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Growth Empirics: Evidence from Greek Regions

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CENTRE OF PLANNING AND ECONOMIC RESEARCH

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Εμπειρικές Εκτιμήσεις της Οικονομικής Μεγέθυνσης:
Αποτελέσματα από τις Ελληνικές Περιφέρειες.

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ΠΕΡΙΛΗΨΗ

Σκοπός της παρούσας εργασίας είναι να εκτιμηθούν οι συνιστώσες της οικονομικής μεγέθυνσης των Ελληνικών περιφερειών και να αναλυθεί η επίδραση τούς στην άσκηση οικονομικής πολιτικής σε εθνικό επίπεδο. Ο παραπάνω σκοπός επιτυγχάνεται με δύο τρόπους. Αρχικά, παρατίθεται για πρώτη φορά το σύνολο των εκτιμήσεων που σχετίζονται με την έννοια της οικονομικής μεγέθυνσης, βασισμένες σε δεδομένα επενδύσεων και απασχόλησης 16 διαφορετικών οικονομικών κλάδων, τα οποία προέρχονται από περιφερειακούς λογαριασμούς. Με αυτόν τον τρόπο λαμβάνουμε υπόψιν την ετερογένεια των συνιστωσών της οικονομικής μεγέθυνσης μεταξύ περιφερειών και κλάδων οικονομικής δραστηριότητας. Δεύτερον, ως προς την οικονομετρική μεθοδολογία, χρησιμοποιείται η τεχνική των διαστρωματικών χρονολογικών σειρών (panel data) με βάση τους εκτιμητές επίδρασης (Random & Fixed Effect) αλλά και με τον εμπλουτισμένο εκτιμητή GMM (Arellano-Bond, 1991) που λαμβάνει υπόψη του την ενδογένεια και την μη παρατηρήσιμη ετερογένεια (endogeneity & unobserved heterogeneity).

Η εργασία περιλαμβάνει τις παρακάτω ενότητες. Πρώτων, μια περιγραφή της περιφερειακής οικονομικής πολιτικής στην Ελλάδα. Δεύτερον, το οικονομετρικό πλαίσιο και τη μεθοδολογία. Τρίτον, τα αποτελέσματα των εκτιμήσεων και τέλος, τα συμπεράσματα της εργασίας και σειρά προτάσεων πολιτικής.

Ως προ την οικονομετρική μεθοδολογία της εργασίας, εκτιμάται η επίδραση της απασχόλησης και των επενδύσεων 16 διαφορετικών οικονομικών κλάδων στο κατακεφαλήν ΑΕΠ, με τη χρήση της συνάρτηση παραγωγής τύπου Cobb-Douglas. Παράλληλα, επιχειρείται η διερεύνηση της ύπαρξης (ή μη) οικονομικού δυϊσμού με βάση τη γεωγραφική τοποθεσία των περιφερειών (βορράς-νότος, ανατολή-δύση, νησιωτική-ηπειρωτική χώρα). Επίσης, μέσα από τον διαχωρισμό των περιφερειών σε υψηλού και χαμηλού εισοδήματος εξετάζεται η ύπαρξη διαφορετικών περιφερειακών ομάδων.

Το εμπειρικό μέρος της εργασίας περιλαμβάνει την εκτίμηση τριών διαφορετικών μοντέλων. Αρχικά παρατίθενται οι εκτιμήσεις του μοντέλου στο οποίο η οικονομία περιλαμβάνει τρείς βασικούς τομείς: τον πρωτογενή, το δευτερογενή και τις υπηρεσίες. Στη συνέχεια εκτιμάται ένα εμπλουτισμένο μοντέλο που περιλαμβάνει εφτά οικονομικούς κλάδους (γεωργία & αλιεία, δευτερογενή, μεταποίηση, κατασκευές, εμπόριο & ξενοδοχεία, χρηματοπιστωτική διαμεσολάβηση και άλλες υπηρεσίες συμπεριλαμβανομένης και της γενικής κυβέρνησης). Τέλος, το πλήρες μοντέλο περιλαμβάνει εκτιμήσεις από 16 κλάδους οικονομικής δραστηριότητας.

Αναφορικά με το πλήρες μοντέλο οικονομικής δραστηριότητας, τα αποτελέσματα των εκτιμήσεων εμφανίζουν μια σειρά σημαντικών σχέσεων. Έτσι, παρατηρείται ότι οι επενδύσεις αλλά και η απασχόληση στο κλάδο των κατασκευών παρουσιάζουν μια αρνητική σχέση με την οικονομική μεγέθυνση. Αρνητική επίσης σχέση παρουσιάζουν οι επενδύσεις και η απασχόληση στους κλάδους της εκπαίδευσης και της υγείας. Παράλληλα με τα παραπάνω, παρατηρείται μια αρνητική σχέση μεταξύ των επενδύσεων στην αλιεία και το κατακεφαλήν ΑΕΠ. Μια ακόμη σημαντική εκτίμηση είναι η θετική σχέση των επενδύσεων στο κλάδο των ορυχείων & λατομείων με το περιφερειακό ΑΕΠ, η οποία ερμηνεύει μερικώς την θετική επίδραση του κατασκευαστικού τομέα στην οικονομία.

Πρόσθετα, παρατηρείται μια θετική σχέση ανάμεσα στην περιφερειακή οικονομική μεγέθυνση και τις επενδύσεις στον κλάδο της μεταποίησης και των ξενοδοχείων & εστιατορίων. Αντίθετα αρνητική επίπτωση στο περιφερειακό ΑΕΠ έχουν οι επενδύσεις του κλάδου των μεταφορών & επικοινωνιών. Χαρακτηριστική είναι επίσης η θετική σχέση του δείκτη περιφερειακής ειδίκευσης στις επενδύσεις (Balassa-Hoover Index) με το κατακεφαλήν ΑΕΠ. Τέλος, δεν παρατηρείται η ύπαρξη οικονομικού δυϊσμού με βάση την γεωγραφική τοποθεσία των περιφερειών, ενώ οι περιφέρεις που ανήκουν στην ομάδα χαμηλού εισοδήματος απολαμβάνουν συνολικά υψηλότερο ρυθμό οικονομικής μεγέθυνσης.

Συνολικά, η εργασία συμπεραίνει την ύπαρξη ανομοιοτήτων στην κατανομή του φυσικού και ανθρώπινου κεφαλαίου στις ελληνικές περιφέρειες. Σύμφωνα με τα εμπειρικά αποτελέσματα η παραπάνω ανισοκατανομή έχει άμεσο αντίκτυπο στην οικονομική μεγέθυνση.

ABSTRACT

The objective of this paper is to empirically examine the growth experience of the Greek regions, in the period towards and following the adoption of the Euro. We focus on the role that investment and employment play in regional growth and analyse how the spatial dynamics and patterns of industry affect the design of growth-promoting policies. After applying three different model specifications, our results indicate that investment in the service sector (hotels and restaurants) and business activities (real estate) enhance growth. Nevertheless, strong evidence of differential growth paths is found in terms of per capita income and time.

J.E.L. Classification: R11, C23.

Keywords: Regional Growth, Panel Data, Greece.

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1. Introduction

In recent years, there has been an upsurge of regional economic studies, as their importance is widely recognised when considering short and long-run policy design (Mauro, 2004; Salinas-Jimenez, 2004). This is due to higher integration driven by institutional factors (notably, the European Union and the World Trade Organisation) and new socioeconomic trends (globalisation, technological and scientific progress) which disintegrate national borders and expose regional entities to increased competition (Malmberg et al, 1996; Fatás, 1997). A stylised fact that emerges from the empirical literature is that regional disparities are larger and more persistent when compared to cross-national differences, at least within the industrialised nations.

At the European Union (EU) level, although income differences among member-states appear to have narrowed, the persistence of significant disparities between regions is challenging the capacity of national governments to design growth-promoting policies (Quah, 1996; Martin, 1998; Boldrin and Canova, 2001). Parallel with the above, interregional inequality has been one of the main issues of development policies in Greece. The country's presence in the European unification process (European Monetary System, European Monetary Union) has shaped its national and regional economic policy orientation. A central question is whether the integration course has enhanced regional growth and reduced disparities. In this context, several empirical studies have attempted to analyse convergence in Greece.[1] Empirical results report mixed evidence at both regional and prefecture levels.[2]

Although there are several papers on convergence in Greece, there seems to be a shortage of studies examining regional growth in terms of industry level dynamics. In this paper, our aim is to estimate the regional growth determinants and analyse their implications for economic policy at the national level. Our approach features two important aspects. First, it represents, to the best of our knowledge, the first attempt to provide a comprehensive set of growth estimates for the Greek economy using regional accounts data for employment and investment corresponding to 16 different industries. This way, we allow for heterogeneity of growth determinants across regions as well as industries. Secondly, regarding the econometric methodology, panel data analysis is carried out using Random Effects (RE) and enhanced GMM (Arellano-Bond, 1991)

[1] These include Athanasiou et al. 1995; Syriopoulos & Asteriou, 1998; Petrakos & Saratsis, 2000; Tsionas, 2002; Michelis et al. 2004; Christopoulos & Tsionas, 2004; Alexiadis & Tomkins, 2004

[2] NUTS 2 & 3 respectively.

estimators in order to handle endogeneity and unobserved heterogeneity problems.

The paper is organised as follows. In section 2, regional economic policy in Greece is presented accompanied by stylised facts concerning regional growth. Section 3 describes the econometric framework and methodology. In section 4, estimation results are presented, while section 5 offers some policy considerations and concluding comments.

2. Regional economic policy in Greece

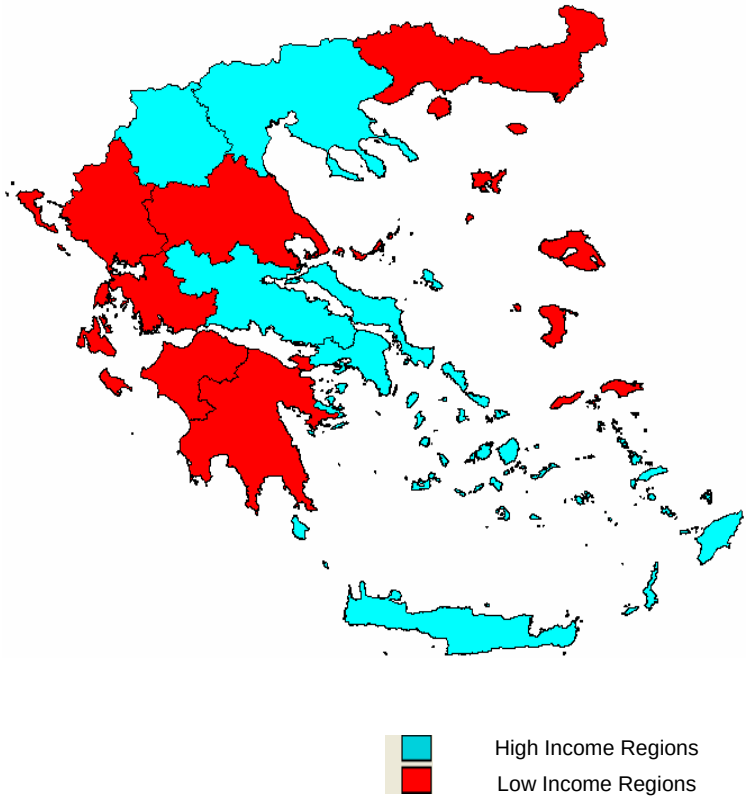
Since the 1990s, a number of significant structural changes have taken place in Greece. Starting from the international economic environment, European Monetary Union (EMU) was underway through the implementation of stabilizing macroeconomic policies. Moreover, the EU of 15 member-states was about to include 10 new ones, with implications for the 'cohesion' concept and the regional policy setting of the community (Michelis et al., 2004). At the national level, all Greek regions[3] enjoyed support from the Second and also the Third Community Support Frameworks (CSF)[4] in terms of physical and human capital investments.

A number of notable disparities exist in the Greek regions regarding GDP per capita. As is evident from Table 3 (see the Appendix) annual growth in Greece increased from 2.6% in the period 1995-1999 to 4.2% during 2000-03. This trend was followed by most regions, while centrally-located Attica and Central Greece, together with heavily touristic regions (the South Aegean and Ionian islands) surpassed the national average over that timeframe. Map 1 below provides a representation of the 13 Greek regions and their division into two sub-groups, on the basis of their average GDP per capita during 1995-2003.[5]

[3] Greece is divided in 13 NUTS 2 level regions.
[4] The 2nd CSF took place from 1994 to 1999 while the 3rd one occurred from 2000 to 2006.
[5] The calculations for the regional income groups can be found in Table 3 in the Appendix.

Map 1: High and Low income regions (NUTS II) in Greece

(average GDP p.c.1995-2003)



Furthermore, according to Figure 1 below and Table 4 (in the Appendix), even though the highest proportion of employment in Greece occurs in the tertiary sector (around 58%), the primary sector is relatively large in a number of regions, i.e. 38% in Peloponnese and Eastern Macedonia & Thrace. On the other hand, investment at the spatial level follows a more uneven pattern, ranging from 0.2%–3.2% in the primary sector to 10.3%–20.5% in services (see Figure 2 below and Table 5 in the Appendix). An additional feature is that specialised service industries, such as financial intermediaries, are located mostly in the regions of Attica and Central Macedonia, where the main urban centres are located (Athens and Thessaloniki respectively). From a dynamic point of view, the construction and service sectors increase in terms of both employment and investment throughout the period of analysis.

Figure 1 : Employment in Greece (in thousands, 1995-2003)

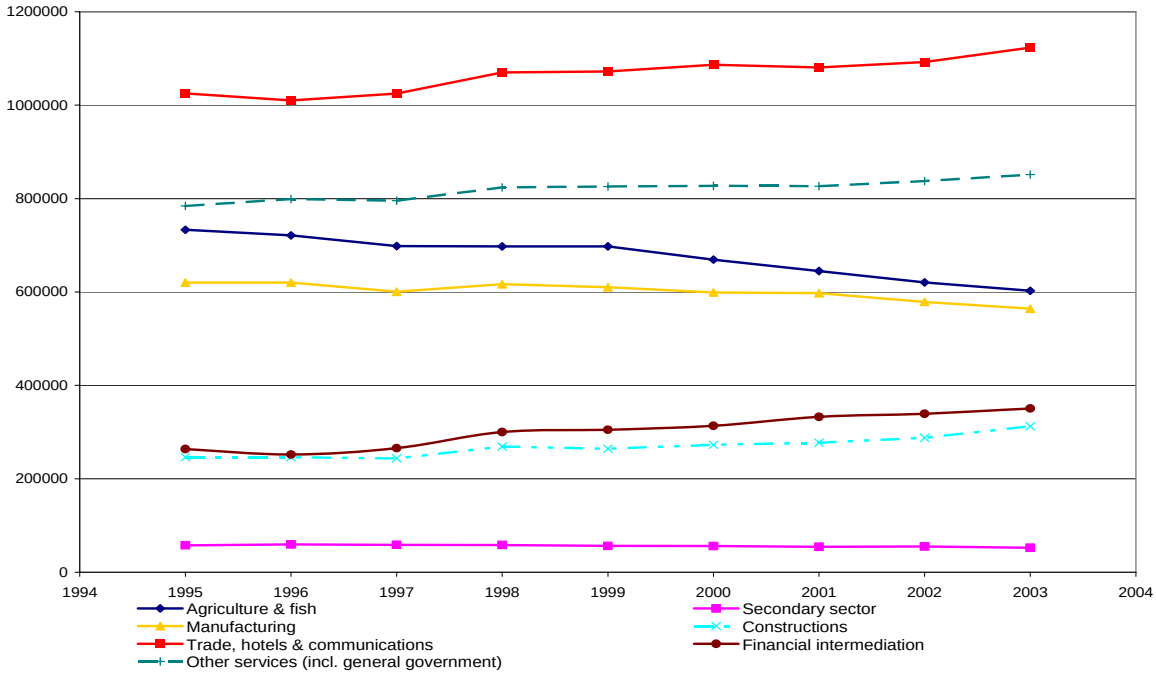
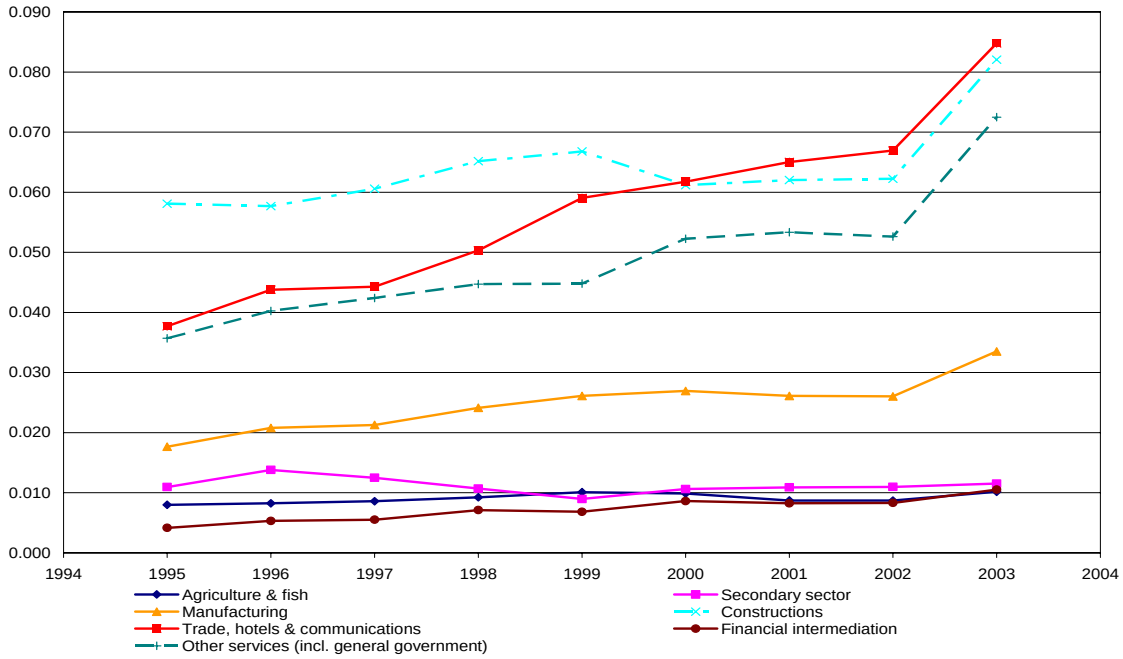


Figure 2 : Investment in Greece (% of GDP, 1995-2003)



3. Empirical investigation of regional growth

3.1. Data and Econometric Framework

In this study, the employment and investment impact on GDP per capita growth is captured by employing a Cobb-Douglas production function. For this reason, a regional accounts dataset on employment and investment in 16 industries for the 13 Greek regions is used. The data were obtained by the National Statistics Agency of Greece and cover the 1995-2003 period. After taking logarithmic differences, the Cobb-Douglas econometric specification can be written as:[6]

$$\Delta(\ln Y_{it}) = \lambda + \alpha \Delta(\ln L_{it}) + \beta \Delta(\ln K_{it}) + \varepsilon_{it} \qquad (1)$$

where the subscripts i and t denote region and year, respectively; Y measures GDP per capita in each region, A is a constant parameter, while t is a time trend. Parameters α and β are the elasticities of employment and investment with respect to the dependent variable and finally ε_{it} is the error term capturing unobserved variations between regions and over time.

As mentioned earlier, a popular view prevailing in Greece is that economic dualism exists regarding the geographical location of regions, such as north/south, east/west or island/mainland. Therefore, regression (1) is augmented by various binary variables, in an effort to explore whether economic dualism is present across regions and to discover possible regional clubs in terms of income in Greece.[7] Additionally, following Blomstrom et al (1994), the 13 regions are divided into two groups on the basis of their average GDP per capita during the period 1995-2003. The first group consists of regions with above average GDP (high-income) and the second corresponds to low-income regions (see Table 3 in the Appendix). Finally, to test whether regional GDP growth has increased in the period around the adoption of the Euro (2000-2003), a dummy variable indicating period effects is also included (see Table 6 in the Appendix).

In an effort to further analyse and evaluate regional disparities in Greece, the Balassa-Hover specialisation index (BH)[8] for employment and investment in the 16 industries was constructed and used as an additional explanatory variable in model (1). This way we estimate the effect of regional specialisation with respect to certain industries over growth.

[6] Barro and Sala-i-Martin (1992) justify this approach when studying growth in discrete time periods.
[7] The definitions of all dummy variables can be found in Table 6 in the Appendix.
[8] A complete definition of the Balassa-Hover specialisation index is available in Table 1 in the Appendix.

3.2. Econometric Methodology

We use a dataset for Greek regions spanning 1995-2003, so we resort to panel data methods. Empirical panel data studies on growth are usually carried out for periods of around 30 years, with five-year averaged observations.[9] Our time period is limited to 9 years, hence we use annual data.

Panel data analysis offers several advantages over time series and cross-section techniques. It allows for more efficient parameter estimates,[10] uncovers dynamic relations[11] and identifies otherwise unidentified models.[12] Although the main premise informing the present empirical work is the effect of regional employment and investment on respective GDP p.c. growth, the association does not mean that causality runs exclusively in one direction. If this is the case, biased and inconsistent estimates will be obtained. To account for this problem a GMM estimator is used, as developed by Arellano and Bond (1991).[13] In our model, the explanatory variables are treated as endogenous, in that we suppose that past values of the error term have some impact on their future realisations. A maximum of two lags is used, in order to retain a sufficient number of observations, which is necessary to derive reliable conclusions.

4. Empirical results concerning the performance of Greek regions.

Regressions are performed using a balanced panel dataset consisting of the 13 regions of Greece for the 1995-2003 period. The annual growth rate of GDP per capita is regressed on a number of explanatory variables using the random effects and the Arellano-Bond estimators. Three different versions of model (3) are estimated. First, the three-sector economy model where employment and investment are aggregated to include the primary, the secondary and the service sector industries.[14] Secondly, the seven-sector economy model is estimated which includes a finer disaggregation of the employment and investment data. It consists of the following sectors: (a) agriculture & fisheries, (b) secondary, (c) manufacturing, (d) construction, (e) trade & hotels, (f) financial intermediation and (g) other services (including general government). Finally, the complete model is estimated, where investment and employment data are disaggregated

[9] For example see Barro and Lee, 1994; Caselli, Esquivel & Lefort, 1996.
[10] See Hsiao, Mountain & Ho-Illman, 1995.
[11] See Pakes & Griliches, 1984.
[12] See Biorn, 1992; Griliches & Hausman, 1986.
[13] For further details see Bond (2002) and Baltagi (2002, p. 129-136)
[14] A complete list of the sectors and the corresponding industries is presented in Table 2 in the Appendix.

at the 16 industries level for the 13 corresponding regions of Greece. In the following section, we present the results from the three models described above.

4.1. Three-sector model

The estimation results of the three-sector model are presented in Table 7 in the Appendix. The first column presents the results based on employment and investment (explanatory variables) from the three sectors of the economy. According to the random effect estimator,[16] the elasticities of the GDP p.c. growth rates with respect to the variables are not statistically significant. However, as mentioned earlier, it is possible that these estimates are biased due to endogeneity problems and unobserved heterogeneity. For this reason, the Arrelano-Bond panel data estimator is employed (columns 4 and 5). According to our estimates (column 4), investment in the service sector is negatively and significant related to economic growth (at the 10% significance level). This finding raises a number of questions regarding the overall efficiency of the tertiary sector. The subsequent disaggregated models that include estimations for each service industry will provide a more detailed picture of the sector in question. The rest of the investment and employment growth variables are not statistically significant.

Additional variables are included regarding the employment and investment specialisation of every region in columns 2 and 5 (Ballasa-Hover index). It appears that employment specialisation affects growth positively and significantly at the 5% level, regarding both estimators (RE and GMM). In other words, the employment speciality of every region has a significant effect on growth rates. This finding can be interpreted as an indication of efficiency from the aspect of labour force allocation and regional productivity. On the other hand, the insignificant relation between growth and regional investment specialisation is a sign of economic inefficiency in terms of the distribution and utilisation of capital. It is interesting to see if the above results hold in the models that follow.

Also, estimates with respect to high and low-income regions (column 3) indicate that poor regions enjoyed significantly higher growth rates over the estimated period,

[16] Depending on the assumption about the correlation between the constant effect and the explanatory variables, two different estimation methods can be followed: either the random or the fixed effect panel data estimator. The Hausman (1978) specification test is employed in order to examine the significance of the above correlation and shows that the Random Effects (RE) estimator is appropriate.

holding other factors constant. Results with respect to time indicate that no significant growth differences occurred between the end of the 1990s (1995-1999) and 2000-2003. The additional geographical variables do not indicate any effect on growth.[17]

4.2. Seven-sector model

In this sub-section, empirical results from the seven-sector model are presented (Table 8 in the Appendix). Both estimators demonstrate a negative and significant relation between employment in the financial intermediation sector (which includes financial, real estate and business services) and economic growth in both estimators. According to the rest of the GMM estimation results (columns 4 and 5) employment in the construction industry has a significant but negative effect on growth. This result is considered to be influenced by two main facts: the concentration of the industry in certain regions [18] and the short data span of our analysis. Also, the financial intermediation sector (which includes financial and business services) has a negative effect in terms of investment. As this type of services is mainly located in the urban regions of Greece (Attica and Central Macedonia) we expect the last disaggregated model to provide a more comprehensive picture for the above relationship.

Additionally, from the investment side of our model, estimations exhibit a positive and significant effect regarding the secondary sector and the broad sector of trade, hotels and communications. The secondary sector of this model includes commodities linked with the energy industry, so this type of investment is expected to have a positive and direct link with growth. Also, the extensive trade, hotels and communications sector includes investment in the important tourist industry, so the following estimates can clarify the origins of this relation too.

The employment specialisation index exhibits a positive and significant influence on GDP growth (columns 2 and 5). Note that this result is in line with previous estimations from the three-sector model. Estimates regarding high and low-income regional groups demonstrate once more that poor regions enjoy higher growth than the rich ones, *ceteris paribus* (column 3).

4.3. 'Sixteen industries' model

[17] Only significant estimates regarding dummy variables are reported in the Appendix. Results are available from the authors, upon request.
[18] Mainly in the regions of Epirus and South & North Aegean.

In the final model of regional economic activity, regional GDP per capita growth is regressed on employment growth and investment data from 16 industries (Table 9 in the Appendix). Regarding the random effect estimates, we conclude that only employment in real estate and business services and employment in the public sector appear to have a significant and negative impact on growth, together with investment in manufactured products (column 1). On the contrary, the GMM estimator reveals a number of additional relations. Specifically, a significantly strong and negative relation between construction and growth is revealed in terms of both employment and investment (column 4). This relation can be partially explained by the regional misallocation of capital investment and labour force in the specific industry (see Tables 4 and 5 in the Appendix). Parallel with the above, employment growth and investment in education services exhibit a significantly negative impact on economic growth. This result is perhaps due to the short time span of our model. Most empirical studies argue that such expenditures may take several years to have a positive effect on growth (for example, see Bleaney, Gemmell & Kneller, 2001). The revealed relationship could also be a sign of inefficiency regarding the regional allocation of human and physical capital resources in the Greek educational system. The same arguments apply to the negative relation concerning growth and investment in health, social and other community services.

Furthermore, investment in the fisheries industry is estimated to have a negative impact on growth rates. Although the industry in question has a low value-added at the national level, it is a major source of income for some island regions. Also, our model identifies a very interesting link between investment in the 'mining & quarrying' industry and growth. This relation is closely linked to housing activity and partially captures the positive effect that the construction industry has on economic growth at the national level. In line with the above, investment in the energy industry is found to have a positive impact on growth and can be viewed as an indicator of a direct link between this factor of production and economic activity.

Another notable estimation result is the positive association between investment in the manufacturing industry and regional growth rates. During the 1980s, Greece has experienced a de-industrialisation which signalled a restructuring of the traditional manufacturing industry (Athanassiou, 2003). The above finding probably indicates that the surviving firms managed to efficiently surpass this turmoil. Similar results are reported by P.I. Prodromidis (2006). Regarding the traditional tourist industry, estimation

results show the expected positive link between investment in 'hotels & restaurants' and economic activity. The latter estimation confirms the specialisation of the Greek economy in services associated with the tourist industry and its significance in certain regions. Our finding is in line with Christopoulos & Tsionas (2004), who suggest that convergence in the service sector is the main factor responsible for overall convergence among Greek regions because of the existence of considerable infrastructure in the tourism industry.

Continuing with the remaining service industries, the estimation results suggest that investment in the transport, storage and communication industry exhibits a negative impact on growth. Again, a possible explanation of this relation is the shortage of observations. On the other hand, general business services affect economic activity positively. The service sector is considered to be a major source of growth in modern economies. At this point, we should re-emphasise the regional disparities regarding business services activities, since most of them are located in the two main urban centres of Greece (Attica and Central Macedonia). Moreover, government services (such as public administration, defence and security) exhibit the expected positive relationship with economic activity. In general, it is believed that such public services protect property rights and therefore enhance growth.

Regarding the variables dealing with regional specialisation, only employment is estimated to have a positive effect on economic activity (columns 2 and 6). As commented earlier, this is an indication of robustness regarding our estimation results. In an effort to further evaluate the significance of these relations, we can conclude that regional investment is far from being efficiently allocated in order to augment spatial growth. Our finding is in line with previous studies arguing that regional investment is deficient in terms of planning from the side of the government and related incentives for the private sector (see Lambrinidis, Psycharis & Rovolis, 2005; Psycharis, 1990).

Furthermore, when the income binary variable is included, a statistically significant growth differential in favour of poor regions is revealed (column 3). This result is significant in all three model specifications and clearly indicates that poor regions are in the process of catching up with rich ones, conditional on employment growth and investment, and converging to a steady-state in terms of per capita GDP. An explanation for this result may be the higher funds (national and EU) that poor Greek regions enjoyed during the examined period (Alexiadis & Tomkins, 2004).

As a concluding exercise of this section, GDP p.c. growth was further regressed

on statistically significant variables from the 16 industries. The estimation confirms the relations with economic growth identified in the previous model.[19] A novel result of this exercise is the negative link between the time dummy variable and growth. Since this variable takes the value of 1 for 1995-99, we conclude that the second period of our analysis (2000-03) was characterised by higher growth. This is an anticipated result, considering that most of the Greek regions enjoyed higher growth rates during this period (see Table 3 in the Appendix).

5. Policy implications and concluding comments

This paper has empirically evaluated regional growth disparities across 13 Greek regions using employment and investment data from 16 industries. The period of our analysis includes the decisive phase before and after the adoption of the single European currency, thus comprising the effort of the Greek economy for nominal convergence with the EMU member-states. Three model specifications were applied with different industry specific data at different levels of disaggregation. All the empirical results support the significance of the service sector for economic growth with emphasis on investment in the tourist industry (hotels & restaurants) and business activities (real estate & renting). While employment and investment in construction have a negative link with growth, investment in the broader mining and quarrying industry provide evidence of a strong and positive growth impact. Nevertheless, when regional specialisation indices are included in the models, estimates robustly suggest an insignificant effect of investment, while employment specialisation has a positive effect. Thus, our results suggest that the spatial allocation of capital formation is – on the whole – inefficient. Finally, a differential growth path in favour of poor regions is detected and a positive time effect is identified for the period around the EMU accession.

The existence of regional disparities across Greece has important implications for the implementation of economic policy at the national level. Although regional performance and development are affected by the corresponding infrastructure and the geographical position with respect to internal and external markets, we should also consider their potential capacity in innovation, and human or social capital. So, knowledge-related investment is the key driver of future diffusion and generation of growth. The last argument provides grounds for further research.

[19] Estimation results are available upon request from the authors.

APPENDIX

Table 1: Definitions of specialisation indices

Variable	Description	Source
Employment by industry – specialisation (Balassa-Hoover index)	the Balassa-Hoover index measures the ratio between the weight of an industry in a region and the weight of the same industry in the country: $BH_i = \frac{Y_{ij}/Y_j}{Y_i/Y}$ where Y_{ij} is total employment of industry i in region j, Y_j is total employment in region j of all industries Y_i is national employment of all industries. A value of the index above 1 shows specialisation in an industry and a value below 1 shows despecialisation. The degree of specialisation in region j is measured by adding up the absolute deviations from 1 of the Balassa-Hover indexes over all industries: $\sum_{i=1}^{N} \lvert BH_i - 1 \rvert \,/\, N$ where BH_i is the Balassa-Hoover index of industry i	Methodology and definition from OECD, (Regions at a glance, 2007) Data from Greek Regional Accounts (1995-2003); National Statistical Service of Greece
Investments by industry – specialisation (Balassa-Hoover index)	the Balassa-Hoover index measures the ratio between the weight of an industry in a region and the weight of the same industry in the country: $BH_i = \frac{Y_{ij}/Y_j}{Y_i/Y}$ where Y_{ij} is total investment of industry i in region j, Y_j is total investments in region j of all industries Y_i is national investment of all industries. A value of the index above 1 shows specialisation in an industry and a value below 1 shows despecialisation. The degree of specialisation in region j is measured by adding up the absolute deviations from 1 of the Balassa-Hover indexes over all industries: $\sum_{i=1}^{N} \lvert BH_i - 1 \rvert \,/\, N$ where BH_i is the Balassa-Hoover index of industry i	Methodology and definition from OECD, (Regions at a glance, 2007) Data from Greek Regional Accounts (1995-2003); National Statistical Service of Greece

Table 2: List of economic sectors & models

	Sectors	Industries[†]
3 sector model	1. Primary Sector	Agriculture, hunting & forestry
		Fish
	2. Secondary Sector	Mining & quarrying products
		Manufactured products
		Electrical energy, gas & water
		Construction work
	3. Service Sector (incl. general government)	Wholesale & retail trade services
		Hotels & restaurants services
		Transport, storage & communications
		Financial intermediation services
		Real estate, renting & business services
		Public administration, defence & social security
		Education services
		Health & social services
		Other community services
		Private households with employed persons
7 sector model	1. Agriculture & fish	Agriculture, hunting & forestry
		Fish
	2. Secondary sector	Mining & quarrying products
		Electrical energy, gas & water
	3. Manufacturing	Manufactured products
	4. Constructions	Constructions
	5. Trade, hotels & communications	Wholesale & retail trade services
		Hotels & restaurants services
		Transport, storage & communications
	6. Financial intermediation	Financial intermediation services
		Real estate, renting & business services
	7. Other services (incl. general government)	Public administration, defence & social security
		Education services
		Health & social services
		Other community services
		Private households with employed persons
16 industries model		Agriculture, hunting & forestry
		Fish
		Mining & quarrying products
		Manufactured products
		Electrical energy, gas & water
		Constructions
		Wholesale & retail trade services
		Hotels & restaurants services
		Transport, storage & communications
		Financial intermediation services
		Real estate, renting & business services
		Public administration, defence & social security
		Education services
		Health & social services
		Other community services
		Private households with employed persons[*]

[†] industries are classified and reported according to the European System of National Accounts (ESA, 1995)

[*] not available for gross fixed capital formation (GFCF).

Table 3: GDP per capita (period averages, in Euros & 2000 constant prices)*

	1995 - 1999		2000 - 2003		1995 - 2003	
Anat. Makedonia & Thraki	8264.8	**1.9**	9422.3	**3.4**	8779.2	**2.1**
Kentriki Makedonia	10532.5	**3.9**	12066.9	**2.9**	11214.5	**3.1**
Dytiki Makedonia	10714.3	**3.6**	12272.4	**3.0**	11406.8	**4.0**
Thessalia	9291.3	**3.2**	10748.0	**4.2**	9938.7	**3.0**
Ipeiros	7901.9	**5.3**	9819.8	**4.7**	8754.3	**4.9**
Ionia Nisia	9198.8	**4.4**	11073.2	**4.6**	10031.9	**3.5**
Dytiki Ellada	8385.0	**0.9**	9333.5	**4.1**	8806.5	**1.9**
Sterea Ellada	15268.8	**0.7**	17201.0	**4.9**	16127.6	**6.2**
Peloponnisos	9691.3	**4.3**	11610.6	**4.0**	10544.3	**3.0**
Attiki	10793.5	**1.8**	12911.4	**4.8**	11734.8	**3.5**
Voreio Aigaio	9081.4	**5.4**	11763.5	**6.3**	10273.5	**7.7**
Notio Aigaio	11893.3	**5.1**	13861.8	**2.3**	12768.2	**3.6**
Kriti	10303.0	**2.9**	11905.3	**4.4**	11015.1	**2.7**
Greece	*10364.2*	***2.6***	*12140.3*	***4.2***	*11153.6*	***3.2***

* average growth rates in bold

Table 4: Employment rates in the Greek regions (average 1995-2003, % of regional total employment)

	Primary Sector	Secondary Sector	Service Sector
Anat. Makedonia & Thraki	37.7	20.5	41.7
Kentriki Makedonia	18.3	27.3	54.4
Dytiki Makedonia	22.0	33.0	45.0
Thessalia	33.4	19.8	46.7
Ipeiros	26.0	21.7	52.2
Ionia Nisia	27.1	14.2	58.6
Dytiki Ellada	36.1	18.4	45.5
Sterea Ellada	26.3	31.5	42.2
Peloponnisos	39.7	18.4	41.9
Attiki	1.1	26.5	72.3
Voreio Aigaio	23.4	19.7	56.9
Notio Aigaio	11.2	21.1	67.7
Kriti	34.2	14.9	51.0
Greece	*17.7*	*24.1*	*58.2*

Table 5: Gross fixed capital formation in the Greek regions (average 1995-2003, % of regional GDP, in Euros & 2000 constant prices)

	Primary Sector	Secondary Sector	Service Sector	Total
Anat. Makedonia & Thraki	3.2	12.7	12.5	28.3
Kentriki Makedonia	1.2	9.6	10.4	21.3
Dytiki Makedonia	1.2	24.2	10.3	35.7
Thessalia	2.2	10.2	11.3	23.7
Ipeiros	2.3	12.8	14.6	29.7
Ionia Nisia	0.6	10.0	20.5	31.1
Dytiki Ellada	1.4	12.2	13.5	27.1
Sterea Ellada	1.0	11.3	8.1	20.4
Peloponnisos	0.9	13.1	11.9	26.0
Attiki	0.2	9.1	11.0	20.3
Voreio Aigaio	1.0	7.6	13.8	22.5
Notio Aigaio	0.6	9.7	14.7	25.0
Kriti	1.1	8.4	17.3	26.8
Greece	*0.9*	*9.0*	*11.2*	*22.2*

Table 6: Definitions of dummy variables

Variable	Description (NUTSII level)
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 Variable	
High / Low	*High-income group* (regions with GDP >10544.28 median for 95-03 period): Kentriki Makedonia, Dytiki Makedonia, Sterea Ellada, Attiki, Notio Aigaio, Kriti *Low-income group* (regions with GDP <10544.28 median for 95-03 period): Anat. Makedonia & Thraki, Thessalia, Ipeiros, Dytiki Ellada, Ionio, Peloponnisos, Voreio Aigaio The dummy variable takes the values of 1 for Low-income regions and 0 for High-income ones.
Time Variable	
Time Period	*First period*: 1995 – 1999; *Second period*: 2000-2003 The dummy variable takes the values of 1 for the first period and 0 for second one.

Table7: Estimation Results - 3 Sector Model

Explanatory Variables	Random Effects Estimates[1†]			Arrelano – Bond Estimates[2]	
	(1)	(2)	(3)	(4)	(5)
Constant	0.031**	0.038**	0.031**	0.002	0.003
	(2.97)	(2.64)	(2.93)	(1.26)	(1.53)
Employment growth - Primary Sector	-0.015	-0.015	-0.011	-0.021	-0.030
	(-0.37)	(-0.37)	(-0.26)	(-0.51)	(-0.62)
Employment growth - Secondary Sector	-0.003	-0.005	0.000	-0.035	-0.035
	(-0.10)	(-0.15)	(0.01)	(-0.72)	(-0.73)
Employment growth - Service Sector	-0.049	-0.051	-0.066	-0.095	-0.084
	(-0.80)	(-0.83)	(-1.05)	(-1.51)	(-1.54)
Investment - Primary Sector	-0.060	-0.108	-0.258	0.247	-0.003
	(-0.21)	(-0.34)	(-0.78)	(0.52)	(-0.01)
Investment - Secondary Sector	-0.013	-0.023	-0.005	0.147	0.164
	(-0.27)	(-0.42)	(-0.11)	(1.26)	(1.50)
Investment - Service Sector	0.058	0.036	0.043	-0.110*	-0.108*
	(1.09)	(0.62)	(0.79)	(-1.70)	(-1.72)
Employment by industry – specialisation	-	0.587**	-	-	0.069***
		(2.21)			(2.83)
Investments by industry – specialisation	-	0.010	-	-	0.011
		(1.00)			(0.98)
High / Low income group	-	-	0.033**	-	-
			(2.07)		
Obs.	104	104	104	78	78
R^2	0.025	0.032	-	-	-
Sargan Test (p-value)[3]	-	-	0.458	0.560	0.522
Autocovariance test of order 2 (p-value)[4]	-	-	-	0.782	0.964

Note: Dependent variable GDP per capita in region i (i =1,…,13) in period t (t =1995,…,2003). z-statistics are reported in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively.[1] Random effects estimates heteroskedasticity consistent.[2] Dependent variable lagged 1 period. Dependent variable lagged 1 period and all explanatory variables lagged 1 to 6 periods were used as instruments [3] The null hypothesis is that the instruments used are not correlated with the residuals. [4] The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. [†] The Hausman statistic is distributed as a chi-square whose value reaches 2.25 (p-value: 0.49) when the initial hypothesis is that the difference in coefficient estimates is not systematic.

Table 8: Estimation Results - 7 Sector Model

Explanatory Variables	Random Effects Estimates [1] †			Arrelano – Bond Estimates[2]	
	(1)	(2)	(3)	(4)	(5)
Constant	0.043	0.043	0.048	0.002	0.003
	(2.82)	(2.79)	(3.13)	(1.30)	(1.67)
Employment growth - Agriculture & fish	-0.014	-0.015	0.001	-0.030	-0.033
	(-0.34)	(-0.31)	(0.03)	(-0.92)	(-0.80)
Employment growth - Secondary Sector	0.011	0.024	0.017	0.000	0.008
	(0.38)	(0.64)	(0.49)	(0.01)	(0.25)
Employment growth - Manufacturing	-0.010	-0.009	-0.013	-0.016	-0.014
	(-0.50)	(-0.46)	(-0.65)	(-0.92)	(-0.76)
Employment growth - Constructions	-0.023	-0.008	-0.009	-0.041**	-0.043**
	(-0.89)	(-0.49)	(-0.58)	(-1.96)	(-2.20)
Employment growth - Trade, hotels & comms.	0.055	0.042	0.029	0.016	0.017
	(1.10)	(0.78)	(0.55)	(0.24)	(0.25)
Employment growth - Financial intermediation	-0.049***	-0.049***	-0.054***	-0.068***	-0.057***
	(-2.01)	(-2.00)	(-2.22)	(-3.39)	(-3.06)
Employment growth - Other services	-0.065	-0.075	-0.088	-0.094	-0.101
	(-1.03)	(-1.24)	(-1.45)	(-1.08)	(-1.14)
Investment - Agriculture & fish	-0.135	0.111	-0.102	-0.034	-0.306
	(-0.38)	(0.28)	(-0.27)	(-0.07)	(-0.65)
Investment - Secondary Sector	0.014	0.002	0.098	0.249***	0.231***
	(0.17)	(0.01)	(0.80)	(2.39)	(1.93)
Investment - Manufacturing	-0.254	-0.260	-0.257	-0.085	-0.071
	(-1.41)	(-1.48)	(-1.56)	(-0.23)	(-0.17)
Investment - Constructions	-0.091	-0.063	-0.292	0.067	0.123
	(-0.43)	(-0.29)	(-1.09)	(0.25)	(0.44)
Investment - Trade, hotels & comms	-0.026	0.020	-0.037	0.249**	0.248**
	(-0.29)	(0.21)	(-0.38)	(2.39)	(2.37)
Investment - Financial intermediation	0.405	0.345	0.199	3.19**	3.240**
	(0.38)	(0.30)	(0.96)	(1.93)	(1.92)
Investment - Other services	0.013	0.011	-1.014	-0.017	0.029
	(0.12)	(0.14)	(-0.19)	(-0.17)	(0.25)
Employment by industry – specialisation	-	0.058*	-	-	0.074***
		(1.70)			(2.05)
Investments by industry – specialisation	-	0.020	-	-	0.010
		(0.03)			(1.21)
High / Low income group	-	-	0.014**	-	-
			(1.87)		
Obs.	104	104	104	78	78
R^2	0.109	0.110	0.147	-	-
Sargan Test (p-value)[3]	-	-	-	0.883	0.831
Autocovariance test of order 2 (p-value)[4]	-	-	-	0.318	0.405

Note: Dependent variable GDP per capita in region i (i =1,…,13) in period t (t =1995,…,2003). z-statistics are reported in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively.[1] Random effects estimates heteroskedasticity consistent.[2] Dependent variable lagged 1 period. Dependent variable lagged 1 period and all explanatory variables lagged 1 to 6 periods were used as instruments. [3] The null hypothesis is that the instruments used are not correlated with the residuals. [4]The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. † The Hausman statistic is distributed as a chi-square whose value reaches 2.21 (p-value: 0.54) when the initial hypothesis is that the difference in coefficient estimates is not systematic.

Table 9: Estimation Results - 16 Industries Model

Explanatory Variables	Random Effects Estimates[1] †			Arrelano – Bond Estimates [2]	
	(1)	(2)	(3)	(4)	(5)
Constant	0.062	0.060**	0.069	0.002	0.003
	(2.65)	(2.28)	(2.93)	(0.89)	(1.39)
Employment growth -	-0.004	-0.002	0.012	-0.020	-0.025
Agriculture, hunting & forestry	(-0.07)	(-0.05)	(0.24)	(-0.47)	(-0.53)
Employment growth -	0.020	0.020	0.010	-0.014	-0.199
Fish	(0.80)	(0.79)	(0.38)	(-0.74)	(-0.92)
Employment growth -	-0.003	-0.003	-0.006	-0.021	-0.019
Mining & quarrying products	(-0.20)	(-0.24)	(-0.40)	(-1.03)	(-0.80)
Employment growth -	-0.004	-0.004	-0.009	-0.023	-0.021
Manufactured products	(-0.18)	(-1.18)	(-0.38)	(-1.16)	(-1.12)
Employment growth -	0.006	0.006	-0.002	0.018	0.016
Electrical energy, gas & water	(0.21)	(0.22)	(-0.06)	(0.53)	(0.46)
Employment growth -	-0.007	-0.006	-0.010	-0.100***	-0.098***
Constructions	(-0.21)	(-0.21)	(-0.33)	(-2.52)	(-2.33)
Employment growth -	-0.015	-0.014	0.003	0.026	0.021
Wholesale & retail trade services	(-0.30)	(-0.29)	(0.06)	(0.59)	(0.53)
Employment growth -	0.020	0.020	0.006	-0.042	-0.034
Hotels & restaurants services	(0.51)	(0.50)	(0.14)	(-0.97)	(-0.68)
Employment growth -	-0.004	-0.002	-0.010	-0.016	-0.019
Transport, storage & comms.	(-0.10)	(-0.05)	(-0.27)	(-0.53)	(-0.70)
Employment growth -	0.008	0.007	0.005	0.002	0.004
Financial intermediation	(0.37)	(0.34)	(0.22)	(0.15)	(0.19)
Employment growth -	-0.043*	-0.042*	-0.043*	-0.006	-0.009
Real estate, renting & services	(-1.84)	(-1.77)	(-1.85)	(-0.23)	(-0.30)
Employment growth -	-0.118**	-0.120**	-0.124**	-0.004	-0.003
Public admin., defence & security	(-2.62)	(-2.55)	(-2.77)	(-0.09)	(-0.06)
Employment growth -	0.000	-0.000	-0.003	-0.065***	-0.070***
Education services	(-0.01)	(-0.01)	(-0.07)	(-2.57)	(-2.69)
Employment growth -	-0.013	-0.012	-0.009	0.069	0.073
Health & social services	(-0.31)	(-0.30)	(-0.22)	(1.38)	(1.46)
Employment growth -	0.037	0.037	0.034	0.018	0.019
Other community services	(1.22)	(1.20)	(1.11)	(0.74)	0.77
Employment growth -	-0.012	-0.011	-0.015	-0.048***	-0.046***
employed pers. in private househ.	(-0.89)	(-0.89)	(-1.16)	(-3.86)	(-3.30)
Investment -	-0.016	0.014	-0.132	0.696	0.622
Agriculture, hunting & forestry	(-0.03)	(0.03)	(-0.26)	(1.15)	(1.03)
Investment -	0.124	0.405	-0.350	-7.158**	-7.155**
Fish	(0.03)	(0.08)	(-0.08)	(-1.98)	(-2.28)
Investment -	-3.148	-3.116	-1.680	13.349***	13.549**
Mining & quarrying products	(-1.46)	(-1.32)	(-0.73)	(2.71)	(2.49)
Investment -	-0.348*	0.353*	-0.347*	1.108**	1.229**
Manufactured products	(-1.71)	(1.66)	(-1.72)	(1.91)	(2.13)

Investment -	0.261	0.267	0.265	0.378***	0.364***
Electrical energy, gas & water	(1.38)	(1.37)	(1.42)	(2.60)	(3.02)
Investment -	-0.232	-0.248	-0.457	-0.996***	-0.967**
Constructions	(-0.86)	(-0.86)	(-1.54)	(-3.31)	(-2.58)
Investment -	0.304	0.323	0.245	-0.581	-0.535
Wholesale & retail trade services	(0.73)	(0.75)	(0.60)	(-1.81)	(-1.85)
Investment -	-0.017	-0.008	0.100	0.791***	0.705**
Hotels & restaurants services	(-0.10)	(-0.04)	(0.56)	(3.13)	(2.61)
Investment -	-0.028	-0.042	-0.096	-0.451**	-0.400**
Transport, storage & comms.	(-0.13)	(-0.18)	(-0.44)	(-2.18)	(-1.81)
Investment -	-1.175	-1.098	1.775	-4.35	-5.802
Financial intermediation	(-0.24)	(-0.22)	(0.34)	(-0.74)	(-0.91)
Investment -	0.298	0.340	1.341	6.594***	7.173***
Real estate, renting & services	(0.24)	(0.25)	(0.96)	(3.82)	(3.51)
Investment -	0.063	0.060	0.043	0.172***	0.205***
Public admin., defence & security	(0.47)	(0.44)	(0.32)	(3.63)	(3.58)
Investment -	0.094	0.141	-0.047	-1.211***	-1.221**
Education services	(0.21)	(0.27)	(-0.10)	(-3.34)	(-2.30)
Investment -	0.250	0.314	0.285	-1.311**	-1.536**
Health & social services	(0.28)	(0.32)	(0.32)	(-2.04)	(-2.10)
Investment -	-0.942	-0.819	-1.650	-8.569*	-9.182*
Other community services	(-0.41)	(-0.34)	(-0.71)	(-1.65)	(-1.73)
Employment by industry – specialisation	-	0.058** (2.08)	-	-	0.069* (1.78)
Investments by industry – specialisation	-	0.003 (0.17)	-	-	0.039 (0.73)
High / Low income group	-	-	0.014* (1.67)	-	-
Obs.	104	104	104	78	78
R^2		0.277	0.306	-	-
Sargan Test (p-value)[2]	0.788	-	0.689	0.778	0.716
Autocovariance test of order 2 (p-value)[3]	-	-	-	0.135	0.268

Note: Dependent variable GDP per capita in region i (i =1,…,13) in period t (t =1995,…,2003). z-statistics are reported in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively.[1] Random effects estimates heteroskedasticity consistent.[2] Dependent variable lagged 1 period. Dependent variable lagged 1 period and all explanatory variables lagged 1 to 6 periods were used as instruments. [3] The null hypothesis is that the instruments used are not correlated with the residuals. [4]The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. † The Hausman statistic is distributed as a chi-square whose value reaches 2.29 (p-value: 0.41) when the initial hypothesis is that the difference in coefficient estimates is not systematic.

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