of view there is both a slight increase in the concentration of GDP and population in space over time and the increase in the concentration of population is proportionally higher than the increase in the concentration of GDP. Fourth, there is a remarkable stability over time in the proportion of space that corresponds to 15-20% of the richest population in the European Union. Moreover, on analysing the regional distribution of this population, we again find the above mentioned stability. Out of the 14 regions that represent the richest 15% of the total population in 1984 eleven remained the same in 1994.

A step forward has been taken by econometrically testing the explanatory power that population potentials have on the levels of development. By using a logarithm specification for the relationship between population potentials and levels of development and estimating cross-section regressions for different time periods we evaluate whether or not the explanatory power of population potentials holds constant over time or whether they vary as we become more distanced from the year in which our cross-section regression estimates began.

We have found that proximity to large consumer markets, or in other words, market potential, was an important explanatory variable for regional income in the early eighties, but its significance in determining regional income in the 1990's has decreased even though it is still a very significant factor in explaining regional per head GDP.

Thus, regions which are dynamic in terms of income have also emerged on the periphery, and need not necessarily be close to rich regions. This fact might mean a decrease in the importance of distance because of globalization processes, changes in transport and information and communication technologies and, moreover, should lead us to reflect on the possible effects that the "new" European Union regional policy for objective 1 regions has exerted from the mid eighties onwards. European Union regional policy has had an important effect in terms of boosting the growth of peripheral regions and by extension their income levels, and the results given here provide some fairly conclusive evidence to this end.

On analysing regional convergence, we have adopted a two-prongued approach. First, we have retaken the traditional tools of regional scientists, tools that have been abandoned in favour of more sophisticated macroeconomic techniques. We believe that traditional tools remain of use and are in complete agreement with Cheshire and Carbonaro's view that the actual pattern of dispersion of regional incomes over time "is a valid dimension of equity with which policy, at least in the EU, is specifically concerned" (Cheshire and Carbonaro 1995, p.109). Second, we also carry out the traditional macroeconomic analysis of convergence by following the approach of Barro and Sala-i-Martín.

In line with the work of other contemporary regional scientists we have chosen the Theil index of concentration as a tool for verifying global regional convergence. Various authors have highlighted the merits of this index for analysing spatial distributions. These advantages include its weighting system and its "decomposability".

The index has been used for the Population data and GDP (PPS at 1985 prices) which has been furnished by the Eurostat-Regio database. The results of this analysis show that income disparities between the two groups being considered, that is the objective 1 group or "poor" regions and non-objective 1 group or "rich" regions, have been shrinking since 1987-1988 until now for all of the samples used in our study (EU12 1982-1997, EU15 1988-1997 and EU15 1995-1999 using the new accounting system (ESA95)). This indicates that a process of catching-up or convergence is taking place with respect to the income levels of the two groups being considered.

From a macroeconomic point of view, the cross-section regressions of convergence indicate that from 1982 to 1986 there is a clear non-convergence pattern for all of the regions, both in EU9 and EU12. Absolute β-convergence has been the norm since 1987. That is, the poor regions within these countries tend to grow faster per capita than those that are rich. The values found for absolute β-convergence in 1987-1992 are higher in EU15 than in EU12 (a speed of convergence of about 2% in EU15 and 1.77% in EU12). However, in 1993-1997 the speed of convergence reached similar values both for the EU12 and EU15, the figure being about 1.9%.

Finally we analysed the growth performance of objective 1 regions in a little more detail. In order to avoid a bias that might stem from allotting the same weight to two regions that have very different levels of population, we have analysed regional growth in population deciles and in population quintiles for 1989-1992 and for 1995-1999. By this means the geographical location of individuals within the European space may be partially ignored. On analysing 1989-1992 growth according to quintiles of population, there appears to be a clear negative correlation between the growth rates and the population quintiles. However, when analysing growth for the same period according to deciles of population we find that the negative relationship no longer holds true. Rather, we observe a "U"-shaped profile in the EU-15. This pattern indicates a process in which regional growth is becoming polarized. This model of polarized growth is known as the so-called "twin peaks" model (Chaterij, 1993, Quah, 1996a, 1996b, 1997). It has created what Baumol called convergence "clubs", polarized either at the highest or lowest levels of income (Ben-David 1994, Quah, 1996a, 1996b, Fagerberg and Verspagen, 1996).

The analysis of the period 1995-1999 differs from the period 1989-1993. The negative relationship between average growth rates and population quintiles holds, both in the case of quintiles and deciles. The "U" profile which characterized the 1989-1993 is no longer present. When we assign the population deciles and quintiles to the respective NUTS II regions, we have observed that most of the population in the first two deciles or equivalently the population of the first quintile (deciles and quintiles of population have been ordered by decreasing levels of growth rates) belong to objective 1 regions.

This sheds fresh light on the dynamic growth of the objective 1 regions. In order to corroborate the positive performance of the objective 1 regions, we use a panel data model with fixed effects. The model proxies the catching-up process of the objective 1 regions towards the European Union Per Capita GDP average in different periods of time, i.e., before the implementation of the CSFs, and during the first and second Delors packages (CSF I and CSF II). The results show that the catching-up process started during the first Delors package and the speed at which the regions caught up was higher in the first than in the second CSF. The positive effects of the CSFs on the regions whose development is sluggish leads us to analyse the figures an amounts assigned by the European Union regional policy for the next programming period 2000-2006 within the framework of EU enlargement to the Central and Eastern European Countries. This analysis conclude that, according to the figures foreseen in the financial perspectives for the EU-15 and in the financial framework for an enlarged EU-21 set out by the Berlin European Council in March 1999, there is enough financial leeway to assist 90% of the CEECs population and 75% of the current objective 1 population.

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Annexes

Region Code	Region	Region Code	Region
at	Austria	de6	Hamburg
be1	Région Bruxelles	de71	Darmstadt
be21	Antwerpen	de72	Gießen
be22	Limburg (B)	de73	Kassel
be23	Oost-Vlaanderen	de91	Braunschweig
be24	Vlaams Brabant	de92	Hannover
be25	West-Vlaanderen	de93	Lüneburg
be31	Brabant Wallon	de94	Weser-Ems
be32	Hainaut	dea1	Düsseldorf
be33	Liège	dea2	Köln
be34	Luxembourg (B)	dea3	Münster
be35	Namur	dea4	Detmold
de11	Stuttgart	dea5	Arnsberg
de12	Karlsruhe	deb1	Koblenz
de13	Freiburg	deb2	Trier
de14	Tübingen	deb3	Rheinhessen-Pfalz
de21	Oberbayern	dec	Saarland
de22	Niederbayern	def	Schleswig-Holstein
de23	Oberpfalz	dk	Denmark
de24	Oberfranken	es11	Galicia
de25	Mittelfranken	es12	Principado de Asturias
de26	Unterfranken	es13	Cantabria
de27	Schwaben	es21	Pais Vasco
de5	Bremen	es22	Comunidad Foral de Navarra

Region Code	Region	Region Code	Region
es23	La Rioja	fr52	Bretagne
es24	Aragón	fr53	Poitou-Charentes
es3	Comunidad de Madrid	fr61	Aquitaine
es41	Castilla y León	fr62	Midi-Pyrénées
es42	Castilla-la Mancha	fr63	Limousin
es43	Extremadura	fr71	Rhône-Alpes
es51	Cataluña	fr72	Auvergne
es52	Comunidad Valenciana	fr81	Languedoc-Roussillon
es53	Baleares	fr82	Provence-Alpes-Côte d'Azur
es61	Andalucia	fr83	Corse
es62	Murcia	gr11	Anatoliki Makedonia, Thraki
es63	Ceuta y Melilla (ES)	gr12	Kentriki Makedonia
es7	Canarias (ES)	gr13	Dytiki Makedonia
fr1	Île de France	gr14	Thessalia
fr21	Champagne-Ardenne	gr21	Ipeiros
fr22	Picardie	gr22	Ionia Nisia
fr23	Haute-Normandie	gr23	Dytiki Ellada
fr24	Centre	gr24	Sterea Ellada
fr25	Basse-Normandie	gr25	Peloponnisos
fr26	Bourgogne	gr3	Attiki
fr3	Nord - Pas-de-Calais	gr41	Voreio Aigaio
fr41	Lorraine	gr42	Notio Aigaio
fr42	Alsace	gr43	Kriti
fr43	Franche-Comté	ie	Ireland
fr51	Pays de la Loire	it11	Piemonte

Region Code	Region	Region Code	Region
it12	Valle d'Aosta	nl33	Zuid-Holland
it13	Liguria	nl34	Zeeland
it2	Lombardia	nl41	Noord-Brabant
it31	Trentino-Alto Adige	nl42	Limburg (NL)
it32	Veneto	pt11	Norte
it33	Friuli-Venezia Giulia	pt12	Centro (P)
it4	Emilia-Romagna	pt13	Lisboa e Vale do Tejo
it51	Toscana	pt14	Alentejo
it52	Umbria	pt15	Algarve
it53	Marche	ukc1	Tees Valley and Durham
it6	Lazio	ukc2	Northumberland, Tyne and Wear
it71	Abruzzo	ukd1	Cumbria
it72	Molise	ukd2	Cheshire
it8	Campania	ukd3	Greater Manchester
it91	Puglia	ukd4	Lancashire
it92	Basilicata	ukd5	Merseyside
it93	Calabria	uke1	East Riding and North Lincolnshire
ita	Sicilia	uke2	North Yorkshire
itb	Sardegna	uke3	South Yorkshire
lu	Luxembourg	uke4	West Yorkshire
nl11	Groningen	ukf1	Derbyshire and Nottinghamshire
nl12	Friesland	ukf2	Leicestershire, Rutland and Northants
nl13	Drenthe	ukf3	Lincolnshire
nl2	Oost-Nederland	ukg1	Herefordshire, Worcestershire and Warks
nl31	Utrecht	ukg2	Shropshire and Staffordshire
nl32	Noord-Holland	ukg3	West Midlands

Region Code	Region
ukh1	East Anglia
ukh2	Bedfordshire, Hertfordshire
ukh3	Essex
uki	London
ukj1	Berkshire, Bucks and Oxfordshire
ukj2	Surrey, East and West Sussex
ukj3	Hampshire and Isle of Wight
ukj4	Kent
ukk1	Gloucestershire, Wiltshire and North Somerset
ukk2	Dorset and Somerset
ukk3	Cornwall and Isles of Scilly
ukk4	Devon
ukl	Wales
ukm	Scotland
ukn	Northern Ireland

Region Code	Region	Region Code	Region
at11	Burgenland	de22	Niederbayern
at12	Niederösterreich	de23	Oberpfalz
at13	Wien	de24	Oberfranken
at21	Kärnten	de25	Mittelfranken
at22	Steiermark	de26	Unterfranken
at31	Oberösterreich	de27	Schwaben
at32	Salzburg	de3	Berlin
at33	Tirol	de4	Brandenburg
at34	Vorarlberg	de5	Bremen
be1	Reg. Bruxelles	de6	Hamburg
be21	Antwerpen	de71	Darmstadt
be22	Limburg	de72	Gießen
be23	Oost-Vlaanderen	de73	Kassel
be24	Vlaams Brabant	de8	Mecklenburg-Vorpommern
be25	West-Vlaanderen	de91	Braunschweig
be31	Brabant Wallon	de92	Hannover
be32	Hainaut	de93	Lüneburg
be33	Liège	de94	Weser-Ems
be34	Luxembourg	dea1	Düsseldorf
be35	Namur	dea2	Köln
de11	Stuttgart	dea3	Münster
de12	Karlsruhe	dea4	Detmold
de13	Freiburg	dea5	Arnsberg
de14	Tübingen	deb1	Koblenz
de21	Oberbayern	deb2	Trier

Region Code	Region	Region Code	Region
deb3	Rheinhessen-Pfalz	es61	Andalucía
dec	Saarland	es62	Región de Murcia
ded1	Chemnitz	es63	Ceuta y Melilla
ded2	Dresden	es7	Canarias
ded3	Leipzig	fi13	Itä-Suomi
dee1	Dessau	fi14	Väli-Suomi
dee2	Halle	fi15	Pohjois-Suomi
dee3	Magdeburg	fi16	Uusimaa (Suuralue)
def	Schleswig-Holstein	fi17	Etelä-Suomi
deg	Thüringen	fi2	Åland
dk	Danmark	fr1	Île de France
es11	Galicia	fr21	Champagne-Ardenne
es12	Principado de Asturias	fr22	Picardie
es13	Cantabria	fr23	Haute-Normandie
es21	Pais Vasco	fr24	Centre
es22	C. Foral de Navarra	fr25	Basse-Normandie
es23	La Rioja	fr26	Bourgogne
es24	Aragón	fr3	Nord - Pas-de-Calais
es3	Comunidad de Madrid	fr41	Lorraine
es41	Castilla y León	fr42	Alsace
es42	Castilla-la Mancha	fr43	Franche-Comté
es43	Extremadura	fr51	Pays de la Loire
es51	Cataluña	fr52	Bretagne
es52	C. Valenciana	fr53	Poitou-Charentes
es53	Islas Baleares	fr61	Aquitaine

Region Code	Region	Region Code	Region
fr62	Midi-Pyrénées	ie02	Southern and Eastern
fr63	Limousin	it11	Piemonte
fr71	Rhône-Alpes	it12	Valle d'Aosta
fr72	Auvergne	it13	Liguria
fr81	Languedoc-Roussillon	it2	Lombardia
fr82	Provence-Alpes-Côte d'Azur	it31	Trentino-Alto Adige
fr83	Corse	it32	Veneto
fr91	Guadeloupe	it33	Friuli-Venezia Giulia
fr92	Martinique	it4	Emilia-Romagna
fr93	Guyane	it51	Toscana
fr94	Réunion	it52	Umbria
gr11	Anatoliki Makedonia, Thraki	it53	Marche
gr12	Kentriki Makedonia	it6	Lazio
gr13	Dytiki Makedonia	it71	Abruzzo
gr14	Thessalia	it72	Molise
gr21	Ipeiros	it8	Campania
gr22	Ionia Nisia	it91	Puglia
gr23	Dytiki Ellada	it92	Basilicata
gr24	Sterea Ellada	it93	Calabria
gr25	Peloponnisos	ita	Sicilia
gr3	Attiki	itb	Sardegna
gr41	Voreio Aigaio	lu	Luxembourg (Grand-Duché)
gr42	Notio Aigaio	nl11	Groningen
gr43	Kriti	nl12	Friesland
ie01	Border, Midland and Western	nl13	Drenthe

Region Code	Region	Region Code	Region
nl21	Overijssel	ukc2	Northumberland and Tyne & Wear
nl22	Gelderland	ukd1	Cumbria
nl23	Flevoland	ukd2	Cheshire
nl31	Utrecht	ukd3	Greater Manchester
nl32	Noord-Holland	ukd4	Lancashire
nl33	Zuid-Holland	ukd5	Merseyside
nl34	Zeeland	uke1	East Riding & North Lincolnshire
nl41	Noord-Brabant	uke2	North Yorkshire
nl42	Limburg	uke3	South Yorkshire
pt11	Norte	uke4	West Yorkshire
pt12	Centro	ukf1	Derbyshire & Nottinghamshire
pt13	Lisboa e Vale do Tejo	ukf2	Leicestershire, Rutland & Northants
pt14	Alentejo	ukf3	Lincolnshire
pt15	Algarve	ukg1	Herefordshire, Worcestershire & Warks
pt2	Açores	ukg2	Shropshire & Staffordshire
pt3	Madeira	ukg3	West Midlands
se01	Stockholm	ukh1	East Anglia
se02	Östra Mellansverige	ukh2	Bedfordshire, Hertfordshire
se04	Sydsverige	ukh3	Essex
se06	Norra Mellansverige	uki1	Inner London
se07	Mellersta Norrland	uki2	Outer London
se08	Övre Norrland	ukj1	Berkshire, Bucks & Oxfordshire
se09	Småland med Öarna	ukj2	Surrey, East & West Sussex
se0a	Västsverige	ukj3	Hampshire & Isle of Wight
ukc1	Tees Valley & Durham	ukj4	Kent

Region Code	Region
ukk1	Gloucestershire, Wiltshire & North Somerset
ukk2	Dorset & Somerset
ukk3	Cornwall & Isles of Scilly
ukk4	Devon
ukl1	West Wales & the Valleys
ukl2	East Wales
ukm1	North Eastern Scotland
ukm2	Eastern Scotland
ukm3	South Western Scotland
ukm4	Highlands & Islands
ukn	Northern Ireland

Poor Group

Region Code	Region	Region Code	Region
de93	Lüneburg	gr23	Dytiki Ellada
es11	Galicia	gr24	Sterea Ellada
es12	Principado de Asturias	gr25	Peloponnisos
es13	Cantabria	gr3	Attiki
es24	Aragón	gr41	Voreio Aigaio
es41	Castilla y León	gr42	Notio Aigaio
es42	Castilla-la Mancha	gr43	Kriti
es43	Extremadura	ie	Ireland
es52	C.Valenciana	it72	Molise
es61	Andalucia	it8	Campania
es62	Murcia	it91	Puglia
es63	Ceuta y Melilla (ES)	it92	Basilicata
es7	Canarias (ES)	it93	Calabria
gr11	Anatoliki Makedonia, Thraki	ita	Sicilia
gr12	Kentriki Makedonia	itb	Sardegna
gr13	Dytiki Makedonia	pt11	Norte
gr14	Thessalia	pt12	Centro (P)
gr21	Ipeiros	pt14	Alentejo
gr22	Ionia Nisia	pt15	Algarve

Rich Group

Region Code	Region	Region Code	Region
be22	Limburg (B)	dea5	Arnsberg
be23	Oost-Vlaanderen	deb1	Koblenz
be24	Vlaams Brabant	deb2	Trier
be25	West-Vlaanderen	deb3	Rheinhessen-Pfalz
be31	Brabant Wallon	dec	Saarland
be32	Hainaut	def	Schleswig-Holstein
be33	Liège	dk	Denmark
be34	Luxembourg (B)	es21	Pais Vasco
be35	Namur	es22	C. Foral de Navarra
de13	Freiburg	es23	La Rioja
de14	Tübingen	es3	C. de Madrid
de22	Niederbayern	es51	Cataluña
de23	Oberpfalz	es53	Baleares
de24	Oberfranken	fr21	Champagne-Ardenne
de25	Mittelfranken	fr22	Picardie
de26	Unterfranken	fr24	Centre
de27	Schwaben	fr25	Basse-Normandie
de72	Gießen	fr26	Bourgogne
de73	Kassel	fr3	Nord - Pas-de-Calais
de91	Braunschweig	fr41	Lorraine
de92	Hannover	fr42	Alsace
de94	Weser-Ems	fr43	Franche-Comté
dea2	Köln	fr51	Pays de la Loire
dea3	Münster	fr52	Bretagne
dea4	Detmold	fr53	Poitou-Charentes

Rich Group

Region Code	Region	Region Code	Region
fr61	Aquitaine	nl41	Noord-Brabant
fr62	Midi-Pyrénées	nl42	Limburg (NL)
fr63	Limousin	pt13	Lisboa e Vale do Tejo
fr71	Rhône-Alpes	be1	Région Bruxelles
fr72	Auvergne	be21	Antwerpen
fr81	Languedoc-Roussillon	de11	Stuttgart
fr82	Provence-Alpes-Côte d'A:	de12	Karlsruhe
fr83	Corse	de21	Oberbayern
it11	Piemonte	de5	Bremen
it13	Liguria	de6	Hamburg
it31	Trentino-Alto Adige	de71	Darmstadt
it32	Veneto	dea1	Düsseldorf
it33	Friuli-Venezia Giulia	fr1	Île de France
it51	Toscana	fr23	Haute-Normandie
it52	Umbria	it12	Valle d'Aosta
it53	Marche	it2	Lombardia
it6	Lazio	it4	Emilia-Romagna
it71	Abruzzo	nl11	Groningen
lu	Luxembourg		
nl12	Friesland		
nl13	Drenthe		
nl31	Utrecht		
nl32	Noord-Holland		
nl33	Zuid-Holland		
nl34	Zeeland		

Poor Group

Region Code	Region	Region Code	Region
pt3	Madeira (PT)	it92	Basilicata
pt2	Açores (PT)	es63	Ceuta y Melilla (ES)
gr21	Ipeiros	ita	Sicilia
gr41	Voreio Aigaio	ie	Ireland
pt12	Centro (P)	it8	Campania
gr23	Dytiki Ellada	es62	Murcia
es43	Extremadura	es41	Castilla y León
pt11	Norte	gr42	Notio Aigaio
gr11	Anatoliki Makedonia, Thraki	gr24	Sterea Ellada
gr14	Thessalia	es12	Principado de Asturias
gr22	Ionia Nisia	it91	Puglia
es61	Andalucia	nl23	Flevoland
it93	Calabria	itb	Sardegna
gr43	Kriti	es52	Comunidad Valenciana
es11	Galicia	es13	Cantabria
pt14	Alentejo	ukn	Northern Ireland
gr25	Peloponnisos	es7	Canarias (ES)
gr12	Kentriki Makedonia	pt13	Lisboa e Vale do Tejo
es42	Castilla-la Mancha	be32	Hainaut
gr3	Attiki	it72	Molise
at11	Burgenland	fr83	Corse
pt15	Algarve	it71	Abruzzo
gr13	Dytiki Makedonia		

Rich Group

Region Code	Region	Region Code	Region
ukk3	Cornwall and Isles of Scilly	fr53	Poitou-Charentes
be31	Brabant Wallon	fr72	Auvergne
ukd5	Merseyside	deb2	Trier
de93	Lüneburg	nl21	Overijssel
at22	Steiermark	ukg1	Herefordshire, Worcestershire and
uke3	South Yorkshire	fr25	Basse-Normandie
nl12	Friesland	fr52	Bretagne
be35	Namur	ukj4	Kent
at21	Kärnten	es21	Pais Vasco
fr63	Limousin	fr62	Midi-Pyrénées
fi13	Itä-Suomi	fr22	Picardie
be24	Vlaams Brabant	fr3	Nord - Pas-de-Calais
ukc2	Northumberland, Tyne and Wear	es51	Cataluña
nl13	Drenthe	ukd4	Lancashire
ukk4	Devon	nl42	Limburg (NL)
ukf3	Lincolnshire	de23	Oberpfalz
ukc1	Tees Valley and Durham	de22	Niederbayern
es24	Aragón	fi14	Väli-Suomi
es23	La Rioja	ukk2	Dorset and Somerset
fr81	Languedoc-Roussillon	ukf1	Derbyshire and Nottinghamshire
nl22	Gelderland	es3	Comunidad de Madrid
at12	Niederösterreich	fi15	Pohjois-Suomi
ukg2	Shropshire and Staffordshire	es22	C. Foral de Navarra
be34	Luxembourg (B)	fr41	Lorraine
ukh3	Essex	deb1	Koblenz

Rich Group

Region Code	Region	Region Code	Region
de94	Weser-Ems	be23	Oost-Vlaanderen
uke4	West Yorkshire	fr24	Centre
uke2	North Yorkshire	se02	Östra Mellansverige
dea3	Münster	fr82	Provence-Alpes-Côte d'Azur
nl41	Noord-Brabant	se06	Norra Mellansverige
uke1	East Riding and North Lincolnshire	at33	Tirol
de72	Gießen	de73	Kassel
ukd3	Greater Manchester	dec	Saarland
fr51	Pays de la Loire	ukh2	Bedfordshire, Hertfordshire
fr43	Franche-Comté	se04	Sydsverige
be33	Liège	it53	Marche
ukg3	West Midlands	be22	Limburg (B)
es53	Baleares	ukf2	Leicestershire, Rutland and Northants
it52	Umbria	dea5	Arnsberg
fr26	Bourgogne	nl31	Utrecht
ukj2	Surrey, East and West Sussex	de91	Braunschweig
def	Schleswig-Holstein	be25	West-Vlaanderen
at31	Oberösterreich	dea4	Detmold
ukj3	Hampshire and Isle of Wight	ukk1	Gloucestershire, Wiltshire and North
ukh1	East Anglia	nl33	Zuid-Holland
de26	Unterfranken	ukd2	Cheshire
de24	Oberfranken	at34	Vorarlberg
fr61	Aquitaine	dk	Denmark
fr21	Champagne-Ardenne	de27	Schwaben

Rich Group

Region Code	Region	Region Code	Region
se08	Övre Norrland	de25	Mittelfranken
nl34	Zeeland	de12	Karlsruhe
fr71	Rhône-Alpes	be21	Antwerpen
it51	Toscana	it4	Emilia-Romagna
ukd1	Cumbria	it12	Valle d'Aosta
de13	Freiburg	se01	Stockholm
ukj1	Berkshire, Bucks and Oxfordshire	it2	Lombardia
fr23	Haute-Normandie	lu	Luxembourg
se07	Mellersta Norrland	fi2	Åland
fr42	Alsace	de11	Stuttgart
it6	Lazio	de5	Bremen
de92	Hannover	de21	Oberbayern
deb3	Rheinhessen-Pfalz	at13	Wien
nl32	Noord-Holland	de71	Darmstadt
it13	Liguria	be1	Région Bruxelles-capitale/Brussels
de14	Tübingen	fr1	Île de France
dea2	Köln	de6	Hamburg
it32	Veneto	fi16+fi17	Uusimaa (suuralue)
it33	Friuli-Venezia Giulia	se09+se0a	Småland med öarna
at32	Salzburg	uki	London
it31	Trentino-Alto Adige	ukl	Wales
it11	Piemonte	ukm	Scotland
dea1	Düsseldorf		
nl11	Groningen		

Poor Group

Region Code	Region	Region Code	Region
de93	Lüneburg	gr23	Dytiki Ellada
es11	Galicia	gr24	Sterea Ellada
es12	Principado de Asturias	gr25	Peloponnisos
es13	Cantabria	gr3	Attiki
es24	Aragón	gr41	Voreio Aigaio
es41	Castilla y León	gr42	Notio Aigaio
es42	Castilla-la Mancha	gr43	Kriti
es43	Extremadura	ie	Ireland
es52	Comunidad Valenciana	it72	Molise
es61	Andalucia	it8	Campania
es62	Murcia	it91	Puglia
es63	Ceuta y Melilla (ES)	it92	Basilicata
es7	Canarias (ES)	it93	Calabria
gr11	Anatoliki Makedonia, Thraki	ita	Sicilia
gr12	Kentriki Makedonia	itb	Sardegna
gr13	Dytiki Makedonia	pt11	Norte
gr14	Thessalia	pt12	Centro (P)
gr21	Ipeiros	pt14	Alentejo
gr22	Ionia Nisia	pt15	Algarve

The group of "rich" regions used in the computations takes in the regions that are in annex B except this ones.