



# Long-run growth and welfare in a two sector endogenous growth model with productive and non-productive government expenditure

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## ABSTRACT

We develop a two-sector model of physical and human capital accumulation, where public goods provide both productive capital (i.e. infrastructures) and utility enhancing services. We analyze the impact of both the level of government expenditure and its composition on growth and welfare, under different production technologies, and derive their respective growth and welfare-maximizing levels. We show that contrary to what happens with welfare, the long-run growth rate is increasing in the intertemporal elasticity of substitution but decreasing in the relative weight of public goods in utility. Furthermore, the welfare-maximizing tax rate is lower than the growth-maximizing tax rate, whereas the welfare maximizing share of productive government expenditure is greater than the growth maximizing share. Finally, we employ numerical simulations to get a better understanding of the model.

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*"...It's a handwritten letter from Abraham Lincoln – back when he was a regular citizen – requesting that better roads be built by the government..."*

Brad Meltzer, The Inner Circle (2011, chapter 69).

## 1. Introduction

The importance of government expenditure for growth and welfare has been widely studied and recognized, with the impact depending on whether government expenditure on goods and services is classified as productive (productivity-enhancing) or nonproductive (utility-enhancing). Productivity-enhancing government expenditure usually refers to expenditures on infrastructure, education, health and workers' training, etc., and thus expected to yield significant growth benefits.<sup>1</sup> Nonproductive expenditures usually refer to expenditures on social programs, national defense, national parks, etc., and thus likely to have important welfare benefits and possibly negative growth implications. In this paper we follow Chatterjee and Ghosh (2011), and

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<sup>1</sup> See Agénor (2012) for a comprehensive treatment of the theoretical literature, and Bom and Ligthart (2009), and Gramlich (1994) for a review of the empirical literature.

argue that public goods such as infrastructures, education, and healthcare play a dual role by being simultaneously productivity and utility enhancing.

To help motivate this idea, we present a few examples.<sup>2</sup> For instance, it is not hard to imagine that the presence of electricity allows the access to computers and other devices that improve the production process, hence increasing productivity. However, the presence of electricity might also be an important source of utility to consumers, who might get pleasure from watching TV, going to the movies, or playing games on the computer. In addition, the presence of electricity increases the time of study, thus increasing capital accumulation, which ultimately makes the economy more productive but also allows better educated people to enjoy higher utility derived from reading books.

Once we accept that productive government expenditure plays a dual role, it becomes important to understand how the government allocates limited public resources among competing productivity-enhancing activities. More precisely, how should governments distribute resources between the industrial sector (final good sector) and education? This is an important question, central to the debate on poverty reduction, real convergence, and sustained per capita income growth. The answer although extremely important for policy decisions, is not simple. Understanding the impact on the growth and welfare performance of both types of investment (education or final output) is critical, for instance, for the receiving countries of the European structural funds, created to reduce income disparities between the so called rich countries and the developing economies. Furthermore, the recent shift in the role assigned to public expenditure in the United Nations Development Project, from an instrument of short-run macroeconomic adjustment, at the time of its inception in 1999, to a “supply-side” instrument that can generate sustained per-capita growth, in the 2005 version, makes the answer to this question central to understand where the government should focus its attention.

The impact of public infrastructures on growth has been extensively analyzed both empirically and theoretically.<sup>3</sup> The empirical literature relating public investment to growth was made popular by the early work of [Aschauer \(1989\)](#), who found very strong effects of public capital on total factor productivity for the U.S. economy,<sup>4</sup> later supported by [Barro \(1991\)](#) who obtained a positive effect of government investment on growth. More recently,<sup>5</sup> [Easterly and Rebelo \(1993\)](#), [Evans and Karras \(1994a, 1994b\)](#), [Canning \(1998, 1999\)](#), [Demetriades and Mamuneas \(2000\)](#), and [Calderon and Servén \(2005\)](#) find a positive relationship between infrastructure and long-term growth. This empirical evidence has stimulated the development of theoretical work looking at the impact of public investment on economic growth.

The theory has followed two distinct approaches.<sup>6</sup> The first approach treats public spending as a flow, raising the marginal product of capital directly. This was pioneered by [Barro \(1990\)](#) and followed by [Rebelo \(1991\)](#), [Glomm and Ravikumar \(1994\)](#), [Turnovsky and Fisher \(1995\)](#), [Turnovsky \(2000a\)](#). The second approach starts from the idea that as long as productive government expenditures are intended to represent infrastructures, it should be represented as a stock, rather than a flow. Therefore, public investment raises the stock of public capital, which in turn affects the marginal product of private capital. Authors following this approach include [Futagami et al \(1993\)](#), [Fisher and Turnovsky \(1998\)](#), [Rioja \(1999\)](#), [Rivas \(2003\)](#), [Turnovsky \(2004\)](#), [Gomez \(2008\)](#), and [Agénor \(2011a, 2011b, 2012\)](#). It is generally accepted that the choice between these two approaches involves a tradeoff between tractability and realism. Moreover, flow and stock specification have been shown to yield qualitatively similar results in some cases.

The impact of public capital on education outcomes and human capital accumulation has only recently begun to receive much attention. This is interesting if one considers that in most countries education is provided free of charge, at least at the primary and secondary levels, by the government and that school attendance is mandatory. The empirical evidence relating spending on education with economic growth, however, is not consensual. [Cullison \(1993\)](#), [Easterly and Rebelo \(1993\)](#), [Barro and Lee \(1994\)](#), and [Barro and Sala-i-Martin \(1999\)](#) find that government spending on education has a positive effect on growth, while [Levine and Renelt \(1992\)](#) conclude that only 3 variables are robustly correlated with the growth rate of income, and government spending on education is not one of them.<sup>7</sup>

At the theoretical level, various contributions have extended the [Lucas \(1988\)](#) framework to account for government spending on education. They include but are not limited to [Cullison \(1993\)](#), [Barro and Lee \(1994\)](#), and [Eckstein and Zilcha \(1994\)](#), [Glomm and Ravikumar \(1992, 1997, 1998\)](#), and [Blakeanu and Simpson \(2004\)](#). For example, [Glomm and Ravikumar \(1992, 1997, 1998\)](#), develop an overlapping generations (OLG) model which distinguishes between public and private investment in education, [Eckstein and Zilcha \(1994\)](#), investigate the effects of compulsory schooling on growth using an OLG model with productive

<sup>2</sup> Readers should refer to [Chatterjee and Ghosh \(2011\)](#) for further examples.

<sup>3</sup> This research can actually be traced back to [Kuznets \(1973\)](#), who emphasized the increased significance of government for economic growth, resulting from the growing significance of public infrastructures, such as roads, ports, airports and water systems, as well as the increased role for formal education as one characteristic of modern economic growth in the growth process.

<sup>4</sup> [Aschauer \(1989\)](#) estimation of the elasticity of output with respect to public capital was around 0.36. Similarly, [Munnell \(1990\)](#) found that the marginal product of capital was around 0.34. These high results were challenged in later empirical studies, and more recently [Bom and Ligthart \(2009\)](#) finds an average figure for the contribution of public capital of around 0.08. A good survey of the early empirical literature, along with a discussion of the econometric issues, can be found on [Gramlich \(1994\)](#).

<sup>5</sup> See [Calderon and Servén \(2004\)](#), [Bom and Ligthart \(2009\)](#) and [Arslanalp et al. \(2011\)](#), for a summary of some recent empirical studies.

<sup>6</sup> A good literature survey can be found in [Irmen and Kuehnel \(2008\)](#).

<sup>7</sup> Recent work by [Minier \(2007\)](#) points to the fact that the small number of significant variables found by [Levine and Renelt \(1992\)](#) may be at least partly due to the common assumption of linearity in growth regressions. The generalization of the specification of the growth regression to allow the marginal effect of explanatory variables to vary, the number of robust variables increases substantially, with the most striking result being the robustness of fiscal policy variables when one controls for nonlinearities.

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