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Macroeconomic effects of the regional allocation of public capital formation ☆

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ABSTRACT

This paper proposes a multi-regional, general equilibrium model with capital accumulation to analyze the economic impact of the spatial distribution of public capital formation. This model is calibrated and solved by using data for the Spanish economy in order to simulate some comparative dynamic exercises of fiscal policy changes. These analyses illustrate the role that public investment plays in generating the existing imbalances in regional development. This is done by computing the spillover effects and the opportunity costs of regional distribution of public investment. Finally, two rankings of regional priorities in public investment can be derived: one based on the criterion of reducing regional disparities, and another based on an efficiency criterion.

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1. Introduction

Public investment in productive infrastructures is one of the fundamental responses of governments to the existing imbalances in regional development. This public intervention is based on the view that observed disparities in income per capita across regions primarily reflect differences in endowments of production factors and in total factor productivity (TFP, henceforth). Since this regional policy absorbs a lot of resources, recent literature has explored the effectiveness of public investment in reducing the observed differences in income levels across regions. In this line, this paper sets up a multi-regional, dynamic-optimization model with capital accumulation as a tool with which to analyze the effects of public infrastructure investment on regional economic performance.

The interest in evaluating the impact of public capital formation in private output was brought by Aschauer (1989), who concluded that public capital formation would have a meaningful positive effect on TFP. This conclusion, together with the observed differences in the endowments of public capital across regions, has inspired subsequent research focusing on the regional dimension of public capital formation. This literature has found no clear evidence of a positive linkage between public capital and private output at the regional level.[3] The inconclusive nature of this literature may be partially explained by the fact that the majority of these works estimate the parameters of aggregate production functions, where the coefficient on public capital is interpreted as the elasticity with respect to this variable. Thus, this methodology can only account for the direct effects of public capital on private output as a determinant of regional TFP. However, public capital formation can also affect economic performance by changing saving, capital accumulation and/or time devoted to productive activities. One must explicitly model the economic behavior of agents to explore these indirect effects. In this paper, we propose a general equilibrium framework to characterize the impact of public capital on regional differences in income levels. In particular, we use the Spanish experience from the process of fiscal decentralization during the last few decades to assess the macroeconomic effects

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[3] See, among many others, Evans and Karras (1994), Holtz-Eakin (1994) or García-Milá et al. (1996).

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of the distribution of public investment in infrastructures across regions. To our knowledge, the literature on dynamic macroeconomics does not deal with this issue. An exception is the study by Arcalean et al. (2007), which uses an endogenous growth model calibrated with data for the Portuguese economy to analyze the growth effects of regional redistribution policies.[4]

The evaluation of public capital formation as a tool of regional policy should consider some specific issues in order to derive a complete cost–benefit analysis. First of all, public infrastructure investment in a region may affect the economic activity of other regions as this investment can improve their accessibility and alter the terms of interregional trade. Thus, the evaluation of the regional impact of public capital formation should include the study of the possible existence of regional spillover effects. However, this issue has received little attention in the literature. Munnell (1992) conjectures that the existence of these spillover effects explains the fact that the elasticities of output with respect to public capital obtained with regional data tend to be lower than those obtained with aggregate data.[5] Subsequent studies, such as those by Holtz-Eakin (1994), Holtz-Eakin and Schwartz (1995) and Boarnet (1998), directly address this issue and find inconclusive evidence on the empirical relevance of regional spillover effects from public capital formation.[6]

In order to test the existence of regional spillover effects from public capital formation, the majority of research estimates either production or cost functions. The common procedure consists of augmenting the public capital of each region with a weighted sum of the stocks of other regions. In this way, these works are testing whether a *technological spillover effect* exists, i.e., whether the public capital stock of a region directly affects the TFPs of other regions. These spatial spillover effects come from the fact that most elements of public infrastructures, as can be the case of roads, telecommunications or railways, have network characteristics that improve the accessibility of regions. However, public infrastructure investment in one region may also indirectly affect the economic activity of other regions due to openness and interregional competition.[7] This *non-technological* or *economic spillover effect* could have an impact on the regional accumulation of production factors, so they might not be directly captured from the estimation of production and cost functions. Furthermore, these economic spillover effects also depend on the distortions associated with the tax financing of public investment. Hence, these spillover effects can only be computed by means of a dynamic general equilibrium analysis that explicitly models the individuals' decision margins and the economic relation among regions. One of the main objectives of this paper is to introduce this methodology to simulate how public investment in one region affects economic performance of other regions.

Additionally, public investment in one region also implies an opportunity cost given by the foregone increase in the private output of the region that exhibits the largest social profitability of public capital. The decision on the spatial allocation of public investment is subject to a standard tradeoff between regional equality and social efficiency.[8] Governments tend to devote large sums of public investment to improving the productivity capacity of their less developed regions, in order to obtain a regional convergence in income per capita. However, the allocation of public resources in the poorest regions can sometimes lead to suboptimal levels of national income since those regions often exhibit the smallest profitability of public investment. de la Fuente (2003) estimates that the Spanish policy of regional redistribution through public infrastructure investment during the last decade exhibited a meaningful opportunity cost. Another main objective of this paper is to propose a theoretical framework that permits us to compare the current spatial allocation of public investment in infrastructures with alternative distributions of this investment across regions.

This paper incorporates all these issues concerning the economic impact of public infrastructure investment by using the theoretical foundations of open economy macroeconomic analysis based on dynamic optimization. In particular, we use a multi-region, perfect-foresight, dynamic general equilibrium model with infinitely lived representative consumers and capital accumulation. In the model, a central or supra-regional government provides public infrastructures available to all firms with some congestion costs. Infrastructures in a region enhance the TFP of all regions. The central government collects revenue by taxing labor income, capital income and consumption across regions. Finally, there is a single supra-regional capital market in which equities are traded. Equities represent a claim to the capital stock of a region.

There is a large tradition in macroeconomic literature in using these kinds of models as a laboratory to analyze the international spillover effects of country-specific supply-side shocks. For example, Lipton and Sachs (1983), Bianconi (1995), Devereux and Shi (1991) and Ono and Shibata (1992), among others, investigate the response of each country's capital accumulation and terms of trade to tax policy and technological shocks in a two-country model. This type of theoretical framework is also used by the "open economy real business cycle" literature. Using a two-country, general equilibrium model, Bakus et al. (1992) and Baxter and Crucini (1995), among others, study the role of international financial markets in the international transmission of business cycles.[9]

In these multi-region dynamic-optimization models with capital accumulation, one needs the initial distribution of wealth across regions to characterize competitive equilibrium. By following Kehoe et al. (1992), we then propose computing the equilibrium path by means of a pseudo-social planning problem that maximizes a distorted social welfare function.[10] After that, we perform some numerical simulations in order to illustrate the kind of results that can be derived from the proposed framework. In particular, our model is calibrated and solved using data and estimates for the Spanish economy in order to simulate some comparative dynamic exercises of fiscal policy changes. We obtain that the current policy of public investment explains a meaningful fraction of the observed differences in output per capita across Spanish regions. Furthermore, we also illustrate that the economic regional spillovers are a crucial determinant of the macroeconomic effects of the current public investment.

The paper is organized as follows. Section 2 describes the theoretical model and derives the conditions defining the interregional competitive equilibrium. In Section 3 we present the solution procedure based on the pseudo-social planning problem to compute the competitive equilibrium. Section 4 discusses the calibration of the model, and Section 5 presents the numerical experiments and interprets the results. Section 6 ends with some concluding remarks.

[4] Other studies also use a general equilibrium approach to quantify the effects of public capital (see, e.g., Rioja, 1999 and 2005). However, these works only focus on aggregate impact, without any consideration for regional effects.

[5] Munnell (1990), Eisner (1991) and García-Milá and McGuire (1992) also find that output elasticity with respect to public capital is much smaller at the regional level than that at the aggregate level.

[6] For the Spanish case, Mas et al. (1996), Moreno et al. (1997), Pereira and Roca-Sagalés (2003) and Moreno and López-Bazo (2007), among others, have instead found evidence of the existence of positive spillover effects from public capital formation.

[7] In fact, this non-technological spillover effect from public capital formation may be negative. As Boarnet (1998) points out, public investments in one location can draw production from other locations since they enhance the comparative advantage of that location relative to the other places.

[8] See a detailed discussion in de la Fuente (2002b).

[9] See, for example, the surveys by Bakus et al. (1995) and Baxter (1995) for more details of this literature.

[10] Recently, Farmer and Lahiri (2005) also used this procedure to characterize the competitive equilibrium in a two-country model of endogenous growth with production externalities.

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