



# Investment in public infrastructure with spillovers and tax competition between contiguous regions

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## ABSTRACT

Two contiguous regions compete to attract a population of heterogeneous firms. They choose infrastructure levels in a first stage and compete in taxes in a second stage. We study the properties of Subgame Perfect Nash equilibria in this stage game depending on the extent to which the benefits of infrastructure spill over from one region to the other. First, we show that the presence of inter-regional spillovers allows jurisdictions to control for the intensity of tax competition and therefore affects the optimal levels of infrastructure selected at equilibrium. Second, by comparing the non-cooperative and cooperative outcomes, we show that the extent to which regions overinvest in infrastructures negatively depends on the intensity of the spillovers.

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## 1. Introduction

The last decades have been marked by a sharp decrease in transportation costs, and more generally trade costs. In addition, market liberalization drastically increased the mobility of capital and of the labour force. As a result, the location of firms' productive activities is increasingly disconnected from the destination market of their final products. A possibly unhappy consequence of this evolution is that tax competition at national or regional levels is an increasingly important concern for governments. In particular, local authorities face the risk that firms actually bid up one region against the other to obtain tax reliefs or specific infrastructure investments. Observations suggest that the risk is indeed present. For instance, [Sorensen \(2000\)](#) presents evidence of a significant fall in capital nominal tax rate from the 80s to the end of the 90s.

A growing body of the literature deals with tax competition games. Fortunately, this literature shows, more often than not the development

of a mitigated tax competition ([Wilson and Wildasin, 2004](#)). Accordingly, tax revenues may not decrease that much because of tax competition. At the same time, it is obvious that fiscal motives are by far not the only reason why firms would delocalize production. The specific amenities of regions, be it exogenous or resulting from agglomeration externalities, enter the picture as well and public authorities are not passive in this respect. In particular they tend to attract firms by magnifying their local amenities, and/or stimulating the emergence of strong spatial externalities. Thus, local authorities may affect firms' location decisions in essentially two ways: by offering an attractive fiscal package, and/or by developing a favorable economic environment (i.e. enhancing the quality of their infrastructure, broadly defined). [Head et al. \(1999\)](#) conducted an empirical analysis revealing the sensitiveness of firms to non-fiscal arguments.<sup>3</sup> The fact that jurisdictions actually combine various tools to enhance their attractiveness has not been explored in detail in the tax competition literature. Noticeable exceptions are [Justman et al. \(2002, 2005\)](#) who formalize this idea in models where firms are heterogeneous and jurisdictions specialize their infrastructure packages in order to relax tax competition.<sup>4</sup>

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<sup>3</sup> See also [Dembour \(2008\)](#) for a recent selective survey on theoretical models dealing with competition for business units.

<sup>4</sup> Other recent contributions in this area are [Zissimos and Wooders \(2003, 2006\)](#). More generally, local authorities are very likely to transfer tax competition towards less direct fields. See for instance [Peralta et al. \(2006\)](#).

In these papers, local authorities compete one against the other in the level of taxes as well as in the level of infrastructures. Firms have to decide in which of two regions to locate and the infrastructure packages are entirely specific to each region, i.e. their benefits are strictly tied to the location within the jurisdiction. Therefore, regional infrastructures are viewed as substitute amenities from the point of view of the firms. Actually, within such a framework, regional governments face two major risks. The first is to engage in a race-to-the-top whereby regions end up providing infrastructure levels well beyond those required to attract firms. The second risk is that regions engage into a race-to-the-bottom tax competition process. In any case, most of the investment efforts is captured by the incoming firms through increased rents.

Assuming that regional infrastructures are strictly substitutes is clearly reasonable when jurisdictions significantly differ in their geographical locations, i.e. they are located at a significant distance from each other. Suppose however that a well-defined economic activity area is actually divided in two (or several) jurisdictions, each being endowed with fiscal autonomy.<sup>5</sup> In this case firms first contemplate the possibility of locating their activities in the economic area, as a whole. And second, if they choose to move to the area, they would have to address the question of where (i.e. in which jurisdiction) to locate *within the area*. The choice of a particular jurisdiction will reflect the presence of tax differentials as well as possible differences in the infrastructure supplied by these jurisdictions. However, if jurisdictions are contiguous, it is difficult to argue that the benefits of an infrastructure developed by one of the regional government are entirely confined to its political frontiers. In many cases, a “local” infrastructure will inevitably see its “benefits” spill over across political entities onto the whole economic area. If this is the case, then an infrastructure located in one jurisdiction might be viewed as a *complement* to the development strategy of the neighbouring entities.

Consider for example an airport terminal located in one jurisdiction. Clearly enough, this infrastructure increases the attractiveness of that particular jurisdiction. However, it is hard to imagine that it would not increase that of the contiguous ones as well. By contrast, the positive impact of a high speed telecommunication network could be more easily restricted to the jurisdiction in which it is made available. Similarly, it is reasonably easy to condition access to “administrative” support services to the fiscal location of firms.<sup>6</sup> In each of these three examples, the infrastructure increases the economic attractiveness of the economic area as a whole. However, the extent to which it relaxes tax competition between local jurisdictions might be quite different.

The present paper builds upon this intuition. We consider a model where local governments compete for attracting firms by choosing the “quality” of the infrastructure they will make available to the incoming firms. They also compete in taxes. Regarding infrastructure, the critical issue is the extent to which the benefits derived from the infrastructure supplied by one jurisdiction are truly specific to that jurisdiction or spill over onto contiguous ones. Two polar cases are those of a strictly specific infrastructure and an infrastructure whose effects are equally distributed across jurisdictions. In the former case, infrastructure could be called intra-regional whereas in the latter case, they would be referred to inter-regional infrastructures. Notice however that in many instances, partial spillovers are likely to apply. Several questions then emerge: to which extent does the economic nature of the infrastructure alter the equilibrium taxes in the two jurisdictions? To which extent does the nature of the infrastructure determine the level of infrastructure

supplied at equilibrium? When political and economic frontiers differ, is regional competition a good or a bad thing? This classical question<sup>7</sup> might be revisited in this particular context where regional spillovers are present.

We develop a stylized model inspired by the canonical location model of *Hotelling (1929)*. This model will allow to formalize regional competition as a two-stage game between two contiguous regions. In the first stage regions choose infrastructure levels non-cooperatively, in the second stage they set taxes non-cooperatively. Then firms decide on location.<sup>8</sup> Our equilibrium concept is Subgame Perfect Nash equilibrium. The importance of regional contiguity is captured by a parameter that measures the extent to which infrastructure benefits spill over across regions. Note that in this set-up a cooperative solution can be viewed as a proxy for the case where political and economic frontiers coincide. Then, by comparing a cooperative solution to the non-cooperative one, one may easily assess the effects of regional competition and the consequences of infrastructure spillovers.

Our main results are the following. First, when the infrastructure has an inter-regional nature, i.e. spillovers across regions are significant, tax competition is mitigated as compared to the case of “intra-regional” infrastructure. More specifically, *regional governments manage to control for tax competition intensity through infrastructure decisions*. Second, if governments mainly care about tax revenues and/or citizens’ well-being, i.e. the payoff of incoming firms does not enter into the objective function of the regions, we show that the discrepancies between cooperative and non-cooperative outcomes tend to disappear, provided infrastructure spillovers are large enough.

The remainder of the paper is as follows. The next section presents the basic model. *Section 3* develops the equilibrium analysis of the tax competition stage and the infrastructure stage. To this end we concentrate on the case where infrastructure decisions affect firms symmetrically.<sup>9</sup> *Section 4* discusses the normative implications of our analysis as well as some possible extensions. *Section 5* concludes.

## 2. The model

Let us consider a well-defined economic area or country, denoted by  $C$ . It is divided in two contiguous “regions” (from now on, “regions” designate local jurisdictions):  $A$  and  $B$ .

These two regional authorities play a two-stage game. In the first stage, they choose non-cooperatively the level of investment in infrastructure they supply to the firms. In a second stage, they set corporate tax levels non-cooperatively. Then, firms choose their location.

### 2.1. The regions

The objective of local authorities is to maximize the tax revenue minus the cost of providing infrastructure. Formally, the objective function of region  $i$  is given by

$$W_i = t_i M_i - c(K_i)$$

where  $M_i$  denotes the number of firms locating in the region,  $t_i M_i$  is thus the tax revenue and  $c(K_i)$  is the cost of infrastructure built by region  $i$ . This simplified objective function implies that the additional regional welfare accruing from the increase in economic activity is not directly taken into account. Similarly, the surplus obtained by the incoming firms is neglected. This simplified functional form is retained in order to focus on two basic ideas. First, while local

<sup>5</sup> This is typically the case for the Brussels Region in Belgium as for, more generally, economic areas eligible to the Interreg program of the European Commission. More generally, intra-metropolitan competition between jurisdictions may also obey this scenario.

<sup>6</sup> Recent papers (*De Borger et al., 2005, 2007*) have considered the problem of contiguous regions investments in, and access-pricing to, transport infrastructure under congestion. Regional contiguity is central to the analysis because regional routes are substitutes for transit traffic. However the focus is placed on the trade-off between local and transit traffic, through differentiated pricing.

<sup>7</sup> Studied for instance by *Edwards and Keen (1996)*.

<sup>8</sup> The stage game set-up is meant to capture the idea that infrastructure investments are less easy to alter than tax levels, so that governments may more easily commit to the former.

<sup>9</sup> A comparable analysis for type-dependent benefits of infrastructure is developed in the working paper version of the present article, *Dembour and Wauthy (2003)*.

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