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Transport infrastructure and long-run economic growth in OECD countries



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ABSTRACT

This paper provides an empirical evaluation of the growth impact of public infrastructure in a panel of 18 OECD countries during 1870–2009. This study goes beyond the traditional analysis of growth accounting models by exploring the indirect effect of stock of core infrastructure on output growth through its impact on productivity. Constructing a long-run historical dataset on infrastructural capital formation spanning from 1870, estimated results show that growth in both labour productivity and total factor productivity are positively, but not substantially, influenced by growth in the stock of infrastructure. Furthermore, applying the system GMM technique (Generalised Method of Moments) reveals that although rate of returns to investment in infrastructure exceed the private rate in OECD countries, it is not as high as positive externalities associated with investment in equipment and structure investment.

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1. Introduction

An important part of government expenditure is the finance and maintenance of infrastructure capital as one of the productive sectors in any economy. Public infrastructure forms a means by which governments can effectively promote economic growth, as it performs a vital role in stimulating countries' economies, so much so that the World Bank refers to public capital, especially infrastructure, as the “wheels” of any economic activity (World Bank, 1994). Amongst different types of infrastructure, transport as a productive public expenditure is one of the critical sectors in any economy, since an economy can benefit from transport facilities by accelerating access to the services, increasing the market mobility, saving time and reducing business costs.

The purpose of this paper is to provide empirical evidence for investigating the influence of government expenditures on infrastructure in stimulating the economic performance of OECD countries. To address this, it is crucial to know whether an increase in public investment in infrastructure have an indirect and significant effect on the long-run economic growth of OECD countries by increasing their productivity. In order to answer this question, this study empirically tests a growth model in which the connection between productivity and public spending in infrastructure is examined. Furthermore, the rate of returns to infrastructure investments is also investigated, so as to determine the extent to which rate of returns to investments in the transport sector exceed its private returns amongst the OECD members.

This paper contributes to the literature in three ways. The first one is the construction of a long-run historical dataset on infrastructural capital formation, over the last 140 years for a panel of 18 OECD countries. To the best of my knowledge, the existing literature has only covered post-war periods for cross-section studies, from 1950 onward, and this is the first time

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that a longer perspective is taken into account in analysing the links between investment in infrastructure and economic growth.

Secondly, this paper presents a model in which the role of stock of infrastructure investment as an influential factor of economic growth is examined through productivity gains. While a few studies have addressed the indirect impact of infrastructure on economic growth through raising total factor productivity (TFP) or labour productivity, they only considered regional or industrial levels, and did not take into account cross-country levels (see [Hulten and Schwab, 1991](#); [La Ferrara and Marcellino, 2000](#)). It is worth mentioning that two different measurements of productivity are used in this study, namely labour productivity and total factor productivity. This is done to enable us to analyse the differences in the impact of public infrastructure on each measure over the time period considered, and across selected countries.

Finally, in contrast to the existing literature, which has used “total public expenditure” as a proxy for infrastructure investment, this paper focuses on a more precise classification of infrastructure called “core infrastructure” which includes roads, highways, airports, railways, inland waterways and public transport, on productivity growth. Public investment expenditure, which has been used in many previous studies, cannot properly represent infrastructure investment, since, rather than only taking into account infrastructure, it contains more dimensions, and therefore is not a reliable proxy ([Gramlich, 1994](#); [Fernández and Montuenga-Gómez, 2003](#)). In line with what was mentioned earlier, this paper demonstrates that the final impact of infrastructure on economic growth is due, not only to the input role that infrastructure has in the production function as a public good, but also to the indirect effect of capital infrastructure in shifting productivity in an economy in various ways, such as improvements in learning by doing, increasing the efficiency of labour, and saving working time.

The paper is organized as follows. Next section reviews the existing literature on the links between investment in public capital and economic growth. In Section 3 the anatomy of public infrastructure growth over the last 140 years is presented. Section 4 describes the model specification, variables, and the methodology, while Section 5 devoted to the empirical results and the robustness check of investigating the link between infrastructure investment and productivity. Section 6 is devoted to exploring the social rate of returns to investment in transport infrastructure. Last section concludes the paper.

2. Infrastructures and economic growth: a review

Following the publication of the seminal work of [Barro \(1991\)](#), who introduced government spending into the production function as a public good, many scholars focused on the impacts of fiscal policy, through public expenditure and taxation, on long-run economic growth. Prior to Barro, the study of infrastructure as a productive sector dates back to the pioneering contribution of [Aschauer \(1989\)](#), in which he highlighted the importance of productive government services for the US economy in the 1970s, although his results were challenged by scholars such as [Gramlich \(1994\)](#) and [Sturm \(1998\)](#), who proved that the actual growth impact of real government capital is much smaller than what Aschauer reported.

According to [Romp and De Haan \(2007\)](#), the existing empirical literature on public capital can be grouped into four methodological strands, including production function approach, cost function approach, growth models, and Vector Auto-Regressive Models. Moreover, each approach can be categorized into three different subsections: (1) national and cross-country, (2) regional, and (3) industry studies.

First, the production function approach, which models the amount of output that can be produced for each factor of production. Assuming technological constraints, public infrastructure enters these models as an input supported by government (see, for instance, for cross-country studies: [Esfahani and Ramirez, 2003](#); [Boopen, 2006](#); for regional studies see, [Picci, 1999](#); [La Ferrara and Marcellino, 2000](#); and for industry studies see, [Fernald, 1999](#); [Yeoh and Stansel, 2013](#)). Second, the cost function approach, which assumes infrastructure as a free input provided by the government with the cost savings impact. The main aim of studies which used this approach is to determine whether or not increases in infrastructure endowment decrease the cost of output (see for cross-country studies: [Demetriades and Mamuneas, 2000](#); [Loizides and Tsionas, 2002](#); for regional studies, [La Ferrara and Marcellino, 2000](#); [Vijverberg et al., 2011](#); and for industry studies, [Moreno et al., 2003](#)). Third, the endogenous growth models, which try to investigate the growth impact of infrastructure, based on the idea that economic growth is not driven merely by exogenous factors, but is in fact an endogenous phenomenon (see for cross-country studies: [Easterly and Rebelo, 1993](#); [Égert et al., 2009](#); for regional studies, [Mas et al., 1996](#); [Jayme et al., 2009](#); and for Industry Studies, [Cellini and Torrisi, 2009](#)). Finally, data-oriented models which do not rely heavily on economic theory but analyse the relationships between several data series, including infrastructures and GDP (for cross-country studies see, [Kamps, 2005](#); [Ghani and Din, 2006](#); [Guo et al., 2011](#) and for regional studies, [Herranz-Loncán, 2007](#); [Márquez et al., 2011](#)).

To conclude, although many empirical studies have examined the growth impact of public infrastructure, but an overall review of the literature highlighted the existing gaps in this area of research, suggesting the need for a new dimension of time, necessity of using a proper proxy for infrastructure investment, and applying a new growth model in which infrastructure investment is examined through productivity gains. The following sections attempt to address the above mentioned issues.

3. Anatomy of public infrastructure growth over the last 140 years

Before examining the productivity impact of infrastructure investment, it is worth looking at the long run trend of public spending on infrastructure and its decomposition results for the 18 OECD countries, namely, Australia, Belgium, Canada,

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