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International Rivalry Between Landlocked and Coastal Countries And Strategic Transportation Policies

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By

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Abstract

Establishing a Cournot international duopoly model where a firm from a landlocked country (LC) and a firm from a costal country (CC) compete in a third-country market, we analyze international rivalry between the two firms. Since the LC country has no sea port, its firm incurs extra costs to export its goods through the CC's port. We assume that the LC's firm adopts a transport-cost reducing R&D activity and its government subsidizes such R&D, whilst the CC imposes a specific toll fee on the LC's firm in rivalry with the R&D of the LC's firm. We find, *inter alia*, that since a change in the LC's R&D subsidy (the CC's toll fee) has a positive effect on the LC's (CC's) export and a negative effect on the CC's (LC's) export, the R&D subsidy and the toll fee are both effective as strategic export policies and that the optimal levels for these strategic policies are both positive.

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1. Introduction

It is common knowledge that the landlocked developing countries in Central Asia, Southeast Asia, and Africa have a comparative disadvantage when exporting their products, due in part to their geographical location. They are at a disadvantage since they must incur extra costs, due to the longer distance to ports in coastal countries. As compared with costal countries, landlocked countries generally must pay higher transportation costs, in addition to the original production costs. In some cases, strategic toll fees are imposed by costal countries. Furthermore, the geographical barrier is a burden factor that affects their trade volumes, and land transportation might constraint the amount of products transported and/or destroyed some of fragile goods.[1]

As the landlocked countries depend on the transportation facilities and trade policies of their neighboring coastal countries, their economies are primarily affected not only by the high costs of freight services but also by the high degree of unpredictability in transport time. Poor performance of transit logistics, the efficiency of the system, regulations, policies, and toll fees lead to a relatively higher cost of transportation in these areas. Therefore, it is quite natural that firms and governments of landlocked countries have incentives to implement certain policies to improve their comparative advantage. Furthermore, it can be assume that coastal countries might take countermeasures against

policies implemented by the landlocked countries. In this paper, we will analyze such international trade rivalry between landlocked and coastal countries.[2]

Although there are several types of trade strategies that are adopted by landlocked and coastal countries in the circumstances mentioned above, this paper focuses on the most typical case. We suppose that a landlocked country's firm engages in transportation-cost reducing R&D fuel-efficient, quantity-keeping and quality-maintaining means of transportation and its government subsidizes such firm's R&D, and that a coastal country imposes a toll fee on the landlocked country's goods exported via the coastal country. It is well noted that, some direct trade policies, such as tariffs and export subsidies, are prohibited by the World Trade Organization (WTO). However, both an R&D policy and a toll fee policy are not prohibited in principle. Furthermore, since these policies are implemented independently by the landlocked and coastal countries based on their separate decisions, they can evade some difficulties through cooperative decisions. Thus, these policies are regarded by both the landlocked and coastal countries as the most appropriate ways in improving their comparative advantages in international trade.[3,4]

In order to discuss the issue mentioned above, we extend a third-country trade model originated by Brander and Spencer (1985) and Spencer and Brander (1983). Although our model seems similar to their model at a first glance, there are important differences between them. In their model, the impact of countervailing measures was not considered because all goods were directly exported to a third market. Furthermore, the countries were assumed to be identical in geographical factors or simply no geographical impacts were

measured. A potentially crucial element not captured by this line of analysis is the retaliation that one country applies directly to the rival country's firm. However, our model explicitly introduces a geographical difference between the landlocked and coastal countries that is significant in their international rivalry. Thus, whilst a landlocked country's firm has an incentive to engage in transportation-cost- reducing R&D and the landlocked country's government subsidizes its firm's R&D, the coastal country charges a toll fee on the landlocked country's firm as a countermeasure. Therefore, we can examine the countervailing effects of both governments' policies on the firms' choices.[5]

The rest of this paper is organized as follows. In section 2, we establish a three-stage game model of a third-country trade. In section 3, we analyze the optimal export choices of the two firms. In section 4, we examine the optimal amount of transportation-cost reducing R&D of the landlocked country's firm. In section 5, we investigate the optimal R&D subsidy offered by the landlocked country's government and the optimal toll fee imposed by the coastal country's government. Finally, we present some concluding remarks in section 6.

2. Basic Model and Assumptions

Suppose an international duopolistic industry is composed of a firm from a coastal country (henceforth, CC) and a firm from a landlocked country (henceforth, LC). These firms produce homogeneous goods in their own countries, respectively, and they both export all their products to a third country where they compete on quantities a la Cournot.

While the CC's firm exports its product from the nearest seaport in its country, the LC's firm must transport its goods through the nearest seaport in the CC that is far from its home country and export it. Obviously, the distance that exporting goods are carried from the factory to a sea port in the CC is further for the LC's firm than for the CC's firm. Therefore, as compared with the CC's firm, the LC's firm must incur extra transportation costs, and thus it has a disadvantage in international trade due to its geographical location.

However, it is very common that in such circumstances the LC's firm pursues a transportation-cost reducing R&D (henceforth, TCR-R&D) to improve its comparative advantage. This is the most likely and effective course of action for the LC's firm when seeking an improvement in term of the geographical disadvantage due to the extra transportation costs.[6] However, when the LC's firm engages in a TCR-R&D activity, its government often subsidizes such R&D to support its firm's difficult position in international trade. Hence, we assume that the LC's firm adopts the TCR-R&D investment under the TCR-R&D subsidy of the LC's government. Furthermore, we assume that the CC's government charges a toll fee on the LC's exports via the CC to counter the TCR-R&D subsidy by the LC. The toll fee policy is more appropriate for the CC as a countermeasure than an export subsidy policy from the standpoint of the WTO. We also highlight in this paper the geographical differences between the LC and the CC, and that the CC's firm has no transportation costs and no toll fees, but incurs only ordinary production costs.

Under the assumptions mentioned above, profit π of the LC's firm and profit π^* of

the CC's firm are respectively given by

$$\pi = p(x + x^*)x - C(x) - t(I)x - \tau x - q(I) + sI\,, \tag{1}$$

$$\pi^* = p(x + x^*)x^* - C^*(x^*)\,. \tag{2}$$

In (1) and (2), x and x^* are outputs of the LC's and CC's firms, respectively, and $p(x + x^*)$ is an inverse demand function in the third-country market with $p'(x + x^*) < 0$ (throughout this paper, variables with a superscript * refer to the CC's firm's while those without a superscript * correspond to the LC's firm). $C(x)$ is a product cost function of the LC's firm with usual features of $C'(x) > 0$ and $C''(x) > 0$. $t(I)$ is a unit transportation cost of the LC's firm that has features of $t'(I) < 0$ and $t''(I) > 0$. τ is a unit toll fee that the CC's government imposes on the LC's firm. $q(I)$ is a cost function of the TCR-R&D investment I with ordinary features: $q'(I) > 0$ and $q''(I) \geq 0$. And, s is a unit specific subsidy (tax when positive) to the TCR-R&D investment given by the LC's government. It is assumed, for simplicity, that the transportation cost and toll fee are both zero for the CC's firm. The LC's firm and the CC's firm act so as to maximize their profits, given governments' political decisions, respectively.

Taking into consideration that in the third-country model both the LC and the CC export all products, the economic welfare of the LC and the CC in the industry, W and W^*, are respectively defined as

$$W = \pi - sI\,, \tag{3}$$

$$W^* = \pi^* + \tau x\,. \tag{4}$$

Obviously, while the LC's welfare consists of its firm's profit and its TCR-R&D subsidy

payment given to its firm, the CC's welfare is the sum of its firm's profit and the toll fee revenue levied on the LC's firm. Therefore, (3) and (4) demonstrate that the LC's firm has some direct relations with the two countries' policies but the CC's firm has nothing to do with them directly. The LC's and CC's governments determine a unit TCR-R&D subsidy and a unit toll fee so as to maximize their economic welfare before their firms begin their actions.

In this paper, we assume that the two firms and the two governments play a three-stage game. In the first stage, the LC's and CC's governments set a unit TCR-R&D subsidy s and a unit toll fee τ, respectively, to maximize their economic welfare before their firms' output choices. The governments are the first players and can influence the equilibrium outcome of the game played by the firms. Then, in the second stage, the LC's firm sets its TCR-R&D investment level I so as to maximize its profit, given the political variables set in the first stage, but the CC's firm does nothing. In the third stage, the LC's and CC's firms independently choose their outputs so as to maximize their profits under the Cournot type of quantity competition, given the political variables decided in the first and second stages. In order to solve this three-stage game, we adopt a method of backward induction. The sub-game perfect equilibrium incorporates all three stages.

3. Firms' Export-Output Choices in the Third Stage

In the third stage, as the LC' firm and the CC's firm are engaged in the Cournot quantity competition at the third-country market, they respectively choose outputs (= exports), x

and x^*, so as to maximize their profits define as (1) and (2), given all the decisions made by governments and firms in earlier stages and the rival's output. Therefore, using subscripts to denote derivatives ($\pi_x = \frac{\partial \pi}{\partial x}$, $\pi_{xx^*} = \frac{\partial^2 \pi}{\partial x^* \partial x}$, $\pi^*_{x^*} = \frac{\partial \pi^*}{\partial x^*}$ and so on), the Cournot-Nash industrial equilibrium in the third stage is given by

$$p(x+x^*) + p'(x+x^*)x - C'(x) - t(I) - \tau = 0, \tag{5}$$

$$p(x+x^*) + p'(x+x^*)x^* - C^{*\prime}(x^*) = 0, \tag{6}$$

where (5) and (6) are the first-order conditions (known as the reaction functions) of the LC's and CC's firms, respectively. Following the literature norm, we also assume that both the firms' second-order conditions are satisfied and that the effects of output on marginal profit dominate cross effects:

$$\pi_{xx} < \pi_{xx^*} < 0, \quad \pi_{x^*x^*} < \pi_{x^*x} < 0. \tag{7}$$

It follows that the firms' reaction curves in the third stage are both downward sloping and that the industry equilibrium in the third stage is stable.

Here, to examine the geographical disadvantage of the LC, we assume, for a while, that the firms' marginal costs are constant and identical. Then, we get from (5) and (6)

$$x^* - x = \frac{-t(I) - \tau}{p'(x+x^*)} > 0. \tag{8}$$

Therefore, we can demonstrate from (8) that the output (export) of the LC's firm is smaller than that of the CC's firm and that the degree of the LC's geographical disadvantage measured by the difference between the firms' outputs depends on the extra transportation cost and a toll fee as well as the demand function of the third country.

Now, let's return to the original model and analyze the effects of changes in the TCR-R&D investment and the toll fee on firms' exports. By totally differentiating (5) and (6) with respect to x, x^*, I and τ, we have

$$\begin{bmatrix} \pi_{xx} & \pi_{xx^*} \\ \pi^*_{x^*x} & \pi^*_{x^*x^*} \end{bmatrix} \begin{bmatrix} dx \\ dx^* \end{bmatrix} = \begin{bmatrix} t'(I)dI + d\tau \\ 0 \end{bmatrix}. \tag{9}$$

Then, taking into consideration (7) and $t'(I) < 0$, from (9) we first derive the effects of a change in I on x and x^*:

$$x_I = \frac{t'(I)\pi^*_{x^*x^*}}{D} > 0,$$

$$x^*_I = -\frac{t'(I)\pi^*_{x^*x}}{D} < 0, \tag{10}$$

where $D = \pi_{xx}\pi_{x^*x^*} - \pi_{xx^*}\pi_{x^*x} > 0$. It follows that an increase in the TCR-R&D investment I of the LC's firm raises its own export and reduces its rival's export, and *vice versa*. Additionally, (7) and (10) combine to give $x^*_I - x_I < 0$ and $x_I + x^*_I > 0$, which shows that a rise in the TCR-R&D investment of the LC's firm improves the LC's geographical advantage and increases the sum of exports of the two firms to the third country, and *vice versa*. While a rise in the TCR-R&D investment of the LC's firm might be objected by the CC, it would be welcomed by the third country.

Furthermore, considering conditions (7), we also obtain from (9) the effects of a change in τ on x and x^*:

$$x_\tau = \frac{\pi^*_{x^*x^*}}{D} < 0,$$

$$x_\tau^* = -\frac{\pi_{x^*x}^*}{D} > 0. \tag{11}$$

It follows that a rise in the toll fee set by the CC's government decreases the LC's export but increases the CC's export, and *vice versa*. However, since $x_\tau + x_\tau^* < 0$ and $x_\tau^* - x_\tau > 0$ hold under (7) and (11), a hike in the CC's toll fee reduces the total export by the firms to the third country and aggravates the LC's geographical disadvantage, and *vice versa*. Although the CC can gain its geopolitical lucrative position and acquire some toll fee revenues by imposing a toll fee on the LC's firm, it might simultaneously damage its international friendship with the LC and the third country.

4. TCR-R&D Investment Decision of the LC's Firm in the Second Stage

In the second stage, the CC's firm does nothing because it has no control variable in this stage. However, the LC's firm decides its TCR-R&D investment so as to maximize its profit, given all the governments' political decisions in the first stage and the firms' optimal choices in the third stage. It follows that there exists an asymmetrical relationship between the firms' decisions in the second stage.

The industrial equilibrium in the second stage is illustrated by

$$p'(x+x^*)xx_I^* - t'(I)x - q'(I) + s = 0, \tag{12}$$

where $\pi_I = \frac{\partial \pi}{\partial I}$. Since $p'(x+x^*)xx_I^* - t'(I)x$ and $q'(I) - s$ imply a marginal revenue and a marginal cost in the TCR-R&D investment, (12) shows the equality between a marginal revenue and a marginal cost in the optimal TCR-R&D investment decision. In this section, since we also assume, as in the previous section, that the second-order condition of

the LC's firm is satisfied: $\pi_{II} = \frac{\partial^2 \pi}{\partial I^2} < 0$, by solving (12) the optimal TCR-R&D investment of the LC's firm is given as a function of the TCR-R&D subsidy: $I = I(s)$.

In order to investigate the relationship between the TCR-R&D investment and its subsidy, totally differentiating (12) with respect to s and I, we easily obtain

$$I_s = -\frac{1}{\pi_{II}} > 0. \tag{13}$$

It follows that the TCR-R&D investment of the LC's firm is an increasing function of the TCR-R&D subsidy given by the LC's government. Of course, it is immediately obvious that, since (12) does not include the toll fee τ set by the CC's government, the optimal TCR-R&D investment of the LC's firm is independent of τ. Consequently, we obtain

$$I_\tau = 0. \tag{14}$$

Now that we get the effects of changes in a TCR-R&D subsidy of the LC and a toll fee of the CC on the T-R&D investment of the LC's firm, we can examine the effects of these political variables on optimal exports and profits of the LC's and the CC's firms. Taking into consideration (10) and (13), the effects of a change in the TCR-R&D subsidy on exports of the LC's and the CC's firms are respectively given by

$$\begin{aligned} x_s &= x_I I_s > 0, \\ x_s^* &= x_I^* I_s < 0. \end{aligned} \tag{15}$$

It follows that a rise in the T-R&D investment subsidy of the LC's government raises the LC's export and reduces the CC's output, and *vice versa*. Moreover, taking account of (10) and (13), the effects of a change in the TCR-R&D subsidy on profits of the LC's and the

CC's firms are respectively derived as

$$\pi_s = xp'x_I^* I_s + I > 0, \qquad \pi_s^* = x^* p' x_I I_s < 0. \tag{16}$$

This shows that an increase in the TCR-R&D subsidy of the LC increases the profit of the LC's firm and reduces the profit of the CC's firm, and *vice versa.* It follows from (15) and (17) that the LC's governments can adopt the TCR-R&D subsidy as an effective strategic trade policy.

On the other hand, by combining (5), (6), (11), and (14) we obtain

$$\pi_\tau = xp'x_\tau^* - x < 0,$$

$$\pi_\tau^* = x^* p' x_\tau > 0, \tag{17}$$

which means that a rise in the toll fee set by the CC's government decreases the LC's firm's profit and increases the CC's firm's profit, and *vice versa.* Therefore, it is obvious from (11) and (17) that a toll fee can also be used as an effective strategic trade policy by the CC's government. However, unlike the TCR-R&D subsidy policy of the LC, the toll fee policy of the CC has a feature of retaliation by the CC that applies directly to the firm's TCR-R&D investment and the government's TCR-R&D subsidy in the LC.

5. Governments' Political Determinations in the First Stage

In the first stage, the governments of the LC and the CC determine the TCR-R&D subsidy and the toll fee so as to maximize their own economic welfare defined by (3) and (4), respectively. We posit that both the governments know the firms' optimal decisions in the second and third stages. Accordingly, the first-order conditions of the LC's and CC's

governments in the first stage are respectively given by

$$xp'x_I^*I_s - sI_s = 0,$$

$$x^*p'x_\tau + x + \tau x_\tau = 0. \tag{18}$$

It is also assume here that the second-order conditions for the governments hold at the equilibrium. Then, combining (10), (11), and (18) we obtain

$$s = xp'x_I^* > 0,$$

$$\tau = -x^*p' - \frac{x}{x_\tau} > 0. \tag{19}$$

Clearly, the optimal TCR-R&D subsidy of the LC is equal to the marginal profit of the LC's firm with respect to the TCR-R&D investment, and the CC's optimal toll fee is equivalent to the marginal profit of the CC's firm with respect to the toll fee. Moreover, the optimal TCR-R&D subsidy of the LC and the optimal toll fee of the CC are both positive. In other words, this means that while the LC subsidizes the TCR-R&D investment of its firm to improve its geographical advantage against the CC, the CC charges a toll fee on the LC's firm in order to recover its lost advantages. However, as long as the extra transportation cost of the LC's firm is positive, it is impossible for the LC to remove its geographical disadvantages completely.

6. Concluding Remarks

In this paper, establishing a third-country trade model of an international Cournot duopoly where a LC's firm and a CC's firm compete under geographical differences, we examined international rivalry in firms' export choices and in governments' policy

decisions. Since the LC does not have any seaports for exporting goods, the LC's firm must transport its product to the nearest port in the CC. Then, the LC's firm has a comparative disadvantage against the CC's firm from a geographical point of view, because it must incur extra transportation costs due to its geographical disadvantage, *ceteris paribus.* In such circumstances, it is often observed that the LC's firm will engage in TCR-R&D investment to improve its comparative advantage and the LC subsidizes its firm's TCR-R&D investment to strengthen its firm, whilst the CC uses a toll fee on the LC's firm to countervail the effect of the LC's policy. In this paper, we modeled such an international duopoly and analyzed relationships among these firms' export choices and governments' political determinations.

The main findings are summarized as follows. We find that both the LC's TCR-R&D subsidy and the CC's toll fee are effective as strategic export policies, respectively. While a rise in the LC's TCR-R&D subsidy raises (reduces) export, market share and profit of the LC's firm (the CC's firm), a rise in the CC's toll fee increases (decreases) export, market share and profit of the CC's firm (the LC's firm), and *vice versa.* We also demonstrate that the optimal levels of the LC's TCR-R&D subsidy and the CC's toll fee are both positive in a Cournot international duopoly setting. Moreover, we show that the implementation of the LC's TCR-R&D subsidy improves the LC's comparative advantages and extends total exports by the LC and the CC to the third country, whilst the imposition of the CC's toll fee boosts the LC's comparative disadvantages and contracts the total exports by the two countries. From the standpoint of the third country, the implementation of the LC's

TCR-R&D subsidy is a welcomed policy, but the imposition of the CC's toll fee has a negative implication.

Although the present model discusses only the case of non-cooperative policies between the LC and the CC, it could be extended in several directions to study many other economic problems among LCs and CCs. For example, improvement of some transportation facilities in CC proposed by its neighbor LC, such as pavement of the CC's roads and/or dredging the CC's harbors, would be considered as cooperative policies because these are beneficial to the CC as well as the LC. Furthermore, cooperative constructions of some storage facilities and/or correspondence facilities are also conceivable examples of cooperative policies. However, these will be investigated in future papers.

Endnotes

1. Indeed, about 43 countries face this problem and lose their comparative advantage because of obstacles in transporting goods. Jean-Francois et al. (2007) have summarized that landlocked countries trade less, on average 30% less, compared with coastal countries, and landlocked countries experience weaker growth, 1.5% less than maritime countries. Moreover, a study by UNCTAD (2006) has reported that, in comparison with neighboring coastal countries, landlocked economies trade half as much.
2. Brain and Charlie (1995) have reported that Tanzanian and Kenyan ports are very

important as transits for landlocked countries in east African. Klink and Berg (1998) have shown that gateways, such as Rotterdam, play an important role as points of transshipment in intercontinental logistic chains for Central European countries.

3. Naturally, a coastal country that has hostile relations with a neighboring landlocked country would close its border road. This paper considers a landlocked country and a coastal country that are not hostile in their political relations but just rivals in their economic relations.

4. For example, Klaus and Helmut (1997) have demonstrated that certain government policies on transportation facilities could be used as a strategic trade policy, and Christopher (2007) has indicated that a transit country's infrastructure improvement would increase a landlocked country's trade significantly. A similar situation is also observed in entrepot economies such as Hong Kong and Singapore. Robert and Gordon (2004) have reported that over the period of 1988-1998, more than half of Chinese exports were shipped through Hong Kong and that these were influenced by Hong Kong trade policies.

5. As far as we know, there has been no paper to model the geographical disadvantage of a landlocked country and a coastal country's retaliation solely, although Jan and Hans (2008) have examined the R&D subsidy rivalry when both countries grant subsidies.

6. For instance, investment in fuel-efficient transportation measures is a typical example of TCR-R&D investment. Moreover, investment in refrigerators for perishable goods and/or shockproof vehicles for fragile products is also regarded as TCR-R&D

investment.

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