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Transportation Costs, International Rivalry between Landlocked and Coastal Countries, and Strategic Transportation Policies

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Abstract

Establishing a Cournot international duopoly model where a firm from a landlocked country (LC) without ports and a firm from a costal country (CC) with ports compete in a third-country market, we analyze international rivalry between two countries. It is assumed that since the LC's firm has a geographical disadvantage that it incurs extra costs to export its good through the CC. For that it adopts a transport-cost deducing R&D and its government subsidizes such a R&D and the CC imposes a toll fee on the LC's firm against the LC's movement. As a result, we find, among others, that both the LC's R&D subsidy and the CC's toll fee work as strategic trade policies and that these optimal levels are both positive.

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International Rivalry between Landlocked and Coastal Countries, and Transportation Policies

1. Introduction

The landlocked developing countries in Central Asia, Southeast Asia and Africa have less of a comparative advantage due in part to their geographical location when exporting their products. Their comparative advantage becomes less because they must pay extra costs, such as transport costs, toll fees and so on, in addition to ordinal production costs because of the distance to ports in costal countries. Furthermore, the geographical barrier is the burden factor which impacts their trade volumes and results. The land transportation might restrict the transport amount of products and/or destroy a certain part of fragile goods.

Approximately, 43 countries face this problem and lose their comparative advantage because of obstacles in the transportation of goods. Jean-Francois et.al (2007) summarized that landlocked countries trade less, on average 30% less, vis-à-vis coastal countries, and landlocked countries experience weaker growth, 1.5% less, than the maritime. A study by UNCTAD (2006) reported that in comparison with neighbor costal

countries landlocked economies trade half less.

As the landlocked countries depend on transportation facilities and trade policies of their neighbor costal countries, their economies are primarily affected not only by high costs of freight services but also by high degree of unpredictability in transport time. Poor performance of transit logistics, efficiency of system, regulation, policies, and toll fees causes a relatively higher cost of transportation in these areas. Therefore, it is natural that firms and governments of the landlocked countries have incentives to implement certain policies to improve their less comparative advantage while the costal countries take some countermeasures against such movements of the landlocked countries. In this paper, we will analyze such international trade rivalry between landlocked and costal countries.[1]

Though several types of trade strategies adopted by the landlocked and costal countries are conceivable in circumstances mentioned above, this paper will focus on the most typical case. Where, the landlocked country's firm engages in transportation-cost reducing R&D and its government subsidizes such firm's R&D. As well, the costal country imposes a toll fee on the landlocked country's goods which is exported via the coastal country. The transportation-cost reducing R&D represents to invent

fuel-efficient, quantity-keeping and/or quality-maintaining transportation ways. And, the toll fee implies extra costs the firm of the landlocked country must pay to use roads and/or ports of the costal country.

As is well known, while some direct trade policies, such as tariffs and export subsidies and so on, are prohibited by the new WTO, both a R&D policy and a toll policy are not prohibited in principal. Furthermore, since these policies are implemented independently by the landlocked and costal countries based on their separate decisions, they have merits to evade some difficulties that are often observed in cooperative decisions. Therefore, these policies are respectively regarded by both of the landlocked and costal countries as ones of the most appropriate meanings for improving their comparative advantages in international rivalry. As a matter of course, a costal country that has hostile relation with a neighbor landlocked country would close its border road. We consider, in this paper, a landlocked country and a costal country that are not currently hostile in their political relation but just rivalry in their economic relation.[2]

In order to discuss issued mentioned above, we will extend a third-country trade model originated by Spencer and Brander (1983) to include a firm from the landlocked country and a firm from the costal country and to analyze essential issues between these countries. Though

our model be similar to the Spencer and Brander model at first glance, there are essential differences between them. In their models, any countervailing was not considered because all goods were directly exported to the third market. Besides, the countries were assumed identical in geographical factors or simply no such geographical impacts were measured. A potentially crucial element not captured by this line of analysis is the retaliation by a certain country which implies directly to its rival firm.

On the other hand, our third-country trade model established in this paper will explicitly introduce a geographical difference between the landlocked and costal countries that is an important factor for their international rivalry because of extra transportation costs. Thus, a landlocked country's firm has an incentive to begin transportation-cost decreasing R&D, and the landlocked country’s government subsidizes its firm's R&D, because of their initial geographical disadvantages. Also, our model will consider as a toll fee as a countermeasure the coastal country can directly charge the landlocked country's firm that must use some transportation facilities in the costal country when exporting its goods. Then, we will examine not only the effects of governments' policies on firms' choices of exports and R&D but also the optimal R&D subsidy of

the landlocked country and the optimal toll fee of the costal country.[3]

The rest of this paper is organized as follows. In section 2, we will establish a three-stage game model of third-country trade where the landlocked country's government decides a optimal subsidy for its own firm's R&D while the costal country's government sets its toll fee for its opponent firm in the first stage, then only the landlocked country's firm decides its transportation-cost reducing R&D in the second stage, and the two Countries' firms non-cooperatively choose their exports (outputs) for the third country in the third stage. We shall solve this three-stage game by backward induction. Thus, in section 3 we analyze optimal output (export) choices of the firms from the two firms, in section 4 we examine the optimal decision of transportation-cost reducing R&D of the landlocked country's firm, in section 5 we investigate the optimal R&D subsidy of the landlocked country's government given to its own firm and the optimal toll fee of the costal country's government imposed on the landlocked country's firm, and in section 6 we present some concluding remarks.

Consequently, this paper finds how a landlocked country's R&D subsidy supports its firm in decreasing transportation costs burden and how a coastal country's toll fee affects its landlocked neighbor as a countervailing policy. It also shown, among others, the landlocked

country's R&D subsidy and the costal country's toll fee are both positive and that they are both effective as strategic export policies.

2. A Basic Model and Assumptions

In this section, we shall establish a basic model for analyzing issues mentioned in the previous section. Consider an international duopolistic industry composed of a firm from a coastal country (CC) and a firm from a landlocked country (LC) both of which produce homogeneous goods in their own countries and export all of them to the third-country market where two firms compete on quantities a la Cournot. While the CC's firm transports its product to the nearest seaport in its own country, the LC's firm transports the good to the nearest seaport in the CC far from home. Apparently, the distance that exporting goods are carried from the manufacturing location to a shipping port in the CC is longer for the LC's firm than for the CC's firm. Thus, since the LC's firm incurs extra transportation costs, it has initially certain disadvantages in international trade due to its geographical location against the CC's firm.[4]

However, it is supposed, in this paper, that the LC's firm takes transportation-cost decreasing R&D (T-R&D) to improve its comparative disadvantage. This is the most likely and effective meaning for the LC's

firm when improving its disadvantage caused by the extra transportation costs. Furthermore, we assume the LC's government subsidizes the T-R&D of its firm because it knows its own firm's difficult position in international trade and the CC's government charges a toll fee on the LC's export via the CC in rivalry with such a movement of the LC for enhancing comparative advantage. The toll fee policy is more appropriate for the CC as a countermeasure than export subsidy policy from a standpoint of the new WTO. Lastly, we suppose, for highlighting the geographical difference of the LC and the CC, the CC's firm does not pay any transportation costs and toll fees, but incurs just 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 defined as

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

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

In (1) and (2), $p(x + x^*)$ is an inverse demand function in the third-county market that has a feature $p'(x + x^*) < 0$. $C(x)$ denotes a cost function of the LC's firm for producing output x with usual features of $C'(x) > 0$ and $C''(x) > 0$. $t(I)$ is a unit transportation cost of the LC's firm for conveying its goods, and it is assumed to be a decreasing and convex

function of T-R&D investment I of the LC's firm: $t'(I) < 0$ and $t''(I) > 0$. We assume, for simplification, that the transportation cost of the CC's firm is normalized to zero. τ is a unit toll fee the CC's government impose on the LC's firm. $q(I)$ is a cost function for carrying out T-R&D investment I with ordinary features: $q'(I) > 0$ and $q''(I) \geq 0$. s is a unit T-R&D subsidy (tax when positive) given by the LC's government. And, a variable with a superscript * represents that of the CC's firm. It is assumed in this paper that the LC's firm and the CC's firm act so as to maximize their own profits after their governments' political decisions, respectively.

On the other hand, taking into consideration that in the third-country model both the LC and the CC don't consume the goods in question, the economic welfare of LC and the CC obtained from the industry in question, W and W^*, are respectively given by

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

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

While (3) shows that the LC's welfare consists of its firm's profit and its T-R&D subsidy payment given to its firm, (4) illustrates that the CC's welfare is the sum of its firm's profit and the toll fee revenue levied from the LC's firm. (3) and (4) combine to demonstrate that the LC's firm has

some direct relations with the two countries' policies but the CC's firm has directly nothing to do with them. We assume that the LC's government and the CC's government determine a unit T-R&D subsidy and a unit toll fee so as to maximize their economic welfare before their firms begin their actions, respectively.

In this paper, we regard that the two firms and the two governments play a three-stage game. In the first stage, the LC's government and the CC's government respectively set a unit T-R&D subsidy s and a unit toll fee τ to maximize their economic welfare before their firms' output choices. The governments become the first players and can influence the equilibrium outcome of the game played by firms. Then, in second stage, the LC's firm sets its T-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. And, in the third stage, the LC's firm and the CC's firm non-cooperatively choose their outputs x and x^* so as to maximize their profits under the Cournot type of quantity competition, given the political variables decided in the first stage, the T-R&D investment determined in the second stage and the rival’s output. In order to solve this two-stage game we adopt a method of backward induction. The sub-game perfect equilibrium incorporates two stages.

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

When the third-country market is under the Cournot type of quantity competition, the landlocked and coastal firms respectively choose outputs x and x^* so as to maximize their own profits, given all the decisions made by governments and firms in the 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

$$\pi_x = p(x+x^*) + p'(x+x^*)x - C'(x) - t(I) - \tau = 0, \qquad (4)$$

$$\pi^*_{x^*} = p(x+x^*) + p'(x+x^*)x^* - C^{*\prime}(x^*) = 0, \qquad (5)$$

where (4) and (5) are the first-order conditions (the reaction functions) of the landlocked country's firm and the costal country's firm, respectively.

We also assume, as is supposed in many papers, that the firms' second-order conditions are both satisfied and that own effects of output on marginal profit dominate cross effects:

$$\pi_{xx} < \pi_{xx^*} < 0, \quad \pi_{x^*x^*} < \pi_{x^*x} < 0. \qquad (6)$$

It is easily shown that (6) is always true when the demand function in the third-country market is linear in quantity. (6) ensures that the firms'

reaction curves in the third stage are both downward sloping and that the industry equilibrium in the third stage is stable (locally). Obviously, the optimal outputs (market shares) of the firms depend on T-R&D investment I and toll fee τ.The simultaneous solution to these equations presents the industry equilibrium, $x = x(I,\tau)$ and $x^* = x^*(I,\tau)$.

Here, in order to examine the geographical disadvantage of the LC, assume, for simplification, that firms' marginal costs are constant and same as each other. Then, we get from (4) and (5)

$$x^* - x = \frac{-t(I)-\tau}{p'(x+x^*)} > 0. \qquad (7)$$

Accordingly, it is obvious from (7) that the output (export) of the LC's firm is generally smaller than that of the CC's firm and that the LC's geographical disadvantage (measured by the difference between firms' outputs) depends on a transportation cost, a toll fee and the demand function of the third country.

Next, totally differentiating (4) and (5) with respect to x, x^*, I and τ, we have

$$\begin{bmatrix} \pi_{xx} & \pi_{xx^*} \\ \pi^*_{x^*x} & \pi^*_{x^*x^*} \end{bmatrix} \begin{bmatrix} dx \\ dx^* \end{bmatrix} = \begin{bmatrix} t'(I)dI + d\tau \\ 0 \end{bmatrix}. \qquad (8)$$

Then, taking into consideration (6) and $t'(I) < 0$, we derive from (8):

$$x_I = \frac{t'(I)\pi^*_{x^*x^*}}{D} > 0, \qquad x^*_I = -\frac{t'(I)\pi^*_{x^*x}}{D} < 0, \tag{9}$$

where $D = \pi_{xx}\pi_{x^*x^*} - \pi_{xx^*}\pi_{x^*x} > 0$. It follows that an increase in the T-R&D investment I of the LC's firm increases its own output (export) but reduces its rival's output (output), and *vice versa*. Moreover, (6) and (8) combine to give $x^*_I - x_I < 0$ and $x_I + x^*_I > 0$, which means, in turn that a rise in the T-R&D investment I of the LC's firm improves the geographical disadvantage of the LC and increases total exports to the third country, and *vice versa.*

Furthermore, taking account of the conditions of (6), we also obtain, from (8), the effects of a change in τ on x and x:

$$x_\tau = \frac{\pi^*_{x^*x^*}}{D} < 0, \qquad x^*_\tau = -\frac{\pi^*_{x^*x}}{D} > 0. \tag{10}$$

It follows that while a rise in the toll fee set by the CC's government decreases the LC's output (export) but increases the CC's output (export), and *vice versa.* However, since $x_\tau + x^*_\tau < 0$ and $x^*_\tau - x_\tau > 0$ hold under (6) and (10), a hike in the CC’s toll fee reduces total exports to the third country and aggravates the LC's geographical disadvantage, and *vice versa.* Therefore, though the CC can regain its geopolitically lucrative position and acquire some toll revenues by imposing a toll fee on the LC’s firm and acquire , it might simultaneously damage its international friendship with

the LC and the third country.

4. T-R&D Decision of the LC's firm in the Second Stage

In the second stage, while the LC's firm decides its T-R&D investment so as to maximize its profit, given all the governments' political decisions in the first stage and the firms' first-order conditions in the third stage, the CC's firm does nothing. Hence, the industrial equilibrium in the second stage is illustrated by

$$\pi_I = p'(x+x^*)xx_I^* - t'(I)x - q'(I) + s = 0, \qquad (11)$$

where $\pi_I = \frac{\partial \pi}{\partial I}$. In (11), since $p'(x+x^*)xx_I^* - t'(I)x$ and $q'(I) - s$ are respectively a marginal revenue and a marginal cost in the T-R&D investment, (11) shows the equality between a marginal revenue and a marginal cost in the optimal T-R&D investment decision. We assume, as in the previous section, that the second-order condition of the LC's firm in the second stage is also satisfied: $\pi_{II} = \frac{\partial^2 \pi}{\partial I^2} < 0$. Then, solving (11), we get the optimal T-R&D investment I of the LC's firm in the second stage as a function of the T-R&D subsidy s: $I = I(s)$.

Totally differentiating (11) with respect to s and I, we obtain

$$\pi_{II} dI = -ds, \qquad (12)$$

which, in turn, gives

$$I_s = -\frac{1}{\pi_{II}} > 0. \qquad (13)$$

Thus, (13) demonstrates that the T-R&D investment of the LC's firm is an increasing function of the T-R&D subsidy of the LC's government. Of course, it is immediately obvious that, since (11) does not include the toll fee τ set by the CC's government, the optimal T-R&D investment of the LC's firm is independent of τ. Thus, we have

$$I_\tau = 0. \qquad (14)$$

Now that we get the effects of changes in a T-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 discuss effects of these political variables on outputs (exports) and profits of the LC's and the CC's firms.

Taking into consideration (9) and (13), the effects of a change in the T-R&D investment subsidy on outputs of the LC's firm and the CC's firm are respectively given by

$$x_s = x_I I_s > 0, \qquad x_s^* = x_I^* I_s < 0. \qquad (15)$$

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, from (6), (9) and (13) we present

$$x_s + x_s^* > 0, \tag{16}$$

which implies that an increase in the LC's T-R&D investment subsidy raises the total exports from the LC and the CC to the third country, and *vice versa.*

On the other hand, taking account of (9) and (13), the effects of a change in the T-R&D investment subsidy on profits of the LC's firm and the CC's firm are respectively derived as

$$\begin{aligned} \pi_s &= xp'x_I^* I_s + I > 0, \\ \pi_s^* &= x^* p' x_I I_s < 0. \end{aligned} \tag{17}$$

Therefore, an increase in the T-R&D subsidy of the LC rises the profit of LC's firm and reduces the profit of the CC's firm, and *vice versa.* Furthermore, (4), (5), (10) and (14) combine to present

$$\begin{aligned} \pi_\tau &= xp'x_\tau^* - x < 0, \\ \pi_\tau^* &= x^* p' x_\tau > 0. \end{aligned} \tag{18}$$

Hence, a raise in the toll fee set the CC's government decreases the LC's firm’s profit increases the CC's firm’s profit, and *vice versa.* It is follows from (17) and (18) that the LC's and CC’s governments can adopt the T-R&D subsidy and the toll fee as strategic export policies, respectively.

5. Governments' Political Determinations in the First Stage

In the first stage, the governments of the LC and the CC determine the T-R&D subsidy and the toll fee so as to maximize their own economic welfare defined as (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 and the CC in the first stage are respectively given by

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

$$W_\tau^* = x^* p' x_\tau + x + \tau x_\tau = 0. \qquad (19)$$

We also assume that the governments' second-order conditions of welfare maximization are both satisfied at the equilibrium. Then, (19) gives, together with $p' < 0$, $x_I^* < 0$ from (9) and $x_\tau < 0$ from (10),

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

$$\tau = -x^* p' \left(-\frac{x}{x_\tau}\right) > 0 \qquad (20)$$

at the equilibrium. It follows that the optimal LC's T-R&D subsidy is equal to the marginal profit of the LC's firm with respect to the T-R&D investment and that the CC's optimal toll fee is equivalent to the marginal profit of the CC's firm with respect to the toll fee. Moreover, (20) also indicates that the optimal LC's T-R&D subsidy and the CC's optimal toll fee are both positive. In the real world, This means that while the LC

subsidizes the T-R&D investment of its firm improve its geographical disadvantages against the CC, the CC charges a toll fee on the LC’s firm in order to recover its lost advantages. However, as far as the extra transportation cost of the LC’s firm is positive, it is impossible for the LC to remove completely its geographical disadvantages.

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 a geographical difference, we examined international rivalry in firms' export-output choices and in governments' policy determinations. Since the LC does not have any seaports for exporting goods, the LC's firm must transport its goods to the nearest port in the CC. Then, the LC's firm has a comparative disadvantages against the CC's firm from a geographical point of view, because it must incur extra transportation costs, *ceteris paribus.* It is thus assumed the LC's firm adopts the T-R&D investment to reduce its comparative disadvantage due to its geographical handicap and that while the LC subsidizes its firm's T-R&D investment to reinforce its firm's effort, the CC imposes a toll fee on the LC's firm to countervail the effect of such a LC's policy. Of course, it is also assumed

the LC and the CC are not hostile in their political relation but just rivalry in their economic relation.

The main findings are, among others, summarized as follow. The first is that both the LC's T-R&D subsidy and the CC's toll fee are used as the LC's and the CC's strategic export policies, respectively. While a rise in the LC's T-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*. The second is the optimal levels of the LC's T-R&D subsidy and the CC's toll fee are positive.

In view of industrial trades by the LC and the CC, the implementation of the LC's T-R&D subsidy improves the LC's comparative disadvantages and extends total exports from the LC and the CC to the third country, which leads to the price decline in the third country. On the other hand, the imposition of the CC's toll fee boosts the LC's comparative disadvantages and contracts the total exports by the two countries, which results in the price soar in the third country. Consequently, the former is welcomed by the third country, but the latter is disliked by the third country.

Though the present model discusses only a case of non-cooperative policies between the LC and the CC, it will be extended to several

directions to study many economic problems among LCs and CCs. We don’t examine any cooperative policies supported by both LCs and CCs. For example, improvement of some transportation facilities in a CC proposed by its neighbor LC, such as pavement of the CC's roads and/or dredging of CC’s harbors, would be approved as cooperative policies because these are beneficial to the CC as well as the LC. Furthermore, cooperative construction of some storage facilities and/or that of correspondence facilities are also conceivable cases. However, these would be investigated in future papers.

Footnotes

1. Brain and Jacques (1995) have reported that Tanzanian and Kenyan ports are very important as a transit for landlocked countries in east

African. Van Klink & Van den Berg (1998) have shown that the acts of gateway, for instance Rotterdam, play an important role as a point of transshipment in intercontinental logistic chains for central European countries.

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

3. As far as we know, there has been no paper to model a geographical disadvantage of landlocked country and coastal country retaliation solely, though Haaland and Kind (2008) have examined the R&D subsidy rivalry which both countries grant a subsidy.

4. For instance, investment to fuel-efficient transportation measures is a typical example of the T-R&D investment. Moreover, investment to refrigerators for perishable goods and/or shockproof vehicles for fragile

products is also regarded as the T-R&D investment.

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