

No 105

**The Role of Human Capital
in Economic Growth:
Evidence from Greek Regions**

Stelios Karagiannis & Nikos Benos

September 2009

Stelios Karagiannis

Research Fellow

Centre for Planning and Economic Research (KEPE), Athens, Greece

e-mail for correspondence: stkarag@kepe.gr

Nikos Benos

Lecturer, Department of Economics, University of Ioannina, University
Campus, 451 10 Ioannina, Greece.

e-mail for correspondence: nbenos@cc.uoi.gr

**The Role of Human Capital
in Economic Growth:
Evidence from Greek Regions**

Copyright 2009
by the Centre for Planning and Economic Research
11, Amerikis Street, 106 72 Athens, Greece

Opinions or value judgements expressed in this paper
are those of the authors and do not necessarily
represent those of the Centre for Planning
and Economic Research.

CENTRE FOR PLANNING AND ECONOMIC RESEARCH

The Centre for Planning and Economic Research (KEPE) was established as a research unit, under the title “Centre of Economic Research”, in 1959. Its primary aims were the scientific study of the problems of the Greek economy, the encouragement of economic research and the cooperation with other scientific institutions.

In 1964, the Centre acquired its present name and organizational structure, with the following additional objectives: first, the preparation of short, medium and long-term development plans, including plans for local and regional development as well as public investment plans, in accordance with guidelines laid down by the Government; second, the analysis of current developments in the Greek economy along with appropriate short and medium-term forecasts, the formulation of proposals for stabilization and development policies; and third, the additional education of young economists, particularly in the fields of planning and economic development.

Today, KEPE focuses on applied research projects concerning the Greek economy and provides technical advice on economic and social policy issues to the minister of the Economy and Finance, the Centre’s supervisor.

In the context of these activities, KEPE produces five series of publications, notably: Studies. They are research monographs.

Reports. They are synthetic works with sectoral, regional and national dimensions.

Statistical Series. They refer to the elaboration and processing of specified raw statistical data series.

Discussion Papers series. They relate to ongoing research projects.

Research Collaborations. They are research projects prepared in cooperation with other research institutes.

The number of the Centre’s publications exceed 650.

The Centre is in a continuous contact with foreign scientific institutions of a similar nature by exchanging publications, views and information on current economic topics and methods of economic research, thus furthering the advancement of economics in the country.

Ο ρόλος του ανθρωπίνου κεφαλαίου στην οικονομική μεγέθυνση:

Αποτελέσματα από τους ελληνικούς νομούς

Στέλιος Καραγιάννης & Νίκος Μπένος

ΠΕΡΙΛΗΨΗ

Σκοπός της παρούσας εργασίας είναι να εκτιμηθεί εμπειρικά η σχέση ανθρωπίνου κεφαλαίου και οικονομικής μεγέθυνσης για τους ελληνικούς νομούς την περίοδο 1981-2003. Χρησιμοποιούμε ως δείκτες εκπαίδευσης τις εγγραφές στο πρώτο και δεύτερο επίπεδο δευτεροβάθμιας εκπαίδευσης ως ποσοστό της αντίστοιχης πληθυσμιακής ομάδας και το λόγο μαθητών-καθηγητών στα δύο επίπεδα εκπαίδευσης. Επίσης, κάνοντας μια ευρύτερη θεώρηση του ανθρωπίνου κεφαλαίου, χρησιμοποιούμε δύο δείκτες υγείας, τους νοσοκομειακούς γιατρούς και τα νοσοκομειακά κρεβάτια. Οι εκτιμήσεις μας δείχνουν ότι τα ποσοστά εγγραφής στα δύο επίπεδα εκπαίδευσης έχουν θετική συσχέτιση με την μεγέθυνση, ενώ ένας ψηλότερος λόγος μαθητών-καθηγητών έχει αρνητικό αποτέλεσμα στη μεγέθυνση. Επιπλέον, ο αριθμός των νοσοκομειακών γιατρών φαίνεται ότι ενισχύει τη μεγέθυνση. Ορίζουμε δύο ομάδες νομών (ψηλού και χαμηλού εισοδήματος) και υπάρχουν ισχυρές ενδείξεις ετερογένειας μεταξύ των δύο ομάδων ως προς τις αποδόσεις του ανθρωπίνου κεφαλαίου. Επιπρόσθετα, υπάρχουν σημαντικές θετικές εξωτερικές επιδράσεις ανθρωπίνου κεφαλαίου μεταξύ όμορων νομών.

Πιο συγκεκριμένα, για το σύνολο του δείγματος οι εκτιμήσεις δείχνουν ότι τα ποσοστά εγγραφής των μαθητών έχουν μια μικρή, αλλά σημαντική συσχέτιση με την μεγέθυνση στις περισσότερες περιπτώσεις. Ακόμη, όσο περισσότεροι είναι οι μαθητές σε σχέση με τους καθηγητές, το οποίο μετρά την ποιότητα της εκπαιδευτικής διαδικασίας, τόσο επιβραδύνεται η μεγέθυνση. Επίσης, ένας ψηλότερος αριθμός νοσοκομειακών γιατρών ενισχύει την αναπτυξιακή δυναμική. Ο ετήσιος ρυθμός κατά συνθήκη σύγκλισης εκτιμάται σε 17%.

Κατόπιν, χωρίζουμε τους νομούς σε χαμηλού και υψηλού εισοδήματος ανάλογα με το αν το μέσο κατά κεφαλή ΑΕΠ τους την περίοδο 1981-2003 είναι μεγαλύτερο ή μικρότερο του διάμεσου ΑΕΠ όλων των νομών το ίδιο διάστημα και κάνουμε τις ίδιες εκτιμήσεις με αυτές, που κάναμε για το σύνολο του δείγματος. Τα αποτελέσματα δείχνουν μια στατιστικά σημαντική θετική συσχέτιση των ποσοστών εγγραφής στα δύο επίπεδα δευτεροβάθμιας εκπαίδευσης στη μεγέθυνση στις περιοχές υψηλού εισοδήματος, ενώ η συσχέτιση είναι στατιστικά ασήμαντη στις περιοχές χαμηλού εισοδήματος. Αυτό εξηγεί τη μικρή συσχέτιση αυτών των μεταβλητών με τη μεγέθυνση στο σύνολο του δείγματος. Ακόμη, διαπιστώνεται μια

στατιστικά σημαντική αρνητική συσχέτιση του λόγου μαθητών-καθηγητών με μεγέθυνση στους νομούς χαμηλού εισοδήματος, ενώ η συσχέτιση είναι ασήμαντη στους νομούς χαμηλού εισοδήματος έχοντας ως συνέπεια ένα αδύναμο αποτέλεσμα για το σύνολο του δείγματος. Επιπλέον, περισσότεροι νοσοκομειακοί γιατροί είναι ωφέλιμοι για την οικονομική ανάπτυξη και στις δύο ομάδες περιοχών. Επιπλέον, φαίνεται ότι υπάρχει κατά συνθήκη σύγκλιση και στις δύο ομάδες νομών.

Επιπρόσθετα, οι εκτιμήσεις για το σύνολο των νομών δείχνουν ότι ο ρυθμός μεγέθυνσής τους συσχετίζεται θετικά με τους δείκτες εκπαίδευσης και υγείας των όμορων νομών, το οποίο δείχνει την ύπαρξη θετικών εξωτερικοτήτων του ανθρωπίνου κεφαλαίου μεταξύ γειτονικών περιοχών.

Οι εκτιμήσεις για τους νομούς χαμηλού και υψηλού εισοδήματος χωριστά δείχνουν ότι οι εξωτερικότητες εκπαίδευσης είναι ισχυρότερες στις πλούσιες περιοχές σε σχέση με τις φτωχότερες, ενώ οι εξωτερικότητες υγείας είναι εντονότερες στους νομούς χαμηλού εισοδήματος. Η ύπαρξη κατά συνθήκη σύγκλισης επιβεβαιώνεται και σε αυτές τις εκτιμήσεις.

Τα παραπάνω αποτελέσματα δείχνουν ότι η υγεία είναι σημαντικότερη για τη μεγέθυνση στους νομούς χαμηλού εισοδήματος, ενώ η εκπαίδευση είναι ζωτικότερης σημασίας για τους πλουσιότερους νομούς. Συνεπώς, μεγαλύτερο μερίδιο της δημόσιας χρηματοδότησης για υπηρεσίες υγείας είναι σκόπιμο να δοθεί στις οικονομικά υστερούσες περιοχές, ενώ σχετικά υψηλότερο μερίδιο της χρηματοδότησης για εκπαίδευση είναι χρήσιμο να κατευθυνθεί στις ευπορότερες περιοχές. Γενικά, τα αποτελέσματα τονίζουν την ανάγκη για μεγαλύτερη χρηματοδότηση τόσο της υγείας όσο και της παιδείας σε όλες τις περιοχές της Ελλάδας προκειμένου για την προώθηση της οικονομικής μεγέθυνσης. Πιστεύουμε ότι οι ασκούντες πολιτική πρέπει να λάβουν σοβαρά υπόψη αυτά τα ευρήματα στο σχεδιασμό πολιτικής σε εθνικό και περιφερειακό επίπεδο.

ABSTRACT

The objective of this paper is to empirically examine the relation between human capital and economic growth for the Greek regions (NUTS III), for the period 1981-2003. We employ education indicators including the enrolment rates in lower and upper secondary education and the respective student/teacher ratios. Moreover, taking a broader view of human capital, we include two healthcare indicators – the number of medical doctors and hospital beds. Our estimations reveal that student enrolment rates at both levels of secondary education have a positive impact on growth, while a higher student-teacher ratio inhibits growth. Also, the number of medical doctors seems to boost growth. We define two regional groups (high and low income) and there is strong evidence of heterogeneity in rates of return to human capital. Besides these, there are important human capital externalities across neighbouring regions. Thus, the evidence implies the need for larger public spending on education and healthcare in all regions as a growth-enhancing policy. We believe that policy makers in Greece should take this into account in designing policies at the national and regional levels.

Keywords: Human capital, Regional growth, Panel data

JEL classification: O15, R11, C23

Acknowledgments: The authors would like to thank the two anonymous referees for comments and constructive remarks. They also thank K. Angelopoulos, P. Kammass, C. Karpētis, P-I. Prodromídīs for constructive and helpful suggestions. They would also like to thank participants in the Conference on Institutional and Social Dynamics of Growth and Distribution in Lucca, Italy (2007), the 15th World Congress of the International Economic Association, Istanbul (2008) and the 7th Conference on Research on Economic Theory and Econometrics in Naxos, Greece (2008), for their fruitful comments.

1. Introduction

Human capital theory argues that there are positive educational externalities: that is, benefits of individually-acquired education are not restricted to the individual but spill over to higher levels of aggregation in the same industry, city, region or the macroeconomy as a whole. These externalities provide the economic justification for public funding of education.¹

In the recent literature, attempts have been made to empirically test the relationship between human capital and economic growth, usually employing cross-sectional country data. These studies use measures of formal education as proxies for human capital, since investment in education plays a central role in human capital accumulation. They provide contrasting results regarding the impact of human capital on growth: effects are found to be positive, statistically insignificant or even negative in some cases (Pritchett, 2001; Barro & Sala-i-Martin, 2004).

The main cause of these puzzling results is probably that most studies use international data sets, but incorrectly impose equal returns to schooling (single coefficients) among sample countries (Temple, 1999; Krueger & Lindahl, 2001; Di Liberto, 2007). This problem arises when education quality is affected by educational institutions, which often differ across countries. In this context, one explanation for the estimated low returns to education in international data sets is that national statistics are dissimilar. Moreover, returns to education tend to be higher in countries with a better-educated labour force, as predicted by some growth models (Azariadis & Drazen, 1990). Another issue appears to be that acquisition of educational skills is not linked with productivity in some cases – that is, education is not only an investment but also a consumption good for the individual. Finally, in many countries (especially those which are less developed), the public sector employs most of the skilled labour force: this creates distortions in the estimation of returns to

¹ A commonly used definition of human capital includes the set of knowledge, skills, competencies and abilities embodied in individuals and acquired through education, training and experience (Bassetti, 2007).

schooling, owing to measurement problems of public sector output, inefficiency and lack of innovative activities in this sector (Griliches, 1997).

In this paper, our objective is to estimate the impact of human capital on regional economic growth in Greece, and analyse the implications for economic policy. In order to control for the problems described above, we focus on a fairly homogeneous data set, which at the same time is relatively diverse in terms of human capital characteristics of the various regions. Furthermore, Greek regions are characterised by common institutions and, especially a homogenous educational system.

Our approach features several important contributions. First, this study represents, to the best of our knowledge, the first attempt to provide a comprehensive set of estimates of the impact of human capital dynamics on growth of Greek regions (NUTS III level) for a fairly long period (1981-2003). Secondly, we define human capital more broadly than most of the literature, using various measures of education as well as healthcare. Thirdly, we investigate systematic growth differences between regions, which vary in terms of income level and location. Recent studies emphasise the presence of two income clubs in Greece based on: (a) access to the main transportation network (mostly the Athens-Thessaloniki highway), and (b) highly developed tourist industry in islands (Christopoulos, 2004; Prodromidis, 2006; Benos & Karagiannis, 2008). These two clubs are characterised by identical educational institutions together with significant differences in enrolment rates. This way, we allow for heterogeneity of the effect of human capital on growth across the two regional groups. Finally, we allow for human capital spillovers between neighbouring regions.

Our analysis is carried out using Random Effects (RE) and enhanced GMM (Arellano & Bond, 1991) estimators in order to handle endogeneity and unobserved heterogeneity problems. We find that the number of students in lower and upper secondary education levels affects growth positively. Additionally, a higher student/teacher ratio inhibits growth and the number of medical doctors fosters growth. Besides these, there is

strong evidence of differential effects of the human capital variables between rich and poor regions. Finally, there are important human capital externalities across neighbouring regions.

The paper is organised as follows. In section 2, we present a review of the theoretical and empirical literature on human capital and growth. Section 3 describes the data, while section 4 presents the econometric framework and methodology. In section 5, estimation results are analysed, while section 6 offers policy considerations and concluding comments. An Appendix contains detailed information on our data and empirical results.

2. Literature review

The theoretical literature on the relationship between human capital and economic growth provides different models. In the first group of models, growth is sustained by human capital accumulation – that is, human capital is a factor of production and its accumulation influences the growth process. In this type of model, human capital is a flow variable (Lucas, 1988). In the second category, economic growth depends on the existing human capital stock, which generates new knowledge (Romer, 1990) or facilitates the imitation and adoption of foreign technologies (Nelson & Phelps, 1966). In the third class of models, human capital is a threshold variable – that is, the impact of human capital depends on the human capital stock accumulated within a given time period (Azariadis & Drazen, 1990). So, human capital matters as a stock and flow variable, because its accumulation is necessary to achieve the stock level, above which the impact of human capital strengthens. One implication of these models is the existence of multiple equilibria in the growth path, since the growth path comprises various phases.

Regarding empirics, the investigation of the growth impact of human capital uses measures of formal education, such as adult literacy rates, school enrolment rates and average years of schooling, as proxies for human capital. This follows from the fact that investment in education is central to human capital accumulation and can be measured more easily than other elements, such as on-the-job-training, experience and learning-by-doing.

In one of the early studies that examined the role of human capital on growth, Barro (1991) found that primary and secondary enrolment rates have a positive growth effect, but this was not always true for adult literacy rates. Mankiw et al. (1992) estimated an elasticity of output of about one-third with respect to the average percentage of the working-age population in secondary school. Benhabib & Spiegel (1994) found that the human capital flow did not have a statistically significant growth effect, while the average stock had a positive, though not always significant, growth impact. Durlauf & Johnson (1995) identified different growth regimes for groups of countries characterised by different initial GDP per capita and human capital levels supporting models with multiple equilibria.

More recently, De la Fuente & Domenech (2000) and Bassanini & Scarpetta (2001) estimated a positive effect of schooling years on growth. Bils & Klenow (2000) concluded that initial enrolment rates explain less than one third of the variation in growth rates and half of this is due to the fact that anticipated increases in growth raise schooling. Pritchett (2001) estimated a negative growth impact of human capital growth. However, Krueger & Lindahl (2001) showed that higher education attainment has a positive effect on economic growth once measurement errors are taken into account. Also, they showed that linearity and parameter homogeneity are rejected by the data. Kalaitzidakis et al. (2001) found nonlinear effects of human capital on growth. Papageorgiou (2003) concluded that the role of human capital in the creation and adoption of technology increases with country income. In a review of the empirical literature, Sianesi & Van Reenen (2002) pointed out that education implies indirect growth benefits in terms of physical capital, technology transfer, fertility and other dimensions of human capital (e.g. life expectancy, infant mortality).

Furthermore, some research has recently concentrated on the impact of human capital on regional growth. The idea is that knowledge produces spillovers: that is, firms learn from other firms and people get ideas from other people. So, in regions with high concentration and/or accessibility to human capital, such as large cities, ideas disseminate quickly and human capital externalities are more likely to arise. Knowledge flows between different

localities and regions imply spatial dependence among adjacent regions, which diminishes with distance (Grasjo, 2005; Andersson & Karlsson, 2007).

Finally, a number of recent papers examine the field of health as a human capital component, although several pioneering studies go back a few decades earlier (Mushkin, 1962; Becker, 1964; Fuchs, 1966). In particular, health in the form of life expectancy has appeared in a number of cross country empirics, which confirm the positive effect on the rate of growth (see Bloom & Canning, 2000, 2003). In addition, several papers include health indicators in growth regressions in an effort to incorporate direct or indirect effects on economic growth (see Barro & Lee, 1994; Barro & Sala-i-Martin, 1995; Barro, 1996; Caselli et al. 1996, Bloom & Sachs, 1998; Bloom & Williamson, 1998; Bloom et al., 1999).

3. Description of the data.

We start our analysis with a brief description of the main regional educational and healthcare data used.² Our data include the number of students attending the two levels of secondary education³ (upper and lower) together with the respective number of teachers at both levels.⁴ Using these, we were able to construct the student/teacher ratio for the two levels of education. In addition, we include two healthcare indicators, namely the number of medical doctors and hospital beds available per region. All our variables span from 1981 through 2003 and cover the 51 regions of Greece (NUTS III level).

Map 1, below, presents the division of the 51 NUTS III Greek regions into two sub-groups, according to whether their average GDP p.c. for 1981-2003 lies above or below the

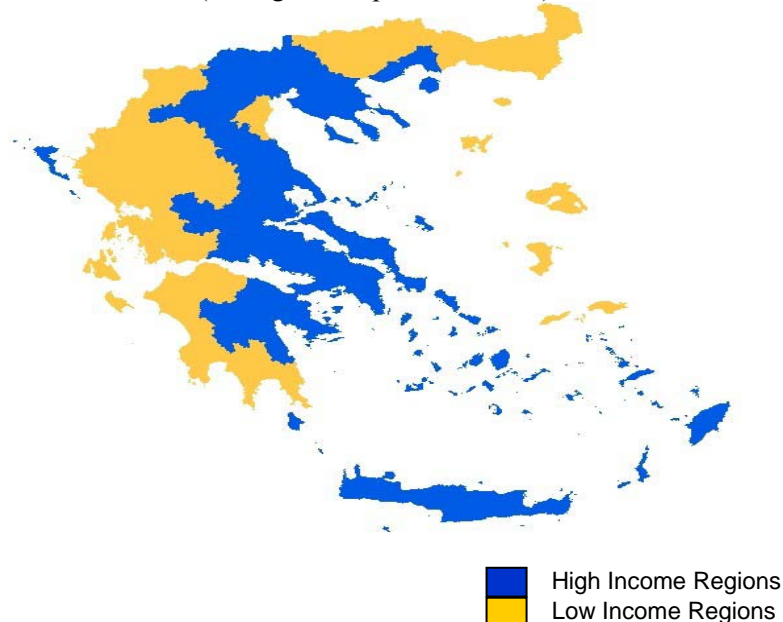
² Detailed definitions of the variables are available in the Appendix (Table 1).

³ We do not include data on the number of primary education students since there is no significant variation across regions, thus we would not be able to identify a distinct growth impact of such variables on regional growth.

⁴ The use of enrolment rates as a human capital variable is justified by the notion that current investment in human capital will be reflected in the future stock of human capital (Basseti, 2007). We would have been keen to use human capital stock in our estimations (i.e. average years of schooling) but unfortunately it is not available for Greek regions (NUTS 3 level). In addition, such data depend on arbitrary assumptions about depreciation and rely on inaccurate measures of benchmark stocks and investment flows (Barro & Sala-i-Martin, 2004). Studies that consider school enrolment rates include Barro (1991), Mankiw et al. (1992) and Levine & Renelt (1992).

median. Tables 3 and 4⁵ provide the descriptive statistics of our variables based on the division of our sample into high and low income regions.

Map 1. High and Low income regions (NUTS III) in Greece
(average GDP pc, 1981-2003)



According to our calculations, there are numerous income, education and healthcare disparities among the Greek regions. High-income regions enjoy higher levels of per capita GDP when compared to low ones (the means are 10,835 and 7,968 Euros respectively, over the period studied). They are characterised by different numbers of students attending lower secondary education (the means are around 591 and 584 students per 1000 of the relevant age group, respectively). On the other hand, low-income regions exhibit a greater proportion of students attending the upper level of education when compared to the high-income ones. Overall, participation rates⁶ in the two levels of secondary education in Greece differ substantially across regions as well as through time. Our data reveal that rural regions present lower enrolment rates compared with urban ones.⁷ The above findings are in line

⁵ Tables 2-4 provide all descriptive statistics (see Appendix).

⁶ Nine years of education (primary and lower secondary) has been compulsory in Greece since 1976 (Hellenic Constitution, article 16, paragraph 3).

⁷ Rural regions present enrolment rates of approximately 60%-65% over the whole period in lower secondary education and include prefectures such as Rodopi, Xanthi, Grevena, Euritania and Rethimno. The same regions exhibit enrolment rates around 30%-40% at the beginning of our sample period. In contrast, urban regions such as Athens, Thessaloniki and Achaia present enrolment rates of around 90%-95%.

with previous studies specialised in this field of work.⁸ Also, participation rates have improved during the period examined – especially in upper secondary education (from 35% in 1981-94 to 60% in the 1995-2003 period).

Healthcare variables reveal a greater inequality between the two sub-samples. The number of available hospital beds and, to a lesser extent, the number of medical doctors are greater in high-income regions when compared to low-income ones (4.05 to 3.10 per 1000 people and 2.40 to 2.03 per 1000 people, respectively). Finally, public investment at regional level is included in our regressions in order to disentangle the effect of physical capital from the effect of human capital on growth (see Krueger & Lindahl, 2001).⁹ We believe this is a good proxy for total investment at regional level. This is so, because public and private capital tend to behave similarly in Greek regions (Louri, 1989). Specifically, our proxy is based on the actual investment included in state budget expenditures at regional level¹⁰. As evident from the descriptive statistics, the regional allocation of public investment in Greece presents disparities across high/low income regions (2.3% and 2.5% respectively) as well as throughout the period examined (2.2% of regional GDP for the 1981-91 period to 2.5% for the 1992-2003).¹¹

4. Theoretical Framework and Empirical model

As human capital is multidimensional (Bloom et al., 2004), we need a model of growth that includes its major components. While most studies identify human capital narrowly with education, they do not consider health to be a crucial aspect of human capital, and therefore a critical ingredient of economic growth. In particular, the population's health impinges on growth through productive efficiency, life expectancy, learning capacity,

⁸ See Kanelopoulos, Mauromaras & Mitrakos (2003), Paleocrassas et al. (1997), Paleocrassas (1996) and Kanelopoulos (1994).

⁹ Here we should note that data on regional private investment (NUTS 3 level) are not available for Greece.

¹⁰ Please note that this is the second attempt for the computation of such a variable in the relevant literature on Greek regions; the initial one was by Labrinidis, Psycharis & Rovolis (2005).

¹¹ According to Labrinidis, Psycharis & Rovolis (2005) regional public investment disparities in Greece are positively associated with the national elections and the infrastructure capital stock, and negatively associated with population size and regional product per capita.

creativity, coping skills and inequality (Howitt, 2005). Also, an increase in survivorship raises the returns from education because educational costs come at earlier ages and returns at later ages (see Becker, 1964 & 1993; Meltzer, 1992; Ehrlich, 2000). In this paper we consider both education and health in the formation of human capital as complementarities exist between its different forms (Becker, 2007).

We study the role of human capital in the growth process, using the framework suggested (among others) by Mankiw et al. (1992), de la Fuente (2002), Bloom et al. (2004), Barro & Sala-i-Martin (2004). Thus, we specify an empirical model by augmenting a standard aggregate production function with a technological progress function. In this framework, we allow for regional fixed effects.

So, we assume a Cobb-Douglas aggregate production function

$$Y_{it} = K_{Gt}^{\theta_{KG}} (A_{it} L_{it})^{\theta_l} S_{it}^{\theta_s} H_{it}^{\theta_h} \quad (1)$$

where Y_{it} denotes total output of region i ($i=1, \dots, 51$) during period t ($t=1981, \dots, 2003$), K_{Gt} the public stock of physical capital, L_{it} is employment, S_{it} the stock of educational human capital, H_{it} is the stock of health human capital, and A_{it} a (labour-augmenting) TFP indicator. Also, we assume $\theta_{KG} + \theta_l + \theta_s + \theta_h = 1$, so we have a Solow-type model. Thus, we take a broader view of human capital than most literature by including education and health in the production function of our economies. Both forms of human capital are seen as production factors, the accumulation of which affects growth, i.e. human capital is a flow variable (Lucas, 1988). However, we allow for differential impact of the two components of human capital (education, health) on output, therefore on economic growth. Finally, incorporating A_{it} , we allow for permanent differences in the production functions of the various regions. The introduction of human capital in a broad sense, along with differential technical progress between regions, gives us the ability to obtain more accurate estimates of the model's parameters.

Now, equation (1) in per capita terms takes the form

$$\frac{Y_{it}}{L_{it}} = K_{Git}^{\theta_{KG}} A_{it}^{\theta_l} L_{it}^{\theta_l-1} S_{it}^{\theta_s} H_{it}^{\theta_h} \quad (2)$$

Taking logs of (2)

$$\ln\left(\frac{Y_{it}}{L_{it}}\right) = \theta_{KG} \ln K_{Git} + \theta_l \ln A_{it} + (\theta_l - 1) \ln L_{it} + \theta_s \ln S_{it} + \theta_h \ln H_{it} \quad (3)$$

and then time differences, we get

$$\Delta \ln\left(\frac{Y_{it}}{L_{it}}\right) = \theta_{KG} \Delta \ln K_{Git} + \theta_l \Delta \ln A_{it} + (\theta_l - 1) \Delta \ln L_{it} + \theta_s \Delta \ln S_{it} + \theta_h \Delta \ln H_{it} \quad (4)$$

Before we estimate (4), we must specify the TFP growth term $\Delta \ln A_{it}$. We assume that the regional TFP variable (measured in logs) is the sum of two components:

$$\ln A_{it} = r_i + b_t \quad (5)$$

where r_i is a regional fixed effect, which captures regional features that affect productivity and are constant over time (e.g. location, climate etc) and b_t is nationwide technical progress, which evolves at a constant rate g :

$$\Delta b_t = g \quad (6)$$

Thus, human capital does not influence technical progress. Therefore, the rate of change of regional TFP is:

$$\Delta \ln A_{it} = \Delta r_i + g \quad (7)$$

and after substitution of (7) and some rearrangements, equation (4) becomes

$$\Delta \ln\left(\frac{Y_{it}}{L_{it}}\right) = \theta_s \Delta \ln S_{it} + \theta_h \Delta \ln H_{it} + \theta_{KG} \Delta \ln K_{Git} + (\theta_l - 1) \Delta \ln L_{it} + \theta_l \Delta r_i + \theta_l g \quad (8)$$

Since we estimate a Solow-type model, we include initial GDP per capita in the empirical counterpart of (8) in order to control for convergence effects on growth. We expect the education, health and public investment parameters to be positive, while the labour force parameter should be negative.

So, real per capita growth is related to an array of control variables, region-specific effects and technological progress effects common to all regions. For the first two terms, we

use several human capital indicators and since it is generally accepted that human capital affects growth with time lags, we use lagged values of these indicators (Di Liberto, 2004, 2007; Midendorf, 2006).¹²

These indicators include the following: a) students at lower secondary education level; b) students at higher secondary education level; c) medical doctors; d) hospital beds.¹³ The first two variables measure schooling and the other two capture the impact of health on growth (Malik, 2006; Ricci & Zachariadis, 2007). Additionally, we use the student-teacher ratio in the two levels of education as a measure of the quality of education provision. We also employ public investment per region regarding the third term in (8). Furthermore, we proxy employment growth by population growth in (8), because there are no available data on the former. Finally, following Andersson & Karlsson (2007) and Grasjo (2005) we include two variables in order to explore the possibility of spatial externalities in terms of human capital (see section 5.3).

Regarding the methodology of estimation, OLS assume that the error in each time period is uncorrelated with the explanatory variables in the same period. However, 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. In light of that, in the first part of our estimations, 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 dependent and explanatory variables. The unobserved effect may represent region-specific technology, tastes, historical and cultural factors. These characteristics are assumed to be correlated over time but uncorrelated with the observed explanatory variables, which is critical for the consistency of our estimates. We proceed with random effects estimation, which exploits the serial correlation in the error, due to the presence of the unobserved

¹² The unavailability of average years of schooling as a measure of human capital, combined with the relatively short time span, led us to use 2-year lags in our estimations. We tried longer lags (3-5 years) and the results were essentially the same. Our final choice was dictated by the need to maintain a sufficient number of observations.

¹³ For detailed definitions of the variables see Table 1 in the Appendix.

effect in every period. We apply GLS and compute robust standard errors of the coefficients.¹⁴

Furthermore, one of the most challenging problems in the empirical growth literature is the likely endogeneity of the right-hand-side variables. This is particularly true in the case of human capital variables, since education is highly income elastic and high-income economies dominated by the service sector require a well-educated workforce. In order to cope with this problem, in the second part of our estimations we use the GMM estimator of Arellano & Bond (1991), which calls for first differencing and using lags of the dependent and explanatory variables as instruments (Caselli et al., 1996). First differencing removes region-specific effects, which are a potential source of omitted variable bias (see above) and deals with series non-stationarity. Also, when choosing instruments, we allow the explanatory variables to be endogenous, which is the least restrictive assumption we can make. Thus, applying GMM we eliminate the inconsistency arising from the incorrect treatment of correlated region-specific effects and the endogeneity of explanatory variables. So, we are more confident about GMM compared with RE results and emphasise the former. At the same time, if the findings are similar, this is a signal of robustness.

5. Empirical results

5.1. Full sample

Full sample estimations reveal that students at lower-secondary level and higher-secondary level exert a positive, albeit small, effect on growth in most cases (Table 5, cols. 1-8). Furthermore, the student-teacher ratios in lower and upper secondary education, which are measures of education quality, exert a negative influence on growth in most cases as well – that is, the higher is the number of students relative to teachers, the lower is human capital accumulation and growth. These findings accord with the fact that controlling for

¹⁴ Spatial autocorrelation might be an issue in this context. However, island prefectures constitute almost 30% of Greek regions and mainland Greece is dominated by a mountain range (Pindos). As a result, labour and capital mobility between Greek regions are quite limited, and the location of economic activity is mostly stable over time, which limits spatial autocorrelation. Nevertheless, spatial externalities are partially taken into account in section 5.3.

labour force quality reduces the impact of schooling on growth (Sianesi & Van Reenen, 2002). Overall, the results concur with our theoretical underpinnings and previous empirical evidence (Barro, 1991; Sianesi & Van Reenen, 2002).

Regarding healthcare indicators, we use the number of medical doctors, as it reflects the quality of health services. This is expected to boost productivity and growth.¹⁴ The evidence confirms our intuition showing a positive impact on regional growth (Table 5, cols. 2, 4, 6 & 8).^{16, 17} Overall, the evidence supports the case for public funding of education and health care in Greece as a growth-enhancing policy.

Public investment does not have a statistically significant growth impact in most cases. This is possibly because it represents a small proportion of GDP in most regions and is inefficiently allocated in accordance with the electoral cycle theory (see Labrinidis, Psycharis & Rovolis, 2005).

The estimated parameter of initial income indicates conditional convergence of Greek NUTS III regions at an annual rate of approximately 17% (Table 5, cols. 5-8).¹⁸ This is in line with our Solow type model, where an economy is in the process of transitional growth towards its steady state. The above convergence speed is similar in magnitude to those found by Caselli et al. (1996) and differs from results commonly found in work on convergence.^{19,20} So, Greek regions are mostly near their steady-states and differences in GDP per capita are due to differences in their steady-state levels. In this framework, areas with high growth are those which experienced repeated shifts in their steady-state during the

¹⁵ The correlations between students (lower & upper secondary level) and medical doctors are 0.13 & 0.57 respectively and thus do not influence our results.

¹⁶ We also tried using hospital beds per 1000 population, but it was not significant. We think this is because it is a measure of the quantity of health services, in contrast with doctors who measure better the quality of services provided.

¹⁷ We do not use variables employed in cross-country studies, like life expectancy and infant mortality, since there are no such data at regional level in Greece.

¹⁸ The relevant specification tests provided no evidence of misspecification of our models.

¹⁹ Caselli et al (1996) showed that their estimation methodology, which is very similar to ours, implies consistent estimates of convergence in contrast with most empirical growth literature.

²⁰ The presence of business cycles possibly induces upward bias in the convergence coefficient. However, in our case regional business cycles are likely to be correlated, so this effect is rather weak. Also, previous work with the same dataset with 5-year averages indicated that findings are not sensitive to the time span employed in the estimation (Benos & Karagiannis, 2008).

period covered by our sample. Finally, population growth exerts a negative influence on per capita income growth in accordance with theory and previous evidence (Eckey et al., 2006).²¹

5.2. *Convergence clubs.*

As mentioned in Section 2, there is a strong case, both theoretically and empirically, for different effects of human capital on growth among regions which vary in terms of income. Consequently, we split regions into low-income and high-income according to whether their average GDP per capita is below or above the median for our sample period (1981-2003).^{22,23} First, we estimate the same equations as before for the two sub-samples.

According to Tables 6-7, for the rich and poor regions respectively, we see that lower secondary education students have a positive impact on growth in the former (Table 6, cols. 1, 5-6), while they are not statistically significant in the latter (Table 7). Furthermore, there are positive growth returns to upper secondary education in the high-income regions (Table 6, cols. 3-4, 7-8), while they are mostly insignificant in the low-income ones (Table 7, cols. 3-4, 7-8). These differences among the income groups explain the very weak growth influence of both variables in the full sample estimation and agree with previous work (Durlauf & Johnson, 1995).

Also, we identify a strong negative effect on per capita growth of the student-teacher

²¹ Furthermore, we include in our model a number of geographical dummies (North/South, East/West, and islands/mainland) in order to capture spatial effects across groups of Greek regions. Our estimations exhibit a positive sign regarding mainland regions, meaning that these regions enjoy a positive growth differential with respect to islands. This might be explained by the insufficient public infrastructure and problematic connection of the islands with the mainland, especially during the non-tourist period of the year.

²² See Map 1 (section 3) for the spatial allocation of the two income groups. The *high-income group* includes: (a) the mainland regions with access to the main transportation network (from Athens to Thessaloniki), and (b) the island regions with highly developed tourist industry (Crete, Corfu, Cyclades, Dodecanese). The *low-income group* includes most regions of Thrace, Western Macedonia, Epirus, Peloponnese, North Aegean and Eptanisa.

²³ Our spatial division of Greek regions concurs with the findings of recent studies. Christopoulos (2004) reports similar evidence on the spatial segregation of Greek regions and states that such regional divergence exists due to employment and output differentials. Prodromidis (2006) traces the same effects at NUTS 4 (post code) level and argues that access to the Athens-Thessaloniki transportation network acts as an income corridor between Greek regions. Finally, Benos & Karagiannis (2008) present similar findings arguing that two convergence clubs exist in the Greek economy.

ratio at both the lower secondary and upper secondary education levels in the rich regions (Table 6, cols. 1, 5-8). In poor regions, this impact appears mostly insignificant (Table 7, cols. 1-8), implying a weak effect of this variable in the full sample. Besides these, the number of medical doctors boosts regional growth in both sub-samples (Tables 6-7, cols. 2, 4, 6, 8). However, it seems that the effect of healthcare on regional growth is stronger in low-income areas than high-income ones.

In addition, we estimate regressions, which include interaction terms for our education and health indicators in order to check the robustness of the previous results. In particular, we interact a binary variable that indicates rich and poor areas with the education and health variables. Our findings confirm the stronger impact of lower secondary education students and student-teacher ratio in lower secondary education on growth in high income regions relative to the poor areas (Table 11, cols. 1-2, 5).

Thus, our evidence suggests parameter heterogeneity regarding the effect of human capital on growth – confirming previous studies. So, from a policy perspective the evidence presented above implies that it is optimal to direct public spending on education mostly towards rich regions if the aim is growth maximization.²⁴ Also, conditional convergence seems to hold in both sub-samples, as it was the case for the whole sample. Finally, public investment does not have a growth impact and population growth affects per capita income growth negatively as before.

5.3 Spatial externalities

²⁴ However, one must always keep in mind that economic growth is only one of the government objectives along with e.g. stabilization, income equality, and external balance. In light of that, higher funding on education in rich regions relative to poor ones may not be desirable, because it will increase spatial income inequality.

Next, we proceed to examine if there is dependence of regional growth on human capital in neighbouring regions – that is, human capital externalities among regions. We construct three types of variables to capture these effects. The first type includes students of both the region in question and its neighbouring regions (*Regional Students*). It replaces the students of the region in question in the regressions. The second type corresponds to the students of the neighbouring regions only (*Extra-Regional Students*). It is used in the equations in addition to the student variables used in the previous section. The third type refers to two variables: they add the number of university medical doctors and hospital beds, when direct access to a university hospital is available, to the medical doctors and hospital beds at the regional level used in the original estimations creating *University Medical Doctors* and *University Hospital Beds* respectively.

By looking at Table 8, *Regional Students* of lower secondary (see cols. 9-10) and upper secondary education (see cols. 11-12), have a much stronger impact on growth than the original student variables (Table 5). This is in line with the evidence, which shows that students of neighbouring regions (*Extra-Regional Students*) have a positive effect on growth (Table 8, cols. 13-14). Lower and upper secondary school students continue to affect growth positively (Table 8, cols. 2, 6, 10, 12-13). Regarding healthcare variables, *University Medical Doctors* affect growth positively and *University Hospital Beds* do not influence the growth process as before (Table 8, cols. 7-8, 15-16). Thus, there is quite strong evidence of spatial externalities, in the sense that regions seem to be affected by the performance of their neighbours in terms of education and health status. This is in accordance with recent findings for Sweden (Andersson et al., 2008). The results do not change when we incorporate public investment in the regressions, which continues to be statistically insignificant (Table 11, cols. 5-7).

When estimating the same equations in the two sub-samples of rich and poor regions, the findings are somewhat different. We observe that the positive impact of *Regional Students* (both lower and upper secondary levels) on growth is stronger in the wealthy

regions compared to the lagging ones (Tables 9-10, cols. 9-12). The same pattern is true for the *Extra-Regional Students* at both education levels (Tables 9-10, cols. 13-14). Besides these, students of lower and upper secondary level education continue to exert a positive growth influence in all but one case in rich regions (Table 9, cols. 2, 6, 10, 12-13), while their effect is not statistically significant in poor regions in most cases (Table 10, cols. 2, 4-6, 10, 12-14). Furthermore, *University Medical Doctors* and *University Hospital Beds* do not affect growth in the affluent regions, contrary to the results for the former variable in the full sample, while they have a positive growth impact in poor regions (Tables 9-10, cols. 7-8, 15-16). At this point we should note that *Medical Doctors* are significant in high income regions (see Table 6, cols. 2, 4, 6 & 8) but *University Medical Doctors* are not. This seemingly awkward result can be explained by the fact that university hospitals are mainly hosted in rich regions, thus their effect is captured by *Medical Doctors*. Consequently, there is no additional impact of *University Medical Doctors* to be estimated in these regions.

These findings are consistent with the evidence obtained when we use interaction terms to estimate the differential impact of *Regional Students*, *Extra-Regional Students* and *University Medical Doctors* on growth between high and low income areas (Table 11, cols. 5-7). For example, *Regional Students* in upper secondary education boost growth in rich regions more strongly than in poor ones. Also, *University Medical Doctors* have a larger growth impact in poor areas compared to rich ones. Thus, we continue to find evidence of parameter heterogeneity regarding human capital variables in Greek regions, when we take into account spatial externalities. Also, in both sub-samples conditional convergence holds and population growth is detrimental to per capita output growth, as is true for the whole sample.

As a result, evidence presented in this section emphasizes the need for larger public funding of education and health in both high and low income regions in order to realize the benefits arising from spatial externalities of human capital accumulation on regional growth. Additionally, the results underline that healthcare is a more important growth determinant in

poor regions relative to rich ones. On the contrary, education seems to matter more for growth in wealthy rather than lagging regions. In light of these, policy makers should direct a larger share of the funding for human capital accumulation towards healthcare in poor regions and education in rich ones.²⁵

6. Conclusions

This paper examines the social returns to human capital at regional level in Greece using education and healthcare indicators. We estimate the effect of these variables for all regions and separately for poor and rich ones, allowing for spatial heterogeneity of rates of return to human capital. Overall, we find that there are differences between the two regional clubs. In particular, our results show a positive impact of education on growth in high-income regions, while the evidence is much weaker for low-income regions. On the contrary, health is more important for growth in poor regions relative to rich ones. Also, there are important human capital externalities across neighbouring regions. Thus, the findings imply the need for larger public spending on education and healthcare in all areas as a growth-enhancing policy. However, the policy makers should direct a larger share of human capital expenditure on education in wealthy regions and health in lagging regions.

We conclude with some possible research extensions. We could employ alternative estimation methods as a check for the robustness of the results (i.e. spatial econometrics). We might also use other measures of human capital, taking into account in a more comprehensive way its quality, additional stages of education (higher education) and other forms of education (job training) when data become available. These are left for future work.

APPENDIX

Table 1. Description of Variables

²⁵ However, we should point here that policy makers should also take into account the overall characteristics of every region, such as geographic location, when designing specific growth promoting policies.

| Dependent Variable | Description | Source |
|--|--|---|
| <i>GDP per capita</i> | in Euros, at 2000 constant prices; | National Statistical Service of Greece, Quarterly Regional & Satellite Accounts Section |
| Explanatory Variables | | |
| Public Investment | Investment of the state budget at regional level (NUTS 3) as a % of regional GDP. The variable is constructed by extracting payments for services rendered from total regional state budget expenditures. | National Statistical Service of Greece, Public Sector Survey Section |
| Students; Lower Secondary Level | Number of students attending the lower secondary level of education at regional level (NUTS 3). The variable is denoted per 1000 children aged 10 to 14 years of age. | National Statistical Service of Greece, Social Accounts Section |
| Student; Upper Secondary Level | Number of students attending the upper secondary level of education at regional level (NUTS 3). The variable is denoted per 1000 children aged 15 to 19 years of age. | National Statistical Service of Greece, Social Accounts Section |
| Students – Teachers Ratio; Lower Secondary Level | The number of students divided with the number of teachers at the lower secondary level of education at regional level (NUTS 3). Teachers are denoted per 1000 inhabitants at regional level. | National Statistical Service of Greece, Social Accounts Section |
| Students – Teachers Ratio; Upper Secondary Level | The number of students divided with the number of teachers at the upper secondary level of education at regional level (NUTS 3). Teachers are denoted per 1000 at regional level. | National Statistical Service of Greece, Social Accounts Section |
| Medical Doctors | Number of medical doctors per 1000 inhabitants at regional level (NUTS 3). | National Statistical Service of Greece, Social Accounts Section |
| Hospital Beds | Number of hospital beds per 1000 inhabitants at regional level (NUTS 3). | National Statistical Service of Greece, Social Accounts Section |
| Regional Students; Lower Secondary Level | Number of students attending the lower secondary level of education at regional level (NUTS 3), including students at the same level of education from the neighbouring regions. | National Statistical Service of Greece, Social Accounts Section |
| Regional Students; Upper Secondary Level | Number of students attending the upper secondary level of education at regional level (NUTS 3), including students at the same level of education from the neighbouring regions. | National Statistical Service of Greece, Social Accounts Section |
| Extra Regional Students; Lower Secondary Level | Number of students attending the lower secondary level of education from the neighbouring regions only (NUTS 3). | National Statistical Service of Greece, Social Accounts Section |
| Extra Regional Students; Upper Secondary Level | Number of students attending the upper secondary level of education from the neighbouring regions only (NUTS 3). | National Statistical Service of Greece, Social Accounts Section |
| University Medical Doctors | Number of university medical doctors per 1000 inhabitants at regional level (NUTS 3). The number of university medical doctors (when direct access to the respective university hospital is available) is added to medical doctors at regional level (NUTS 3). | National Statistical Service of Greece, Social Accounts Section |
| University Hospital Beds | Number of university hospital beds per 1000 inhabitants at regional level (NUTS 3). The number of university hospital beds (when direct access to the respective university hospital is available) is added to hospital beds at regional level (NUTS 3). | National Statistical Service of Greece, Social Accounts Section |

Table 2. Descriptive Statistics: Greek Regions, 1981 – 2003 (NUTS III)

| | obs. | mean | st. dev. | min | max |
|--|------|--------|----------|--------|---------|
| GDP per capita | 1173 | 9373.0 | 2796.8 | 5272.6 | 33490.7 |
| GDP pc growth | 1173 | 0.016 | 0.069 | -0.349 | 0.521 |
| Population growth | 1173 | 0.003 | 0.010 | -0.121 | 0.060 |
| Public Investment | 1169 | 0.024 | 0.015 | 0.001 | 0.123 |
| Students; Lower Secondary Level | 1168 | 587.2 | 71.8 | 300.8 | 995.8 |
| Student; Upper Secondary Level | 1168 | 393.0 | 124.9 | 140.2 | 775.9 |
| Students – Teachers Ratio; Lower Secondary Level | 1168 | 1168 | 207.8 | 41.7 | 80.0 |
| Students – Teachers Ratio; Upper Secondary Level | 1168 | 1170 | 180.2 | 32.2 | 87.5 |
| Medical Doctors | 1173 | 1173 | 2.211 | 1.152 | 0.47 |
| Hospital Beds | 1173 | 1173 | 3.569 | 1.964 | 0.51 |

Table 3. Descriptive Statistics: Low-Income Regions, 1981 – 2003 (NUTS III)

| | obs. | mean | st. dev. | min | max |
|--|------|--------|----------|--------|---------|
| GDP per capita | 598 | 7967.7 | 1435.9 | 5272.6 | 16509.5 |
| GDP pc growth | 572 | 0.016 | 0.071 | -0.256 | 0.400 |
| Population growth | 572 | 0.003 | 0.009 | -0.072 | 0.060 |
| Public Investment | 597 | 0.025 | 0.012 | 0.001 | 0.104 |
| Students; Lower Secondary Level | 595 | 583.8 | 80.7 | 300.8 | 995.8 |
| Student; Upper Secondary Level | 596 | 394.8 | 123.7 | 151.1 | 700.1 |
| Students – Teachers Ratio; Lower Secondary Level | 595 | 205.8 | 40.7 | 95.4 | 365.7 |
| Students – Teachers Ratio; Upper Secondary Level | 596 | 177.1 | 28.6 | 107.9 | 271.9 |
| Medical Doctors | 598 | 2.03 | 1.04 | 0.47 | 7.11 |
| Hospital Beds | 598 | 3.10 | 1.25 | 1.03 | 8.12 |

Table 4. Descriptive Statistics: High-Income Regions, 1981 – 2003 (NUTS III)

| | obs. | mean | st. dev. | min | max |
|--|------|---------|----------|--------|---------|
| GDP per capita | 575 | 10834.6 | 3103.1 | 6377.4 | 33490.7 |
| GDP pc growth | 550 | 0.016 | 0.067 | -0.349 | 0.521 |
| Population growth | 550 | 0.004 | 0.012 | -0.121 | 0.040 |
| Public Investment | 572 | 0.023 | 0.018 | 0.001 | 0.123 |
| Students; Lower Secondary Level | 573 | 590.7 | 61.2 | 380.9 | 755.2 |
| Student; Upper Secondary Level | 574 | 391.2 | 126.2 | 140.2 | 775.9 |
| Students – Teachers Ratio; Lower Secondary Level | 573 | 209.9 | 42.7 | 80.0 | 342.7 |
| Students – Teachers Ratio; Upper Secondary Level | 574 | 183.6 | 35.3 | 87.5 | 505.1 |
| Medical Doctors | 575 | 2.40 | 1.23 | 0.75 | 6.83 |
| Hospital Beds | 575 | 4.05 | 2.41 | 0.51 | 15.88 |

Table 5. Panel Data Estimates: Education and Health Care Variables (All Regions)

| Explanatory Variables ⁴ | Random Effects Estimates | | | | Arrelano Bond Estimates | | | |
|---|--------------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Students; Lower Secondary Level | 0.001** (2.51) | 0.148** (2.24) | - | - | 0.001*** (3.55) | 0.001 (1.41) | - | - |
| Students – Teachers Ratio; Lower Secondary Level | -0.062*** (-5.75) | -0.024** (-2.14) | - | - | -0.018 (-0.64) | -0.003 (0.13) | - | - |
| Student; Upper Secondary Level | - | - | 0.001*** (5.80) | 0.001** (1.51) | - | - | 0.001*** (3.12) | 0.001*** (3.88) |
| Students – Teachers Ratio; Upper Secondary Level | - | - | -0.033*** (-2.66) | -0.018** (-1.49) | - | - | -0.020 (-0.85) | -0.011*** (-0.50) |
| Medical Doctors | - | 0.024*** (4.59) | - | 0.010*** (2.97) | - | 0.092*** (4.52) | - | 0.092*** (4.61) |
| <i>GDP Initial</i> ¹ | -0.005 (-0.06) | -0.016 (-1.52) | -0.004 (-0.45) | -0.016 (-1.51) | -0.185*** (-6.31) | -0.166*** (-5.81) | -0.182*** (-6.23) | -0.158*** (-5.58) |
| <i>Public Investment</i> | 0.002 (0.69) | -0.007* (-1.73) | 0.001 (0.49) | -0.005 (-1.33) | 0.005 (0.78) | 0.002 (0.31) | -0.007 (1.16) | 0.003 (0.51) |
| <i>Population Growth</i> | -1.147*** (-5.77) | -1.303*** (-6.73) | -1.124*** (-5.69) | -1.297*** (-6.66) | -1.411*** (-5.68) | -1.545*** (-6.56) | -1.421*** (-5.78) | -1.555*** (-6.68) |
| Obs. | 1070 | 1019 | 1070 | 1020 | 1019 | 968 | 1019 | 968 |
| R ² | 0.066 | 0.075 | 0.084 | 0.079 | - | - | - | - |
| Sargan Test (p-value) ² | - | - | - | - | 0.104 | 0.116 | 0.121 | 0.138 |
| Autocovariance test of order 2 (p-value) ³ | - | - | - | - | 0.302 | 0.128 | 0.670 | 0.312 |

Note: Dependent variable GDP per capita growth in region i ($i=1, \dots, 51$) in period t ($t=1981, \dots, 2003$). z-statistics in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively. ¹ Initial per capita GDP in region i in period $t-1$. ² The null hypothesis is that the instruments used are not correlated with the residuals. ³ The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. ⁴ See Table 1 in the Appendix for the definition of the variables used. Explanatory variables lagged 2 periods and Medical Doctors lagged 3 periods. All the explanatory variables were used as instruments.

Table 6. Panel Data Estimates: Education and Health Care Variables (High Income Regions)

| Explanatory Variables ⁴ | Random Effects Estimates | | | | Arrelano Bond Estimates | | | |
|---|--------------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Students; Lower Secondary Level | 0.001** (2.33) | 0.001 (0.46) | - | - | 0.001*** (3.47) | 0.001** (2.36) | - | - |
| Students – Teachers Ratio; Lower Secondary Level | -0.051*** (-3.59) | -0.021 (-1.41) | - | - | -0.003** (-0.09) | -0.018** (-2.11) | - | - |
| Student; Upper Secondary Level | - | - | 0.001*** (4.30) | 0.001** (2.04) | - | - | 0.001*** (3.45) | 0.001*** (3.93) |
| Students – Teachers Ratio; Upper Secondary Level | - | - | -0.021** (-1.25) | -0.012** (-0.73) | - | - | -0.055** (-2.05) | -0.049** (-1.88) |
| Medical Doctors | - | 0.018** (2.45) | - | 0.005** (0.53) | - | 0.058** (2.05) | - | 0.055** (0.50) |
| <i>GDP Initial</i> ¹ | -0.001 (-0.00) | -0.012 (0-.74) | -0.018 (-1.12) | -0.022 (-1.37) | -0.133*** (-3.20) | -0.128*** (-3.03) | -0.133*** (-3.21) | -0.118*** (-2.82) |
| <i>Public Investment</i> | -0.001 (-0.29) | -0.009 (-2.45) | -0.002 (-0.48) | -0.007 (-1.20) | 0.008 (0.95) | 0.002 (0.24) | 0.008 (1.08) | 0.001 (0.06) |
| <i>Population Growth</i> | -1.066*** (-4.31) | -1.143*** (-4.64) | -1.085*** (-4.50) | -1.125*** (-4.64) | -1.413*** (-4.83) | -1.474*** (-5.12) | -1.366*** (-4.70) | -1.409*** (-4.94) |
| Obs. | 524 | 499 | 524 | 499 | 499 | 474 | 499 | 474 |
| R ² | 0.067 | 0.068 | 0.086 | 0.068 | - | - | - | - |
| Sargan Test (p-value) ² | - | - | - | - | 0.062 | 0.074 | 0.099 | 0.106 |
| Autocovariance test of order 2 (p-value) ³ | - | - | - | - | 0.176 | 0.122 | 0.146 | 0.144 |

Table 7. Panel Data Estimates: Education and Health Care Variables (Low Income Regions)

| Explanatory Variables ⁴ | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Students; Lower Secondary Level | 0.001 (1.51) | -0.001 (-0.83) | - | - | 0.001 (0.97) | -0.001 (-0.81) | - |
| Students – Teachers Ratio; Lower Secondary Level | -0.080*** (-4.64) | -0.023 (-1.24) | - | - | -0.046 (-1.19) | -0.003 (-0.10) | - | - |
| Student; Upper Secondary Level | - | - | 0.001*** (4.08) | 0.001 (0.82) | - | - | 0.001 (1.27) | 0.029 (0.72) |
| Students – Teachers Ratio; Upper Secondary Level | - | - | -0.042** (-2.14) | -0.014 (-0.76) | - | - | -0.039 (-1.11) | -0.020 (-0.63) |
| Medical Doctors | - | 0.028*** (3.66) | - | 0.026*** (2.92) | - | 0.089*** (3.71) | - | 0.087*** (3.64) |
| <i>GDP Initial</i> ¹ | -0.032 (-1.21) | -0.047** (-1.87) | -0.031 (-1.21) | -0.049** (-1.96) | -0.245*** (-6.07) | -0.215*** (-5.65) | -0.244*** (-6.05) | -0.211*** (-5.55) |
| <i>Public Investment</i> | -0.001 (-0.25) | -0.001 (-0.19) | 0.007 (1.02) | -0.001 (-0.19) | -0.001 (-0.04) | 0.001 (0.06) | 0.003 (0.36) | 0.003 (0.39) |
| <i>Population Growth</i> | -1.367*** (-4.02) | -1.547*** (-4.78) | -1.210*** (-3.51) | -1.502*** (-4.52) | -1.548*** (-3.77) | -1.702*** (-4.49) | -1.560*** (-3.80) | -1.632*** (-4.32) |
| Obs. | 546 | 520 | 546 | 520 | 520 | 494 | 520 | 494 |
| R ² | 0.070 | 0.092 | 0.084 | 0.095 | - | - | - | - |
| Sargan Test (p-value) ² | - | - | - | - | 0.129 | 0.280 | 0.123 | 0.330 |
| Autocovariance test of order 2 (p-value) ³ | - | - | - | - | 0.302 | 0.314 | 0.620 | 0.524 |

Note: Dependent variable GDP per capita growth in region i ($i = 1, \dots, 25$) for High Income Regions and i ($i = 1, \dots, 26$) for Low Income Regions; in period t ($t = 1981, \dots, 2003$). z-statistics in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively. ¹ Initial per capita GDP in region i in period $t-1$. ² The null hypothesis is that the instruments used are not correlated with the residuals. ³ The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. See Table 1 in the Appendix for the definition of the variables used. Explanatory variables lagged 2 periods. All the explanatory variables were used as instruments and Medical Doctors lagged 3 periods.

Table 8. Panel Data Estimates: Regional & Extra Regional Education and Health Care Variables (All Regions)

| Explanatory Variables ⁴ | Random Effects Estimates | | | | | | | | Arrelano Bond Estimates | | | | | | | | |
|--|--------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | |
| Regional Students; Lower Secondary Level | -0.005 (-1.61) | -0.011*** (-3.32) | - | - | - | - | - | - | 0.253*** (4.79) | 0.236*** (4.41) | - | - | - | - | - | - | |
| Regional Students; Upper Secondary Level | - | - | 0.003 (1.07) | 0.002 (0.79) | - | - | - | - | - | - | 0.092*** (4.03) | 0.783*** (3.37) | - | - | - | - | |
| Extra Regional Students; Lower Secondary Level | - | - | - | - | -0.003 (-0.83) | - | - | - | - | - | - | - | 0.295*** (3.88) | - | - | - | |
| Extra Regional Students; Upper Secondary Level | - | - | - | - | - | -0.003 (-0.85) | - | - | - | - | - | - | - | 0.086** (2.27) | - | - | |
| Students; Lower Secondary Level | - | - | - | 0.000 (1.24) | -0.026 (-1.51) | - | - | - | - | - | - | 0.155*** (3.43) | 0.086** (1.39) | - | - | - | |
| Students; Upper Secondary Level | - | 0.000*** (7.16) | - | - | - | 0.045*** (5.66) | - | - | - | 0.047** (2.34) | - | - | - | 0.001** (0.02) | - | - | |
| University Medical Doctors | - | - | - | - | - | - | 0.016 (3.19) | - | - | - | - | - | - | - | 0.106*** (3.99) | - | |
| University Hospital Beds | - | - | - | - | - | - | - | 0.002 (0.45) | - | - | - | - | - | - | - | - | 0.038 (1.26) |
| <i>GDP Initial</i> ¹ | -0.003 (-0.39) | -0.003 (-0.35) | -0.009 (-0.95) | -0.010 (-0.99) | -0.003 (-0.29) | -0.004 (-0.45) | -0.015 (-1.62) | -0.011 (-1.17) | -0.186*** (-6.40) | -0.182*** (-6.28) | -0.174*** (-6.01) | -0.176*** (-6.10) | -0.187*** (-5.92) | -0.167*** (-5.29) | -0.168*** (-5.93) | -0.163*** (-1.26) | |
| <i>Population Growth</i> | -1.168*** (-5.73) | -1.231*** (-6.17) | -1.045*** (-5.12) | -1.075*** (-5.24) | -1.220*** (-5.39) | -1.123*** (-5.56) | -1.233*** (-6.43) | -1.210*** (-6.29) | -1.37*** (-5.60) | -1.369*** (-5.60) | -1.389** (-5.70) | -1.350*** (-5.53) | -1.482*** (-5.56) | -1.493*** (-5.60) | -1.629*** (-6.96) | -1.147*** (-6.35) | |
| Obs. | 1071 | 1071 | 1071 | 1071 | 903 | 903 | 1020 | 1020 | 1020 | 1020 | 1020 | 1020 | 860 | 860 | 969 | 969 | |
| R ² | 0.031 | 0.080 | 0.051 | 0.040 | 0.035 | 0.079 | 0.064 | 0.043 | - | - | - | - | - | - | - | - | |
| Sargan Test (p-value) ² | - | - | - | - | - | - | - | - | 0.656 | 0.722 | 0.632 | 0.740 | 0.629 | 0.832 | 0.680 | 0.741 | |
| Autocovariance test of order 2 (p-value) ³ | - | - | - | - | - | - | - | - | 0.530 | 0.563 | 0.788 | 0.707 | 0.621 | 0.813 | 0.941 | 0.799 | |

Note: Dependent variable GDP per capita growth in region i ($i=1, \dots, 51$) in period t ($t=1981, \dots, 2003$). z-statistics in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively.¹ Initial per capita GDP in region i in period $t-1$.² The null hypothesis is that the instruments used are not correlated with the residuals.³ The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation.⁴ See Table 1 in the Appendix for the definition of the variables used. Explanatory variables lagged 2 periods and Doctors University & Beds University lagged 3 periods. All the explanatory variables were used as instruments.

Table 9. Panel Data Estimates: Regional & Extra Regional Education and Health Care Variables (High Income Regions)

| Explanatory Variables ⁴ | Random Effects Estimates | | | | | | | | Arrelano Bond Estimates | | | | | | | |
|--|--------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| Regional Students; Lower Secondary Level | -0.004 (-0.89) | -0.010** (-2.08) | - | - | - | - | - | - | 0.345*** (4.19) | 0.293*** (3.45) | - | - | - | - | - | - |
| Regional Students; Upper Secondary Level | - | - | 0.004 (1.08) | 0.003 (0.85) | - | - | - | - | - | - | 0.113*** (3.71) | 0.089*** (2.83) | - | - | - | - |
| Extra Regional Students; Lower Secondary Level | - | - | - | - | -0.001 (-0.32) | - | - | - | - | - | - | - | 0.309*** (2.81) | - | - | - |
| Extra Regional Students; Upper Secondary Level | - | - | - | - | - | -0.002 (-0.50) | - | - | - | - | - | - | - | 0.475** (2.43) | - | - |
| Students; Lower Secondary Level | - | - | - | 0.037 (1.35) | -0.039 (-1.28) | - | - | - | - | - | - | 0.184*** (2.65) | 0.007** (1.19) | - | - | - |
| Students; Upper Secondary Level | - | 0.045*** (5.04) | - | - | - | 0.048*** (4.35) | - | - | - | 0.068** (2.44) | - | - | - | -0.086** (2.27) | - | - |
| University Medical Doctors | - | - | - | - | - | - | 0.008 (1.11) | - | - | - | - | - | - | - | 0.052 (1.42) | - |
| University Hospital Beds | - | - | - | - | - | - | - | 0.004 (0.54) | - | - | - | - | - | - | - | 0.004 (0.11) |
| <i>GDP Initial</i> ¹ | -0.007 (-0.49) | -0.009 (-0.66) | -0.014 (-0.98) | -0.013 (-0.87) | -0.005 (-0.32) | -0.011 (-0.72) | -0.018 (-1.18) | -0.011 (-0.77) | -0.130*** (-3.15) | -0.122*** (-2.96) | -0.114*** (-2.77) | -0.119*** (-2.89) | -0.150*** (-3.43) | -0.127*** (-2.91) | -0.116*** (-2.79) | -0.117*** (-2.81) |
| <i>Population Growth</i> | -1.08*** (-4.36) | -1.254*** (-5.10) | -0.984*** (-3.96) | -1.064*** (-4.17) | -1.117*** (-4.33) | -1.125*** (-4.73) | -1.125*** (-4.66) | -1.082*** (-4.50) | -1.35*** (-4.69) | -1.393*** (-4.82) | -1.348*** (-4.69) | -1.385*** (-4.81) | -1.368*** (-4.52) | -1.369*** (-4.52) | -1.428*** (-4.98) | -1.349*** (-4.79) |
| Obs. | 525 | 525 | 525 | 525 | 462 | 462 | 500 | 500 | 500 | 500 | 500 | 500 | 440 | 440 | 475 | 475 |
| R ² | 0.039 | 0.087 | 0.051 | 0.055 | 0.039 | 0.089 | 0.054 | 0.047 | - | - | - | - | - | - | - | - |
| Sargan Test (p-value) ² | - | - | - | - | - | - | - | - | 0.872 | 0.541 | 0.911 | 0.852 | 0.853 | 0.832 | 0.734 | 0.741 |
| Autocovariance test of order 2 (p-value) ³ | - | - | - | - | - | - | - | - | 0.946 | 0.827 | 0.761 | 0.2808 | 0.762 | 0.813 | 0.638 | 0.622 |

Note: Dependent variable GDP per capita growth in region i ($i=1, \dots, 25$) in period t ($t=1981, \dots, 2003$). z-statistics in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively.¹ Initial per capita GDP in region i in period $t-1$.² The null hypothesis is that the instruments used are not correlated with the residuals. ³ The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. ⁴ See Table 1 in the Appendix for the definition of the variables used. Explanatory variables lagged 2 periods and Doctors University & Beds University lagged 3 periods. All the explanatory variables were used as instruments.

Table 10. Panel Data Estimates: Regional & Extra Regional Education and Health Care Variables (Low Income Regions)

| Explanatory Variables ⁴ | Random Effects Estimates | | | | | | | | Arrelano Bond Estimates | | | | | | | |
|--|--------------------------|----------------------|----------------------|-------------------|-------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| Regional Students; Lower Secondary Level | 0.005 (1.27) | 0.011 (2.51) | - | - | - | - | - | - | 0.150** (2.38) | 0.148** (2.32) | - | - | - | - | - | - |
| Regional Students; Upper Secondary Level | - | - | 0.002 (0.61) | 0.015 (0.37) | - | - | - | - | - | - | 0.057* (1.77) | 0.054* (1.67) | - | - | - | - |
| Extra Regional Students; Lower Secondary Level | - | - | - | - | -0.004 (-0.79) | - | - | - | - | - | - | - | 0.266*** (2.98) | - | - | - |
| Extra Regional Students; Upper Secondary Level | - | - | - | - | - | -0.003 (-0.59) | - | - | - | - | - | - | - | 0.080* (1.67) | - | - |
| Students; Lower Secondary Level | - | - | - | 0.019 (0.95) | 0.026 (1.18) | - | - | - | - | - | - | 0.042 (0.81) | 0.020 (0.30) | - | - | - |
| Students; Upper Secondary Level | - | 0.051*** (5.25) | - | - | - | 0.045*** (3.79) | - | - | - | 0.014 (0.53) | - | - | - | -0.033 (-0.84) | - | - |
| University Medical Doctors | - | - | - | - | - | - | 0.025*** (3.43) | - | - | - | - | - | - | - | 0.094*** (3.00) | - |
| University Hospital Beds | - | - | - | - | - | - | - | 0.001 (0.15) | - | - | - | - | - | - | - | 0.071*** (0.01) |
| <i>GDP Initial</i> ¹ | -0.299 (-1.14) | -0.039 (-1.52) | -0.382 (-1.46) | -0.043 (-1.62) | -0.040 (-1.20) | -0.047 (-1.48) | -0.022 (-0.87) | -0.035 (-1.34) | -0.024*** (-6.20) | -0.248*** (-6.17) | -0.241*** (-6.04) | -0.241*** (-6.05) | -0.237*** (-5.30) | -0.022*** (-4.99) | -0.224*** (-5.92) | -0.219*** (-5.69) |
| <i>Population Growth</i> | -1.26*** (-3.61) | -1.171*** (-3.42) | -1.102*** (-3.14) | -1.094 (-3.12) | -1.32 (-3.18) | -1.199*** (-2.92) | -1.153*** (-3.43) | -1.154*** (-3.40) | -1.443*** (3.58) | -1.419*** (-3.50) | -1.456*** (-3.62) | -1.416*** (-3.50) | -1.861*** (3.85) | -1.898*** (-3.92) | -1.771*** (-4.75) | -1.657*** (-4.40) |
| Obs. | 546 | 546 | 546 | 546 | 441 | 441 | 546 | 546 | 520 | 520 | 520 | 520 | 420 | 420 | 494 | 494 |
| R ² | 0.025 | 0.080 | 0.032 | 0.032 | 0.029 | 0.070 | 0.072 | 0.026 | - | - | - | - | - | - | - | - |
| Sargan Test (p-value) ² | - | - | - | - | - | - | - | - | 0.810 | 0.781 | 0.881 | 0.970 | 0.997 | 0.747 | 0.897 | 0.789 |
| Autocovariance test of order 2 (p-value) ³ | - | - | - | - | - | - | - | - | 0.982 | 0.954 | 0.854 | 0.910 | 0.781 | 0.968 | 0.741 | 0.822 |

Note: Dependent variable GDP per capita growth in region i ($i=1, \dots, 26$) in period t ($t=1981, \dots, 2003$). z-statistics in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively. ¹ Initial per capita GDP in region i in period $t-1$. ² The null hypothesis is that the instruments used are not correlated with the residuals. ³ The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation. ⁴ See Table 1 in the Appendix for the definition of the variables used. Explanatory variables lagged 2 periods and Doctors University & Beds University lagged 3 periods. All the explanatory variables were used as instruments.

Table 11. Panel Data Estimates: Robustness Analysis (Arrelano & Bond Estimates)

| Explanatory Variables ⁴ | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Students; Lower Secondary Level | 0.001 (1.33) | -0.001 (-1.28) | - | - | -0.013 (-0.45) | 0.036 (1.07) | - |
| Students; Upper Secondary Level | - | - | 0.001* (1.84) | 0.001** (1.92) | - | - | - |
| Students–Teachers Ratio; Lower Secondary Level | -0.022 (-0.56) | 0.222 (1.29) | - | - | - | - | - |
| Students–Teachers Ratio; Upper Secondary Level | - | - | -0.017 (-0.49) | 0.003 (0.10) | - | - | - |
| Medical Doctors | - | 0.085*** (4.59) | - | 0.114*** (4.83) | - | - | - |
| Students; Lower Secondary Level * Income | 0.250** (2.55) | 0.229** (6.14) | - | - | 0.100** (1.82) | 0.159*** (3.71) | - |
| Students; Upper Secondary Level * Income | - | - | 0.027 (0.89) | 0.049 (1.38) | - | - | - |
| Students–Teachers Ratio; Lower Secondary Level * Income | 0.016 (0.28) | -0.072*** (-2.77) | - | - | - | - | - |
| Students–Teachers Ratio; Upper Secondary Level * Income | - | - | -0.004 (-0.11) | -0.022 (-0.51) | - | - | - |
| Medical Doctors * Income | - | -0.012 (-0.67) | - | 0.057* (1.77) | - | - | - |
| Regional Students; Upper Secondary Level | - | - | - | - | 0.113** (14.94) | - | - |
| Extra Regional Students; Lower Secondary Level | - | - | - | - | - | 0.190** (2.59) | - |
| University Medical Doctors | - | - | - | - | - | - | 0.094*** (10.37) |
| Regional Students; Upper Secondary Level * Income | - | - | - | - | 0.046*** (3.76) | - | - |
| Extra Regional Students; Lower Level * Income | - | - | - | - | - | 0.017 (0.18) | - |
| University Medical Doctors * Income | - | - | - | - | - | - | -0.030*** (-3.85) |
| <i>GDP Initial</i> ¹ | -0.187*** (-6.34) | -0.144*** (-11.36) | -0.180*** (-6.13) | -0.158*** (-5.56) | -0.071*** (-6.42) | -0.191*** (-6.00) | -0.161*** (-5.80) |
| <i>Public Investment</i> | 0.006 (0.87) | 0.001 (0.11) | -0.007 (-1.06) | -0.003 (-0.54) | 0.004 (1.00) | 0.003 (-0.79) | -0.004 (-1.28) |
| <i>Population Growth</i> | -1.445*** (-5.81) | -1.506*** (-6.01) | -1.419*** (-5.73) | -1.516*** (-6.45) | -1.372*** (-21.2) | -1.504*** (-5.70) | -1.559*** (-6.84) |
| Obs. | 1019 | 968 | 1019 | 968 | 968 | 859 | 968 |
| Sargan Test (p-value) ² | 0.610 | 0.115 | 0.712 | 0.773 | 0.804 | 1.000 | 1.000 |
| Autocovariance test of order 2 (p-value) ³ | 0.807 | 0.509 | 0.720 | 0.244 | 0.941 | 0.608 | 0.540 |

Note: Dependent variable GDP per capita growth in region i ($i=1, \dots, 26$) in period t ($t=1981, \dots, 2003$). z-statistics in parentheses; *, **, *** denote 10%, 5% & 1% significance respectively.¹ Initial per capita GDP in region i in period $t-1$.² The null hypothesis is that the instruments used are not correlated with the residuals.³ The null hypothesis is that the errors in the first-differenced regression exhibit no second order serial correlation.⁴ Explanatory variables lagged 2 periods & University Medical Doctors lagged 3 periods. All the explanatory variables used as instruments.

INCOME is a binary variable taking the value of 1 if observation belongs to high income regions.

REFERENCES

- Andersson, M., Grasjo, U. & Karlsson, C. (2008) Human Capital and Productivity in a Spatial Economic System – Relating the Extent of Spatial Dependence to Localities Position, *Annals of Economics and Statistics* [forthcoming].
- Andersson, M. & Karlsson, C. (2007). Knowledge in Regional Economic Growth – The Role of Knowledge Accessibility, *Industry and Innovation*, 14, 2, 129-149.
- Arellano, A. & Fullerton, T.M. JR. (2005). Educational Attainment and Regional Economic Performance in Mexico, *International Advances in Economic Research*, 231-242.
- Azariadis, C., & Drazen, A. (1990). Threshold Externalities in Economic Development. *Quarterly Journal of Economics*, 105, 501–526.
- Arellano, M., Bond, S., (1991). Some Tests of Specification or Panel Data: Monte Carlo Evidence and an Application to Employment Equations, *The Review of Economic Studies*, 58 (2), 277-297.
- Barro, R.J. (1996). Determinants of Economic Growth: A Cross Country Empirical Study, *National Bureau of Economic Research*, Working Paper No. 5698, August.
- Barro, R.J. (1991). Economic Growth in a Cross Section of Countries, *Quarterly Journal of Economics*, 106, 407-443.
- Barro, R.J. and J-W. Lee (1993). International Comparisons of Educational Attainment, *Journal of Monetary Economics*, 23(3), 363-94.
- Barro, R.J & Sala-i-Martin, X., (2004). *Economic Growth*, MIT Press.
- Barro, R.J & Sala-i-Martin, X., (1996). *Economic Growth*, McGraw Hill, Inc., New York.
- Barro, R.J & Sala-i-Martin, X., (1992). Convergence. *Journal of Political Economy* 100(2), 223-251.
- Barro, R.J & Sala-i-Martin, X., (1991). Convergence Across States and Regions, *Brookings Papers on Economic Activity*, 1, 107-182.
- Bassanini, A. & Scarpetta S. (2001). The Driving Forces of Economic Growth: Panel Data Evidence for the OECD Countries, *OECD Economic Studies*, 33, 9-56.
- Bassetti, T. (2007). Human Capital and Economic Growth: A Selective Survey, *PRIN 2005, Working Paper 018*, May, 1-35.
- Becker, G.S. (2007). Health as Human Capital: Synthesis and Extensions, *Oxford Economic Papers*, 59,379-410.
- Becker, G.S. (1993). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, University of Chicago Press, Chicago.
- Becker, G.S. (1964). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, National Bureau of Economic Research, New York
- Benhabib, J. & Spiegel, M. (1994). The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data, *Journal of Monetary Economics*, 34, 143-174.
- Benos, N. & Karagiannis, St. (2008). Convergence and Economic Performance in Greece: Evidence at Regional and Prefecture Level, *Review of Urban & Regional Development Studies*, March, 20-1.
- Bils, M. & Klenow, P.J. (2000). Does Schooling Cause Growth?, *American Economic Review*, 90, 1160-1183.
- Bloom, D.E. and Canning, D. (2000). Health as Human Capital and its Impact on Economic Performance, *The Geneva Papers on Risk and Insurance*, 28:2, 304-315.
- Bloom, D.E. and Canning, D. (2000). Health and the Wealth of Nations', *Science*, 287, 1207-9.
- Bloom, D.E, Canning, D. & Sevilla, J. (2004). The Effect of Health on Economic Growth: A Production Function Approach, *World Development*, 32, 1, 1-13.
- Bloom, D.E, & Sachs, J. (1998). Geography, Demography, and Economic Growth in Africa, *Brookings Papers on Economic Activity*, vol. 2, 207–295.

- Bloom, D.E, & Williamson, J. (1998). Demographic Transitions and Economic Miracles in Emerging Asia, *World Bank Economic Review*, vol. 12, No. 3, 419–55.
- Bloom, D.E, Bloom, B., Cohen, J. & Sachs, J. (1999). Investing in the World Health Organization, *Science*, 284, 911.
- Caselli, F., Esquivel, G. & F. Lefort (1996). Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics, *Journal of Economic Growth*, 1, 3, 363-389.
- Christopoulos, D. (2004). The Relationship Between Output and Unemployment: Evidence From Greek Regions, *Papers in Regional Science*, (83), 611-20.
- De la Fuente, A. (2002). On the Sources of Convergence: A Close Look at the Spanish Regions, *European Economic Review*, 46, 569-599.
- De la Fuente, A. & Domenech, R. (2000). *Human Capital in Growth Regressions: How Much Difference Does Data Quality Make ?*, Mimeo, Universidad Autonoma de Barcelona, January.
- Di Liberto, A. (2007). Education and Italian Regional Development, *Economics of Education Review*, [forthcoming].
- Di Liberto, A. (2004). *Convergence Clubs, and the Role of Human Capital in Spanish Regional Growth*, CRENOS Working Paper, 2004/18.
- Durlauf, S.N & Johnson, P.A (1995) Multiple Regimes and Cross-Country Growth Behaviour, *Journal of Applied Econometrics*, 10, 365-384.
- Eckey, H-F, Dreger, C., Turck, M. (2006). *European Regional Convergence in a Human Capital Augmented Solow Model*, University of Kassel Working paper, 88, 1-19.
- Ehrlich, I. (2000). Uncertain Lifetime, Life Protection, and the Value of Life Saving, *Journal of Health Economics*, 19, 341–67.
- Fuchs, J. (1966). The Contribution of Health Services to the American Economy, *Milbank Memorial Fund Quarterly*, 44-65, 65-102.
- Grasjo, U. (2005) *Human capital, R&D and Regional Exports*, Working Paper Series in Economics and Institutions of Innovation, 50, Royal Institute of Technology, CESIS.
- Griliches, Z. (1997). Education, Human Capital and Growth: A Personal Perspective. *Journal of Labour Economics*, 15, 330–344.
- Kalaitzidakis, P., Mamuneas, T., Savvides, A. & Stengos, T. (2001). Measures of Human Capital and Nonlinearities in Economic Growth, *Journal of Economic Growth*, 6, 229-254.
- Howitt, P. (2005). Health, Human Capital, and Economic Growth: A Schumpeterian Perspective, in Lopez & Casasnovas, G., Rivera, B. & Currais, L. (eds), *Health and Economic Growth: Findings and Policy Implications*, The MIT Press.
- Kanelopoulos, K., (1994). *Greek Education in the 2000 Horizon*, Reports No. 10, KEPE, Athens. [in Greek]
- Kanelopoulos, K., Mauromaras, K. & Mitrakos, Th. (2003). *Education and the Labour Market*, Studies No. 50, KEPE, Athens. [in Greek]
- Krueger, A. B., & Lindahl, M. (2001). Education for Growth: Why and For Whom? *Journal of Economic Literature*, 39, 1101–1136.
- Lambrinidis, M., Psycharris, Y. & Rovolis, A. (2005). Regional Allocation of Public Infrastructure Investment: The Case of Greece, *Regional Studies*, Vol. 39.9, 1231-1244.
- Levine R. & Renelt D. (1992). A Sensitivity Analysis of Cross-Country Growth Regressions, *American Economic Review*, No. 82, 942-963.
- Louri, H. (1989). Regional Policy and Investment Behaviour: The Case of Greece, 1971-1982, *Regional Studies*, Vol. 23.3, 231-239.
- Lucas, R. E. (1988). On The Mechanics of Economic Development, *Journal of Monetary Economics*, 22, 3–42.
- Malik, G. (2006). An Examination of the Relationship Between Health and Economic Growth, *Working Paper, ICRIER September*.
- Mankiw, N., Romer, D. & Weil, D. (1992). A Contribution to the Empirics of Economic

- Growth, *Quarterly Journal of Economics*, 108, 407-437.
- Meltzer, D.O. (1992). *Mortality Decline, the Demographic transition, and Economic Growth*, Dissertation, University of Chicago, December.
- Middendorf, T., (2006). Human Capital and Economic Growth in OECD Countries, *Jahrbucher Fur Nationalokonomie Und Statistik*, 226(6), 670-686.
- Mushkin, S.J., (1962). Health as an Investment, *Journal of Political Economy*, 70, supplement, 129-157.
- Nelson, R.R. and Phelps, S.E. (1966). Investment in Humans, Technological Diffusion, and Economic Growth, *American Economic Review*, 56, 69-75.
- Paleocrassas, St. (1996). *Student Dropouts in Gymnasium and Their Needs for Professional Educations and Training*, Pedagogical Institute, OEEK. [in Greek]
- Paleocrassas, St. Rousseas, P. Vretakou, V. (1997). Greek Lower Secondary School Dropouts: Results from a National Survey, *European Educational Research Association Bulletin*, April Vol.3, No.1, 12-18.
- Papageorgiou, C. (2003). "Distinguishing Between the Effects of Primary and Post-Primary Education on Economic Growth, *Review of Development Economics*, 7 (4), 622-635.
- Pritchett, L. (2001). Where Has all the Education Gone?, *World Bank Economic Review*, 15, 3, 367-391.
- Prodromidis, P.I. (2006). *A Regional Analysis of Declared Incomes in Greece*, Studies No. 63, KEPE, Athens.
- Ricci, F. & Zachariadis, M. (2007). Determinants of Public Health Outcomes: A Macroeconomic Perspective, June, mimeo.
- Romer, P. M. (1990). Endogenous Technological Change, *Journal of Political Economy*, 98, 71-102.
- Sianesi, B. & Van Reenen, J. (2002). The Returns to Education: A Review of the Empirical Macroeconomic Literature, *Institute for Fiscal Studies, Working Paper 02/05*.
- Temple, J. (1999). The New Growth Evidence, *Journal of Economic Literature*, 37, 112-156.

IN THE SAME SERIES

No 103 E. Athanassiou, "Fiscal Policy and the Recession: The Case of Greece". Athens, 2009.

No 102 St. Karagiannis, Y. Panagopoulos and Ar. Spiliotis, "Modeling banks' lending behavior in a capital regulated framework". Athens, 2009.

No 101 Th. Tsekeris, "Public Expenditure Competition in the Greek Transport Sector: Inter-modal and Spatial Considerations". Athens, 2009.

No 100 N. Georgikopoulos and C. Leon, "Stochastic Shocks of the European and the Greek Economic Fluctuations". Athens, 2009.

No 99 P. I. Prodromidis, "Deriving Labor Market Areas in Greece from commuting flows". Athens, 2009.

No 98 Y. Panagopoulos and Prodromos Vlamis, "Bank Lending, Real Estate Bubbles and Basel II". Athens, 2008.

No 97 Y. Panagopoulos, "Basel II and the Money Supply Process: Some Empirical Evidence from the Greek Banking System (1995-2006)". Athens, 2007.

No 96 N. Benos, St. Karagiannis, "Growth Empirics: Evidence from Greek Regions". Athens, 2007.

No 95 N. Benos, St. Karagiannis, "Convergence and Economic Performance in Greece: New Evidence at Regional and Prefecture Level". Athens, 2007.

No 94 Th. Tsekeris, "Consumer Demand Analysis of Complementarities and Substitutions in the Greek Passenger Transport Market". Athens, 2007.

No 93 Y. Panagopoulos, I. Reziti, and Ar. Spiliotis, "Monetary and banking policy transmission through interest rates: An empirical application to the USA, Canada, U.K. and European Union". Athens, 2007.

No 92 W. Kafouros and N. Vagionis, "Greek Foreign Trade with Five Balkan States During the Transition Period 1993-2000: Opportunities Exploited and Missed. Athens, 2007.

No 91 St. Karagiannis, "The Knowledge-Based Economy, Convergence and Economic Growth: Evidence from the European Union", Athens, 2007.

No 90 Y. Panagopoulos, "Some further evidence upon testing hysteresis in the Greek Phillips-type aggregate wage equation". Athens, 2007.

No 89 N. Benos, "Education Policy, Growth and Welfare". Athens, 2007.

No 88 P. Baltzakis, "Privatization and deregulation". Athens, 2006 (In Greek).

No 87 Y. Panagopoulos and I. Reziti, "The price transmission mechanism in the Greek food market: An empirical approach". Athens, 2006. Published in *Agribusiness*, vol. 24 (1), 2008, pp. 16-30.

- No 86 P. I. Prodromídis, " Functional Economies or Administrative Units in Greece: What Difference Does It Make for Policy?" Athens, 2006. Published in: Review of Urban & Regional Development Studies, vol. 18.2, 2006, pp. 144-164.
- No 85 P. I. Prodromídis, "Another View on an Old Inflation: Environment and Policies in the Roman Empire up to Diocletian's Price Edict". Athens, 2006.
- No 84A E. Athanassiou, "Prospects of Household Borrowing in Greece and their Importance for Growth". Athens, 2006. Published in: South-Eastern Europe Journal of Economics, vol.5, 2007, pp. 63-75.
- No 83 G. C. Kostelenos, "La Banque nationale de Grèce et ses statistiques monétaires (1841-1940)". Athènes, 2006. Published in: Mesurer la monnaie. Banques centrales et construction de l' autorité monétaire (XIXe-XXe siècle), Paris: Edition Albin Michel, 2005, 69-86.
- No 82 P. Baltzakis, "The Need for Industrial Policy and its Modern Form". Athens, 2006 (In Greek).
- No 81 St. Karagiannis, "A Study of the Diachronic Evolution of the EU's Structural Indicators Using Factorial Analysis". Athens, 2006.
- No 80 I. Resiti, "An investigation into the relationship between producer, wholesale and retail prices of Greek agricultural products". Athens, 2005.
- No 79 Y. Panagopoulos, A. Spiliotis, "An Empirical Approach to the Greek Money Supply". Athens, 2005.
- No 78 Y. Panagopoulos, A. Spiliotis, "Testing alternative money theories: A G7 application". Athens, 2005. Published in Journal of Post Keynesian Economics, vol. 30 (4), 2008, pp.607-629
- No 77 I. A. Venetis, E. Emmanuilidi, "The fatness in equity Returns. The case of Athens Stock Exchange". Athens, 2005.
- No 76 I. A. Venetis, I. Paya, D. A. Peel, "Do Real Exchange Rates "Mean Revert" to Productivity? A Nonlinear Approach". Athens, 2005.
- No 75 C. N. Kanellopoulos, "Tax Evasion in Corporate Firms: Estimates from the Listed Firms in Athens Stock Exchange in 1990s". Athens, 2002 (In Greek).
- No 74 N. Glytsos, "Dynamic Effects of Migrant Remittances on Growth: An Econometric Model with an Application to Mediterranean Countries". Athens, 2002. Published under the title "The contribution of remittances to growth: a dynamic approach and empirical analysis" in: Journal of Economic Studies, December 2005.
- No 73 N. Glytsos, "A Model Of Remittance Determination Applied to Middle East and North Africa Countries". Athens, 2002.
- No 72 Th. Simos, "Forecasting Quarterly gdp Using a System of Stochastic Differential Equations". Athens, 2002.
- No 71 C. N. Kanellopoulos, K. G. Mavromaras, "Male-Female Labour Market Participation and Wage Differentials in Greece". Athens, 2000. Published in: Labour, vol. 16, no. 4, 2002, 771-801.

- No 70 St. Balfoussias, R. De Santis, "The Economic Impact of The Cap Reform on the Greek Economy: Quantifying the Effects of Inflexible Agricultural Structures". Athens, 1999.
- No 69 M. Karamessini, O. Kaminioti, "Labour Market Segmentation in Greece: Historical Perspective and Recent Trends". Athens, 1999.
- No 68 S. Djajic, S. Lahiri and P. Raimondos-Moller, "Logic of Aid in an Intertemporal Setting". Athens, 1997.
- No 67 St. Makrydakis, "Sources of Macroeconomic Fluctuations in the Newly Industrialized Economies: A Common Trends Approach". Athens, 1997. Published in: Asian Economic Journal, vol. 11, no. 4, 1997, 361-383.
- No 66 N. Christodoulakis, G. Petrakos, "Economic Developments in the Balkan Countries and the Role of Greece: From Bilateral Relations to the Challenge of Integration". Athens, 1997.
- No 65 C. Kanellopoulos, "Pay Structure in Greece". Athens, 1997.
- No 64 M. Chletsos, Chr. Kollias and G. Manolas, "Structural Economic Changes and their Impact on the Relationship Between Wages, Productivity and Labour Demand in Greece". Athens, 1997.
- No 63 M. Chletsos, "Changes in Social Policy - Social Insurance, Restructuring the Labour Market and the Role of the State in Greece in the Period of European Integration". Athens, 1997.
- No 62 M. Chletsos, "Government Spending and Growth in Greece 1958-1993: Some Preliminary Empirical Results". Athens, 1997.
- No 61 M. Karamessini, "Labour Flexibility and Segmentation of the Greek Labour Market in the Eighties: Sectoral Analysis and Typology". Athens, 1997.
- No 60 Chr. Kollias and St. Makrydakis, "Is there a Greek-Turkish Arms Race?: Evidence from Cointegration and Causality Tests". Athens, 1997. Published in: Defence and Peace Economics, vol. 8, 1997, 355-379.
- No 59 St. Makrydakis, "Testing the Intertemporal Approach to Current Account Determination: Evidence from Greece". Athens, 1996. Published in: Empirical Economics, vol. 24, no. 2, 1999, 183-209.
- No 58 Chr. Kollias and St. Makrydakis, "The Causal Relationship Between Tax Revenues and Government Spending in Greece: 1950-1990". Athens, 1996. Published in: The Cyprus Journal of Economics, vol. 8, no. 2, 1995, 120-135.
- No 57 Chr. Kollias and A. Refenes, "Modelling the Effects of No Defence Spending Reductions on Investment Using Neural Networks in the Case of Greece". Athens, 1996.
- No 56 Th. Katsanevas, "The Evolution of Employment and Industrial Relations in Greece (from the Decade of 1970 up to the Present)". Athens, 1996 (In Greek).
- No 55 D. Dogas, "Thoughts on the Appropriate Stabilization and Development Policy and the Role of the Bank of Greece in the Context of the Economic and Monetary Union (EMU)". Athens, 1996 (In Greek).

No 54 N. Glytsos, "Demographic Changes, Retirement, Job Creation and Labour Shortages in Greece: An Occupational and Regional Outlook". Athens, 1996. Published in: *Journal of Economic Studies*, vol. 26, no. 2-3, 1999, 130-158.

No 53 N. Glytsos, "Remitting Behavior of "Temporary" and "Permanent" Migrants: The Case of Greeks in Germany and Australia". Athens, 1996. Published in: *Labour*, vol. II, no. 3, 1997, 409-435.

No 52 V. Stavrinou, V. Droucopoulos, "Output Expectations Productivity Trends and Employment: The Case of Greek Manufacturing". Athens, 1996. Published in: *European Research Studies*, vol. 1, no. 2, 1998, 93-122.

No 51 A. Balfoussias, V. Stavrinou, "The Greek Military Sector and Macroeconomic Effects of Military Spending in Greece". Athens, 1996. Published in N.P. Gleditsch, O. Bjerkholt, A. Cappelen, R.P. Smith and J.P. Dunne: *In the Peace Dividend*, , Amsterdam: North-Holland, 1996, 191-214.

No 50 J. Henley, "Restructuring Large Scale State Enterprises in the Republics of Azerbaijan, Kazakhstan, the Kyrgyz Republic and Uzbekistan: The Challenge for Technical Assistance". Athens, 1995.

No 49 C. Kanellopoulos, G. Psacharopoulos, "Private Education Expenditure in a "Free Education" Country: The Case of Greece". Athens, 1995. Published in: *International Journal of Educational Development*, vol. 17, no. 1, 1997, 73-81.

No 48 G. Kouretas, L. Zarangas, "A Cointegration Analysis of the Official and Parallel Foreign Exchange Markets for Dollars in Greece". Athens, 1995. Published in: *International Journal of Finance and Economics*, vol. 3, 1998, 261-276.

No 47 St. Makrydakis, E. Tzavalis, A. Balfoussias, "Policy Regime Changes and the Long-Run Sustainability of Fiscal Policy: An Application to Greece". Athens, 1995. Published in: *Economic Modelling*, vol. 16 no. 1, 1999, 71-86.

No 46 N. Christodoulakis and S. Kalyvitis, "Likely Effects of CSF 1994-1999 on the Greek Economy: An ex Ante Assessment Using an Annual Four-Sector Macroeconometric Model". Athens, 1995.

No 45 St. Thomadakis, and V. Droucopoulos, "Dynamic Effects in Greek Manufacturing: The Changing Shares of SMEs, 1983-1990". Athens, 1995. Published in: *Review of Industrial Organization*, vol. 11, no. 1, 1996, 69-78.

No 44 P. Mourdoukoutas, "Japanese Investment in Greece". Athens, 1995 (In Greek).

No 43 V. Rapanos, "Economies of Scale and the Incidence of the Minimum Wage in the less Developed Countries". Athens, 1995. Published: "Minimum Wage and Income Distribution in the Harris-Todaro model", in: *Journal of Economic Development*, 2005.

No 42 V. Rapanos, "Trade Unions and the Incidence of the Corporation Income Tax". Athens, 1995.

No 41 St. Balfoussias, "Cost and Productivity in Electricity Generation in Greece". Athens, 1995.

- No 40 V. Rapanos, "The Effects of Environmental Taxes on Income Distribution". Athens, 1995. Published in: *European Journal of Political Economy*, 1995.
- No 39 V. Rapanos, "Technical Change in a Model with Fair Wages and Unemployment". Athens, 1995. Published in: *International Economic Journal*, vol. 10, no. 4, 1996.
- No 38 M. Panopoulou, "Greek Merchant Navy, Technological Change and Domestic Shipbuilding Industry from 1850 to 1914". Athens, 1995. Published in: *The Journal of Transport History*, vol. 16, no. 2, 159-178.
- No 37 C. Vergopoulos, "Public Debt and its Effects". Athens, 1994 (In Greek).
- No 36 C. Kanellopoulos, "Public-Private Wage Differentials in Greece". Athens, 1994.
- No 35 Z. Georganta, K. Kotsis and Emm. Kounaris, "Measurement of Total Factor Productivity in the Manufacturing Sector of Greece 1980-1991". Athens, 1994.
- No 34 E. Petrakis and A. Xepapadeas, "Environmental Consciousness and Moral Hazard in International Agreements to Protect the Environment". Athens, 1994. Published in: *Journal Public Economics*, vol. 60, 1996, 95-110.
- No 33 C. Carabatsou-Pachaki, "The Quality Strategy: A Viable Alternative for Small Mediterranean Agricultures". Athens, 1994.
- No 32 Z. Georganta, "Measurement Errors and the Indirect Effects of R & D on Productivity Growth: The U.S. Manufacturing Sector". Athens, 1993.
- No 31 P. Paraskevaïdis, "The Economic Function of Agricultural Cooperative Firms". Athens, 1993 (In Greek).
- No 30 Z. Georganta, "Technical (In) Efficiency in the U.S. Manufacturing Sector, 1977-1982". Athens, 1993.
- No 29 H. Dellas, "Stabilization Policy and Long Term Growth: Are they Related?" Athens, 1993.
- No 28 Z. Georganta, "Accession in the EC and its Effect on Total Factor Productivity Growth of Greek Agriculture". Athens, 1993.
- No 27 H. Dellas, "Recessions and Ability Discrimination". Athens, 1993.
- No 26 Z. Georganta, "The Effect of a Free Market Price Mechanism on Total Factor Productivity: The Case of the Agricultural Crop Industry in Greece". Athens, 1993. Published in: *International Journal of Production Economics*, vol. 52, 1997, 55-71.
- No 25 A. Gana, Th. Zervou and A. Kotsi, "Poverty in the Regions of Greece in the late 80's. Athens", 1993 (In Greek).
- No 24 P. Paraskevaïdes, "Income Inequalities and Regional Distribution of the Labour Force Age Group 20-29". Athens, 1993 (In Greek).
- No 23 C. Eberwein and Tr. Kollintzas, "A Dynamic Model of Bargaining in a Unionized Firm with Irreversible Investment". Athens, 1993. Published in: *Annales d' Economie et de Statistique*, vol. 37/38, 1995, 91-115.

- No 22 P. Paraskevaides, "Evaluation of Regional Development Plans in the East Macedonia-Thrace's and Crete's Agricultural Sector". Athens, 1993 (In Greek).
- No 21 P. Paraskevaides, "Regional Typology of Farms". Athens, 1993 (In Greek).
- No 20 St. Balfoussias, "Demand for Electric Energy in the Presence of a two-block Declining Price Schedule". Athens, 1993.
- No 19 St. Balfoussias, "Ordering Equilibria by Output or Technology in a Non-linear Pricing Context". Athens, 1993.
- No 18 C. Carabatsou-Pachaki, "Rural Problems and Policy in Greece". Athens, 1993.
- No 17 Cl. Efstratoglou, "Export Trading Companies: International Experience and the Case of Greece". Athens, 1992 (In Greek).
- No 16 P. Paraskevaides, "Effective Protection, Domestic Resource Cost and Capital Structure of the Cattle Breeding Industry". Athens, 1992 (In Greek).
- No 15 C. Carabatsou-Pachaki, "Reforming Common Agricultural Policy and Prospects for Greece". Athens, 1992 (In Greek).
- No 14 C. Carabatsou-Pachaki, "Elaboration Principles/Evaluation Criteria for Regional Programmes". Athens, 1992 (In Greek).
- No 13 G. Agapitos and P. Koutsouvelis, "The VAT Harmonization within EEC: Single Market and its Impacts on Greece's Private Consumption and Vat Revenue". Athens, 1992.
- No 12 C. Kanellopoulos, "Incomes and Poverty of the Greek Elderly". Athens, 1992.
- No 11 D. Maroulis, "Economic Analysis of the Macroeconomic Policy of Greece during the Period 1960-1990". Athens, 1992 (In Greek).
- No 10 V. Rapanos, "Joint Production and Taxation". Athens, 1992. Published in: Public Finance/Finances Publiques, vol. 3, 1993.
- No 9 V. Rapanos, "Technological Progress, Income Distribution and Unemployment in the less Developed Countries". Athens, 1992. Published in: Greek Economic Review, 1992.
- No 8 N. Christodoulakis, "Certain Macroeconomic Consequences of the European Integration". Athens, 1992 (In Greek).
- No 7 L. Athanassiou, "Distribution Output Prices and Expenditure". Athens, 1992.
- No 6 J. Geanakoplos and H. Polemarchakis, "Observability and Constrained Optima". Athens, 1992.
- No 5 N. Antonakis and D. Karavidas, "Defense Expenditure and Growth in LDCs - The Case of Greece, 1950-1985". Athens, 1990.
- No 4 C. Kanellopoulos, The Underground Economy in Greece: "What Official Data Show". Athens (In Greek 1990 - In English 1992). Published in: Greek Economic Review, vol. 14, no.2, 1992, 215-236.

No 3 J. Dutta and H. Polemarchakis, "Credit Constraints and Investment Finance: No Evidence from Greece". Athens, 1990, in M. Monti (ed.), Fiscal Policy, Economic Adjustment and Financial Markets, International Monetary Fund, (1989).

No 2 L. Athanassiou, "Adjustments to the Gini Coefficient for Measuring Economic Inequality". Athens, 1990.

No 1 G. Alogoskoufis, "Competitiveness, Wage Rate Adjustment and Macroeconomic Policy in Greece". Athens, 1990 (In Greek). Published in: Applied Economics, vol. 29, 1997, 1023-1032.