Interregional Trade, Industrial Location and Import Infrastructure

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Abstract

The purpose of this study is to illustrate, with a simple two-region, two-good, two-factor model, how an improvement in one region's import infrastructure can affect firms' location decisions and the nature of the trading equilibrium. It is shown that, through improvements in import infrastructure, one region might divert high-tech industries to another region. This effect reduces the incentive to improve import infrastructure.

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1 Introduction

In the last decade the role of public infrastructure in regional economies, such as ports, railway networks, and new telecommunications networks, has been widely discussed.[1] It is increasingly recognized that the growing connectivity of individuals and organizations is achieved through improvements in the quality of public infrastructure which reduces transaction costs between regions, and a consequent increase in the flow of goods and services across regions. Related to this, competing new economic geography theories imply that regional integration might serve to greatly reduce regional inequalities.[2]

In a recent influential contribution, Martin and Rogers (1995) proposed a new way to model various types of public infrastructure, which allows the analysis of its impact on trade patterns, industrial location, and welfare. They show that firms with increasing returns will tend to locate in the countries (or regions) with the best infrastructure in order to take advantage of economies of scale. In particular, they show that an improvement in domestic infrastructure in one country (or region) will imply a relocation of firms to this country (or region) (Martin and Rogers, 1995, p. 344). The intuition is that, as the quality of infrastructure improves, the transaction costs of goods produced and consumed in that country (or region) decrease, increasing the effective demand.

However, Martin and Rogers (1995) do not distinguish between export infrastructure and import infrastructure: an improvement in the quality of infrastructure implies a *symmetric* reduction in transaction costs for both exports and imports. This assumption is justified for simplification. However, infrastructure improvements often cause *asymmetric* reductions in transaction costs. For example, an improvement in the quality of a region's local transport networks affects the region's imports more than its exports.[3] Given these observations, the present study focuses on the role of *import* infrastructure in

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[1]See, for example, Costa-Font and Rodriguez-Oreggia (2005), Limao and Venables (2001), and Mori and Nishikimi (2002).

[2]See, for example, Fujita et al. (1999), Ottaviano and Thisse (2004), and Behrens et al. (2007).

[3]See World Bank (2004) for discussion.

facilitating import transactions. The purpose of this study is to illustrate, with a simple two-region, two-good (homogeneous good/differentiated high-tech products), two-factor (labor/capital) model, how an improvement in one region's import infrastructure can affect firms' location decisions and the nature of the trading equilibrium. In contrast to Martin and Rogers (1995), it will be shown that, through improvements in *import* infrastructure, one region might divert high-tech industries to another region. The main result of the current study, which captures the negative effect of the domestic infrastructure, has not appeared in the existing literature.

Section 2 presents the model. Section 3 analyzes the impact of an improvement in the quality of import infrastructure on the location of industries.

2 The Model

Suppose that there are two regions (Region 1 and Region 2), each with two factors (capital, K and labor, L) and two types of goods (a homogeneous good and a large variety of differentiated high-tech products). Assume that the regions are identical in regard to tastes, size, and technology, but differ with respect to the costs of importing differentiated high-tech products. We assume these costs are directly related to the quality of *import* infrastructure.

It is important to note that the present model is a variant of Kikuchi (2005). There are two main differences between the present setup and Kikuchi (2005)'s one: (1) the former labels two factors as capital and labor, while the latter labels those as skilled and unskilled labor; (2) the former assumes that the distribution of factor endowments is identical among regions, while the latter assumes that the distribution of factor endowments is different between countries. Although the assumption of the identical factor endowments is quite strong, it is in order for simplifying the analysis.

Consumers have Cobb-Douglas preferences over both categories and spend fraction μ of their income on high-tech products. Region i's price index for high-tech products is represented by the Dixit-Stiglitz form:

$$P_i = \left[n_i (p_i)^{1-\sigma} + n_j (t_i p_j)^{1-\sigma} \right]^{1/(1-\sigma)}, \quad \sigma > 1, \tag{1}$$

where σ is the degree of substitution among all products, p_i is the producer prices for high-tech products produced in region i, and n_i is the number of varieties produced in region i, respectively. Import costs t_i $(t_i > 1)$ for the high-tech products are in the form of "iceberg costs." We assume these costs are directly related to the quality of region i's import infrastructure: changes in these costs represent changes in import infrastructure. Thus, the consumer demand functions in region i for a region i (i.e., local) variety and a region j (i.e., imported) variety are respectively

$$c_{ii} = p_i^{-\sigma} P_i^{\sigma-1} \mu E_i, \tag{2}$$

$$c_{ij} = (t_i p_j)^{-\sigma} P_i^{\sigma-1} \mu E_i, \tag{3}$$

where E_i is the total income in Region i (i, j=1, 2).

The homogeneous good is produced with constant returns, using only labor as an input. Units are chosen so that one unit of labor produces one unit of output. As usual in new geography models, no transport costs exist for the homogeneous good, which serves to tie down the wage rate. Also assume that the parameters of the model are such that both regions produce the homogeneous good; thus, constant, identical wages for labor hold (hereafter set to unity).

The production of each variety of high-tech product requires one unit of capital to develop the product and β units of labor per unit of output. As in Martin and Rogers (1995) and Martin and Ottaviano (1999), the central assumption of the present analysis is that the capital is firm specific, but it moves freely between regions: if a variety developed by Region 1's capital is produced in Region 2, the operating profits are repatriated to Region 1. Given a Dixit-Stiglitz specification with constant elasticity σ, each firm sets its price as $p_1 = p_2 = (\beta\sigma)/(\sigma - 1)$. In order to simplify the analysis, we choose units such that $\beta = (\sigma-1)/\sigma$ to have

$$p_1 = p_2 = 1. \tag{4}$$

Given that one unit of capital is required to develop a product, the payment for each unit of capital employed in Region i (i=1, 2), r_i, must satisfy

$$r_i = p_i x_i - \beta x_i = x_i / \sigma, \tag{5}$$

where x_i is the output of a representative firm in Region i. When capital mobility is unrestricted, the payment for capital will be equalized between regions, which implies that $r_1 = r_2$ and thus

$$x_1 = x_2. \tag{6}$$

3 Import Infrastructure and Industrial Location

Now consider the firms' location decisions. The product market equilibrium in Region i requires that supply equals demand for each variety: $x_i = c_{ii} + t_j c_{ji}$. Substituting (2), (3), and (4) into this condition yields the following equilibrium condition:

$$x_1 = \left(\frac{1}{n_1 + \tau_1 n_2} + \frac{\tau_2}{\tau_2 n_1 + n_2} \right) \mu E, \tag{7}$$

$$x_2 = \left(\frac{\tau_1}{n_1 + \tau_1 n_2} + \frac{1}{\tau_2 n_1 + n_2} \right) \mu E, \tag{8}$$

where $E \equiv r_i K + L$ and $\tau_i \equiv t_i^{1-\sigma}$ $(\tau_i < 1)$ measures the freedom of trade, which is directly related to the quality of Region i's import infrastructure.

Using (6), (7) and (8), the equilibrium share of Region 1 firms, s_1 can be obtained:

$$s_1 \equiv \frac{n_1}{n_1+n_2} = \frac{1}{2}\left[1-\frac{\tau_1-\tau_2}{(1-\tau_1)(1-\tau_2)}\right]. \tag{9}$$

Equation (9) implies the surprising feature of infrastructure policies, which is highly contrasted with the result of Martin and Rogers (1995) (i.e., firms' relocation to the region with a better infrastructure).

Proposition: *An improvement in the quality of import infrastructure in a region will induce a diversion of high-tech products away from that region.*

Figure 1 illustrates the implications of this proposition. The horizontal axis shows the share of high-tech firms in Region 1, s_1, and the vertical axis shows the equilibrium output level in each region, x_i. A decreasing (resp. increasing) curve corresponds to (7) [resp. (8)]: the equilibrium share of firms is obtained from the intersection of these curves. To simplify the argument, let us assume that initially $\tau_1 = \tau_2$ holds and $s_1 = 1/2$.

Now, suppose that the quality of Region 1's import infrastructure improves (i.e., τ_1 increases). This change induces two effects. First, it shifts the curve representing Region 1's equilibrium condition downward: lower trade costs imply an increase in the *effective* number of imported varieties, $\tau_1 n_2$, which leads to a fall in local demand for locally produced varieties in Region 1. Second, it shifts the curve representing Region 2's equilibrium condition upward: easier access to the Region 1 market increases the advantage of locating in Region 2. These two effects reinforce each other and induce high-tech firms (i.e., capital) to flow out of Region 1.

This result has important policy implications for regional economies. Improvements in import infrastructure in one region can divert firms in high-tech industries over to another region. This lowers the incentive to improve import infrastructure. Although better import infrastructure reduces import transaction costs, it also induces industrial diversion and raises the transaction costs of receiving products from those industries that relocate elsewhere. The possibility that industries will be diverted provides some theoretical grounds for the coordination of infrastructure investments among regional economies. Further research should focus on these policy implications.

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Figure 1