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Public capital, employment and productivity: An empirical investigation for Greece

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Abstract

Scope: The aim of this study is to bring out the importance of public employment, in the Greek economy's productivity and competitiveness.

Method: A brief introduction followed by a literature review, the model adopted, the estimates and analysis of results and brief concluding remarks.

Expected results: Identification of the possibilities of redistribution of employment from the public to the private sector of the economy, in the case of Greece.

Originality: Better understanding of the productivity improvement and its side effects on international competitiveness and sustainable development. Usefulness for combined stabilization and sustainable development strategies.

Key words: public capital; public employment; economic development**.**

1. Introduction

In this paper, a documented analysis of the factors of productivity in Greece during the period 1970-2000 is presented. Immediately below follows a brief review of the relevant literature, focusing on (a) the effects of public expenditure and public consumption, (b) the role of public capital and public investment in infrastructure and (c) the relationship between investment in infrastructure and productivity. Due to lack of international literature on the effects of public employment on productivity and development, this topic is covered in the second section. The third section describes the model used to make estimates from and to justify the introduction of public employment as another distinct input. Subsequently, the sources of statistical data used for each variable are discussed and the estimates are presented. The fourth section is a commentary on the analysis carried out, on the estimates, while the basic conclusions are summarised in section five.

2. Literature review

Since productivity is the core or the other side of the economic development, its revisit is useful in terms of concept (definitions, coding, sources, factors, motivations, etc.), research specification and methodology, in view of the broad subject of economic development and structural change (to mention famous names such as Meier and Baldwin, Lewis, Rostow, Galenson and Leibenstein, Hirschman, Chenery, Timbergen, Nurkse, Currie, Arrow, the Solow/Denison controversy, etc.).

Practical importance has the more recent research of tracing out the causes of productivity from the middle of the decade of the 1970's, in the developed Western countries. For example, Griliches (1980), Nadiri (1980) and Terleckyj (1980) investigated the role of research and development (R&D)

expenditure. Denison (1979), Jorgenson and Fraumeni (1981) and Berndt (1982) found that energy prices were somehow related. Others like Clark (1982), Buck and Fitzroy (1988) and Bitros and Panas (2001) offered plausible evidence that the level and acceleration of inflation affect negatively productivity. Other researchers focused on the role of public expenditure, infrastructure, etc.

Research efforts in the direction of public expenditure, proceeded on four fronts. Specifically, one group of researchers paid attention to the total public expenditure, either as an absolute magnitude or as a percentage of the gross domestic product (GDP). A characteristic study in this category is that of Dar and Amir Khalkhali (2002), which used statistical data from databases of the organisation of economic co-operation and development (OECD) and of the International Monetary Fund (IMF) between the period 1971-1999. According to this research, the role of public expenditure to the increase in the real GDP during that period was negative. In addition, this negative effect was found to be constant regardless of the amount of public expenditure as a percentage of the GDP in the countries considered.

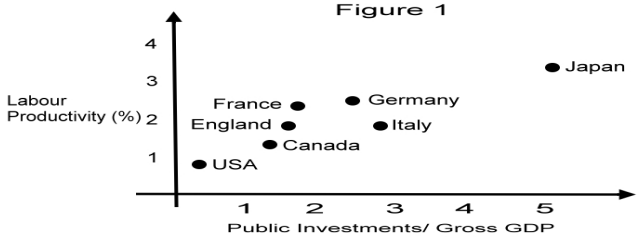
Another group of research focused on the effects of public consumption. Scientists across the board have agreed that the effect of public consumption is negligible, if not negative. This outcome is justified by Aschauer (1989) for the U.S.A. and the countries of the G7 group, from Kalyvitis (2003) for Canada and from Segoura and Christodoulakis (1996) for Greece in particular. Given that result, economist estimates highlighting the extravagant operational cost of the public sector are justified.

Research on a third front, looked at the role of public capital and public investment on productivity. Regarding public capital, Aschauer (1989) and Otto and Voss (1994) estimated its impact on productivity of the private sector of the economy with statistical data from the U.S.A. and Australia respectively. These results showed that in both cases public capital during the sample period affected positively productivity. What is surprising in this case is that the size of the effect is approximately the same, even though the economies of the U.S.A and Australia are different. Moreover, the claim that the relationship between public capital and productivity in the private sector of the economy is a positive one is supported by the research of Alesina, Gruen and Jones (1991), also with data from Australia.

The same conclusions, more or less, were drawn by researchers on the expansion at global economy level. In particular, it was shown that in the developed economies the expansion of public capital causes changes of GDP per private capital unit (U.S.A., Japan, Canada) first and then that of private capital. It is worth noting that according to the results of Shioji (2001) and Kalyvitis (2003), the beneficial consequences from the expansion of public capital are seen in the long term. Accordingly, this is due to the existence of elements of adaptation cost and scale economies (costs of information, training, restructuring production), because the latter require a period of adaptation to the new economic infrastructure. An exception to the above conclusions is the work of Evans and Karras (1994). Using data from seven OECD countries for the period of 1963-88, they found that the contribution of public capital to the increase of GDP was negligible.

Regarding the influence of public investment, the research is not restricted to developed countries but also to the less developed ones. Starting with the former, Aschauer (1989) used time series data from the member countries of the G7 for the period 1973-85 and found statistically significant positive relation between the percentage increase in product per employee –either public or private- and the ratio of public investment over the gross GDP. That relationship can be clearly seen in Figure 1 below.

Figure 1



Similar to the one above is the relationship estimated by Ram (1996) for the less developed countries. The data used in this model originate from 53 countries (cross section analysis) and independent checks for each country included in the model (time series analysis). In conclusion, the research resets conversely that both public as well as private investment contributes positively to the increase in productivity, regardless of income level or debt level. In any case, from the beginning of the 1980s up until 1990 and in contrast to what happened previously, Ram found that the role of public investment in the rise of real GDP has primary importance, exceeding even the role of capital. The reason is, according to the author, that due to environmental circumstances public expenditure was directed towards more productive uses. Positive correlation between public investment and the increase rate of GDP was also found by Segoura and Christodoulakis (1996) for Greece for the period 1951-1990.

Finally, measurement of the effect of public expenditure through research and development (R&D) on productivity has been made by Mamuneas and Nadiri (1994). Their results showed that public expenditure in R&D reduce the production cost of the private sector and therefore increase its productivity. During the period of 1960-69 when there was a 2% annual increase of total productivity of the American private sector, public expenditure in R&D increased at an annual rate of 6.5%, while according to Aschauer (1989) during the period 1969-79, when the productivity increase rate was literally flat (0.8% for the years 1971-85), the mean rate of the increase in public expenditure for R&D was 2.6%.

In summary, from the literature review the following main conclusions can be drawn. First, the productivity is negatively correlated to public expenditure and public consumption. Secondly, productivity is related positively to public capital and public investment in infrastructure in research and development. Thirdly, public investment in infrastructure has long-term rewards via three channels: the increase of productivity in the private sector, the increase of private investment, and possible improvement in the quality of life and the social welfare.

3. The model, the variables and the estimates

As mentioned, the research of the effects of public sector activity on the productivity has focused exclusively on the contribution of public capital and public investment in infrastructure. It means that within the framework of the model of Aschauer (1989) adopted, explicitly or implicitly, by the great majority of researchers, the role of public employment was ignored. However, private sector productivity takes places within a framework which can be considered as part of a country's social infrastructure. For example, law and order services which are important for the operation of private markets, assume extended public employment which must have a positive influence on productivity. Therefore, one innovation of this paper is the incorporation of the public employment in the model and to trace its effects on the private sector of the economy.

3.1 The model

Following Aschauer's (1989) model we assume that the production function in the private

economy is of the type Cobb-Douglas, which takes the form

$$Y = A \cdot F(N_p, N_s, K_p, K_s), \qquad (1)$$

where symbols Y, Np, and Kp correspond to the production of goods and services, and the employment and private sector capital respectively, whereas Ns and Ks correspond to the services provided by public employment and public infrastructure. Expressed with logarithms, (1) becomes

$$y = \alpha + e_{Np} * n_p + e_{Ns} * n_s + e_{Kp} * k_p + e_{Ks} * k_s, \qquad (2)$$

where the variables with lower-case letters represent the logarithms of the variables with corresponding capital letters. It is also assumed that for all inputs there hold constant scale economies i.e.

$$e_{Np} + e_{Ns} + e_{Kp} + e_{Ks} = 1$$

Under the last hypothesis, it is easily confirmed that the productivity of private capital is shown by:

$$y - k_p = a + e_{np}(n_p - k_p) + e_{ns}(n_s - k_p) + e_{np}(k_s - k_p) \quad (3)$$

Finally, due to the time series possibly exhibiting a linear tendency and also reflecting the effects of the economic cycle, the model for estimation takes the form

$$y - k_p = a_0 + \alpha_1 t + a_2(n_p - k_p) + a_3(n_s - k_p) + a_4(k_s - k_p) + a_5 u + \varepsilon \quad (4)$$

where t is the time variable, u is the unemployment percentage and ε is a disturbance term.

3.2 The variables

The statistical data for the employment variables in the private and in the public sector and of the unemployment percentage for the estimation of the effects of the economic cycle, were drawn from the databank of annual economic series AMECO of the European Commission and refer to the period 1971-2000. For the measurement of the production of goods and services in the private sector, the above source does not distinguish between gross domestic product of the private sector and that of the public sector. For this reason, the series of GDP in constant Euro values from 1995 in the private sector was produced by summing the GDP of selected fields from the basis of macro-economic chronological series of the Greek Ministry of Economy and Finance. More precisely, assuming that in the aforementioned fields, production activity is mainly due to private entities, that variable was constructed by the sum of the GDP in the fields of agriculture, manufacturing, construction, commerce, housing and other services.

Finally, for the sake of completeness, we note that the two variables of net capital deposit in the private and public sector of the economy were constructed with the method of infinite deposit (taken from Professor Bitros). The construction of a time series of net capital deposit using the above mentioned method requires (a) the series of investments incorporated into the capital, (b) the starting observation of the series of capital deposit and (c) the pay-off coefficient of capital goods comprising the capital deposit. In our case, the only available data was the series of investments in the private and public sectors. For that reason, in order to apply the method of infinite deposit, the method of *Prucha* and *Nadiri* (1996) was adopted. In particular, it was assumed that the capitalistic goods in the private and public sector are paid-off at a rate of 8% and 5% respectively per annum. In addition, to calculate the values of capital deposit in the year 1971, the investments of that year were divided by the pay-off coefficient plus the rate of expansion of the gross domestic product.

3.3. The estimates

The results obtained by the estimates of the model are presented in Table 1 below. From column D.W., it is observed that the only equation which could exhibit an autocorrelation of errors is equation (4.3). For that reason, it was estimated again using the method for correction of possible first-order autocorrelation and the diagnostic test was negative. Therefore we can assume that our estimates are independent of autocorrelation. On the basis of that reasoning and the observation that in equation (4.1) two coefficients are not statistically significant with an acceptable confidence margin, our choice is limited between equation (4.2) and (4.3). However, equation (4.2) is missing the variable of public capital which, apart from being of particular interest to us, is present in all models mentioned in the literature. By elimination, we are left with (4.3) which we may conclude **that** is the most appropriate equation for drawing conclusions.

Table 1

Estimates using model (4)[1]

	Variables						- R^2	D.W.	SSR
	A_0	t	n_p-k_p	n_s-k_p	k_s-k_p	U			
4.1	-19.56 (-1.34)	0.0009 (1.28)	0.640 (2.88)	-0.375 (-3.85)	0.208 (1.10)	-0.027 (-5.28)	0.937	1.99	0.014
4.2	-34.72 (-6.79)	0.016 (6.28)	0.867 (10.1)	-0.393 (-4.07)	…….	-0.031 (-6.53)	0.937	2.09	0.015
4.3	-0.853 (-2.32)	…….	0.374 (4.77)	-0.329 (-3.59)	0.432 (6.19)	-0.023 (-5.93)	0.936	1.73	0.015

Footnotes: 1. All equations were estimates using the ordinary least squares method

2. The numbers in parentheses underneath the estimates correspond to the values of the t-statistic

4. Analysis

From equation (4.3) it is derived that the productivity of private capital in Greece in the 30-year sampling period correlated negatively with public employment and positively with public capital. More precisely, according to the estimates, for each 1% increase of employment in the public sector, productivity was reduced by 0.329%, while the same percentage increase of public capital led to a productivity increase of 0.432%. Therefore, the attempt of the country to obtain infrastructure in that period contributed to an increase in private capital productivity to a degree, which was neutralized by the expansion of public employment. This fundamental observation sheds light on the slowdown of the development process observed in Greece since 1980.

A second conclusion comes from the observation that private employment relates positively to private capital productivity. In particular, equation (4.3) yields that for each 1% increase of private employment, private sector productivity increases by 0.374%. Therefore, had the necessary policies been adopted to change the distribution of employment resources from the public to the private sector,

the consequences on development would have been dramatic. More precisely, for each 1% transfer of employment from the public to the private sector there would be a productivity increase of 0.703%.

A third conclusion is that the contribution of public capital to productivity is very close to that found by other authors. In particular, using a different methodology and sampling period, Segoura and Christodoulakis (1996) found that that the coefficient of public capital in Greece is 0.42, corresponding to our estimate of 0.432. More interestingly, the estimates for other countries are also in the same magnitude. For example, Aschauer (1989) found that the coefficient for the U.S.A is 0.39, while the corresponding coefficient for Australia in the research of Otto and Voss (1994) is 0.445.

Finally, it is worth noting that as expected, the economic cycle expressed by the percentage of unemployment negatively influences the productivity of the private sector. This result coincides with estimates from other researchers who take into account the influences of the economic cycle with variable employment vacancies or the utilization rate of the productivity base of the economy.

5. Conclusions

In the last two decades, there was a great expansion of the infrastructure in the case of Greece. According to the results of this study, as well as those of Segoura and Christodoulakis (1996), due to the acceleration of productivity in the private sector, the development process rate should have been significant. However, the mean rate of increase of the GDP observed was close to zero. One of the reasons for this is that in the same time period there was an over-expansion of public employment which influenced negatively the productivity. Therefore, the best prospects for a faster economic development of Greece will be obtained by redistributing work resources from the public to the private sector.

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