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Convergence and Economic Performance in Greece: New Evidence at Regional and Prefecture Level

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CENTRE OF PLANNING AND ECONOMIC RESEARCH

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Σύγκλιση και οικονομική επίδοση στην Ελλάδα:
Νέα αποτελέσματα σε περιφερειακό και νομαρχιακό επίπεδο

Νίκος Μπένος & Στέλιος Καραγιάννης

ΠΕΡΙΛΗΨΗ

Κατά τα τελευταία χρόνια, ένα από τα σημαντικότερα ζητήματα στα εμπειρικά οικονομικά είναι η υπόθεση της σύγκλισης. Ο σκοπός αυτής της εργασίας είναι η διερεύνηση της περιφερειακής σύγκλισης και διαπεριφερειακών ανισοτήτων σε όρους κατά κεφαλή εισοδήματος στην Ελλάδα.

Η σύγκλιση μπορεί να οριστεί με διάφορους τρόπους. Πρώτον, η σύγκλιση λαμβάνει χώρα αν μια φτωχή οικονομία μεγεθύνεται γρηγορότερα από μια πλούσια (β σύγκλιση) (Barro & Sala-i-Martin, 2004). Το νεοκλασικό υπόδειγμα προβλέπει ότι αν κάποιες οικονομίες έχουν παρόμοιες προτιμήσεις και τεχνολογία, συγκλίνουν στην ίδια σταθερή ισορροπία (απόλυτη β σύγκλιση), ενώ αν δεν ισχύουν αυτές οι προϋποθέσεις, συγκλίνουν σε διαφορετικά επίπεδα σταθερής ισορροπίας (κατά συνθήκη β σύγκλιση).

Δεύτερον, σύγκλιση υπάρχει αν η διακύμανση της διαστρωματικής κατανομής εισοδήματος μιας ομάδας χωρών ή περιοχών μειώνεται διαχρονικά (σ σύγκλιση). Επομένως, η β σύγκλιση είναι αναγκαία, αλλά όχι ικανή συνθήκη για τη σ σύγκλιση.

Σε αυτήν την εργασία, εξετάζουμε την υπόθεση σύγκλισης για τις περιφέρειες και νομούς της Ελλάδας για την περίοδο 1971-2003. Όσο μπορούμε να γνωρίζουμε, είναι η πρώτη εργασία για την Ελλάδα με τόσο μεγάλη χρονική διάσταση, συνεπαγόμενη αύξηση των παρατηρήσεων και μικρότερη μεροληψία στις εκτιμήσεις. Επίσης, είναι η πρώτη έρευνα, που μελετά περιοχές σε δύο επίπεδα αποκέντρωσης, δίνοντας τη δυνατότητα για σύγκριση των αποτελεσμάτων, δεδομένης της ευαισθησίας τους στην επιλογή της χωρικής μονάδας μέτρησης των δεικτών (Magrini, 1999). Επιπλέον, χρησιμοποιούνται δείκτες, που έχουν κατασκευαστεί από τον ΟΟΣΑ για την εκτίμηση των διαφορετικών επιπέδων σταθερής ισορροπίας των περιφερειών και νομών. Ακόμη, γίνεται λεπτομερής διερεύνηση της υπόθεσης οικονομικού δυϊσμού μεταξύ διαφορετικών περιοχών της χώρας (βορράς-νότος, ανατολή-δύση, νησιωτική-ηπειρωτική χώρα). Τέλος, αξιολογούνται τα αποτελέσματα της προσχώρησης στην ΕΟΚ και την ΟΝΕ στην περιφερειακή μεγέθυνση.

Σε σχέση με τα αποτελέσματα, διαπιστώνεται ότι η πλουσιότερη περιφέρεια (Στερεά Ελλάδα) είναι 73% πιο πλούσια από τη φτωχότερη (Ήπειρος) και ο πλουσιότερος νομός (Βοιωτία) έχεις 212% ψηλότερο κατά κεφαλή εισόδημα από το φτωχότερο (Άρτα). Σε σχέση με άλλους δείκτες περιφερειακής ανισότητας, αυτός που μετρά τη γεωγραφική συγκέντρωση του εισοδήματος δείχνει ότι μετά από μια αύξηση στις αρχές της δεκαετίας του 1970 έμεινε σταθερή για ένα διάστημα, μειώθηκε στις αρχές της δεκαετίας του 1980 και κατόπιν αυξανόταν συνεχώς σε επίπεδο περιφερειών και νομών. Η χωρική εισοδηματική ανισότητα, όπως μετράται από το δείκτη Gini, παρέμεινε σταθερή μέχρι τα μέσα της δεκαετίας του 1990 και μετά αυξανόταν συνεχώς και στα δύο επίπεδα μελέτης.

Χρησιμοποιώντας ένα κλασσικό υπόδειγμα σύγκλισης, συμπεραίνουμε ότι υπάρχει β σύγκλιση μεταξύ νομών, αλλά όχι περιφερειών. Η απουσία σύγκλισης στο δεύτερο επίπεδο αποκέντρωσης μπορεί να οφείλεται στο ότι οι η πλειοψηφία των περιφερειών είναι ετερογενείς, δηλαδή περιλαμβάνουν πλούσιους και φτωχούς νομούς και δεν αποτελούν ενιαίες περιφερειακές οικονομίες. Ακόμη, δεν υπάρχει σ σύγκλιση και στα δύο επίπεδα γεωγραφικής διαίρεσης.

Επίσης, η γεωγραφική συγκέντρωση του εισοδήματος και η πυκνότητα του πληθυσμού επηρεάζουν αρνητικά τη μεγέθυνση. Η επίδραση αυτή είναι ισχυρότερη από τη θετική επίπτωση της γεωγραφικής συγκέντρωσης του πληθυσμού και της ανισότητας χωρικής κατανομής του προϊόντος στη μεγέθυνση. Συνεπώς, πολιτικές αποκέντρωσης της οικονομικής δραστηριότητας θα είχαν θετικά αποτελέσματα για την ανάπτυξη και τη χωρική κατανομή του εισοδήματος στην Ελλάδα. Τέλος, δεν εντοπίζεται οικονομικός δυϊσμός μεταξύ γεωγραφικών περιοχών και η σύγκλιση φαίνεται ότι είναι ταχύτερη μεταξύ των πλούσιων από ότι των φτωχών νομών.

ABSTRACT

The purpose of this paper is to test regional convergence and investigate interregional disparities in terms of per capita income in Greece. The novelty of our study lies in the use of a disaggregated dataset for an extended time period (1971-2003) at two regional levels (NUTS II & NUTS III). Our results indicate that there is β convergence between prefectures, but not among regions, while no evidence of σ convergence was found at both regional levels. Also, the GDP geographic concentration and population density have a negative impact on growth, which outweighs the positive growth effect of population geographic concentration and GDP spatial inequality. Thus, policies aiming at the decentralization of economic activity in Greece would enhance growth and regional equality simultaneously. Finally, we do not find economic dualism across geographic areas; however rich prefectures seem to converge faster than poor ones.

Keywords: Regional growth, Panel data
JEL classification: R11, C23

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1. Introduction

In recent years, one of the most controversial issues in empirical economics has been the convergence hypothesis. This relates to the spatial distribution of income, opportunities and activities at the national and international levels: despite increases in the average level of development worldwide, this has not occurred for some countries (at the international level) and some regions (at the national level).

Convergence can be defined in various ways. First, convergence takes place if a poor economy grows faster than a rich one, i.e. there is negative association of the initial level of the variable under consideration, e.g. per capita income, with its growth rate (β convergence) (Barro & Sala-i-Martin, 2004). The neoclassical growth model predicts that if economies have similar tastes and technologies, they converge to the same steady-state (absolute β convergence); if this assumption does not hold, they converge to their own steady-states (conditional β convergence).

Secondly, convergence occurs if the dispersion of the cross-sectional distribution of a variable, such as per capita income (measured, for example, by its standard deviation across a group of countries/regions) declines over time (σ convergence). Convergence of the first kind (β convergence) tends to generate convergence of the second kind (σ convergence), but this process may be offset by new disturbances that increase dispersion. So, β convergence is a necessary but insufficient condition for σ convergence.

In this paper, we examine the convergence predictions of the neoclassical model by looking at Greek regions and prefectures (NUTS II & NUTS III respectively) for 1971-2003, since economic agents within a country are characterized by similar technologies and tastes compared to agents of different countries (Lucas, 1988). Also, regions in the same country share a common central government and the institutions are more similar within a country in relation to those of different countries. Therefore, absolute convergence is more likely to happen across regions of the same country than across countries. In other words, the disaggregation of the data provides a better insight for the results.

To our knowledge, this is the first study for Greece which has such a long time dimension, implying a much larger number of observations than used in previous studies. Consequently, we expect better estimates in terms of asymptotic bias. Also, this study is the first to examine regions at two levels of disaggregation simultaneously, so we are able to compare results and draw relevant conclusions, given the sensitivity of results to the choice of regional unit (Magrini, 1999). Furthermore, indicators constructed by OECD, not used before in such a context, are applied to control for steady-state differences between regions and prefectures. Besides these, a detailed investigation is carried out regarding the possibility of economic dualism across geographical areas (north-south, east-west and mainland-islands). Finally, the effects of EEC accession and European Monetary Union (EMU) on regional growth are assessed. The main variable of interest is GDP per capita, since it is the most commonly used measure of welfare.

In the second section, we review the empirical literature on convergence. In the third part, we present the evolution of regional inequalities in Greece using descriptive statistics. In the fourth section, we present the empirical methodology and in the fifth one we proceed with the results. In the last section, we present the conclusions and implications of our findings for development policy in Greece.

2. Review of the literature

At the policy level, regional convergence has been an objective of most governments all over the world. In Europe, it has been an objective of the EU since its inception as the European Economic Community (EEC) in 1957. In the 1990s, simultaneously with the adoption of rules in order to achieve fiscal and monetary discipline by EU members proceeding towards EMU, policies aiming at regional cohesion were strengthened through the European Regional Development Fund, European Cohesion Fund and European Social Fund (Michelis et al., 2004).

Regional convergence has recently attracted renewed interest from researchers. In Europe, the main reason for this development is that lower regional inequality is necessary in order for EMU to be successful. However, the international evidence is mixed. For example, Barro & Sala-i-Martin (1991) have documented convergence at an approximate annual rate of 2% in the US states/regions for 1880-1988 and 73 EU regions for 1950-1985. Mauro-Podreca (1994) rejected convergence and found dualism between northern and southern Italian regions. Also, Neven-Gouyete (1994) found dualism of the North-South type for the EU, Baccheta (1994) rejected convergence for 35 EU regions and Button-Pentecost (1995) found divergence in EU regional incomes in the 1980s. Furthermore, Chessire-Carbonaro (1995) reported mixed results for 122 urban EU regions. Also, Magrini (1999) concluded there was polarization in the EU in 1979-1990, i.e. there are growth leaders, growth followers and very poor regions at the bottom of the income distribution. Recently, J.R Cuadrado-Roura (2001) found that after a period of regional convergence from 1960 to the mid-1970s, the process stopped and stabilized until 1996 in the EU regions. Finally, Gezici-Hewings (2004) found no evidence of convergence in Turkey for 1980-1997, Arbia et al (2006) obtained evidence of persistent behaviour of EU regions, i.e. poor regions remain poor and rich regions remain rich for 1980-2003 and Eckey et al. (2006) reported convergence at an annual rate of 3-3.5% for the enlarged EU regions during 1995-2003.

Regarding Greece, Athanasiou et al (1995) found that regional inequalities increased during the first post-war decades and subsequently declined. Syriopoulos-Asteriou (1998) reported absence of conditional β convergence and evidence of dualism across the south and northern regions in 1971-1996 and Petrakos-Saratsis (2000) concluded that there was a tendency towards convergence during 1971-1991. Tsionas (2002) found evidence of dualism and non-convergence for 1971-1993, Michelis et al (2004) accepted regional convergence in 1981-1991. Christopoulos-Tsionas (2004) found convergence in terms of labour productivity during the period 1971-1995, while Alexiadis-Tomkins (2004) reported evidence of no convergence and formation of a convergence club for 1970-2000.

3. Regional inequalities in Greece

In the last twenty years or so, it is believed that a significant improvement in living standards has taken place all over Greece. However, this does not necessarily imply a reduction of spatial inequalities across the country.

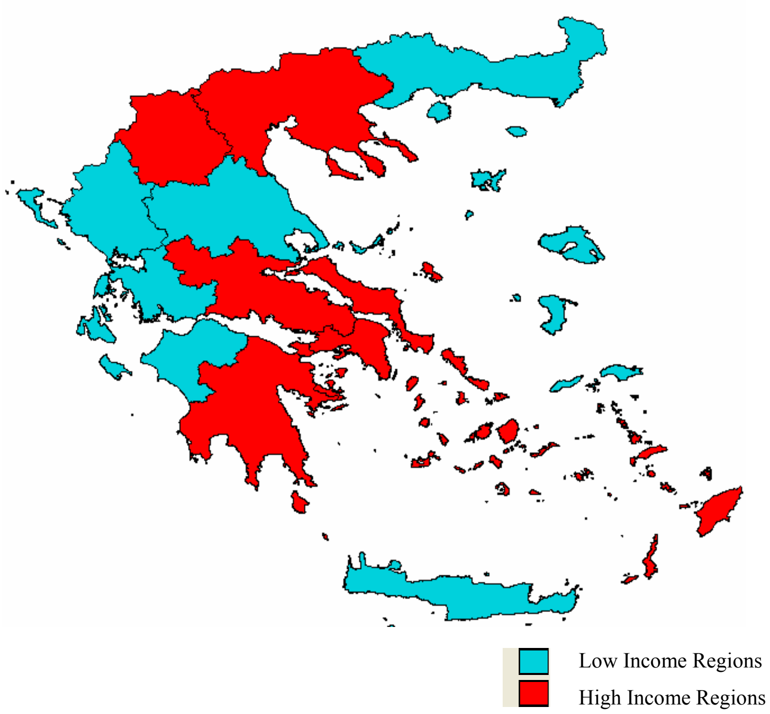
In this paper, we examine regional inequality at the NUTS II (13 regions) and NUTS III (51 prefectures) levels of spatial disaggregation for 1971-2003 using annual data of the National Statistical Service of Greece and not census data like some earlier work (Petrakos-Saratsis, 2000, Michelis et al. 2004)[1] to assess whether the improvement in average living conditions has been balanced across the various areas.[2]

First, there is large variation in terms of per capita GDP at 2000 prices across regions as well as prefectures (see Figure 1 below and Table 2 in the Appendix for details). The richest NUTS II region (Central Greece) is 73% richer than the poorest region (Epirus), while the richest NUTS III region (Voiotia) is 212% richer than the poorest prefecture (Arta). This increase in variation is expected as we go towards finer disaggregation.

[1] The data for 1995-2003 are those of the Greek Regional Accounts and those of earlier years are compatible with these.
[2] For definitions of the variables see Table 1 in the Appendix.

Figure 1. High and Low income regions (NUTS II) in Greece

(average GDP p.c., 1971-2003)



However, in at least two cases, there is the problem that regional GDP is measured according to where economic activities take place and not where income recipients are located (Petrakos-Saratsis, 2000). Specifically, per capita income registered in Voiotia is much higher than that of any other prefecture, because a large part of the Attica based industry is actually located in neighbouring Voiotia. However, the majority of the labour force commutes from Attica. As a result, a high level of GDP is produced in Voiotia, which, combined with its relatively low population, results in a very high GDP per capita (Prodromidis, 2006a). The same argument holds for the second richest prefecture (Corinth). Thus, regional disparities at NUTS III level are in effect smaller than they appear, but are nevertheless important.

Also, the regions differ widely with regard to population density. Even if we exclude Attiki, which is the most densely populated region by a large margin, the second most densely populated region (Western Macedonia) is almost three times more heavily populated than the least heavily populated region (Central Macedonia) (see Table 2 in the Appendix). At the NUTS III level, even if we exclude the prefectures where the two major urban centres (Attica & Thessaloniki) are located, Kerkyra (Corfu) is almost thirteen times more densely populated than Evritania.

Looking at other measures of regional inequality, we use the geographic concentration index of GDP, which compares the area share with the GDP share of each region. The higher the value of this index, the larger is the concentration of income in some areas. At the NUTS II and III levels, concentration rises until the mid 1970s, remains constant for a while, drops in the early 1980s and increases afterwards (see, respectively, Figures 1 and 3 in the Appendix). From the same figures, it follows that the population concentration index, which measures the spatial concentration of population, shows a steady increase throughout the whole period of analysis, but is always lower than the GDP concentration index. Both GDP and population concentration indices are higher at the NUTS III level compared to the NUTS II level. This is due to the smaller size of the NUTS III regions, which implies a greater variability and higher dispersion in the spatial distribution of GDP and population.

The opposite evolution of GDP and population concentration indices implies a relatively constant Gini index of GDP per capita until the mid-1990s at both NUTS II and NUTS III levels (see, respectively, Figures 1 and 3 in the Appendix). The increase of both indices explains the Gini index of GDP afterwards. Hence, inequality in terms of GDP per inhabitant was 1.8 and 2.9 times higher in 2003 compared to 1993 at the regional and prefecture levels respectively.

4. Empirical methodology

In the standard neoclassical growth model, convergence is the outcome of exogenous technical progress available to all countries, which are characterized by similar preferences and technology (Solow, 1956; Cass, 1965; Koopmans, 1965). Under diminishing returns to reproducible capital, poor countries with low capital-labour ratios and high marginal product of capital grow faster than rich countries with high capital-labour ratios and low marginal product of capital. Also, capital and labour mobility imply migration of capital to poor countries and of labour to rich countries, so that returns to factors of production tend to be equal. If there are differences between countries/regions after the process is complete, they are due to the differences in technology, preferences and institutions, i.e. steady-state differences.

However, economic theory is not entirely supportive of convergence. Some endogenous growth theories assume constant returns to scale to a broad measure of capital, which includes physical and human capital, due to externalities in human and physical capital accumulation, implying e.g. migration of skilled workers to rich countries with high concentration of skilled workers and divergence of these relative to poor countries. Externalities may also be due to transportation costs etc. On the other hand, there are new growth theories which predict convergence, due to knowledge spillovers among agents with different levels of human capital (Romer, 1986).

Following Barro-Sala-i-Martin (2004), we use the following equation to test for β convergence:

$$\frac{1}{T}\ln\left(y_{iT} / y_{io}\right) = x - \left[\left(1 - e^{-\beta T}\right)/T\right]\ln\left(y_{io}\right) + \left[\left(1 - e^{-\beta T}\right)/T\right]\ln\left(\hat{y}_i^*\right) + u_{i,0T} \qquad (1)$$

where y_{iT} denotes real GDP per capita in region i (i=1,…,N) in period T, y_{i0} is real GDP per capita in region i (i=1,…,N) in period 0, x is the common rate of technological progress, $\hat{y}_i^*$ is the steady-state income of region i and $u_{i0,T}$ is the effect of the error terms u_{it} between 0 and T.

The left-hand side of (1) is the growth rate of per capita income between periods 0 and T. So, the growth rate of region *i* depends on initial income y_{i0} and steady-state income $\hat{y}_i^*$. If $\beta>0$, we have conditional β convergence, since growth depends negatively on initial income, after we condition on the steady-state. The larger β is, the faster is convergence to the steady-state, so β is called the speed of convergence. If we assume that regions share the same steady-state, the term $\left[\left(1 - e^{-\beta T}\right)/T\right]\ln\left(\hat{y}_i^*\right)$ can be included in the constant term and with $\beta>0$, absolute β convergence applies. The estimated equation is:

$$\frac{1}{T}\ln\left(y_{iT} / y_{io}\right) = a - \left[\left(1 - e^{-\beta T}\right)/T\right]\ln\left(y_{io}\right) + w_{i,0T} \qquad (2)$$

However, if steady-state incomes differ, the term $\left[\left(1 - e^{-\beta T}\right)/T\right]\ln\left(\hat{y}_i^*\right)$ is incorporated in the error term and in case $\hat{y}_i^*$ is correlated with y_{i0}, the error is correlated with y_{i0} and estimates of β will be inconsistent. If there is no correlation of $\hat{y}_i^*$ and y_{i0}, regression (2) is still misspecified, but the estimate of β will be consistent. In regional data sets, it is more likely that steady-states are similar, due to similar technologies, preferences and institutions, so equations like (2) are more likely to give reliable results.

Since we are dealing with regional data, we initially estimate regressions of type (2) at the NUTS II and NUTS III levels by pooled OLS. Afterwards, we run type (1) regressions adding control variables to check whether results are robust. Because the data include different cross-section units and heteroscedasticity is usually a problem, heteroscedasticity robust covariance matrix estimates of the coefficients are obtained.

The above estimations assume that the error in each time period is uncorrelated with the explanatory variables in the same period. However, this assumption may be too strong and in fact a primary motivation for using panel data is to solve the problem of omitted variables, which are effectively part of the error term and cause bias in the coefficient estimates. So, we assume that there is a time-constant unobserved effect, which we treat as a random variable drawn from a population together with the observed explained and explanatory variables. The unobserved effect may represent area-specific historical and cultural factors. In our analysis, we assume that these characteristics are uncorrelated with the observed explanatory variables and proceed with random effects estimation, which exploits the serial correlation in the error, due to the presence of the unobserved effect in every period. We apply GLS and compute robust standard errors of the coefficients. Alternatively, we could assume that the unobserved effect is a function of the explanatory variables and apply fixed effects estimation. However, this methodology excludes time constant explanatory variables from the analysis, which makes impossible its application in our case, since the most important variable is initial per capita income, which is constant over time for all cross section units (regions, prefectures).

5. Testing regional convergence in Greece

5.1 Basic results

We start our empirical investigation by studying σ-convergence. We compute the cross-sectional standard deviation of log(GDP per capita) for 13 NUTS II and 51 NUTS III level regions. Looking at Figures 1 and 2 below, the standard deviation rises in the 1970s, falls and remains stable during the 1980-95 period and rises afterwards at both NUTS II and NUTS III levels.

Figure 1: σ convergence, NUTS II Level

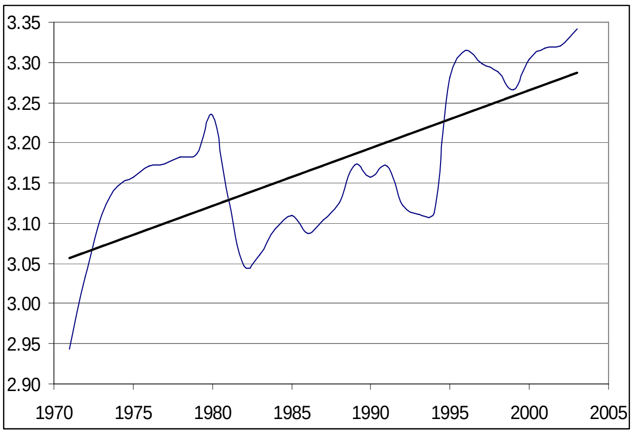
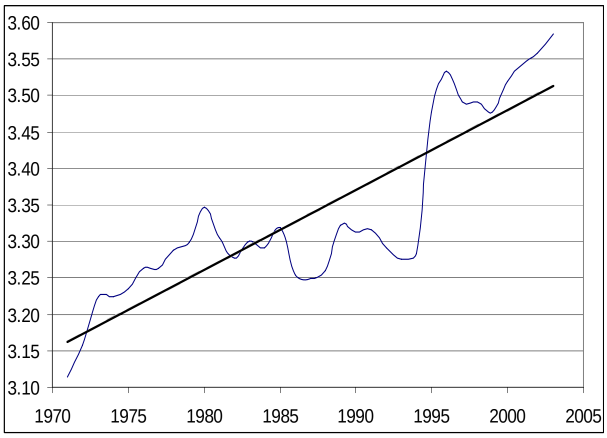


Figure 2: σ convergence, NUTS III Level



Overall, the standard deviation of log(GDP per capita) shows a positive trend indicating the absence of σ-convergence across Greek regions and prefectures for 1970-2003. This is in accordance with the rising concentration of GDP and population (Figures 1 and 3 in the Appendix) and increasing income inequality between areas (Figures 2 and 4 in the Appendix). Also, the findings are in line with the results of Petrakos-Saratsis (2000), who claim that regional inequality falls in recessions and rises during recoveries in Greece (growth was 0.67% and 2.19% in 1982-1991 and 1992-2003 respectively) due to the absence of spatial integration and the existence of a dual economic base.

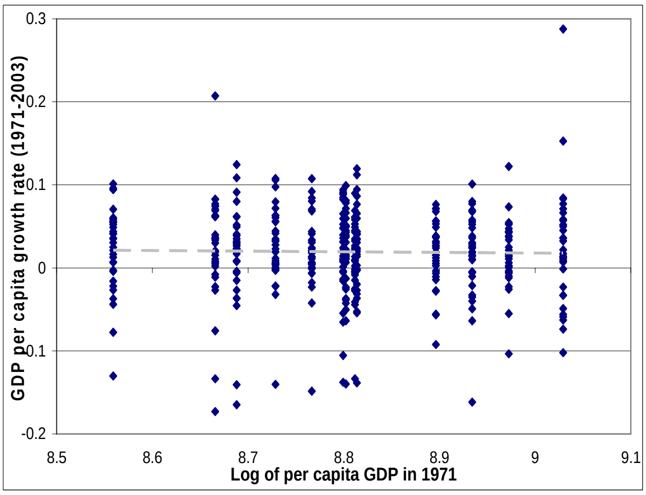
However, σ-convergence measures how the distribution of GDP per capita evolves over time. Moreover, we would like to know if there is mobility of the regions and prefectures within the distribution**.** As a first step, we compute the average GDP per capita during the beginning and the final periods of our sample (1971-1974 & 1999-2003) for all regions and prefectures and obtain a ranking of them for both variables and periods. Then, we calculate the differences in the ranking between the two periods and make a list of the winners and losers in terms of GDP per capita (see Table 3 in the Appendix). We note that 5 regions improved their relative position, 6 regions lost ground and only 2 regions maintained their ranking in per capita income terms. Additionally, 25 prefectures improved their position, 23 prefectures lost ground and only 3 prefectures maintained their ranking in per capita income terms (Table 4 in the Appendix). So, at first glance there is mobility in the regional income distribution in Greece (Tsionas, 2002).

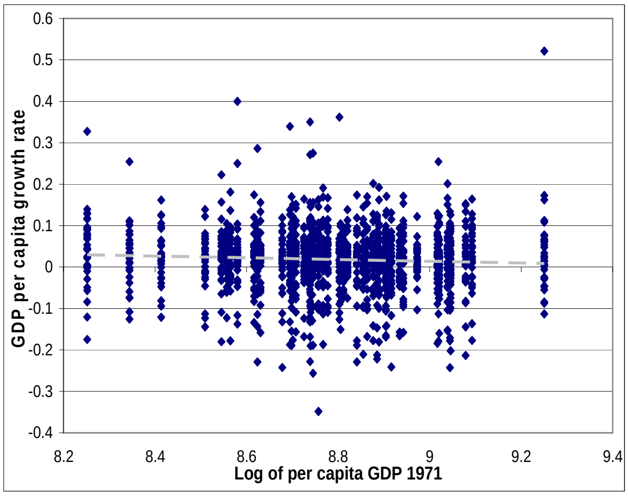
Following this preliminary analysis, we obtain plots of the growth rate versus initial per capita GDP at the NUTS II and NUTS III levels (Figure 3-4). There is no pattern of convergence for regions, while there is a weak negative relation between growth and initial per capita income for prefectures. In order to investigate further these graphical findings, we estimate absolute β convergence using equation (2) for NUTS II and NUTS III regions (Tables 1 & 2 below). We use observations which are yearly and averaged in 4-year periods[3] to check if the results are sensitive to business cycle effects. The coefficient of initial income, i.e. 1971 GDP per capita, is not statistically significant for NUTS II regions, while it is negative and statistically significant for NUTS III regions with both yearly and averaged data.

[3] The final period lasts 5 years, since our sample extends over 33 years.

Figure 3: Growth rate versus initial level of per capita GDP for Regions (NUTS II) & Prefectures (NUTS III) (1971-2003).

3.a. Regions (NUTS II)	3.b. Prefectures (NUTS III)





So, the 13 Greek regions do not converge to a common steady state, but the 51 prefectures within regions converge to a steady state at an annual rate of 3.5% (yearly data) or 16.3% per period (averaged data). These estimates are roughly equivalent due to exponential discounting. The apparently conflicting results for NUTS II & III levels can be explained by the heterogeneity in terms of per capita income within regions, i.e. rich regions include poor prefectures and the opposite holds. Specifically, 8 of the 13 regions contain prefectures that belong to a different income category (see Table 2 in the Appendix). These findings emphasize the need for using disaggregated data. Also, the results might be due to the fact that regions were established near the end of our sample period (1997). So, one could argue that NUTS II regions correspond to administrative units rather than regional economies (Prodromidis, 2006b). In light of this, regions do not seem to be a suitable unit to study regional convergence in Greece and analysis at the prefecture level seems more appropriate. The latter verifies the fundamental result of Brueckner (1998, 2003) who claims that economic findings may vary should we alter the level of aggregation. Our evidence is in line with earlier studies (Tsionas, 2002; Michelis et al., 2004), but no earlier work for Greece integrated the study of convergence simultaneously at two different regional levels.[4]

[4] The results could be even more interesting if more disaggregated data, e.g. at NUTS V level, were available.

Table 1. NUTS II. Unconditional β-convergence results

	Yearly data		Averaged data	
Explanatory Variables	**OLS**	**Random effects**	**OLS**	**Random effects**
Log (Initial income)	-0.0074	-0.0074	-0.0604	-0.0604
	(0.33)	(0.36)	(0.75)	(0.88)
Constant	0.0843	0.0843	0.605	0.605
	(0.43)	(0.47)	(0.86)	(1.00)
R^2	0.0003	0.0003	0.0085	0.0085
Obs	416	416	91	91

Notes: Dependent variable is GDP per capita growth. The multiple year averages are computed by splitting the sample into seven 4-year periods and one 5–year period. OLS estimates are heteroscedasticity-consistent. Absolute values of t- statistics and z-statistics are in parentheses for OLS and Random effects results respectively.

Table 2. NUTS III. Unconditional β-convergence results

	Yearly data		Averaged data	
Explanatory Variables	**OLS**	**Random effects**	**OLS**	**Random effects**
Log (Initial income)	-0.0209**	-0.0209**	-0.0911***	-0.0911***
	(2.12)	(2.32)	(2.78)	(3.24)
Constant	0.2023**	0.2023**	0.8711***	0.8711***
	(2.33)	(2.55)	(3.03)	(3.53)
R^2	0.0033	0.0033	0.0288	0.0288
Obs	1632	1632	357	357

*Notes: Dependent variable is GDP per capita growth. The multiple year averages are computed by splitting the sample into seven 4-year periods and one 5–year period. OLS estimates are heteroscedasticity-consistent. Absolute values of t- statistics and z-statistics are in parentheses for OLS and Random effects results respectively. *, **, *** denote significance at the 10%, 5% and 1% levels respectively.*

Given that the results are similar using yearly and averaged data, we proceed with yearly data in order to have a larger number of observations and obtain more efficient estimates. So, we estimate equations of type (1) in an effort to check the sensitivity of our findings and increase the explanatory power of our models controlling for possible steady-state differences between Greek regional entities. In this context, we use indicators constructed by the OECD to measure the characteristics of regional economies.[5] These estimates confirm the absence of convergence at the NUTS II level (Table 3), while convergence continues to appear at the NUTS III level (Table 4).

[5] See Table 1 in the Appendix for definitions of the variables.

Table 3. NUTS II. Conditional β-convergence results

	Yearly data		Averaged data	
Explanatory Variables	**OLS (1)**	**Random effects (2)**	**OLS (3)**	**Random effects (4)**
Log(Initial income)	0.005	0.005	0.0046	0.0046
	(0.18)	(0.21)	(0.17)	(0.19)
Log (Population share)	-0.0018	-0.0018	-0.0018	-0.0018
	(0.47)	(0.47)	(0.47)	(0.46)
Population geographic concentration growth	1.3327**	1.3327**	1.3451**	1.3451**
	(2.37)	(2.21)	(2.41)	(2.27)
GDP geographic concentration growth	-0.7528***	-0.7528***	-0.7481***	-0.7481***
	(4.32)	(7.31)	(4.25)	(7.39)
Population density growth	-0.7396**	-0.7396**	-0.7095**	-0.7095**
	(2.46)	(2.03)	(2.41)	(1.98)
Log(Gini)	-	-	0.0339***	0.0339***
			(4.64)	(4.03)
Constant	-0.0302	-0.0302	0.0981	0.0981
	(0.12)	(0.14)	(0.41)	(0.45)
R^2	0.1372	0.1372	0.1701	0.1701
Obs	416	416	416	416

*Notes: Dependent variable is GDP per capita growth. OLS estimates are heteroscedasticity-consistent. Absolute values of t- statistics and z-statistics are in parentheses for OLS and Random effects results respectively. *, **, *** denote significance at the 10%, 5% and 1% levels respectively.*

Table 4. NUTS III. Conditional β-convergence results

	OLS	**Random effects**	**OLS**	**Random effects**	**OLS**	**Random effects**
Explanatory Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log (Initial income)	-0.0165	-0.0165*	-0.0172*	-0.0172*	-0.0166*	-0.0166*
	(1.64)	(1.81)	(1.73)	(1.91)	(1.66)	(1.81)
Log(Population share)	0.0006	0.0006	0.0007	0.0007	0.0006	0.0006
	(0.29)	(0.27)	(0.35)	(0.33)	(0.32)	(0.3)
Population geographic concentration growth	1.177***	1.177***	2.1727***	2.1727***	1.2668***	1.2668***
	(3.22)	(3.02)	(5.31)	(5.26)	(3.45)	(3.24)
GDP geographic concentration growth	-0.9358***	-0.9358***	-0.9058***	-0.9058***	-0.9477***	-0.9477***
	(9.58)	(13.94)	(9.20)	(13.64)	(9.87)	(14.1)
Population density growth	-0.6379***	-0.6379***	-0.5801***	-0.5801***	-0.6454***	-0.6454***
	(4.19)	(3.57)	(3.75)	(3.29)	(4.23)	(3.62)
Log (Gini)	-	-	0.0272***	0.0272***	-	-
			(7.21)	(6.64)		
Gini growth	-	-	-	-	0.0302	0.0302**
					(1.48)	(2.44)
Constant	0.1677*	0.1677**	0.2711***	0.2711***	0.1667*	0.1667**
	(1.82)	(1.99)	(3.01)	(3.2)	(1.82)	(1.98)
R2	0.1265	0.1265	0.1495	0.1495	0.1297	0.1297
Obs	1632	1632	1632	1632	1632	1632

*Notes: Dependent variable is GDP per capita growth. OLS estimates are heteroscedasticity-consistent. Absolute values of t- statistics and z-statistics are in parentheses for OLS and Random effects results respectively. *, **, *** denote significance at the 10%, 5% and 1% levels respectively.*

From the same tables, we observe that the results for the remaining variables are qualitatively the same at both regional levels. Specifically, the share of population of each regional unit in the total population, which measures population growth of each region/ prefecture relative to the other regions/prefectures, does not affect growth. This is in accordance with some empirical studies (Syriopoulos-Asteriou, 1998; Barro-Sala-i-Martin, 2004). Note that growth models typically predict that population growth depresses per capita income growth.

In addition, population geographic concentration growth has a positive impact on per capita growth. This is rationalized if we consider it as a proxy for the spatial concentration of labour force and human capital, which creates knowledge spillovers among firms, i.e. each firm benefits from the average economy-wide human capital. This is in line with Lucas' view (1988) that "…human capital is a social activity involving groups of people in a way that has no counterpart with the accumulation of physical capital…".

Also, higher inequality in the spatial distribution of GDP, as measured by the Gini coefficient, in level form (NUTS II) and level/growth form (NUTS III), is beneficial for growth. This arises from the fact that areas where economic activity is concentrated are characterized by high levels of physical capital, which can create externalities, if for example, we assume that knowledge is a side product of investment and spills over across the whole economy boosting productivity and growth (Arrow, 1962).

On the contrary, GDP geographic concentration growth and population density growth inhibit per capita income growth. This means that an increase of the concentration of economic activity and population in certain areas from its current high level would lower growth. This is true for several reasons, e.g. because there is a decline in the quantity of public services (highways, water/sewage systems etc.) available to each consumer and firm (Barro-Sala-i-Martin, 2004). Also, the quality of the environment deteriorates (air, soil and water pollution), which causes aggravation in population health (cardiovascular, heart diseases etc). Such effects reduce productivity and growth.

However, in most cases the negative impact on growth of GDP concentration and population density is quantitatively stronger than the positive effect of population concentration and spatial inequality in GDP distribution (Brueckner, 1998).

The above findings stress the need for decentralization of economic activity in Greece, since this would boost growth and reduce regional inequality at the same time. The evidence rationalizes EU regional policies. However, the fact that almost twenty years after the initiation of such policies and despite increasing funding, the dispersion of GDP per inhabitant among regions and prefectures continues to increase, emphasizes the need for changes in their implementation.[6] First, policies should aim at convergence of the whole economy towards the EU-15 average, because all regions/prefectures have lower per capita income than the EU average. So, some measures should be of a horizontal nature promoting efficiency over the whole economy. Secondly, actions of a vertical nature should focus on areas that lag behind the rest of the country, given the significant spatial disparities within Greece. Such policies should take into account the characteristics of the various regions and exploit their comparative advantages. In this framework, areas could be specialized in e.g. agriculture, tourism, manufacturing, energy production or a combination of industries if possible, so that they have a diversified productive base and be less vulnerable to shocks that hit particular sectors. Finally, policy interventions should be applied consistently, continuously and efficiently. The coming years are very critical, since the 4th Community Support Framework represents the last chance for regional convergence in Greece supported financially to a large extent by the EU. In this context, there is urgent need for proper planning of policies in order to achieve growth of the country as a whole and regional convergence of living standards simultaneously.

5.2 Sensitivity analysis

In an effort to check the robustness of our results, we estimate the conditional convergence equations with two time dummy variables.[7] The first (EEC period dummy) captures the effect of EEC accession (1982-2003) and the second quantifies the impact of the preparation for EMU entry (1992-2003). At the NUTS II level, it seems that EEC membership affects growth negatively (Table 5, columns 1-2), while there is no statistically significant influence at the NUTS III level (results are omitted due to space considerations). These apparently conflicting findings might be due to the prolonged recession that hit Greece in the 1980s (growth in 1982-1991 was 0.67%). This period was characterized by the de-industrialization of areas with large enterprises across prefectures[8] within regions, making it impossible to isolate prefecture effects (Petrakos-Saratsis, 2000).

However, the preparation for EMU entry had a positive impact on growth at both NUTS II (Table 5, columns 3-4) and NUTS III (Table 6, columns 1-2) levels. This, we think, reflects the good growth performance of the Greek economy in 1992-2003 (growth rate

[6] It could be argued that without the presence of EU regional policies, the dispersion of GDP per capita would be even higher.

[7] See Table 5 in the Appendix for a definition of all dummy variables.

[8] Large industrial units competed with similar or larger foreign firms and suffered the consequences of internationalization after 1981, which led to the closure of some of them..

2.19%). This was mainly due to: a) a more favourable macroeconomic environment for both consumers and firms compared to the 1980s in the form of falling inflation, interest rates, public deficit and debt; b) higher financial support by the EU through the Community Support Frameworks (CSFs) for the improvement of physical and human capital (transportation, communication, environment, education etc).

Table 5. NUTS II. Conditional β-convergence results with dummies

Explanatory Variables	OLS (1)	Random effects (2)	OLS (3)	Random effects (4)
Log(Initial income)	0.0056	0.0056	0.0043	0.0043
	(0.2)	(0.23)	(0.16)	(0.18)
Log(Population share)	-0.0019	-0.0019	-0.0015	-0.0015
	(0.5)	(0.5)	(0.4)	(0.39)
Population geographic concentration growth	-0.1235	-0.1235	2.0995***	2.0995***
	(0.21)	(0.15)	(3.68)	(3.26)
GDP geographic concentration growth	-0.8351***	-0.8351***	-0.7620***	-0.7620***
	(4.83)	(7.76)	(4.44)	(7.47)
Population density growth	-0.7644***	-0.7644**	-0.8043***	-0.8043**
	(2.61)	(2.11)	(2.69)	(2.23)
EEC period dummy	-0.0188***	-0.0188**	-	-
	(3.24)	(2.47)		
EMU period dummy	-	-	0.0168***	0.0168***
			(3.54)	(3.18)
Constant	-0.0149	-0.0149	-0.0324	-0.0324
	(0.06)	(0.07)	(0.13)	(0.15)
R^2	0.1498	0.1498	0.1580	0.1580
Obs	416	416	416	416

*Notes: Dependent variable is GDP per capita growth. OLS estimates are heteroscedasticity-consistent. Absolute values of t- statistics and z-statistics are in parentheses for OLS and Random effects results respectively. *, **, *** denote significance at the 10%, 5% and 1% levels respectively.*

Table 6. NUTS III. Conditional β-convergence results with dummies

Explanatory Variables	OLS (1)	Random effects (2)	OLS (3)	Random effects (4)
Log(Initial income)	-0.0167*	-0.0167*	-0.0285***	-0.0285***
	(1.68)	(1.85)	(2.61)	(2.85)
Log(Population share)	0.0001	0.0001	-0.001	-0.001
	(0.47)	(0.44)	(0.47)	(0.45)
Population geographic concentration	2.2522***	2.2522***	1.1626***	1.1626***
	(5.31)	(5.16)	(3.19)	(2.99)
GDP geographic concentration growth	-0.9442***	-0.9442***	-0.9332***	-0.9332***
	(9.8)	(14.18)	(9.59)	(13.93)
Population density growth	-0.6834***	-0.6834***	-0.7247***	-0.7247***
	(4.54)	(3.85)	(4.82)	(4.01)
EMU period dummy	0.0205***	0.0205***	-	-
	(5.36)	(5.29)		
Income dummy	-	-	0.0118***	0.0118***
			(3.07)	(2.91)
Constant	0.1582*	0.1582*	0.2602***	0.2602***
	(1.74)	(1.89)	(2.67)	(2.89)
R^2	0.1413	0,1413	0.1310	0.1310
Obs	1632	1632	1632	1632

*Notes: Dependent variable is GDP per capita growth. OLS estimates are heteroscedasticity-consistent. Absolute values of t- statistics and z-statistics are in parentheses for OLS and Random effects results respectively. *, **, *** denote significance at the 10%, 5% and 1% levels respectively.*

As a next step in our analysis, we split regions into 2 groups depending on whether their GDP per capita is higher than the median regional GDP per capita (high-income regions) or lower than the median GDP per capita (low-income regions). Following the same procedure, we distinguish between rich and poor prefectures. Afterwards, we introduce one dummy variable in each of the two basic conditional convergence models (columns 1-2 in Tables 3-4) taking the value of 1 for wealthy NUTS II and NUTS III regions and 0 for poor regions. This variable is statistically significant at the prefecture level only, while the results for the rest of the variables are qualitatively unaffected (Table 6, columns 3-4). Thus, even if we control for initial income and a set of demographic and economic factors, it seems that there are systematic differences between high and low income prefectures, but not regions.[9]

The estimates of Table 6 reveal that the speed of convergence in the equation with the income dummy is 3.6 times higher (8.6%) than in the equation without the income dummy (2.4%). Thus, if we account for systematic differences between rich and poor prefectures, convergence is much faster, as expected.

We have also looked for systematic differences between northern/southern, island/mainland and eastern/western areas using dummy variables at both NUTS II and III levels, but none of them proved statistically significant. The first two experiments were conducted to check the robustness of earlier results showing a north/south and mainland/island divide (Syriopoulos-Asteriou, 1998; Michelis et al, 2004 respectively). So, we do not find evidence of economic dualism between geographical areas in Greece.

6. Conclusions and policy implications

In this paper, we evaluate the convergence hypothesis for the 13 regions and 51 prefectures of Greece during 1971-2003. The results imply no β convergence at the NUTS II level, but β convergence at the NUTS III level with a convergence speed in the 2.5-3.5% range. Also, there is no evidence of σ convergence.

Furthermore, the GDP geographic concentration and population density have a negative impact on growth, which outweighs the positive effect of population geographic concentration and GDP spatial inequality. Thus, there is scope for policies aiming at the decentralization of economic activity in Greece, since they would enhance growth and regional equality simultaneously. This implies a need for a better implementation of EU and

[9] This evidence accords with the heterogeneity of prefectures within regions, mentioned on page 9.

national regional policies, because the coming years represent the last chance for regional convergence in Greece supported financially to a large extent by the EU.

Additionally, we find a negative effect of EEC accession and a positive impact of the preparation for entry into the EMU on regional growth. Furthermore, there is no evidence of economic dualism across geographical areas, but rich prefectures seem to converge faster than poor ones.

We could increase the explanatory power of our models, for example by including measures of human and physical capital, which are not available at regional level for Greece for all our sample period. Finally, we could use panel co-integration and spatial econometrics methods to check the sensitivity of our results. These are open for future research.

APPENDIX

Table 1: Definitions of Variables

Dependent Variable	Description	Source
GDP per capita	in Euros, at 2000 constant prices; 1971-2003	National Statistical Service of Greece
Explanatory Variables		
Population	number of inhabitants per region or prefecture	National Statistical Service of Greece
Population share	number of inhabitants per region or prefecture as a share of the country's population	National Statistical Service of Greece
Area	total area of region or prefecture in km^2	National Statistical Service of Greece
Area share	total area of region or prefecture in km^2 as a share of the country's area in km^2	National Statistical Service of Greece
Population Density	Population/ total area for a given region or a prefecture	National Statistical Service of Greece
Geographic concentration index of population	$\left(\sum_{i=1}^{N} \lvert p_i - a_i \rvert \big/ 2\right) * 100$ where p_i is the population share of region *i* or prefecture, α_i is the area of region or prefecture *i* as a percentage of the country area, N stands for the number of regions and $\lvert\ \rvert$ indicates absolute value. The index lies between 0 (no concentration) and 1 (maximum concentration) in all regions or prefectures.	Methodology and definition from OECD, (Regions at a glance, 2007) Data from Regional Accounts, National Statistics Agency of Greece
Geographic concentration index of GDP	$\left(\sum_{i=1}^{N} \lvert p_i - a_i \rvert \big/ 2\right) * 100$ where p_i is the GDP share of region or prefecture *i*, α_i is the area of region or prefecture *i* as a percentage of the country area, N stands for the number of regions and $\lvert\ \rvert$ indicates the absolute value. The index lies between 0 (no concentration) and 1 (maximum concentration) in all regions or prefecture.	Methodology and definition from OECD, (Regions at a Glance, 2007) Data from Regional Accounts, National Statistical Service of Greece
Gini index of regional disparities in GDP per capita	$GINI = \frac{2}{N-1} * \sum_{i=1}^{N-1} (F_i - Q_i)$ where N is the number of regions or prefectures, $F_i = \frac{i}{N}$; $Q_i = \sum_{j=1}^{i} y_j \Big/ \sum_{j=1}^{N} y_j$ and y_i is GDP per capita in region or prefecture *i*. The index ranges between 0 (perfect equality: GDP is the same in all regions or prefectures) and 1 (perfect inequality: GDP per capita is nil in all regions except one).	Methodology and definition from OECD, (Regions at a Glance, 2007) Data from Regional Accounts, National Statistical Service of Greece

Table 2: GDP per capita & Population Density, NUTS II & NUTS III Levels (average for 1971-2003)

Region (NUTS 2 level)	(Greek name)	GDP p.c.	Density	Prefecture (NUTS 3 level)	GDP p.c.	Density
East.Macedonia & Thrace	Anat.Makedonia & Thraki	7918.52	40.44	Evros	7821.39	33.90
				Xanthi	7067.07	51.34
				Rodopi	6484.52	41.95
				Drama	7373.86	27.70
				Kavala	10104.48	63.45
Central Macedonia	Kentriki Makedonia	9285.37	30.38	Imathia	9618.95	79.23
				Thessaloniki	10019.57	251.04
				Kilkis	8841.30	32.67
				Pella	9067.60	54.15
				Pieria	7698.29	73.52
				Serres	7450.80	48.95
				Chalkidiki	10202.68	26.64
Western Macedonia	Dytiki Makedonia	9408.21	85.84	Grevena	7178.79	15.05
				Kastoria	7690.37	30.21
				Kozani	10756.48	42.02
				Florina	8113.19	27.51
Thessaly	Thessalia	8561.33	50.84	Karditsa	8177.95	47.55
				Larisa	8880.39	49.00
				Magnisia	9411.38	71.89
				Trikala	7085.35	39.96
Epirus	Ipeiros	7060.69	35.52	Arta	6300.15	46.43
				Thesprotia	6620.64	27.64
				Ioannina	7322.37	30.24
				Preveza	7684.40	55.00
Ionian Islands	Ionia Nisia	8292.26	83.34	Zakynthos	8036.77	81.68
				Kerkyra	8701.77	160.40
				Kefallinia	7790.19	37.89
				Lefkada	7642.38	61.88
Western Greece	Dytiki Ellada	8002.32	60.34	Aitoloakarnania	7501.04	40.96
				Achaia	8820.47	87.98
				Ileia	7300.49	66.22
Central Greece	Sterea Ellada	12218.73	35.02	Voiotia	19718.69	41.39
				Evoia	10502.60	46.60
				Evritania	8067.58	12.50
				Fthiotida	9859.33	37.03
				Fokida	10129.38	19.05
Peloponnese	Peloponnisos	9222.57	37.84	Argolida	9313.33	44.29
				Arkadia	9104.51	23.03
				Korinthia	12085.59	57.04
				Lakonia	7420.38	25.61
				Messinia	7970.55	55.26
Attica	Attiki	10360.74	909.67	Attiki	10360.74	909.67
North Aegean	Voreio Aigaio	7327.43	52.28	Lesvos	7821.31	49.57
				Samos	7176.55	53.68
				Chios	6442.99	57.51
South Aegean	Notio Aigaio	9809.67	47.54	Dodekanisos	10116.39	57.55
				Kyklades	9291.37	36.98
Crete	Kriti	9029.88	63.32	Irakleio	9103.75	97.03
				Lasithi	10018.90	38.78
				Rethimno	8454.42	45.73
				Chania	8676.11	55.75
Greece		*9661.64*	*75.95*	*Greece*	*9661.64*	*75.95*

Table 3: Change in GDP per capita Ranking, NUTS II Level

Region	GDP pc
Notio Aigaio	+8
Voreio Aigaio	+5
Dytiki Makedonia	+2
Ipeiros	+2
Kriti	+1
Ionia Nisia	0
Sterea Ellada	0
Anat. Makedonia & Thraki	-1
Attiki	-1
Kentriki Makedonia	-2
Thessalia	-2
Peloponnisos	-4
Dytiki Ellada	-8

Table 4: Change in GDP per capita, NUTS III Level

Prefecture	GDP pc
Evrytania	+48
Lefkada	+38
Dodekanisos	+27
Rethymni	+26
Lesvos	+24
Kyklades	+24
Chania	+16
Chios	+15
Arkadia	+14
Ioannina	+13
Samos	+12
Grevena	+11
Lasithi	+11
Xanthi	+10
Thesprotia	+10
Kozani	+9
Kefallinia	+9
Magnisia	+8
Kastoria	+5
Thessaloniki	+4
Trikala	+4
Preveza	+3
Kerkyra	+3
Fthiotida	+1
Fokida	+1
Evros	0
Voiotia	0
Korinthia	0
Arta	-2
Rodopi	-3
Florina	-3
Irakleio	-5
Kavala	-6
Chalkidiki	-6
Larisa	-8
Aitoloakarnania	-9
Drama	-10
Evvoia	-10
Attiki	-11
Achaia	-12
Kilkis	-13
Lakonia	-13
Karditsa	-14
Argolida	-21
Zakynthos	-23
Serres	-24
Pieria	-25
Imathia	-28
Messinia	-32
Pella	-33
Ileia	-35

Table 5: Definitions of Dummy Variables

Variable	Description
Geographical Variables*	
North / South 1	*North*: Anat. Makedonia & Thraki, Kentriki Makedonia, Dytiki Makedonia, Thessalia, Ipeiros, Voreio Aigaio. *South*: Ionia Nisia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki, Notio Aigaio, Kriti. The dummy variable takes the values of 1 for Northern regions and 0 for Southern ones.
North / South 2	*North*: Anat. Makedonia & Thraki, Kentriki Makedonia, Dytiki Makedonia, Thessalia, Voreio Aigaio. *South*: Ipeiros,Ionia Nisia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki, Notio Aigaio, Kriti. The dummy variable takes the values of 1 for Northern regions and 0 for Southern ones.
North / South 3	*North*: Anat. Makedonia & Thraki, Kentriki Makedonia, Dytiki Makedonia, Thessalia, Ipeiros. *South*:Ionia Nisia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki, Voreio Aigaio, Notio Aigaio, Kriti. The dummy variable takes the values of 1 for Northern regions and 0 for Southern ones.
North / South 4	*North*: Anat. Makedonia & Thraki, Kentriki Makedonia, Dytiki Makedonia. *South*: Thessalia, Ipeiros, Voreio Aigaio Ionia Nisia, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki, Notio Aigaio, Kriti. The dummy variable takes the values of 1 for Northern regions and 0 for Southern ones.
East / West 1	*East*: Anat. Makedonia & Thraki, Kentriki Makedonia, Thessalia, Sterea Ellada, Attiki, Voreio Aigaio, Notio Aigaio *West*: Dytiki Makedonia, Ipeiros, Ionia Nisia, Dytiki Ellada, Peloponnisos, Kriti. The dummy variable takes the values of 1 for Eastern regions and 0 for Western ones.
East / West 2	*East*: Anat. Makedonia & Thraki, Kentriki Makedonia, Dytiki Makedonia, Thessalia, Sterea Ellada, Attiki, Voreio Aigaio, Notio Aigaio. *West*:, Ipeiros, Ionia Nisia, Dytiki Ellada, Peloponnisos, Kriti. The dummy variable takes the values of 1 for Eastern regions and 0 for Western ones.
East / West 3	*East*: Anat. Makedonia & Thraki, Kentriki Makedonia, Thessalia, Sterea Ellada, Attiki, Voreio Aigaio, Notio Aigaio, Kriti. *West*: Dytiki Makedonia, Ipeiros, Ionia Nisia, Dytiki Ellada, Peloponnisos. The dummy variable takes the values of 1 for Eastern regions and 0 for Western ones.
East / West 4	*East*: Anat. Makedonia & Thraki, Kentriki Makedonia, Thessalia, Sterea Ellada, Attiki, Voreio Aigaio, Notio Aigaio, Kriti, Peloponnisos. *West*: Dytiki Makedonia, Ipeiros, Ionia Nisia, Dytiki Ellada. The dummy variable takes the values of 1 for Eastern regions and 0 for Western ones.
Island / Mainland	*Mainland*: Anat. Makedonia & Thraki, Kentriki Makedonia, Dytiki Makedonia, Thessalia, Ipeiros, Dytiki Ellada, Sterea Ellada, Peloponnisos, Attiki. *Island:* Ionia Nisia, Voreio Aigaio, Notio Aigaio, Kriti. The dummy variable takes the values of 1 for mainland regions and 0 for island ones.
Income Variables	
High / Low (NUTS II Level)	*High-income group* (regions with GDP >9029.89 median for 71-03 period): Kentriki Makedonia, Dytiki Makedonia, Sterea Ellada, Peloponnisos, Attiki, Notio Aigaio, Kriti. *Low-income group* (regions with GDP <9029.89 median for 71-03 period): Anat. Makedonia & Thraki, Thessalia, Ipeiros, Ionia Nisia, Dytiki Ellada, Voreio Aigaio. The dummy variable takes the values of 0 for Low-income regions and 1 for High-income ones.
High / Low (NUTS III Level)	*High-income group* (regions with GDP >8177.95 median for 71-03 period): Kavala, Imathia, Thessaloniki, Kilkis, Pella, Chalkidiki, Kozani, Larisa, Magnisia, Kerkyra, Achaia, Voiotia, Evvoia, Fthiotida, Fokida, Argolida, Arkadia, Korinthia, Attiki, Dodekanisos, Kyklades, Irakleio, Lasithi, Rethymni, Chania. *Low-income group* (regions with GDP <8177.95 median for 71-03 period): Evros, Xanthi, Rodopi, Drama, Pieria, Serres, Grevena, Kastoria, Florina, Karditsa, Trikala, Arta, Thesprotia, Ioannina, Preveza, Zakynthos, Kefallinia, Lefkada, Aitoloakarnania, Ileia, Evrytania, Lakonia, Messinia, Lesvos, Samos, Chios. The dummy variable takes the values of 0 for Low-income prefectures and 1 for High-income ones.
Time Variables	
Period 82-03	*First period*: 1971 – 1981; *Second period*: 1982-2003. The dummy variable takes the values of 0 for the first period and 1 for second one.
Period 92-03	*First period*: 1971 – 1991; *Second period*: 1992-2003. The dummy variable takes the values of 0 for the first period and 1 for second one.

* The description of the dummy variables is presented at NUTS II level for space reasons. The disaggregation of NUTS II level into NUTS III can be found in Table 2 above.

Figure 1: Geographic Concentration of GDP & Population, NUTS II Level

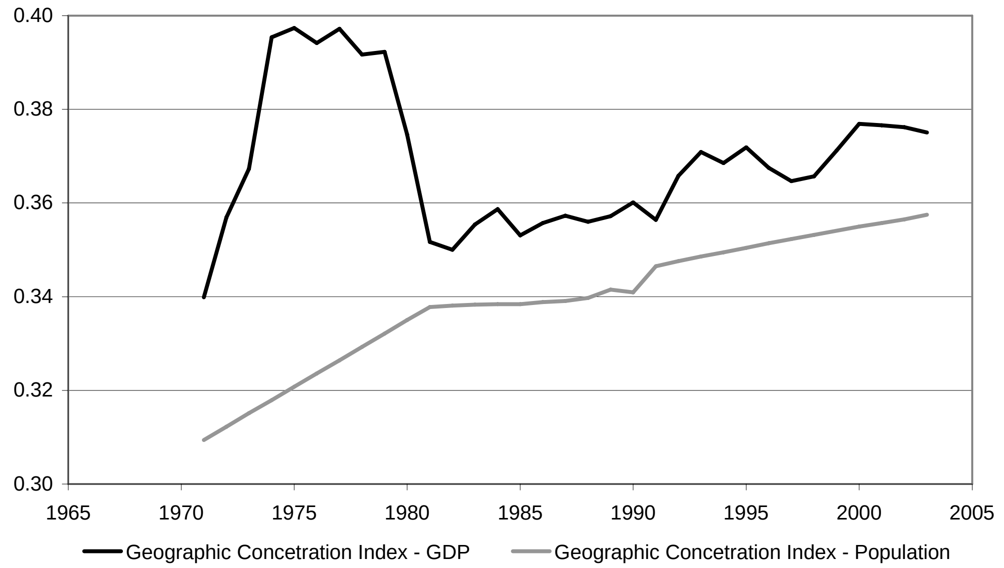


Figure 2: Regional Disparities in GDP, GINI Index, NUTS II Level

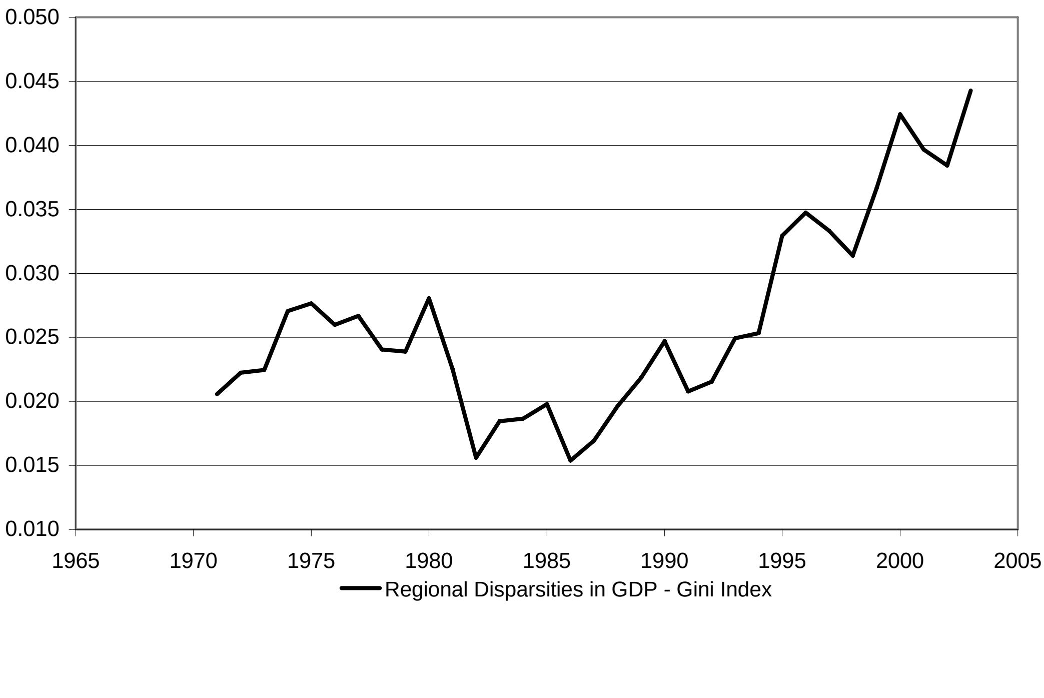


Figure 3: Geographic Concentration of GDP & Population, NUTS III Level

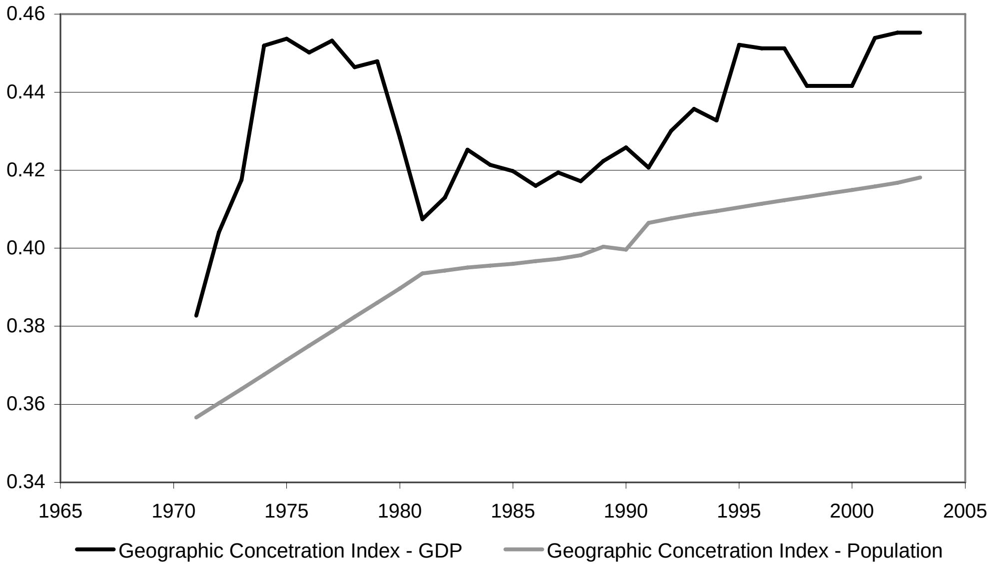
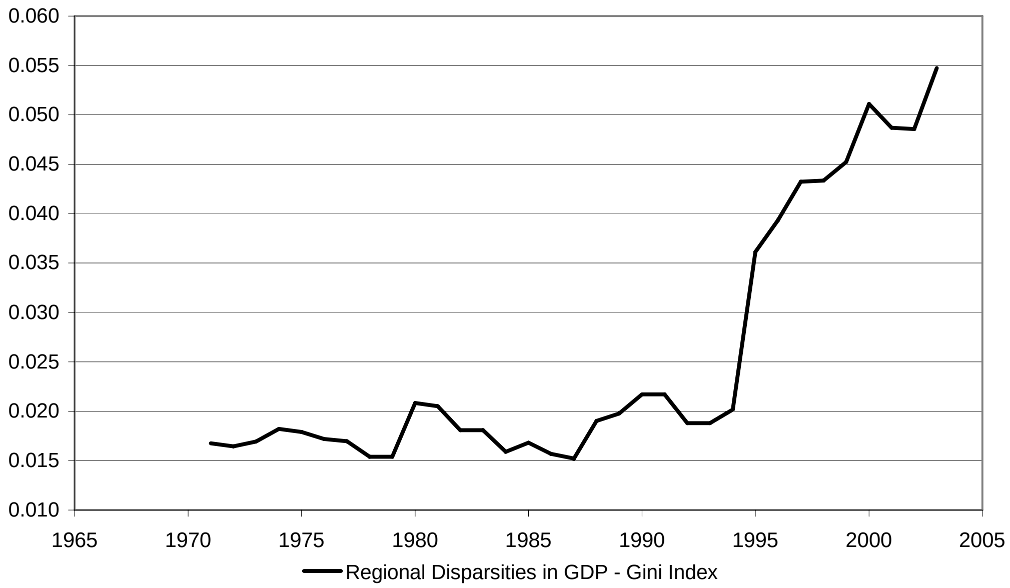


Figure 4: Regional Disparities in GDP, GINI Index, NUTS III Level



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