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PUBLIC EDUCATION EXPENDITURES AND GROWTH IN GREECE OVER THE PERIOD 1960-2000

By

Panagiotis Prontzas, Constantinos Tsamadias**, Petros Papageorgiou****
* Lecturer, Mediterranean College, Athens, Greece
** Assistant Professor, Harokopio University, Athens, Greece
*** Professor, University of Piraeus, Greece

Abstract

This study seeks to estimate the impact of public education expenditures on Greek economy's growth rates over the period 1960-2000. By applying the model introduced by Mankiw *et al*. (1992), up to 60% of Greece's economic growth during a 40 year period is examined. The findings of the empirical analysis reveal that public education expenditures had a positive, statistically significant but quite low effect on economic growth in Greece. The results are not robust, when public education expenditures split on the three levels of education. JEL Classifications: O11, E62.

Keywords: Education, Public Expenditures, Economic Growth.

1. Introduction

Education has been acknowledged as the principal institutional mechanism by which people can improve their knowledge, abilities and skills, while promoting private and social benefits. These are known as market benefits, non-market benefits, externalities and spillovers and concern individuals, households, firms and society as a whole, while they are particularly durable, since education has a consumption and investment element. The relationship between education and economy has been recognized by classical economists (Smith (1776), Marshall (1920)). During the second half of 20th century, education and economic growth has been systematically supported by neoclassical economists (Abramovitz (1956), Schultz (1961), Becker (1962), Denison (1967), Mincer (1974)). Further approaches on the whole effect of education on the economies have been pointed out during the last three decades (Lucas (1988), Romer (1990)).

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The overall literature suggests a strong positive relation between education and growth. In almost all countries, governments follow a variety of public education policies. As a result, there is a growing theoretical literature on the effects of public education policies on economic growth. In general, the contribution of education to growth is presumed to occur through its ability to increase the productivity of the existing manpower in various ways. The contribution of human capital and education on economic growth and welfare were confirmed by many empirical analyses (Azariades and Drazen (1990), Barro (1991), Mankiw *et al*. (1992), Levine and Renelt (1992), Kim (1998), Dahlin (2003)).

Regarding some previous empirical work on the effects of education on Greece's economic growth, Lianos and Milonas (1975) came up with similar results for the period 1961-1971. Caramanis and Ioannides (1980) estimated this contribution between 3% and 5%. Psacharopoulos and Kazamias (1985) estimated the contribution at level 2% (data: sampling NSSG 1977). Tsamadias and Prontzas (2009) estimated the average total effect of education on growth at 3% over the period 1960-2000, while for every 1% increase in the share of enrolled students in secondary education, GDP per worker increases by 0,64-0,82%. But, which is the relation between growth and education expenditures?

Education is often regarded as a basic human right. However, even basic human rights use up scarce resources. At the same time education in not a pure private or public good but can be rather characterized as a semi-public good. In several countries the financing is being carried out by both the public and the private sectors through various organizational schemes. In economic theory a question is raised on how society's resources should be allocated between competing sectors. In all countries, one of the major challenges for governments is the efficient and equitable continuous reallocation of resources.

During the last decades, a basic problem in economics of education and development economics has been to estimate the effect that public expenditure on education has on the growth rate of the economies. In this framework, various models have been proposed, based on neoclassical theories and theories of endogenous growth. Meanwhile, several empirical analyses have been carried out (Angelopoulos *et al*., 2007). Economic literature on the subject has been growing fast, producing conflicting empirical research findings and has yet not revealed a clear relation between education expenditures and economic growth (Hanushen and Kimko, 2000). Indeed, empirical evidence concerning the effects of public education expenditures on economic growth is mixed (Hanushek and Kim (1995), Nunes (2003), Blankenau and Simpson (2004), Rawat and Chauhan (2007)). Economic theory hasn't yet been able to

answer the question of who should pay for education, but it can shed light on both the efficiency and equity implications of alternative methods of education financing.

There are, however, many questions still to be answered: a. defining the right public expenditure share for education, b. how education should be financed, in particular how the financial burden should be shared between the government, employers and individuals and what should be the balance between public and private sources of finance. c. defining the best possible distribution of public expenditure between the three different levels of education, d. achieving an effective management of resources

The purpose of this paper is to contribute to the empirical research on the investigation of the growth effects of public expenditure on education in Greece over the period 1960-2000. The rest of the paper is organized as follows. Section 2 presents some basic findings on the relationship between public education expenditures and economic growth as well as an overview on Greece's economy and the education sector. In section 3 and 4, the model as well as all relevant sources and data are being presented. Section 5 reports and discusses the empirical analysis. Finally, section 6 summarises the main findings and conclusions of the paper.

2. The Economic and Education Environment

The accumulation of knowledge and skills through education is as important as capital accumulation, as far as production is concerned, and it is actually essential to analyze and explain it as thoroughly and systematically as all forms of capital, including natural and financial capital (Piaza, 2002). Countries investing large sums on all levels of education are usually leaders in terms of economic growth.

Education, as it comes out from comparisons on international level, absorbs a particularly large part of most (developed or developing) countries' State Budget, which in some cases, such as Denmark, reaches up to 8,3% of GDP. Governments invest large sums on education because they believe that this will promote their country's development (Figure 1). Expenditure on education seem to be one of the reasons for which many economists attempted to introduce the human capital factor in models estimating a nation's economic growth.

Focusing on greek economy, many changes have occurred between 1960 and until the end of 20th century. This has been a very critical period, including not

only continuous changes on the public education system, especially in the case of higher education, but also many political and economical transformations. Greece has been linked to (1959) and equally joined the EEC (1981) while at the end of the 1990's Greece became the 12th member of the euro-zone. Greek economy has been transformed from a primary sector based economy to a tertiary sector based economy, materializing a number of structural and functional reforms and adjustments, with or without much success. Greece also achieved high growth rates, especially during 1960-1980 and 1995-2000 as well as a satisfactory employment rate. On the other hand, 1980-1995 has been a period of high inflation, increased public debt and elevated public deficits.

Another distinctive feature of these 40 years time are Greece's educational system reforms. More specifically, an important reform during this time period has been the extension of mandatory education from 6 to 9 years (6 year primary and 3 year secondary education). This important reform has first been legally introduced in 1964 (with law decree 4379/1964) but hadn't been applied at that time. Later, law 309/1976 re-introduced and finally put into force the 9-year mandatory education. This reform as well as the general policy followed resulted to the development of all educational levels, while the number of graduates has significantly increased over time.

3. Methodology and Model

In order to estimate the effect of public education expenditures on Greek economy's growth during the time period 1960-2000, this paper will apply the methodology and model of Mankiw et al. (1992) [augmented Solow model]. Mankiw *et al.* (1992) used a Cobb-Douglas production function of the following form

$$Y = K^{\alpha} H^{\beta} (AL)^{1-\alpha-\beta} \tag{1}$$

where Y: the product, K: the physical capital, L: labor, H: human capital and A: the level of technology used. Labor and the level of technology used are considered to increase exogenously by rate n and g respectively. Therefore, in order to estimate the growth rate of the natural (s_k) as well as human (s_h) capital stock per effective unit of labor, we use the following functions

$$\dot{k} = s_k y - (n+g+\delta)k \tag{2}$$

$$\dot{h} = s_h y - (n+g+\delta)h \tag{3}$$

where $y = Y/AL$, $k = K/AL$ and $h = H/AL$ are the level of output, the stock of capital and the stock of human capital per effective unit of labour. Consid-

ering decreasing returns to scale, that is $\alpha + \beta < 1$, using functions (2) and (3) and taking logarithms, we transform framework (1) and end up with an equation on income per worker of the following form

$$\ln\frac{Y}{L} = \ln A + gt - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) \qquad (4)$$

where *sk*: the ratio of investment to product, *sh*: human capital investment, *n, g* and δ: the growth rates of labor, technology and capital amortization respectively and *t*: time. In this study we will use public expenditure on education, as a whole as well as per level of education (primary, secondary, tertiary) as human capital investment index. Proceeding to the last transformation of framework (4) and taking the fist differences, we end up to the following function

$$\Delta\log q_t = c_O + \alpha\Delta\log k_t + \beta\Delta\log(n+g+\delta)_t + \gamma\Delta\log EXP_t + \varepsilon_t \qquad (5)$$

where *q*: output per worker, *k*: investment as percentage of GDP, *EXP*: human capital index (which in this study is public expenditures on education as percentage of GDP), ε: the error term and *n, g,* δ: the growth rates of workers, technology and capital amortization respectively. As Δ we consider the first differences, thanks to which we are able to overcome the lack of time series stationary. In case we want to estimate the effect of public expenditures separately for each level of education, we transform framework (5) as follows

$$\begin{aligned}\Delta\log q_t = c_O + \alpha\Delta\log k_t + \beta\Delta\log(n+g+\delta)_t + \gamma\Delta\log EXP_{PRIM,t} \\ + \delta\Delta\log EXP_{SEC,t} + \psi\Delta\log EXP_{TER,t} + \varepsilon_t\end{aligned} \qquad (6)$$

where EXP_{PRIM} ,EXP_{SEC} ,EXP_{TER} are public expenditure on primary, secondary and tertiary education respectively.

4. Sources and Data

During the last forty years, Greece's average public spending on education has been exceeding 3% of its GDP (Figure 2), while in the years to follow this figure is expected to rise and approach the European average, rating at 5% of GDP[1]. However, before any new funding takes place, it is particularly useful to identify its potential contribution on national income, through achieving the

promotion of human capital. In essence what is under investigation is the effect of this government funding for education on GDP.

As we proceed to comparing the development of total public expenditure and public expenditure on education over time, it becomes clear that during the period 1960-2000 they both grew but following a different growth rate (Table 1). More specifically, during the 1980's took place the highest percentage rise of total public expenditure and the lowest growth rate on public expenditure on education. On the contrary, the highest increase of expenditure on education took place during the 1970's when total public expenditure showed the lowest growth rate. The period of study will be 1960-2000. The data source on GDP per worker, population and investment will be Penn World Table 6.1 and National Greek Accounts, from where we will retrieve the public education expenditures as percentage of GDP. After a first data analysis, we notice that during 1960-2000 there has been a significant GDP increase as well as a radical increase in the share of secondary education (Table 2).

More specifically, over the last forty years, Greece has more than tripled its income per worker, indicating an increase of 6,1%. However, the average level of public education expenditures has not taken this sharp increase. The milestone in the history of national education in Greece has been year 1975, when 9 – year compulsory education has been established constitutionally. Public expenditure increased from 2,5% of GDP in 1960 to 3,7%. However, when this forty- year period splits to four ten- year periods, it becomes obvious that this increase shows no uniformity. The second ten year-period (1960's) amount of expenditure had the highest growth rate, while the 1980's the lowest (Table 2).

Meanwhile, GDP per worker shows its lowest growth rate during the 1980's. It is notably worth mentioning the significant fall of GDP growth rate in 1974, compared to all previous and following years under study, mainly due to the oil crisis. When analyzing these figures per level of education, it becomes obvious that in the beginning of the time period under examination (1960) it was primary education that absorbed the largest part of public expenditure, while in the last year of study (2000) secondary education took its place. During these forty years, of course, funding for all three educational levels exhibited significant fluctuations (Figure 3).

Expenditure on primary education increased from 0,91% in 1960 to almost 1% of GDP in 2000, thus exhibiting the lowest growth rate during this forty year period (Table 3). On the other hand, public expenditure on both secondary and tertiary education doubled during the same time period, reaching 1,21% and

0,94% of GDP respectively. The highest growth rate for both primary and secondary education has been recorded during the 1970's and for tertiary education during the 1960's. But have these figures affected greek economic growth?

5. Empirical Analysis

In order to examine the impact of public expenditure for education on GDP per worker growth and test whether and to what extend this variable has a statistically significant effect, we move on to estimating framework (5) using public expenditure on education as human capital index. Following Mankiw *et al*. (1992) we consider that $g+\delta=0,05$ remains constant during the whole period of study. It is mentioned that all variables are stationary on 5% significant level (Table 4).

The results from estimating framework (5) are depicted on Table 5[2]. The public expenditure coefficient is statistically non-significant and signed negative (case 1). Next, a dummy variable (D) is introduced in the pre-mentioned framework (Prontzas, 2004). This dummy equals zero for the time period 1960-2000, except for year 1974, when income has been greatly disturbed, in which case it equals 1. Introducing this dummy in the framework (case 2) improved its explanatory power (higher R^2), without, significantly influencing coefficients of the rest of the variables.

However, because a significant amount of time is required in order for the effect of public education expenditure on the economy's growth rate to be completed, we are going to proceed to the use of time lags. The introduction of time lags is judged as necessary, especially in the case of education expenditure (see McMahon (1998) and Petrakis and Stamatakis (2002)). This is because a certain time intervenes between the point when public expenditure on education takes place and the activation of the respectively educated workforce (so that it contributes to the economy). We estimate that an average period of eight years is necessary in order for the effects of public education expenditure to show on an economy's growth rate.

By using the previously mentioned dummy and eight period time lags the coefficient of the public expenditures on education becomes positive and statistically significant (case 3). It should also be noted that in this last case the framework's explanatory power has also increased. More specifically, the estimated framework succeeds in explaining up to 55% of the economic growth (Adjusted $R^2=0,55$) achieved in Greece during the same period..

We therefore conclude that the use of time lags when examining public education expenditure's effect on greek economy's growth rate gives positive and statistically significant results. This effect, (equaling 0,09) is, however, relatively low, as for every increase by 1% in the public expenditure on education (as percentage of GDP) causes an increase of 0,09% on GDP per worker. Considering that during 1960-2000 public expenditure on education averagely increased by 1,11%, annualy the effect of public education expenditure on economic growth is estimated to 0,10% per year.

Following these results, it seems necessary to also examine the effect of public expenditure on education, separately for each level, in order to retrieve a more complete picture of their effect on GDP. We then estimate the framework (6). Our data base for estimating these variables has been the National Greek Accounts for years 1960-2000. As mentioned on table 3, all variables are stationary on 5% significant level.

As we can see in table 6, the econometrical estimation of framework (6) doesn't lead to safe conclusions as to the effect of public expenditure for education on economic growth. In case 1, we could see that all coefficients of public expenditure for all three levels of education are statistically non-significant, while the coefficients of the expenditures on secondary and tertiary education are negative. Next the same dummy we used previously is included in the model. As a result, the framework's explanatory power is being improved (higher R^2), without any observed changes in the estimated coefficients.

However, as previously mentioned, it is necessary to estimate the effect of public expenditure on education by using time lags. In this model, we include expenditures structured on three educational levels, so we should use a different time lag for each level. This is considered necessary as the required time period for the effect of education on the economy's growth rate to complete differs for each educational level (primary, secondary and tertiary). For this reason we are going to use twelve time lags for the expenditure on primary education, six time lags for secondary and four time lags for tertiary education (case 3). We see that their coefficients are now positive, but still not statistically significant. We should, however, point out that their explanatory power has been improved (increased R^2). In this case, we succeed in explaining up to 56% of the economic growth (Adjusted $R^2=0,56$) achieved in Greece during the period 1960-2000. However, we don't yet have a clear picture on the effect that public expenditure for all three levels of education has had on Greece's economic growth.

In these cases, we have been able to confirm the conclusions of other studies (see Hanushen and Kimko, 2000), which found a not clearly contributory effect of public expenditure for education on GDP growth. On the other hand, these results may stress the need for a new model or expenditure index, since education does have a series of positive externalities and spillovers. However, expenditure's effect on these externalities can not be incorporated in one production function.

6. Concluding Remarks

According to the existing literature there is a large amount of evidence that human capital, and therefore education, have a significant impact on economic growth. However, there is not clear evidence about the relation between public education expenditures and economic growth. This paper has analyzed the effect of public education expenditures on economic growth (in terms of GDP per worker growth) in Greece during the period 1960-2000. This period has been most crucial as significant economic, political and social changes have taken place. In order to estimate expenditures' contribution on economic growth, this paper used the methodology and model of Mankiw *et al*. (1992) and the percentage of enrollments in secondary education as index.

The econometrical framework explained up to 60% of economic growth rate through the use of a dummy variable and time lags in education expenditures coefficient. The effect of public education expenditures has been proven positive and statistically significant as to GDP per worker growth rate, although its value was very low. Results showed an even slighter effect when public education expenditures split in three levels of education. These findings tend to enforce the need for further research in order to estimate the effect of public education expenditures on economic growth with more suitable models.

APPENDIX

TABLE 1

Total Public Expenditures and Public Expenditures on Education in Greece (1960-2000).

	Total Public Expenditures (as % of GDP)	Public Expenditures on Education (as % of GDP)	Total Public Expenditures average growth rate	Public Expenditures on Education average growth rate
1960	25,73%	2,50%	-	-
2000	46,70%	3,71%	-	-
1960 – 2000	35,84%	3,03%	1,60%	1,11%
1960 – 1970	26,85%	2,87%	1,92%	1,20%
1970 – 1980	30,59%	2,86%	0,86%	1,59%
1980 – 1990	39,44%	3,13%	2,47%	0,44%
1990 – 2000	45,54%	3,26%	1,22%	1,22%

Source: Penn World Table 6.1 and National Greek Accounts 1960 - 2000.

TABLE 2

GDP and Public Expenditures on Education in Greece (1960-2000).

	GDP per worker (USD, 1996 as base year)	Public Expenditures on Education (as % of GDP)	GDP per worker average growth rate	Public Expenditures on Education average growth rate
1960	10.254	2,50%	-	-
2000	35.243	3,71%	-	-
1960 – 2000	26.093	3,03%	6,12%	1,11%
1960 – 1970	15.320	2,87%	11,24%	1,20%
1970 – 1980	27.488	2,86%	4,30%	1,59%
1980 – 1990	30.221	3,13%	0,10%	0,44%
1990 – 2000	31.887	3,26%	1,21%	1,22%

Source: Penn World Table 6.1 and National Greek Accounts 1960 - 2000.

TABLE 3

GDP and Public Expenditures on Education in Greece (1960-2000).

	Public Expenditures on Education (as % of GDP)			Average growth rate		
	Primary level	**Secondary level**	**Tertiaryl level**	**Primary level**	**Secondary level**	**Tertiary level**
1960	0,91%	0,60%	0,45%	-	-	-
2000	0,99%	1,21%	0,94%	-	-	-
1960 – 2000	0,98%	0,91%	0,60%	0,55%	2,28%	4,27%
1960 – 1970	1,01%	0,69%	0,55%	0,82%	0,50%	8,03%
1970 – 1980	0,96%	0,69%	0,54%	0,87%	5,27%	1,67%
1980 – 1990	1,03%	1,04%	0,54%	0,47%	3,09%	1,73%
1990 – 2000	0,95%	1,20%	0,75%	0,12%	0,30%	5,87%

Source: Penn World Table 6.1 and National Greek Accounts 1960 - 2000.

TABLE 4

Result of Unit Root Test

	without include trend or intercept in equation		include intercept in equation		include trend and intercept in equation	
	ADF Test Statistic	**5% Critical Value**	**ADF Test Statistic**	**5% Critical Value**	**ADF Test Statistic**	**5% Critical Value**
$\Delta\log qt$	-2,410978	-1,9504	-3,008586	-2,9446	-3,622190	-3,5386
$\Delta\log kt$	-4,590911	-1,9504	-4,589131	-2,9446	-4,540440	-3,5386
$\Delta\log(n+g+\delta)t$	-7,520745	-1,9507	-7,429648	-2,9472	-7,335609	-3,5426
$\Delta\log EXPt$	-4,187888	-1,9504	-4,177782	-2,9446	-4,195666	-3,5386
$\Delta\log EXP_{PRIM,t}$	-5,219151	-1,9504	-5,108861	-2,9446	-5,122596	-3,5386
$\Delta\log EXP_{SEC,t}$	-5,170191	-1,9504	-5,372403	-2,9446	-5,555731	-3,5386
$\Delta\log EXP_{TER,t}$	-5,842017	-1,9504	-5,848000	-2,9446	-5,833995	-3,5386

Note: The critical values signify that all variables are stationary on 5% significant level. MacKinnon critical values for rejection of hypothesis of a unit root.

TABLE 5

Public expenditure on education effect on GDP growth

	Case 1	**Case 2**	**Case 3**
c_o	0,017 [a]	0,019 [a]	0,013 [a]
	(3,400517)	(4,028280)	(2,760575)
$\Delta\log k_t$	0,279 [a]	0,217 [a]	0,225 [a]
	(4,542079)	(3,503040)	(3,638038)
$\Delta\log(n+g+\delta)t$	-0,004	-0,005	-0,004
	(-0,457087)	(-0,612918)	(-0,553565)
$\Delta\log EXPt$	-0,049	-0,046	
	(-0,769534)	(-0,778952)	
$\Delta\log EXPt(-8)$			0,091 [a]
			(1,857749)
Dum		-0,083 [a]	-0,080 [a]
		(-2,500260)	(-2,674507)
R^2	0,43	0,52	0,61
Adjusted R^2	0,39	0,46	0,55
Observations	38	38	31

Note: The dependent variable is Δlnqt (1960-2000), t-Statistics in parenthesis, [a] indicates that the coefficient is significantly different from 0 at the 5% significance level.

TABLE 6

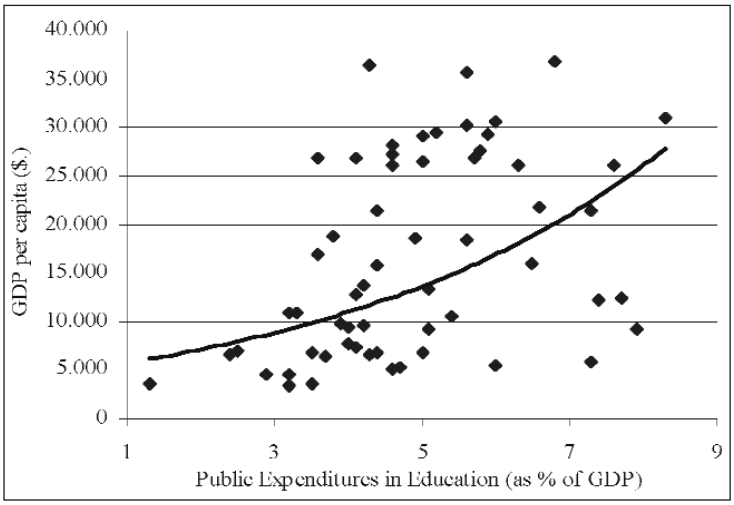
The effect of public expenditure for education (all three levels) on GDP growth

	Case 1	**Case 2**	**Case 3**
c_o	0.019 [a]	0.021 [a]	0.011 [a]
	(3.567157)	(4.086311)	(2.109172)
$\Delta\log k_t$	0.302 [a]	0.244 [a]	0.215 [a]
	(4.811291)	(3.783050)	(3.284289)
$\Delta\log(n+g+\delta)t$	-0.002	-0.004	-0.004
	(-0.274326)	(-0.462659)	(-0.411969)
$\Delta\log EXP_{PRIM,t}$	0.006	-0.009	
	(0.069333)	(-0.099775)	
$\Delta\log EXP_{SEC,t}$	-0.036	-0.023	
	(-0.498116)	(-0.336059)	
$\Delta\log EXP_{TER,t}$	-0.008	-0.007	
	(-0.852705)	(-0.754706)	
$\Delta\log EXP_{PRIM,t}$ (-12)			0.091
			(1.579917)
$\Delta\log EXP_{SEC,t}$ (-6)			0.082
			(1.467260)
$\Delta\log EXP_{TER,t}$ (-4)			0.002
			(0.244602)
Dum		-0.078 [a]	-0.077 [a]
		(-2.277711)	(-2.403530)
R^2	0.43	0.52	0.66
Adjusted R^2	0.36	0.43	0.56
Observations	38	38	27

Note: The dependent variable is Δlnqt (1960-2000), t-Statistics in parenthesis, [a] indicates that the coefficient is significantly different from 0 at the 5% significance level.

FIGURE 1

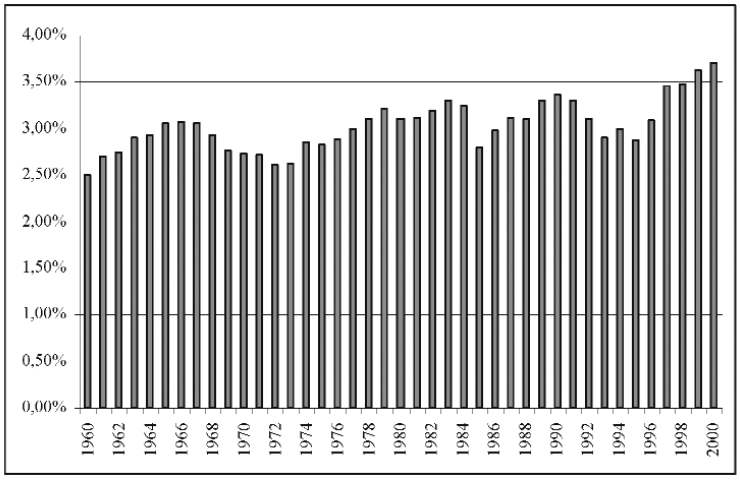
Public expenditure for education and GDP per capita



Source: United Nations, Human Development Indicators, http://hdr.undp.org/.

FIGURE 2

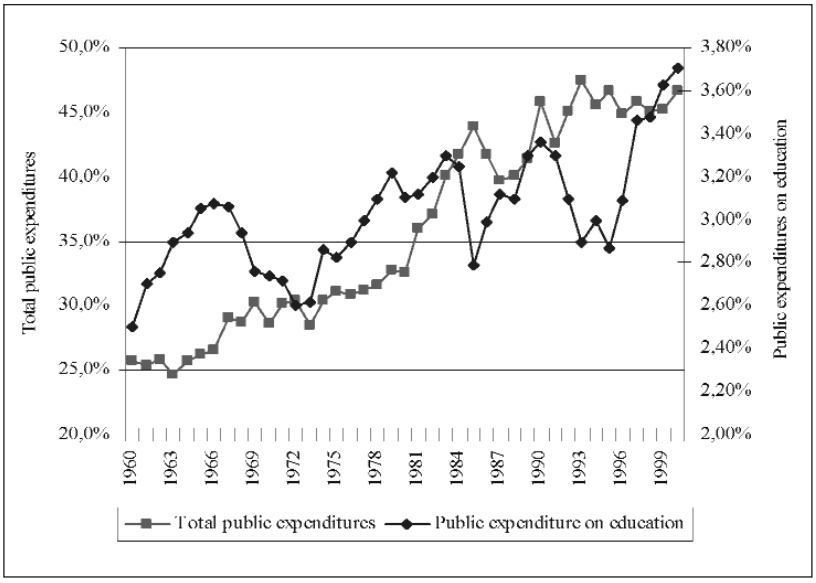
Public expenditure for education in Greece as percentage of GDP (1960-2000)



Source: National Statistical Service, National Accounts 1960 - 2000.

FIGURE 3

Total Public Expenditures and Public Expenditures on Education in Greece (1960-2000). [as % of GDP]



Source: National Statistical Service, National Accounts 1960 - 2000.

Notes

1. It should be mentioned that this paper examined only the public and not the private spending for education. It should, however, be of great interest to include, in another study, private spending for education, which is estimated as particularly high, in order to estimate its effect in economic growth.

2. In all examined cases the Serial Correlation LM test and the White Heteroskedasticity test have been run. They have verified that there is no heteroskedasticity problem in the error terms. We faced first class correlation problem, which we resolved using the Cochrane-Orcutt method.

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