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Essays on Trade Costs and Public Policy

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Essays on Trade Costs and Public Policy

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Contents

Chapter 1

Introduction

1.1 What Does Globalization Bring About?

The phenomenon of globalization can be seen everywhere in the present day world; it began at the distant past and has been proceeding gradually. Even during the earliest days, a group of people had made a variety of contacts with other groups, culminating in, for example, the appearance of the Mediterranean trade during the ancient civilization, the major Germanen migration, and the Silk Road trade between the Tang dynasty and the Roman Empire. Furthermore, the Age of Discovery that followed the invention of the compass accelerated the progress of globalization more than ever before. In most European countries of that age, the sovereign state system had already been established and the national government contributed to the progress of globalization in the form exploration of the new world. Thereafter, the progress of globalization has been significantly supported by the growth of science and technology. The invention of the steam engine during the Industrial Revolution led to the advancement of transport technologies, thus enabling trade with other countries to move beyond national borders more easily. Subsequently, from the 20th century, steam energy started to be replaced by petroleum energy and there soon appeared the modern automobiles and airplanes. Additionally, the development of information and communications technology enabled the exchange of information between persons living in faraway countries without having to travel.

Along with the advancement of globalization, every activity has been spreading worldwide, resulting in significant impacts in each period. The spread of such activities triggered public concern for the world, with spatial views closely related to geographic perspectives. For example, in the Age of Discovery, Magellan and his colleagues succeeded in sailing around the world and returned back to Europe with Asian spices. Spices were highly valued in many European countries, and the

Europeans sailed on long voyages in search of distant islands at severe risk.[1] Surely, they had to struggle to overcome the risk from the locational relationship between European countries and Asian islands. Thus, Magellan's successes induced the people of Europe of those days to experience Asian spices as well as appreciate the geographic separation between them. That is, as the scope of activities extended, people realized the geographic diversity of the world, which has never dramatically varied since then. With regard to geographic characteristics, we find that they generated an objective for people to realize as well as a challenge to overcome; that is, the objective was Asian spices and the challenge, the sailing risk due to the long voyages during the Age of Discovery. It can be said that globalization, including the spatial expansion of activities, has made the importance of geographic factors to be shaped up. Therefore, for a fair picture of the globalized world bringing about further interaction between people, we need to consider the geographic features.

1.2 Why Does Trade Cost Matter?

Of the various factors characterizing geographic features, this dissertation focuses on the spatial separation between locations where people are engaged in some kind of activity. Considering countries as the locational point for such activities and given the spatial relationship between countries, we are required to overcome the spatial separation and engage with foreign countries for a better life. Thus, a spatial analysis that takes into account the separation between countries would help us better understand the activities of people in the globalized world.

How do we express the separation between countries in our analysis? In an economic analysis focusing on the behavior and interaction of people, one central question that arises is, why do people trade goods with others? Thus, the distance between economic agents is our motivation to formulate trade costs in the analysis of trading activities with other agents in distant places. As "trade costs, broadly defined, include all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself" (Anderson and van Wincoop, 2004), the trade costs of economic agents cover a wide range of issues. In particular, trade costs, as broadly defined by Anderson and van Wincoop (2004), include not only the transportation costs or policy barriers but also the costs associated with the differences in currencies, cultures, and languages. Most of these factors could be due to geographic differences, implying that by incorporating trade costs based on their definition, we can include the geographic perspective in our economic analysis.

[1] See Fernandez-Armesto (2006) for details of the European exploration of Asia

Empirical evidence on trade costs also convinces us to include trade costs in our analysis. Some economists challenge to explore the realities of trade costs (Eaton and Kortum, 2002; Head and Mayer, 2004; Anderson and van Wincoop, 2004; Hummels, 2007). Anderson and van Wincoop (2004) comprehensively reviews and summarizes papers on trade costs and stress the importance of some aspects of trade costs between countries. One of them is an empirical analysis showing the broadly defined trade costs large even between developed countries. Their estimation shows that when commodities priced $100 are transported to a foreign country, the trade costs become $170. Such large trade costs can be divided into international and domestic factors: 74% international and 44% domestic. This provides us with further motivation to analyze the economic activities related to trade costs.

Thus, we sum up these discussions and present the purpose of this dissertation. We explore the economic activities of the globalized world by incorporating geographic factors. In particular, we consider the relationship between public policy and trade costs as geographic factor. Given the high mobility of people, goods, or capital, national governments tend to implement policies in order to manipulate favorable objectives. In such conditions, trade costs influence the economic activities related to international trade, particularly if it is relatively large. Thus, public policy should be implemented considering mobility as well as trade costs. Our main objective is to analyze international public policy under a globalized economy influenced by trade costs.

1.3 What We Do

Chapter 2

Chapter 2 presents a stream of research on economic activities in the globalized world. Such topics have been analyzed in international economics. We trace the development of international trade theory and the role of trade costs in theoretical models. First, we explain the concept of comparative advantage and discuss the traditional arguments relating to trade costs. Furthermore, we incorporate the oligopoly market in our analysis and shed light on certain aspects of international trade not considered in standard theory. We then introduce the New Trade Theory. Departing from the assumption of immobility of production factors, we show that firms choose their location to produce and supply goods to domestic as well as foreign markets.

Chapter 3

Chapter 3 focuses on the tariff policy and trade costs that play similar roles as obstacle to the entry of foreign goods. However, there are differences between them in that the tariff rate is determined by the government with certain objectives but trade costs are not. Hence, this chapter examines the effects of trade costs on tariffs that are endogenously determined by the government. We also explore the welfare impact of concluding a free trade agreement (FTA) in the presence of trade costs between countries.

Previous studies on this topic generally argue that FTA formation has beneficial implications for member countries as well as for non-member countries in that the tariff complementarity effects of an FTA induce member countries to employ lower tariffs on the non-member countries. In contrast, the present analysis shows that the effects of tariff complementarity are likely to disappear when the trade costs between countries forming the FTA are sufficiently large. Additionally, welfare analysis sheds light on the negative aspects of an FTA. Thus, the FTA members' welfare could decrease when the trade costs between any two countries are significantly high. Even if international trade could expand with the formation of an FTA, it would generate the additional payment of trade costs and lead to a decrease in national welfare. Thus, higher trade costs, especially between member countries, might worsen the welfare of FTA members.

Chapter 4

Chapter 4 constructs an economic model with the industry unevenly distributed across countries and explores the relationship between a reduction in trade costs and the incentive to cooperate with trade policy in an infinitely repeated game approach. This analysis gives us an insight into the relationship between the recent surge in cooperation between countries and trade costs.

The main issue is whether the trade cost reduction resulting from trade liberalization depends on the trade policy regime. Under a unilateral trade policy regime, we cannot achieve bilateral trade liberalization with a decrease in trade costs. On the other hand, a cooperative trade policy regime can solve the problem. As the trade costs decrease, cooperative governments can impose a lower tariff on each other and bring about bilateral trade liberalization.

Furthermore, we analyze whether a trade cost reduction can induce self-enforcing cooperation. In the stage game where each government chooses its policy regime non-cooperatively, the Nash equilibrium outcome is obviously undesirable. However, considering that such static games are repeated infinitely, we presume that

cooperative trade policy can be achieved under certain conditions. Moreover, a less (more) industrialized country is shown to be more (less) encouraged to cooperate in trade policy as the trade costs decrease, suggesting that a change in trade costs has opposite effects on two countries.

Chapter 5

Chapter 5 separates trade costs into international and domestic transport costs and investigates the impacts of endogenous domestic transport costs via public investment. In particular, we assume that the government's public investment can affect the level of domestic transport costs.

Previous studies have limitations in that they assume exogenous transport costs. In this chapter, we relax this assumption and refine the previous outcomes into more convincing ones. Under exogenous transport costs, the representative result of the existence of home market effect may disappear. However, this result depends on the assumption of exogenous transport costs. Clearly, since a decrease in domestic transport costs improves national welfare, governments generally tend to reduce domestic transport costs. Treating transport costs as the endogenous policy variable, this chapter shows that the home market effect appears unlikely in case of exogenous transport costs.

Chapter 6

Chapter 6 reviews the analysis and results of each chapter. In addition, the issues remaining for a future research are summarized.

Chapter 2

Literature review: Role of trade costs in economic modeling

This chapter reviews some theoretical models to analyze the trade costs in international trade theory. First, considering comparative advantage as the origination of trade theory, we discuss the traditional arguments in the presence of trade costs. We also present an international oligopoly model to show the relationship between trade costs and the market power of firms. Second, departing from the assumption of immobility of production factors, we introduce a trade model with monopolistic competition in which producers choose their location endogenously. This review along with the development of trade theory allows us to better understand what we do in this dissertation.

2.1 Comparative Advantage Approach

Traditionally, comparative advantage has been adopted to discuss issues such as the purpose of international trade and the determinants of trade pattern between countries. In this section, we introduce the traditional trade theory based on perfect competition to explain the trade pattern in accordance with the difference between countries, and discuss the role of international transportation. The traditional theory considers a factor-originating comparative advantage as a sort of difference between countries. Depending on the difference between countries, the perfect competitive model is categorized into the Ricardian model and the Heckscher-Ohlin model (hereafter, H-O model). We discuss the role of trade costs with regard to both models and show how it affects the consequences of traditional argument.

Ricardo (1817) proposed the idea of comparative advantage and showed that the difference in production technology determined the trade flow between countries.

In the Ricardian model, a country has comparative advantage in a good if firms in that country have the technology to produce that good with lower opportunity costs compared to firms in the trade partner country. From the comparative advantage characterized by difference in production technology, each country can export its good produced with relatively superior technology.

Dornbush et al. (1977) developed the Ricardian model to analyze the case of continuum goods and discussed the trade pattern between two countries in the presence of trade costs. Note that the trade costs given exogenously are additional costs for the producer to supply goods to the foreign country. This implies that in order to export a good, the productivity of that good should be high enough to exceed the obstacle of trade costs. Otherwise, goods tradable in the absence of trade costs are not exported for want of comparative advantage and the production advantage disappears due to the presence of trade costs. Thus, Dornbush et al. (1977) shows that the presence of trade costs hinders international trade in the Ricardian model when a part of the goods become non-tradable endogenously.

Next, we introduce some results deduced from the H-O model and discuss the effect of trade costs. Hecksher and Ohlin insisted that a country with a production factor in abundance relative to foreign countries incurs a lower price for that factor and the international difference in factor endowment brings about a production advantage, that is, a comparative advantage (Ohlin 1933). Their ideas were subsequently formulated into some styles by Samuelson (1948) and Jones (1965). The H-O model basically assumes an economy consisting of two production factors (labor and capital), two production sectors (labor intensive and capital intensive), and two countries (capital abundant and labor abundant). A sector is capital (labor) intensive if its production involves a higher (lower) capital-labor ratio compared to the other sector provided the factor prices in both sectors are the same. In contrast to the Ricardian model, the two countries have no difference in production technology but differ in the relative endowment of production factors. The country endowed with richer capital (labor) relative to the foreign country can fully employ the capital (labor) with lower compensation compared to the foreign country in autarkic equilibrium. Thus, since the capital (labor) abundant country can save by less payment for capital (labor), it has an advantage in the capital (labor) intensive sector. Therefore, under free trade equilibrium, the country richer with capital endowment relative to the foreign country exports (imports) the good produced by the capital (labor) intensive sector, implying that the difference in factor endowment determines the trade pattern.

Some studies analyze trade costs based on the H-O model. Samuelson (1954) incorporated trade costs into the H-O model in a very simple style; this is called

iceberg-type costs. Iceberg trade costs lead a part of the goods produced by the domestic producer to melt away for international transportation; this allows us to model the transport service sector simply. Samuelson (1954) and Mundell (1957) reexamined the outcomes of the H-O model by introducing trade costs; they demonstrated that trade costs brought about disparity between the domestic and global relative prices. This disparity in relative prices severely affects the central theorem of the H-O model, that is, the *factor price equalization theorem*, which states that trading countries incur the same factor prices even if the factors are immobile. When the relative price in the international market differs from the relative price in each country, the demand for the production factor of the domestic producer is also different between countries and the factor price equalization theorem does not hold in the presence of trade costs. However, they also showed that the presence of trade costs does not reverse the trade pattern determined by comparative advantage. The gains of trade shrink compared to the case of no trade costs but remain positive.

In contrast to Samuelson (1954) and Mundell (1957), some studies consider trade costs as the endogenous variable; this is seen in the transport industry (Herberg, 1970; Falvey, 1976; Casas 1983). From the perspective of the endogenous supply of transport services, we show how the inclusion of the transport sector affects the distribution of production factors in the equilibrium of the H-O model. When the transport industry employs the production factors of other production sectors for the provision of transport services, it affects the production resources available to produce consumption goods. Herberg (1970) considered the constant returns to scale technology of the transport industry providing transport services for the imported goods of the country where that industry is located. Assuming a small country in which the relative price is constant, he analyzed the effects of incorporating the transport sector on the production structure of import and export goods based on the factor intensity between sectors. When the capital-labor intensities to produce import goods and to supply transport services are identical, the introduction of the transport sector induces the imported (exported) good to decline (remain unchanged). This is because a part of the production factors is used to supply transport services at the same proportion required for the production of the imported good, and so some production factors for producing the import goods move to the transport sector. Thus, the factor intensity in the transport sector can indicate which production sector bears the cost of international transportation via the distribution of production factors.

2.2 International Trade in Oligopolistic Market

The traditional Ricardian and H-O models are based on perfect competition; a large number of firms produce a homogeneous commodity, given the market price. Thus, such models do not consider the case of a few producers taking a large share of the market. In this section, we introduce studies that relax the assumption of perfect competition and incorporate the oligopolistic market. With regard to the international oligopolistic market, these studies show how to approach the economic phenomena or policy without exploring the traditional model.

2.2.1 Strategic trade policy

In this section, we first review the strategic trade policy literature focusing on the international oligopolistic market. The trade model incorporating the oligopolistic market was established in the 1980s following the developments in industrial organization. Numerous studies followed, offering insights into international trade in the presence of oligopoly owing to its tractable models and novel implications. The direction of each paper in this area diverges into several branches, and hence a comprehensive survey in this dissertation is challenging. However, several studies have comprehensively surveyed the literature of strategic trade policy (Helpman and Krugman, 1989; Brander 1995; Leahy and Neary, 2011). Thus, to avoid dispersion of our argument, we introduce the essence of imperfect competition in international market and the role of trade costs here.

One of the contributions to the oligopolistic market is to justify the export subsidy policy, which cannot be optimal in perfect competition. Brander and Spenser (1985) is the pioneering study that established the trade model with Cournot-type oligopoly; this is called the "third-market" model. The study assumes an economy comprising three countries and two firms located in different countries with no consumer; the firms compete with each other by exporting to the third country where there is no firm. They found that the government decides to subsidize the firms' exports to maximize national welfare. Since the two firms compete with each other as strategic substitutes in Cournot fashion in the third-market country, the subsidy policy induces the home-country firm to increase its production and the rival firm to reduce its quantity. This results in a part of the rival firm's rent shifting toward the firm subsidized; thus, the government implements the export subsidy policy in order to shift the rent of the foreign firm to the firm in its own country. As described, the trade policy in imperfect competition leads to a sort of rent-shifting between countries.

Brander (1981) and Brander and Krugman (1983) explain the appearance of

intra-industry trade. They also show that when international trade occurs between similar countries, they are too similar to result in comparative advantage. Their analysis is closely related to our model in Chapters 3 and 4; we confirm the mechanism inducing international trade without comparative advantage and the role of trade costs in oligopolistic markets.

In contrast to the third-market model, Brander (1981) and Brander and Krugman (1983) construct the reciprocal market model in which there are two countries (indexed by i and j), each of which has one firm producing a homogeneous commodity. They assume the consumers' preference in country r ($r = i, j$) is represented by the inverse demand function $p_r(Q_r)$, where Q_r denotes the total amount of consumption and p_r is the consumers' price in country r, satisfying $p_r' < 0$. The producer in each country can supply the product to both countries, but international transportation leads to trade costs of $\tau > 1$ in ad-valorem fashion, so that to provide goods to the foreign country, each firm is required to pay transportation costs in addition to production costs ($\tau = 1$ means no trade cost). From this, it follows that the profit of firms in each country can be written as

$$\begin{aligned} \pi_i &= p_i(Q_i)q_{ii} + p_j(Q_j)q_{ij} - cq_{ii} - c\tau q_{ij} - f, \\ \pi_j &= p_j(Q_j)q_{jj} + p_i(Q_i)q_{ji} - cq_{jj} - c\tau q_{ji} - f, \end{aligned}$$

where q_{rs} stands for the quantity of the homogeneous good produced by the firm in country r ($r, s = i, j$), and thus $Q_r = q_{rr} + q_{sr}$ ($r, s = i, j$ and $r \neq s$) supplied to country s. Furthermore, c (f) represents the constant marginal (fixed) costs of production.

By adopting the constant marginal production cost, we can simplify our analysis by separating the market in each country, meaning that taking the above profit as objective function, firms determine their production for the domestic market and foreign market independently. In fact, the first-order conditions for the profit-maximization problem of the firm in country i become

$$\begin{aligned} \frac{\partial \pi_i}{\partial q_{ii}} &= p_i(Q_i) + q_{ii}\frac{\partial p_i(Q_i)}{\partial q_{ii}} - c = 0, \\ \frac{\partial \pi_i}{\partial q_{ij}} &= p_j(Q_j) + q_{ij}\frac{\partial p_j(Q_j)}{\partial q_{ij}} - c\tau = 0, \end{aligned}$$

Each equation representing the function of either (q_{ii}, q_{ji}) or (q_{jj}, q_{ij}). This holds true for the producer in country j. Thus, the equilibrium quantities in one market are separated from the quantities in the foreign market, and so we analyze one market in isolation from the other market. From now on, we consider the market

in country i only. From the above first-order conditions, the quantity supplied to country i satisfies the following equation:

$$p_i(Q_i)\left[1-\frac{q_{ii}}{Q_i}\frac{1}{\epsilon_i}\right]=c,$$
$$p_i(Q_i)\left[1-\frac{q_{ji}}{Q_i}\frac{1}{\epsilon_i}\right]=c\tau,$$

where $\epsilon_i \equiv -Q_i p_i'/p_i$ represents the demand price elasticity in country i. We compare these equations and find $q_i i > q_j i$ in equilibrium, implying that the foreign firm supplies less goods compared to the domestic firm because they have to pay trade costs. Thus, we find that the foreign firm does not export to country i because of high trade costs. We can then derive the condition under which the foreign firm can penetrate the market in country i as follows:

$$\tau < \frac{\epsilon_i}{\epsilon_i - 1}.$$

This condition shows that the trade costs should be lower relative to $\epsilon_i/(\epsilon_i - 1)$, which represents the markup in a monopoly and hence the capacity of the monopoly's rent. Therefore, when the margin obtained is potentially higher than the trade costs as an additional payment for the provision of the foreign market, the foreign firm can penetrate the market of country i.

As mentioned previously, as long as the markup is sufficiently high relative to trade costs, both countries trade the homogeneous goods with each other, implying intra-industry trade. Furthermore, in this model, no difference exists between countries, thus inducing international trade through a mechanism different from comparative advantage. In an oligopolistic market, the equilibrium quantity of production is smaller than that in a perfect competitive market with zero profit, and so some room exists for the foreign firm with market power to supply to the market even if the product supplied and the domestic firm's product are homogeneous.

Consider the effect of trade cost reduction on welfare in a reciprocal market model. A reduction in trade costs induces the foreign firm to export more and thereby improve consumer surplus. On the other hand, the domestic firm faces further competition from the foreign firm and the rent of the domestic firm shrinks as the trade cost decreases. Such conflicting results make the welfare effect of trade costs ambiguous. Brander and Krugman (1983) extended the reciprocal market model to incorporate the free entry of firms and reduce the oligopoly's profit to zero in equilibrium. Under this situation, as the trade costs decrease, the rent of the domestic firm remains zero, but an individual can enjoy more consumption. Thus, a

trade cost reduction always improves consumer welfare when firms can freely enter the market.

With regard to oligopolistic markets, a few studies formulate a structure to determine trade costs. In particular, Andriamananjara (2004) extended Brander and Krugman's (1983) model by incorporating the international transport service market where oligopolistic firms compete in prices. In this situation, a comparative static analysis shows that trade liberalization induces an increase in transport service prices. A reduction in trade barrier generates more demand for foreign products, and hence firms in the transport service market increase their prices to obtain additional rent.

2.2.2 Foreign direct investment

The oligopolistic market enables us to discuss individual firm behavior, which is suppressed under perfect competition. Foreign direct investment (FDI) studies are blessed with the development of several international trade models. The integration of capital markets internationalizes the form of firm organization, implying that the production activity of even a single firm includes different countries' contributions through FDI. Such firms having internationally multiple production bases are called multinational enterprises (MNEs). In terms of such firm organization, we provide a notable issue related to trade costs. This subsection introduces some FDI studies that focus on the role of trade costs.

In this literature, we consider two types of FDI, horizontal and vertical. Horizontal FDI refers to the situation where the headquarters invests capital abroad for a production base to produce the same commodity the parent firm produces. Through horizontal investment, the firm can supply the commodity to the foreign country without trade barriers such as trade costs or tariffs. Hence, when the firm faces higher trade costs, horizontal FDI becomes attractive to avoid trade costs (Markusen, 1984; Brainard, 1997; Markusen and Vanables, 1998, 2000).

Vertical FDI is useful when the firm decides to partition the production process and moves a part of it abroad. This helps in the reduction of production cost by moving a production process to a foreign country where it can be done at lower cost. In this case, the trade cost is related to the firm's decision to organize a series of production procedures.[1] Now, assume that the production activity is separated into two procedures of producing intermediate goods and assembling them to obtain the final good. Whenever the firm relocates either procedure, but not both, to save

[1]Helpman (1984) explored the mechanism of domestic firms conducting vertical FDI and moving a part of their production activity to a foreign country under the framework of the H-O model without trade costs.

production costs, it is required to consider the trade-off between cost reduction by relocating the production base and the additional costs of transporting the intermediate goods to the country where the assembling base is located. Therefore, a firm's decision on horizontal and vertical FDI is directly related to its trade costs.

Indeed, the classification of FDI as mentioned above apparently clarifies the importance of trade costs in the FDI literature. Many economists have pointed out a third type of complex integration strategy. Behind this third type, the fact is that MNEs simultaneously conduct horizontal and vertical FDI as strategy to organize the production process. In the light of this, some recent studies have addressed this issue (Yeaple, 2003; Grossman et al., 2006; Ekholm et al., 2007). Even if we consider a firm facing both options of horizontal and vertical FDI, the importance of trade costs in this literature does not fade away.

2.3 International Trade and Industrial Agglomeration

The development of trade theory in the oligopolistic market sheds light on an aspect that traditional theory has missed. Since firm behavior is explicitly defined, we discuss the firm's location choice as a determinant of FDI. However, the trade theory of an oligopolistic market cannot analyze an issue at an industrial level expressed as the aggregation of individual firm behavior. It would be a serious problem for trade theory if we try to understand the world where industries are distributed unevenly across countries. The New Trade Theory (NTT) of Helpman and Krugman (1985) and the New Economic Geography (NEG) of Fujita et al. (1999) can resolve this problem.[2] This section introduces the basic NTT model and reviews the literature analyzing industrial agglomeration.

2.3.1 New trade theory

The NTT constructed by Krugman in the 1980s assumes trade costs between countries, "love of variety" of consumer preferences, and the monopolistic competition between firms, allowing us to discuss industrial agglomeration across countries. Assume that the economy consists of two countries ($r = 1, 2$) and two sectors, manufacturing and agriculture. In the manufacturing sector, individual firms produce differentiated goods under monopolistic competition, as in Dixit and Stiglitz (1977),

[2]The difference between NTT and NEG is on population mobility, implying that in NEG, individual consumers move across countries whereas in NTT they do not. For a more comprehensive and detailed survey, see Baldwin et al. (2003), Ottaviano and Thisse (2004), Tharakan and Thisse (2011), and Melitz and Redding (2014). This dissertation analyzes industrial agglomeration based on international trade theory, and so we do not consider the issue of mobile population, which we leave for a later study.

whereas the agricultural sector operates under perfect competition with constant returns to scale. The consumer preference in country r can be represented as

$$U_r = C_{Mr}^{\alpha} C_{Ar}^{1-\alpha},$$

where C_{Ar} is the numéraire consumption of agricultural goods and C_{Mr} is the sub-utility from consuming differentiated goods defined as

$$C_{Mr} = \left[\sum_{m=r,s} \int_0^{n_m} x_{mr}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}.$$

Here, n_r is the number of varieties produced in country r, and $x_{rs}(i)$ represents the consumption of differentiated good i in country s, produced in country r $(r, s = 1, 2)$. The parameter $\sigma > 1$ measures the elasticity of substitution between any two differentiated goods. To confirm whether this preference structure represents the love of variety with regard to manufacturing goods, we suppose that the manufacturing goods produced domestically and abroad are consumed at the same level x. Then, the sub-utility from consuming the manufacturing goods becomes

$$C_{Mr} = (n_r + n_s)^{\frac{\sigma}{\sigma-1}} x.$$

From this equation, the sub-utility can be improved by an increase in the variety of manufacturing goods, $n_r + n_s$, indicating the feature of love of variety. Thus, while consumers prefer the amount of goods in the previous theory, the diversity of that preference generates consumer utility in the NTT model. From the consumer's maximization problem, the demand functions deduced from the consumer preferences are

$$\begin{aligned} x_{sr}(i) &= \frac{p_{sr}(i)^{-\sigma}}{P_r^{1-\sigma}} \alpha y_r, \\ C_r &= (1-\alpha) y_r, \end{aligned}$$

where y_r denotes the consumer's income in country r and $p_{sr}(i)$ is the price of manufacturing good i produced in country s and consumed in country r $(r, s = 1, 2)$. P_r is the price index defined by

$$P_r \equiv \left[\sum_{m=r,s} \int_0^{n_m} p_{mr}(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}}.$$

This price index gives the cost to improve the sub-utility from manufacturing goods.

Manufacturing firms in country r operate under monopolistic competition in order to maximize profit, as follows:

$$\pi_r(i) = [p_{rr}(i) - \beta]\, l_r x_{rr}(i) + [p_{rs}(i) - \beta\tau]\, l_s x_{rs}(i) - f, \quad r \neq s.$$

where β is the marginal cost of production, f is the fixed costs for market entry, τ represents ice-berg trade costs, and l_r denotes the population in country r reflecting the market size. In this setting, firms benefit from economies of scale in production due to fixed costs and constant marginal costs. In monopolistic competition, the number of firms producing differentiated good is supposed to be negligibly small, so that each firm has monopoly power on its own good but cannot affect other firms' behavior (the Chamberlinian large-group assumption). Thus, the decision making of each manufacturing firm does not affect the price index, $\partial P_r/\partial p_{rs} = 0$. Hence, from the profit-maximization problem, the equilibrium prices set by each manufacturing firm becomes

$$p_{rr}(i) = \frac{\sigma\beta}{\sigma - 1}, \quad p_{rs}(i) = \tau p_{rr}(i).$$

From this, it follows that manufacturing goods are priced at the same level, that is, based on the marginal costs, markup rate, and trade costs if any.

Furthermore, under monopolistic competition, firms can freely enter and exit the market and their operating profit becomes zero in equilibrium. Thus, the outcome of free entry and exit endogenously determines the number of manufacturing firms and thus characterizes the industrial distribution across countries. From the demand function, the profit-maximizing behavior of firms, and the zero profit condition of both countries, we have

$$\begin{aligned}
\frac{\alpha}{\sigma}\left(\frac{l_1 y_1}{n_1 + \phi n_2} + \frac{\phi l_2 y_2}{\phi n_1 + n_2}\right) &= f, \\
\frac{\alpha}{\sigma}\left(\frac{\phi l_1 y_1}{n_1 + \phi n_2} + \frac{l_2 y_2}{\phi n_1 + n_2}\right) &= f,
\end{aligned}$$

where ϕ is the trade freeness defined as $\phi \equiv \tau^{1-\sigma} \in (0, 1)$, which is a decreasing function of trade costs. We deduce the above equations from the zero profit condition in countries 1 and 2, respectively. Since consumer income consists of labor wage that is equal to the marginal cost of numéraire production, $y_r = 1$, from above equations, we obtain the relative number of firms as follows:

$$\frac{n_1}{n_2} = \frac{l_1 - l_2\phi}{l_2 - l_1\phi}.$$

Here, we assume that the population in country 1 is larger than that of country 2, $l_1 > l_2$. In order to consider the inter solution of firm number, we suppose that $l_2/l_1 > \phi$; this excludes the high trade costs that all firms cannot afford to pay. Thus, the firms are located in country i that has a large market. From these assumptions, we find that a relatively large number of manufacturing firms in country 1 (n_1/n_2) has a larger share of the market size (l_1/l_2). The reason is as follows. With trade costs, firms are burdened with the additional cost of supplying products to foreign countries. If the firms are located in a large country and they supply to a foreign country, they save on production costs. Thus, firms tend to agglomerate in the large country; this is called *home market effect*. Furthermore, the agglomeration of firms in the large country induces massive production in that industry, and so the country with large (small) market will be a net exporter (importer) of manufacturing goods.

The NTT model can clarify the aspect of home market effect by accounting for individual preferences on the diversity of consumption, monopolistic competition, and trade costs. In contrast to the comparative advantage approach, the NTT explained the appearance of international trade without much difference between countries. Love of variety leads to intra-industrial trade gains, and consumers in both countries enjoy the differentiated goods that the domestic firms cannot produce. Although the trade theory of oligopolistic markets can show other reasons for international trade, its argument on industrial activity is weak. The NTT model with monopolistic competition enables us to analyze the industrial distribution across countries by endogenizing the firms' location choice.

2.3.2 Home market effects

Krugman (1980) and Helpman and Krugman (1985) described the home market effect by which firms are located in a large country and the large country becomes a net exporter of differentiated goods. Trade costs play a critical role in bringing about the home market effect. Many researchers have studied the NTT model from various perspectives and in particular have examined what causes the home market effect. This subsection reviews some studies on the conditions of the home market effect.

Davis (1998) finds that the home market effect does not arise when trade costs exist for non-differentiated goods. The basic NTT model supposes that the shipment of non-differentiated goods treated as numéraire does not lead to trade costs, and so the price of those goods is equal across countries. Thus, the wage rate, which is the only production factor in the model, is also equal across countries. However, when the transportation of the numéraire good incurs the same trade costs as that of

differentiated goods, the home market effect disappears, as shown by Davis (1998). Behind this result are the following intuitions. If the international trade of the numéraire good becomes impossible owing to positive trade costs, the labor wage across countries will be unequal and the country with large market will face higher wages due to large demand for labor forces. Thus, the producers in countries with a large market face higher production costs, and this results in the disappearance of the home market effect.

Yu (2005) generalized Davis' results by adopting the constant elasticity of substitution (CES) utility function instead of the Cobb—Douglas utility function and demonstrated that the home market effect can arise even if numéraire goods are not traded. Under the CES utility, the share of expenditure on numéraire goods and the sub-utility from differentiated goods are not constant, and so if consumers have a strong preference for the differentiated goods, the expenditure share on those goods becomes larger. In this situation, the country with a large market attracts a large number of firms, and this results in the appearance of the home market effect.

Focusing on the different aspects of numéraire goods' trade costs, Behrens et al. (2009b) extended the basic model of two countries to the case of n countries. They showed that the home market effect disappears in many cases even when we assume the basic NTT environment without the number of countries. In particular, they pointed out the possibility of firms agglomerating in a small country where the trade costs are sufficiently lower than in other countries.

Takatsuka and Zeng (2012) analyzed the home market effect using the footloose capital model where the production factor consists of not only the labor force but also capital. The capital required for differentiated goods is mobile across countries and is considered fixed cost, and so the amount of capital invested in a country reflects the number of firms producing the differentiated goods. Takatuska and Zeng (2012) showed that even if the numéraire goods are non-tradable under the Cobb—Douglas utility function, the home market effect emerges as long as mobile capital exists. As Davis (1998) has shown, the wage rate in a country with large market is higher than that with small market. The high wage rate gives conflicting incentives for firms to locate in that country. First, it increases the firms' costs for differentiated goods and hence becomes an obstacle for firms to locate in that country. Second, high wages in a country directly means that the residents earn high income. This implies larger market demand for the differentiated goods in that country compared to the country with small market, and so firms producing the differentiated goods are attracted to locate in that country.[3] In contrast to Davis (1998), fixed costs are

[3]Davis (1998) shows positive effects of higher wages on firm location in a large market country. However, in his model, the firm producing differentiated goods pays fixed costs in the form of labor

capitalized in a footloose capital model and such income effects from higher wages offset the disadvantage of locating in the country with large market.

Thus, trade costs have the important role of characterizing the industrial distribution in NTT rather than the previous theories considering immobile factors. Nevertheless, some recent studies examining how trade costs are determined in an economy (Takahashi, 2006; Behrens et al., 2009a; Behrens and Picard, 2011) challenge the endogenous treatment of trade costs. Chapter 5 discusses the relationship between the home market effect and trade costs endogenously determined by the government.

force and so the negative effect always dominates the positive effect of higher income.

Chapter 3

Trade Costs and Welfare-worsening Free Trade Agreement

This chapter examines the effects of concluding a free trade agreement (FTA) in the presence of international trade costs between countries. In the traditional arguments, the optimal external tariffs set by the FTA members are always lower than the pre-FTA optimal tariffs, which implies that there are the tariff complementarity effects as the FTA forming. To reexamine this argument, we construct a simple three-country model of imperfect competition with endogenously determined (external) tariffs, and demonstrate that in the presence of trade costs, the member countries may employ the higher external tariff as they form the FTA. That is the tariff complementarity effects disappear. We also find that in contrast to traditional argument, the non-member country's welfare may worsen even if there are tariff complementarity effects. Furthermore, the findings show that the FTA is likely to result in the deterioration of the member countries' welfare, depending on the trade costs.[1]

3.1 Introduction

Over the last 2 decades, we have observed the significant surge of regional trade agreements (RTAs) the purpose of which is to eliminate the trade barriers between the signatories. Among the several forms of RTAs, most existing arrangements take the form of free trade agreement (FTA), while less than 10% are represented

[1]This chapter is based on Yanase and Tsubuku (2015)

by customs unions (CUs).[2] Actually, there are now over 250 FTAs in force and a lot of negotiation is on going toward the enforcement. Given their widespread appearance, the relationship between international trade and the FTA formation is enhanced rapidly, so that economic analysis on FTAs provides us with a plenty insight for the world trading system.

Indeed, many researchers have addressed issues related to the surge of FTAs, and in particular, have argued the impact of an FTA on its member's external tariff and on multilateral trade liberalization.[3] A number of studies have highlighted the *tariff complementarity effect* that the enforcement of an FTA induces the member countries to employ the lower tariff on the non-member countries, resulting in multilateral trade liberalization(e.g., Richardson,1993; Bagwell and Staiger, 1999; Yi, 2000; Bond et al, 2004; Ornelas, 2005 and Saggi and Yildiz, 2010). An intuition behind this trade-liberalizing property of FTAs is that the member countries have less incentive to manipulate their terms of trade vis-à-vis non-members since an FTA leads its member countries to import less from non-member countries. In addition, it is more important that tariff complementarity effects lead to positive welfare consequences of FTAs with endogenously determined external tariffs (e.g., Bagwell and Staiger, 1999; Yi, 2000; Bond et al., 2004; Ornelas, 2005). These studies have shown that the tariff complementarity effect is large enough to place the external tariffs below the Pareto-improving external tariffs, and consequently, both members and non-members of FTAs become better off.[4]

Although the previous literature in international trade has explored a lot of properties in favor of an FTA, but it has paid the less attention to all costs except for tariff incurred between countries, so that its analysis has been limited to the economy where there is no cost to trade with abroad. In view of the fact that economic activities are separated in some form, the trade costs incurred from various factors must be considered beyond economic factors. As stated by Anderson and van Wincoop (2004), trade costs are defined as all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself (e.g., transportation costs, policy barriers, information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and

[2]Facchini et al. (2012) develops a political economy model of trade policy under imperfect competition to provide a positive explanation for the prevalence of FTAs rather than CUs.

[3]See, for example, Maggi (2014) for a survey of recent developments.

[4]The well-known Vanek–Ohyama–Kemp–Wan theorem (Vanek, 1965; Ohyama, 1972; Kemp and Wan, 1976) establishes that if two or more countries form a CU by fixing their net external trade vector through a common external tariff and eliminating internal trade barriers, the union as a whole and the rest of the world cannot be worse off than before. Ohyama (2002) and Panagariya and Krishna (2002) extend the Vanek–Ohyama–Kemp–Wan theorem to the case of FTAs; they show the existence of FTAs that lead to Pareto improvements in world welfare.

local distribution costs).[5] In addition, they roughly estimate the trade costs for industrialized countries at 170% in terms of ad valorem tax equivalent.[6] Thus, this empirical evidence that broadly-defined trade costs are considerably large leads us to recognize the importance of incorporating trade costs into the analysis of trade policy. Furthermore, in new trade theory or new economic geography developed by Helpman and Krugman (1985) and Fujita et al. (1999), the analysis on distribution of economic activities is permitted by incorporating the trade costs between countries. The several studies in these fields have discussed the relationship between the capital tax and the firms' agglomeration, but not consider the tariff policy (Ludema and Wooton, 2000; Baldwin and Krugman, 2004; and Ottaviano and van Ypersele, 2005).

The objective of this chapter is to dissolve the limitation of trade costs in a simple three-country model of imperfect competition and explore how trade costs affect the desirability of FTA formation. We treat three policy regimes: tariff discrimination, a most-favored nation (MFN) principle, and an FTA, and we investigate the effects of trade costs on the tariff determined in each regime. Although the tariff discrimination regime may violate the principle of non-discrimination prescribed in the General Agreement on Tariffs and Trade (GATT)/World Trade Organization (WTO) rule, it allows us to understand the basic mechanism under which trade costs affect a country's tariff unconstrained by any rule.

As for the results of comparing the tariff in the MFN with the external tariff in the FTA, it is found that the tariff complementarity effects may disappear with the higher trade costs between the FTA member countries. This implies that considering the trade costs in the economy, the RTA does not always facilitate multilateral trade liberalization, which is in contrast to the previous studies. In the absence of trade costs, tariff elimination by an FTA leads the government to reduce the tariff on other country (non-member) so as to hold balanced consumption between domestic and foreign production, resulting in the tariff complementarity effects.[7] An incorporation of trade costs into the model brings about different outcomes. When the model incorporates the costs to trade with a foreign country, the governments achieve balanced consumption depending on trade cost level. Then, high trade costs

[5] See also Hummels and Skiba (2004), Hummels (2007) and Hummels et al. (2009) for the detail about transportation cost.

[6] This ad valorem tax equivalent includes 55% local distribution costs as well as international trade costs; the latter are composed of 21% transport costs and 44% border-related trade barriers ($1.7 = 1.55 \times 1.21 \times 1.44 - 1$).

[7] Under a similar environment to ours, Yi (2000) has demonstrated that the welfare function of each country is *super-modular* in tariffs that have high welfare with a balanced consumption level, and has shown that if an FTA is formed, the member country imposes lower external tariffs in order to achieve balanced consumption.

within the FTA mean more consumption from non-member countries rather than from the partner country, and thus, discourage the members to decrease the tariff on the non-member country.[8]

We now highlight the results of welfare analysis. As opposed to previous literature, our study demonstrates that an FTA under trade costs may worsen the welfare of member countries and the non-member country. In the analysis of welfare effects of an FTA on member countries, we first consider the case of symmetric countries in which all three countries share the same trade costs. Under such an environment, the member countries are worse off with sufficiently high trade costs. An FTA formation reduces the tariff revenue of member countries and increases the volume of international trade, leading an increase in the payment of trade costs. Thus, under the high trade costs, the serious loss of income for the payment to trade costs induced by signing the FTA. Subsequently, we consider cases in which the countries face asymmetric trade costs and confirm that FTA conclusion can worsen the member's welfare even with the asymmetry in trade costs.

Our results bring about the preserve wisdom of FTA related to trade costs. Supposing that international trade costs arise according to the distance between the countries, the formation of FTA have more beneficial effects on the countries who are located close to each other. Actually, many FTAs are formed by neighboring countries in Americas, European countries, or Asian countries. Although there are some exceptions such as Japan-Chile, and Japan-Mexico FTA, our analysis could explain these cases using the degree of substitutability between domestic and foreign products. As a result of welfare analysis, FTA conclusion has more beneficial effects on the member countries under the low degree of substitutability. Accordingly, since the tendency of international trade between developed country (Japan) and developing country (Chile or Mexico) is to exchange the very differentiated goods with low substitutability between each other, they have more incentive to sign the FTA even if the long distance generate the high trade costs between them.

The remainder of this chapter is organized as follows. Next section shows the simple intra-industrial trade model composed of three countries. In section 3.3, we explore the optimal tariff in each regime and investigate whether there are tariff complementarity effects. Section 3.4 conducts welfare analysis on the FTA members and non-member. Section 3.5 concludes Chapter 3.

[8]Also, our result could provide the hypothesis for empirical analysis about the disappearance of tariff complementarity effect. Some studies empirically analyze the existence of tariff complementarity effects (Limão, 2006 Estevadeordal et al, 2008, and Karacaovali and Limão, 2008), but it is controversial yet. The knowledge provided by our analysis helps to construct the valid hypothesis.

3.2 The Economy

3.2.1 Settings

We construct an intra-industry trade model following Furusawa and Konishi (2007).[9] There are three symmetric countries (indexed by i, j, k) in the economy. Both country has two sectors, the agricultural sector and manufacturing sector. Consumers in all countries have identical preferences for agricultural and manufacturing goods. We assume that each consumer supplies one unit of labor and, thus, the population size μ in each country is equal to labor force endowment.

The agricultural sector operates under perfect competition and constant returns to scale using only labor. To produce one unit of the agricultural good, one unit of labor needs to be employed in this sector. Assuming that agricultural goods are numeraire, the price and wage rates are equal to one.

The firms in the manufacturing sector produce horizontally differentiated goods that are imperfectly substitutable for each other. The production of manufacturing goods operates under imperfect competition. One variety ω is produced by one manufacturing firm, which is negligibly small and does not influence the behavior of other firms in the sector. Formally, there is a continuum Ω of manufacturing firms in the economy. Note that the set Ω also represents the set of all varieties of manufacturing goods in the economy. Assuming no entry to this sector, we normalize the size of the set, $|\Omega| = 1$. In this study, the distribution of manufacturing firms is symmetric between countries, so that domestic consumers own one third of the total number of firms in the economy. The set of firms located in country i is denoted by $\Omega_i \subset \Omega$, whose size is one third, $|\Omega_i| = 1/3$.

To purchase one unit of the manufacturing good from abroad, consumers have to pay the trade costs, in addition to the good's price and the tariff imposed by the government. We refer to the trade costs of transportation from country i to country j as τ_{ij}, which is independent on the direction of transportation, that is, $\tau_{ij} = \tau_{ji}$. The tariff rate imposed on imports from country j by the government of country i is represented as t_{ij}. While the trade costs are given exogenously, the import tariff rate is determined by the government and its revenue is distributed evenly to consumers in each country.[10] To simplify the analysis, agricultural goods are assumed to be

[9] Furusawa and Konishi (2007) employs a network formulation game and analyze whether global free trade is stable among n countries with an intra-industry trade model. Unlike their study, we introduce trade costs and explore the properties of trade policy in the presence of trade costs.

[10] If we suppose the trade costs are compensation for transportation services supplied by the private sector, which is perfectly competitive, transportation services are delivered inelastically with marginal cost pricing. It is reasonable that the trade costs τ are given exogenously as constant marginal costs in the competitive transportation sectors. Some studies introduce the mechanism that transportation costs are determined endogenously and explore its effects on the economy (see,

shipped without trade costs.

Preference

All consumers in the economy are assumed to be identical. We formulate the preferences of consumers with a quadratic utility function as follows:

$$\begin{aligned} & u(q(\omega), q_0; \omega \in \Omega) \\ &= \int_\Omega q(\omega)d\omega - \frac{1-\gamma}{2}\int_\Omega q(\omega)^2 d\omega - \frac{\gamma}{2}\left(\int_\Omega q(\omega)d\omega\right)^2 + q_0, \end{aligned} \tag{3.1}$$

where $q(\omega)$ (q_0) is the amount of manufacturing (agricultural) goods consumption and γ denotes the degree of substitutability between manufacturing goods. A lower γ means that consumers recognize manufacturing goods as more differentiated. If $\gamma = 0$, manufacturing goods are perfectly different from one another. If $\gamma = 1$, every manufacturing good is recognized as identical.

From the utility maximization problem, we can deduce the demand functions for manufacturing goods as follows:

$$q(\omega) = \frac{1}{1-\gamma}[1 - \tilde{p}(\omega) - \gamma(1 - \tilde{P})], \tag{3.2}$$

where $\tilde{p}(\omega)$ represents the consumer price of manufacturing goods ω and $\tilde{P}$ is a price index. If consumers import the manufacturing goods, they have to pay the tariff and trade costs in addition to the price set by the manufacturing firm. As an example, the consumer prices in country r is represented by

$$\tilde{p}(\omega) = \begin{cases} p_{rr}(\omega) & if \ \ \omega \in \Omega_r, \\ p_{sr}(\omega) + t_{sr} + \tau_{sr} & if \ \ \omega \in \Omega_s, \ \ r \neq s, \end{cases} \tag{3.3}$$

where $p_{rs}(\omega)$ denotes the price of manufacturing goods in country r produced in country s ($r, s = i, j, k$) and Ω_r is the set of manufacturing firms located in country r. The price index is defined by the sum of consumer prices that is $\tilde{P} \equiv \int_\Omega \tilde{p}(\omega)d\omega$. Thus, based on Eq. (3.3), the price index for consumers in country r, P_r, is written by

$$P_r = \int_{\Omega_r} p_{rr}(\omega)d\omega + \int_{\Omega_s}[p_{sr}(\omega) + t_{sr} + \tau_{sr}]d\omega. \tag{3.4}$$

e.g., Takahashi, 2006; Mun and Nakagawa, 2010; Tsubuku, 2014).

Manufacturing sector

The manufacturing firm producing a variety of ω supplies to both the domestic country and two foreign countries. Supposing no marginal costs for production, the operating profit $\pi_i(\omega)$ of the firm located in country i is

$$\pi_i(\omega) = \sum_{r=i,j,k} \mu p_{ir}(\omega) q_{ir}(\omega), \tag{3.5}$$

where $q_{rs}(\omega)$ represents the quantity of manufacturing goods supplied to country s produced in country r $(r, s = i, j, k)$ and Ω_r is the set of manufacturing firms located in country r. Given the price index P_r and other firms' behavior in the economy, each firm maximizes its own profit by setting the price.[11] According to the first-order conditions of the profit maximization problem, all the firms in country i set their own prices as follows:

$$p_{ii} = \frac{1}{2}[1 + \gamma(1 - P_i)], \tag{3.6}$$

$$p_{ir} = p_{rr} - \frac{t_{ir} + \tau_{ir}}{2}, \quad r = j, k. \tag{3.7}$$

Regardless of the variety of differentiated goods, manufacturing goods are symmetrically priced by firms. Thus, hereafter, we omit an expression of the variety of ω. The export price set by the firms is cheaper than the domestic price, but the consumer price including the trade costs and tariff $p_{ir} + t_{ir} + \tau_{ir}$ exceeds the domestic price, so that there is no arbitration between countries. In addition, we find half of the trade costs and tariff absorbed by manufacturing firms. From (3.6) and (3.7), the difference between the prices faced by domestic and foreign consumers is $(p_{ir} + t_{ir} + \tau_{ir}) - p_{ii} = (t_{ir} + \tau_{ir})/2.$, which is smaller than the trade costs and tariff paid by consumers.

Substituting (3.6) and (3.7) into the definition of price index $\tilde{P}$, equilibrium prices are determined as follows:

$$p_{ii} = \frac{1}{2 - \gamma}\left[1 - \gamma + \frac{\gamma}{2}(\bar{t}_i + \bar{\tau}_i)\right], \tag{3.8}$$

$$p_{ir} = \frac{1}{2 - \gamma}\left[1 - \gamma + \frac{\gamma}{2}(\bar{t}_r + \bar{\tau}_r)\right] - \frac{t_{ir} + \tau_{ir}}{2}, \quad r = j, k. \tag{3.9}$$

[11] The assumption that differentiated goods in the manufacturing sector are denoted by the continuum of manufacturing firms results in the same equilibrium being deduced regardless of price or quantity competition, so that our model excludes strategic interaction among manufacturing firms.

where $\bar{t}_i, (\bar{\tau}_i)$ is defined by the weighted average of tariffs (trade costs) as

$$\bar{\tau}_i \equiv \frac{1}{3}\sum_{r=j,k} \tau_{ri}, \qquad \bar{t}_i \equiv \frac{1}{3}\sum_{r=j,k} t_{ri}.$$

We can obtain the equilibrium quantities from the relationship, $p_{rs} = (1-\gamma)q_{rs}$, which can be provided by the firm's first-order condition.

3.2.2 Welfare decomposition

We now characterize the welfare of each country that has symmetric economic structure, consumer's preference, firm behavior, and the sizes of population and manufacturing firms, except for the trade costs and tariffs faced by them. Because of the symmetric assumption, only the welfare of country i is shown. Per capita income in country i is constituted by the total of the wage rate, $w_i(=1)$, rents of manufacturing production activities, and distributed tax revenue:

$$y_r = 1 + \frac{1}{3}\frac{\pi_r}{\mu} + \frac{1}{3}\sum_{r=j,k} t_{ri}q_{ri}, \tag{3.10}$$

where the third term represents tariff revenue distributed by the government. Based on the budget constraint of consumers, the demand function for agricultural goods can be represented by manufacturing demand as follows:

$$\begin{aligned} q_0 &= y_r - \frac{1}{3}\left[p_{ii}q_{ii} + \sum_{r=j,k}(p_{ri}+t_{ri}+\tau_{ri})q_{ri}\right] \\ &= 1 + \sum_{r=j,i}(p_{ri}+\tau_{ri})q_{ri} + \sum_{r=j,i} p_{ir}q_{ir}. \end{aligned} \tag{3.11}$$

Assuming $\boldsymbol{\tau}_i = (\tau_{ji}, \tau_{ki})$ and $\mathbf{t}_i = (t_{ji}, t_{ki})$ as the vector of trade costs and tariffs, respectively, we can decompose the welfare in equilibrium, that is

$$\begin{aligned} &V_i(\mathbf{t}_i, \mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \\ &\qquad = U_i(\mathbf{t}_i, \boldsymbol{\tau}_i) - IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i) + EX_i(\mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k), \end{aligned} \tag{3.12}$$

where $U_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$ refers to gross utility and $EX_i(\mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k)$ $(IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i))$ denotes the total value of exports (imports) of country i. Each term is defined by

$$U_i(\mathbf{t}_i, \boldsymbol{\tau}_i) \equiv \frac{1}{3}\sum_{r=i,j,k} q_{ir} - \frac{1-\gamma}{6}\left[\sum_{r=i,j,k} q_{ir}^2\right] - \frac{\gamma}{18}\left[\sum_{r=i,j,k} q_{ir}\right]^2 + 1, \tag{3.13}$$

$$IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i) \equiv \sum_{r\neq i} IM_{ri}(\mathbf{t}_i, \boldsymbol{\tau}_i) = \frac{1}{3}\sum_{r\neq i}(p_{ri} + \tau_{ri})q_{ri}, \tag{3.14}$$

$$EX_i(\mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \equiv \sum_{r\neq i} EX_{ri}(\mathbf{t}_r, \boldsymbol{\tau}_r) = \frac{1}{3}\sum_{r\neq i} p_{ir}q_{ir}, \tag{3.15}$$

where the productions and prices are evaluated at the equilibrium value, which depends on trade costs and tariffs, so that the difference in the welfare level of each country is characterized by trade costs and tariffs paid by consumers.

It is worth referring to the impacts of trade costs and tariffs on Eqs. (3.13), (3.14), and (3.15). First, consider gross utility, which depends on the consumption level of domestic production and the imports from two foreign countries. The effects of a decrease in trade costs or tariffs on gross utility, $U_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$, is ambiguous owing to the substitution effect caused by the reduction. For example, high trade costs τ_{ji} raise the domestic and import demands from country k at the expense of imports produced in country j. Due to this substitution effect, it is not necessary that gross utility is improved by trade cost reduction.

Second, we consider the response of import value $IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$ to trade costs and tariffs. For a similar reason to the case of gross utility, it is obscure whether a high tariff leads consumers to decrease payments for imports from abroad. An increase in the tariff imposed on imports from country j induces consumers to decrease the import value from country j, $IM_{ji}(\mathbf{t}_i, \boldsymbol{\tau}_i)$ and to increase imports from country k, $IM_{ki}(\mathbf{t}_i, \boldsymbol{\tau}_i)$. These import values consist of two factors; the payment for imported goods and international transportation. If the trade costs increase, it directly increases the latter. In addition, the increase in trade costs reduces the former.

Third, the export value of country i is always lowered by high trade costs and tariffs since export values supplied to each foreign country, $EX_{ji}(\mathbf{t}_j, \boldsymbol{\tau}_j)$ and $EX_{ki}(\mathbf{t}_k, \boldsymbol{\tau}_k)$, are independent of each other with regard to trade costs and tariffs.

3.3 Trade Costs and Tariff Policy in Three Regimes

Here, we explore the relationship between trade costs and optimal tariffs determined by government under three regimes; a tariff discrimination regime, the MFN principle, and an FTA. These optimal tariffs are reduced to maximize national welfare

depending on trade costs emerging between countries. In this section, the effect of trade costs on optimal tariffs is investigated and it is shown that the tariff complementarity effects do not appear under certain conditions of trade costs.

3.3.1 Tariff discrimination regime

In order to make clear the incentive to set tariffs, we analyze the tariff discrimination regime as a benchmark case. In this subsection, each government can choose the tariff rate on each import independently. It follows that the maximization problem for each government is

$$\max_{t_{ji},t_{ki}} \ V_i.$$

From, Eqs. (3.13), (3.14), and (3.15), the first-order conditions can be written as

$$\frac{\partial U_i}{\partial t_{ri}} - \frac{\partial IM_{ki}}{\partial t_{ri}} - \frac{\partial IM_{ji}}{\partial t_{ri}} = 0, \quad r = j, k. \tag{3.16}$$

The first term on the left-hand side of Eq. (3.16) shows tariff effects on gross utility, of which the sign is ambiguous, as mentioned at the end of previous section. The second and third terms are the effect on imports from two foreign countries. We can identify the signs of the second and third terms. Considering the effects of t_{ji}, $\partial IM_{ji}/\partial t_{ji}$ is negative and $\partial IM_{ki}/\partial t_{ji}$ is positive. From Eq. (3.16), we find that the tariff level imposed by the government does not depend on the tariff level imposed by the other government, and so, there is no strategic interdependence, as shown in Yi (1996). The discriminatory tariff imposed by country i on imports from country j is denoted as t_{ji}^D. Superscript D means the discrimination regime. Solving Eq. (3.16) for tariffs, we obtain country i's optimal discriminatory tariffs on each foreign country as follows:

$$t_{ji}^D = \frac{36(1-\gamma)(3-2\gamma) - (61\gamma^2 - 168\gamma + 108)\tau_{ji} + 4\gamma(3-2\gamma)\tau_{ki}}{159\gamma^2 - 468\gamma + 324}. \tag{3.17}$$

From Eq. (3.17), it is easy to derive t_{ki}^D owing to the assumption of a symmetric country. The discriminatory tariffs are always positive as long as international trade is feasible. Comparing two discriminatory tariffs, it is found that

$$t_{ji}^D > t_{ki}^D \Leftrightarrow \tau_{ji} < \tau_{ki}. \tag{3.18}$$

This result is summarized as the following Proposition 3.1.

Proposition 3.1 (Tariff discrimination) *Each country under a tariff discrimination regime imposes higher tariffs on foreign goods imported with lower trade costs.*

To explain this result, we provide the following intuition. Under low trade costs incurred in the process of trading with country j, consumers in country i demand more imports from country j. This implies that imposing tariff on the imports from country j rather than country k have more beneficial effect by protecting the domestic firms, so that the government of country i imposes a higher tariff on imports from country j. On the other hand, when the trade costs between country i and j are low, imports from country k are small owing to substitution effect. In order to encourage imports from country k, governments have incentive to reduce tariffs imposed on that country.

In addition, we find that the change in trade costs between a certain two countries out of the three have two effects on tariff policy. For example, the reduction of trade costs between country i and j increases imports from country j, and at the same time decreases import from country k since consumers substitute imports.[12] Under the tariff discriminatory regime, governments can respond to these effects independently and, thus, the discriminatory tariffs, t_{ji}^D and t_{ki}^D, are affected oppositely by the same trade costs.

3.3.2 Most-favored nation principle

In this subsection, we explore the tariff determined by complying with the MFN principle, where each government imposes the same tariff on the other countries. The maximization problem of country i under the MFN principle is defined as

$$\begin{aligned} \max_{t_{ji},t_{ki}} \quad & V_i \\ s.t. \quad & t_{ji} = t_{ki} \end{aligned}$$

According to the first-order condition of this problem, the MFN tariff satisfies the following condition.

$$\sum_{r=j,k}\left(\frac{\partial U_i}{\partial t_{ri}} - \frac{\partial IM_{ki}}{\partial t_{ri}} - \frac{\partial IM_{ji}}{\partial t_{ri}}\right) = 0$$

$$\Leftrightarrow \underbrace{\left(\frac{\partial U_i}{\partial t_{ji}} + \frac{\partial U_i}{\partial t_{ki}}\right)}_{\ominus\text{: Loss of the utility}} \underbrace{-\left(\frac{\partial IM_{ji}}{\partial t_{ji}} + \frac{\partial IM_{ji}}{\partial t_{ki}}\right)}_{\oplus\text{: The income gain}} \underbrace{-\left(\frac{\partial IM_{ki}}{\partial t_{ki}} + \frac{\partial IM_{ki}}{\partial t_{ji}}\right)}_{\oplus\text{:The income gain}} = 0. \tag{3.19}$$

[12] This unilateral reduction in trade costs is induced by the establishment of transport infrastructure that is accessed mainly by the firms in those countries, for example, opening of a highway or railway.

This condition, Eq. (3.19), reveals that when the government increases t_{ji} and t_{ki} simultaneously, its net benefit should be equal to zero and consist of three parts: the loss of utility owing to decreased consumption, and two income gains caused by decreased import payments to foreign countries. The MFN tariff rate imposed by country i is obtained as follows:

$$t_i^{MFN} = \frac{24(1-\gamma)(3-2\gamma) - \left(23\gamma^2 - 60\gamma + 36\right)(\tau_{ji} + \tau_{ki})}{106\gamma^2 - 312\gamma + 216}. \tag{3.20}$$

Based on the assumption that international trade is feasible, the MFN tariff rate can be shown to be positive. Eq. (3.20) shows that what matters is the sum of trade costs, $\tau_{ji} + \tau_{ki}$, not each level of trade costs, since the three countries are symmetric. Compared with the discrimination regime, the linear demand functions yield the MFN tariff in the middle point between two discriminatory tariffs, as shown in Saggi (2009).

Consider the impacts of trade costs on the MFN tariff. The MFN tariff depends on only the sum of trade costs, and a shift in each trade cost is indifferent to the MFN tariff. However, the effect is ambiguous and characterized by the degree of substitutability γ as

$$\frac{dt_i^{MFN}}{d\tau_{ri}} \gtrless 0 \Leftrightarrow \gamma \gtrless \frac{6}{23}\left(5 - \sqrt{2}\right) \approx 0.935,$$

and, thus, we obtain Proposition 3.2.

Proposition 3.2 (Most-favored nation tariff) *When the substitutability between domestic and foreign products is sufficiently high, then trade cost reduction fosters the elimination of tariff.*

The intuition behind Proposition 3.2 is that large γ amplifies the marginal benefits of imposing tariffs, which is the domestic income gains induced by substituting imports for domestic products, so that the MFN tariff increases as trade costs rise. In our model, a reduction in trade costs, for instance τ_{ji}, causes the reduction in import demand from country j as well as the expansion of demand for domestic production and import from country k through the substitution effects. When the manufacturing goods is sufficiently substitutable, the indirect effects like increasing the domestic demands lead the government to increase the MFN tariff as trade costs increase.

Setting the single tariff rate on two countries under the MFN principle, each government is required to take into account the effects on both tariffs, t_{ji} and t_{ki},

together. Increasing trade costs τ_{ji} have negative (positive) effects on imports from country j (country k), which provides the incentive to reduce (raise) the tariff on imports from country j (country k). Such conflicting incentives yielded by change in trade costs keep the effects of trade costs on the MFN tariffs unclear and it is dependent on the degree of substitutability between the products.

3.3.3 Free trade agreement

Supposing that country i and j enforce the FTA and impose a zero tariff rate on each other, we investigate the external tariff imposed by them on the non-member country (country k).[13] The FTA member governments eliminate the tariff barrier within the member countries and set the external tariff on the non-member country in order to maximize their own national welfare. As stated in Articles XXIV of GATT/WTO, the countries signing an FTA are required not to raise the tariff on countries that are not members of the FTA. Thus, the maximization problem is given as

$$\begin{aligned} \max_{t_{ki}} \quad & V_i \\ s.t. \quad & t_{ji} = t_{ij} = 0 \\ & t_{ki} \leq t_i^{MFN} \end{aligned}$$

In this maximization problem, the third constraint reflecting the requirement of GATT/WTO's Articles XXIV forces the government of member country to employ the same or lower tariff on the non-member country.

First, we consider the case of inner solution in which the equality condition holds strictly, that is, $t_{ki} < t_i^{MFN}$. If the optimal external tariff set by the member is lower than the MFN tariff, the first-order condition can be represented by

$$\left.\frac{\partial U_i}{\partial t_{ki}}\right|_{t_{ji}=t_{ij}=0} - \left.\frac{\partial IM_{ki}}{\partial t_{ki}}\right|_{t_{ji}=t_{ij}=0} - \left.\frac{\partial IM_{ji}}{\partial t_{ki}}\right|_{t_{ji}=t_{ij}=0} = 0. \tag{3.21}$$

In contrast to the MFN principle, the FTA member governments can choose the external tariff t_{ki} independently since the tariffs between the member countries, t_{ij} and t_{ji}, is zero. In this case, the external tariff determined by the member

[13]The maximization problem of the non-member country is equivalent to the case of the tariff discrimination regime or the MFN principle owing to the independence of the government's policy strategy.

governments is written by

$$t_{ki}^{FTA} = \frac{12(1-\gamma)(3-2\gamma) + (12-7\gamma)\gamma\tau_{ji} - 4(3-2\gamma)^2\tau_{ki}}{4(3-2\gamma)(9-5\gamma)}. \tag{3.22}$$

In addition, this tariff is positive under the feasibility of international trade. From Eq.(3.22), we can show the effects of trade costs on the external tariff, $dt_{ki}^{FTA}/d\tau_{ki} < 0$ and $dt_{ki}^{FTA}/d\tau_{ji} > 0$, which is summarized in Proposition 3.3 as follows:

Proposition 3.3 (External tariff in FTA) *The external tariff is increased by the higher trade costs between the FTA member countries as well as the lower trade costs between the member and non-member countries.*

We here explain the intuition behind Proposition 3.3. The high trade costs τ_{ji} yield more trade between the members and non-member due to the substitution effects, leading the member country to protect the domestic manufacturing firms from competition with firms in the non-member country. Therefore, under high τ_{ji}, the member governments increase the external tariff in order to avoid competition with firms in the non-member country and to increase domestic firms' profit. Another intuition of this result is that imports from the member country are lowered as trade costs τ_{ji} increase, and thus, the FTA member governments increase the external tariff in order to foster import demand from the member country at the expense of the non-member country. On the other hand, we can provide similar intuitions regarding the trade cost between the member and non-member countries. Lower trade costs, τ_{ki}, induce the government under the FTA to impose a higher external tariff due to intense competition with firms in the non-member country.

The case of inner solution is that under the FTA, the member has no incentive to set the higher tariff than the MFN tariff. If the optimal external tariff lies at a higher level than the MFN tariff, then the inequality condition holds with equality, that is, $t_{ki} = t_i^{MFN}$. This means that the external tariff under the FTA is equivalent to the MFN tariff, implying the tariff complementarity effects disappear. If the following condition is satisfied, then the government of the member country does not decrease the external tariff after the FTA formed.

$$\begin{aligned} &\left.\frac{\partial U_i}{\partial t_{ki}}\right|_{\substack{t_{ji}=t_{ij}=0,\\ t_{ki}=t_i^{MFN}}} - \left.\frac{\partial IM_{ki}}{\partial t_{ki}}\right|_{\substack{t_{ji}=t_{ij}=0,\\ t_{ki}=t_i^{MFN}}} - \left.\frac{\partial IM_{ji}}{\partial t_{ki}}\right|_{\substack{t_{ji}=t_{ij}=0,\\ t_{ki}=t_i^{MFN}}} > 0 \\ \Leftrightarrow \quad & \tau_{ji} > \tilde{\tau}_i\left(\tau_{ki}\right). \end{aligned} \tag{3.23}$$

where $\tilde{\tau}_i$ is the upper bound of τ_{ji} achieving the equilibrium in which the member,

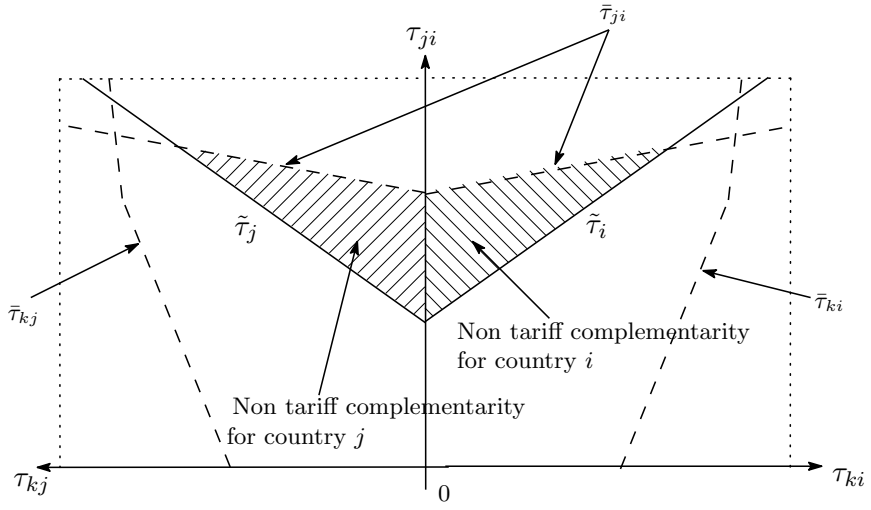

Figure 3.1: Trade costs and tariff complementarity effects

country i, imposes a lower tariff than under the MFN principle. If the trade costs between members exceed this thresholds $\tilde{\tau}_i$, then the members keep the external tariff rate at the same level as the MFN tariff. This implies that tariff complementarity effects do not occur when condition Eq. (3.23) is satisfied. In the absence of trade costs, the external tariff always declines by FTA formation relative to under the MFN principle. Thus, when international trade is not costless, the FTA formation provides the incentive to raise the external tariff.

See the disappearance of tariff complementarity effects about both member countries in a graphic form. From the equilibrium quantities, the requirement for trade costs that assume the feasibility of international trade can be represented as

$$\min\{q_{ji}^{MFN}(\boldsymbol{\tau}_i), q_{ji}^{FTA}(\boldsymbol{\tau}_i)\} \geq 0 \Leftrightarrow \tau_{ji} \leq \bar{\tau}_{ji}(\tau_{ki}), \tag{3.24}$$

$$\min\{q_{ki}^{MFN}(\boldsymbol{\tau}_i), q_{ki}^{FTA}(\boldsymbol{\tau}_i)\} \geq 0 \Leftrightarrow \tau_{ki} \leq \bar{\tau}_{ki}(\tau_{ji}). \tag{3.25}$$

Based on Eqs.(3.23), (3.24) and (3.25), we can illustrate Figure 3.1 regarding the tariff complementarity effects when international trade is feasible. Figure 3.1 shows the two cases of each member, country i and j, in the first and second quadrant, respectively.[14] The dotted lines represent the upper bounds at which international trade is feasible, $\bar{\tau}_{ji}$ and $\bar{\tau}_{ki}$.

In the shaded area in Figure 3.1, the condition Eqs. (3.23), (3.24), and (3.25) are satisfied and, thus, the tariff complementarity effect does not appear in each

[14]Each threshold for country j is developed in the same way as country i.

country.

Proposition 3.4 (Disappearance of complementarity effects) *Under the larger trade costs between the FTA member countries and the smaller trade costs between the member and non-member countries, the external tariff rate remains under the MFN principle.*

Proposition 3.4 shows the possibility that tariff complementarity effects disappear, once we focus on the economy with trade costs occurring in international trade. Under the MFN principle, governments face the constraint of setting the same tariff on the two countries and cannot adjust tariffs, t_{ji} and t_{ki}, to trade costs shifting independently. By contrast, governments concluding an FTA choose the external tariff without such a constraint, and thus, they can employ the tariff policy corresponding to each trade cost independently. Thus, when τ_{ji} and τ_{ki} satisfy Eq. (3.23), then the governments signing an FTA have an incentive to raise the tariff from that under the MFN. Despite such incentive of the members existing, they are restricted to raise the tariff on the non-member country and thus and set it at the same level as the MFN tariff, resulting in no tariff complementarity effect.

3.4 Welfare Analysis

At first glance, the formation of an FTA improves all countries' welfare because international trade is fostered as tariff barriers are eliminated by each government. However, if trade costs occur in the process of international trade, FTA formation is likely to worsen the welfare of member countries under certain conditions. In this section, we explore the effects of the conclusion of an FTA on welfare in the presence of trade costs. Once we focus on the economy in which trade costs exist, perfect market integration cannot be achieved by FTA conclusion in contrast to the previous literature. Without loss of generality, we analyze the case in which county i and j agree to eliminate tariffs on each other ($t_{ji} = t_{ij} = 0$). Let $\mathbf{t}^{FTA}$ ($\mathbf{t}^{MFN}$) represent the tariff schedules set by each government in the FTA (MFN) regime, that is, $\mathbf{t}^{FTA} = (\mathbf{t}_i^{FTA}, \mathbf{t}_j^{FTA}, \mathbf{t}_k^{MFN})$ and $\mathbf{t}^{MFN} = (\mathbf{t}_i^{MFN}, \mathbf{t}_j^{MFN}, \mathbf{t}_k^{MFN})$. As discussed above, these tariff rates depend on trade costs, so that the welfare impact of FTA conclusion is also influenced through the tariff change caused by trade costs.

3.4.1 Non-member

Here, we consider the welfare of the non-member country affected by the FTA conclusion. In our setting, there is no strategic relationship between governments when

they determine the tariff rate. Accordingly, country k (non-member country) retains the tariff rates under the MFN principle, even if countries i and j form an FTA and eliminate the tariff on each other. Thus, the FTA formation affects the non-member's welfare only through the change in tariff rate set by the member countries. In fact, the non-member's welfare effects induced by the FTA can be denoted as follows:

$$\begin{aligned}\Delta V_k(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) &\equiv V_k(\mathbf{t}^{FTA}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) - V_k(\mathbf{t}^{MFN}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \\ &= EX_k(\mathbf{t}_i^{FTA}, \mathbf{t}_j^{FTA}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j) - EX_k(\mathbf{t}_i^{MFN}, \mathbf{t}_j^{MFN}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j),\end{aligned} \tag{3.26}$$

where ΔV_k is the difference between the FTA welfare and MFN welfare of country k, which consists of export values in each state. Eq. (3.26) shows that a change in tariff schedules of the members only matters for non-member country's welfare since the non-member does not change the tariff policy as a response to the FTA formation. In other words, if exports from country k to countries i and j are expanded as they conclude the FTA, the non-member's welfare is sufficiently improved. As Eq. (3.26) shows, the welfare effects are dependent on the tariff schedule of member countries, so that they are closely related to the tariff complementarity effects. If the tariff complementarity effects disappear when the non-member trades with both members, then the non-member's welfare always declines owing to decreases in exports to both members from the non-member.

Supposing the two trade costs faced by the non-member, τ_{ki} and τ_{kj}, are the same level, we can illustrate Figure 3.2 based on Figure 3.1. Figure 3.2 depicts the thresholds for the tariff complementarity effects and the FTA worsening the non-member's welfare. If the tariff complementarity effects disappear, which the member countries do not change the external tariff after the FTA concludes, then the exports from non-member country are not influenced by FTA formation. Thus, in the absence of tariff complementarity, the FTA conclusion does not affect the welfare of non-member country. However, the non-member country could be worse off even if tariff complementarity effects appear. This is because it is not necessary that exports from the non-member country increase even though the FTA formation induces the firms in the non-member country to face a lower external tariff. As the FTA is formed, consumers in both member countries substitute imports from the non-member with those from each other, so that the non-member's exports could decrease even under the tariff complementarity effects.

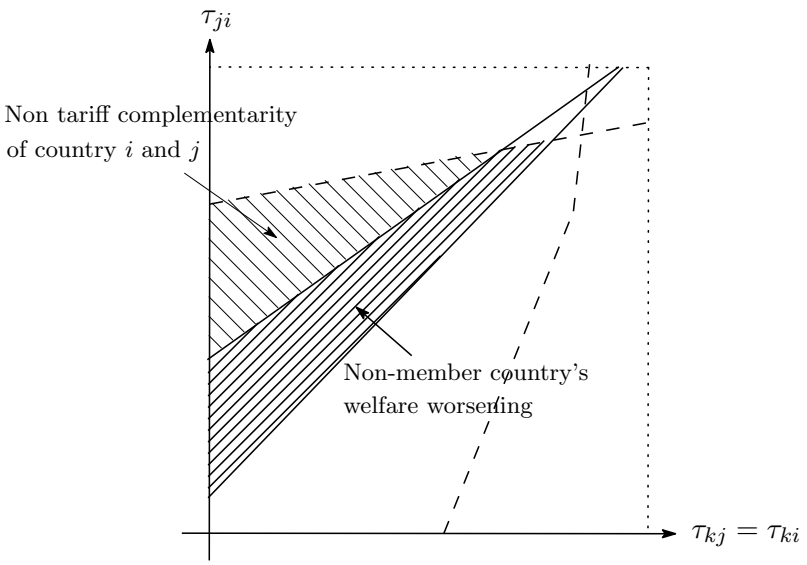

Figure 3.2: Welfare effects on non-member country

3.4.2 FTA members

In this subsection, we explore the welfare effects on the member countries induced by FTA formation. The difference between welfare under the FTA and MFN for the member country (country i) is

$$\begin{aligned}\Delta V_i(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) &\equiv V_i(\mathbf{t}^{FTA}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) - V_i(\mathbf{t}^{MFN}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \\ &= \Delta U_i(\boldsymbol{\tau}_i) + \Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j) \\ &\quad -\Delta IM_{ki}(\boldsymbol{\tau}_i) - \frac{\tau_{ji}}{3}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right], \qquad (3.27)\end{aligned}$$

where ΔU_i and ΔIM_{ki} are the differences between gross utility and the values of imports from country k in each regime and are defined as

$$\Delta U_i(\boldsymbol{\tau}_i) \equiv U_i(\mathbf{t}_i^{FTA}, \boldsymbol{\tau}_i) - U_i(\mathbf{t}_i^{MFN}, \boldsymbol{\tau}_i), \qquad (3.28)$$

$$\Delta IM_{ki}(\boldsymbol{\tau}_i) \equiv IM_{ki}(\mathbf{t}_i^{FTA}, \boldsymbol{\tau}_i) - IM_{ki}(\mathbf{t}_i^{MFN}, \boldsymbol{\tau}_i). \qquad (3.29)$$

Moreover, the welfare effects of member countries depend on the change in trade surplus between them and is represented by $\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$, which is

$$\Delta NE_i(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j) \equiv \frac{1}{3}\Big\{ \left[p_{ij}^{FTA}(\boldsymbol{\tau}_j) q_{ij}^{FTA}(\boldsymbol{\tau}_j) - p_{ji}^{FTA}(\boldsymbol{\tau}_i) q_{ji}^{FTA}(\boldsymbol{\tau}_i)\right] - \left[p_{ij}^{MFN}(\boldsymbol{\tau}_j) q_{ij}^{MFN}(\boldsymbol{\tau}_j) - p_{ji}^{MFN}(\boldsymbol{\tau}_i) q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right] \Big\}. \tag{3.30}$$

In addition, Furusawa and Konishi (2007) demonstrate that the welfare effects by the FTA conclusion can be divided into gross utility effects (ΔU_i), a direct surplus effect (ΔNE_i), and third-country effects (ΔIM_{ki}) like Eq. (3.27). However, supposing that it costs to trade with foreign countries, we should consider another effect caused by FTA conclusion, namely, a trade cost effect $\left(\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3\right)$. This effect could be negative for the country to conclude an FTA. With the formation of an FTA between countries i and j, an increase in imports from country j induces the amount of consumers' payment for importing goods as well as the trade costs. Thus, the consumers in member countries should pay the additional trade costs under the FTA, which is called by the trade cost effect.

Symmetric case

In this subsection, we show that even in the absence of asymmetry in trade costs, FTA conclusion is likely to worsen the member countries' welfare. We assume that the trade costs between any two countries are symmetric, $\tau_{ji} = \tau_{ki} = \tau_{kj} = \tau$.[15] As shown in Figure 3.1, there are tariff complementarity effects under symmetric trade costs. The external tariffs faced by the non-member country are always lowered by both member countries, so that the welfare of the non-member country is improved as a result of the FTA conclusion.

Consider a condition for the feasibility of international trade in the present case. Under the assumption of symmetric trade costs, there are always tariff complementarity effects from Figure 3.1, so that the volume of international trade between any two of the three countries is smaller under the MFN principle than the FTA. Considering the trade volume is the same level for any country under the MFN, the condition for the feasibility of international trade is deduced as

$$q_{ji}(\mathbf{t}_i^{MFN}, \boldsymbol{\tau}) \geq 0 \Leftrightarrow \tau \leq \frac{36 - 69\gamma + 33\gamma^2}{(6 - 5\gamma)^2} \equiv \bar{\tau}. \tag{3.31}$$

Welfare under the MFN principle is supposed to be $V_r(\mathbf{t}^{MFN}, \boldsymbol{\tau})$ for $\forall r$ in which

[15] The symmetric trade costs induce the same tariff rate regardless of the tariff discrimination regime or MFN principle since all countries have perfectly symmetric structure, including the trade costs they face.

three vectors of trade costs are summarized to one since each trade cost vector is symmetric. The MFN principle with symmetric trade costs urges all countries to set the same tariff rate, $t_i^{MFN} = t_j^{MFN} = t_k^{MFN}$, so that each country obtains the same level of welfare. On the other hand, when countries i and j conclude the FTA, the member countries (countries i and j) and non-member country (country k) offers different tariff schedules. We obtain the welfare of member countries, $V_r(\mathbf{t}^{FTA}, \boldsymbol{\tau})$ for $r = i, j$. Under symmetric trade costs, the direct trade surplus effects disappear since $\boldsymbol{\tau}_j = \boldsymbol{\tau}_i$, so that the member's welfare effects induced by the FTA conclusion can be represented as follows:

$$\begin{aligned} \Delta V_i(\boldsymbol{\tau}) &\equiv V_i(\mathbf{t}^{FTA}, \boldsymbol{\tau}) - V_i(\mathbf{t}^{MFN}, \boldsymbol{\tau}) \\ &= \Delta U_i(\boldsymbol{\tau}) - \Delta IM_{ki}(\boldsymbol{\tau}) - \frac{\tau}{3}\left[q_{ji}^{FTA}(\boldsymbol{\tau}) - q_{ji}^{MFN}(\boldsymbol{\tau})\right]. \end{aligned} \tag{3.32}$$

The tariff elimination between member countries and tariff complementarity induce country i to undertake more trading with both the partner and non-member. Hence, the gross utility effects ΔU_i are positive on the welfare of members while the third-country effects ΔIM_{ki} are negative. By comparing Eqs. (3.28) and (3.29), we can show that gross utility increases more than import value from the non-member country as the FTA is forming, $\Delta U_i - \Delta IM_{ki} > 0$, which leads to the FTA improving country i's welfare. However, the third term in Eq. (3.32), trade cost effects $\left(\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3\right)$, work as the FTA conclusion decreases the welfare of country i. It follows that the welfare of the member country can be undermined when the third term is large enough to dominate the positive effects. The threshold of trade costs at which the FTA improves the member's welfare can be deduced as

$$\Delta V_i(\boldsymbol{\tau}) \geq 0 \Leftrightarrow \tau \leq \hat{\tau}. \tag{3.33}$$

We show such $\hat{\tau}$ is smaller than $\bar{\tau}$, as depicted in Figure 3.3, and obtain the following result:

Proposition 3.5 (Welfare-worsening free trade agreement) *Under higher symmetric trade costs between countries, the conclusion of an FTA worsens the welfare of member countries.*

Proposition 3.5 indicates that higher trade costs lead the FTA formation to undermine its member countries' welfare, although the non-member country's welfare increases. An intuition behind Proposition 3.5 is stated below. Tariff reduction by the conclusion of the FTA encourages its members to trade with each other as well as the non-member country. Although the expansion of international trade under

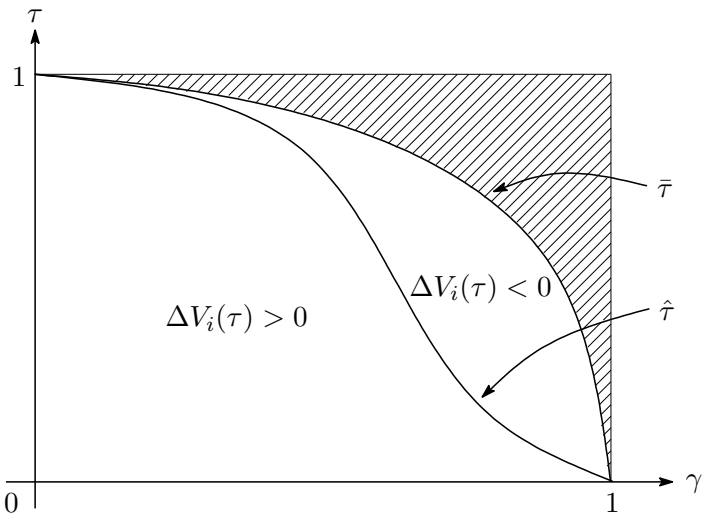

Figure 3.3: Trade costs and FTA formation

the FTA improves the welfare of member countries, it also generates the loss of their welfare in the economy in which trade costs exist. The payment of trade costs by each member country is more expensive under the FTA than the MFN principle. Such payment is loss for firms' rent and has the effect of reducing welfare. Therefore, if higher trade costs per unit τ create a larger loss in the process of trade between member countries, then the welfare loss induced from trade costs exceeds that gains induced by trade expansion.

Asymmetric cases

Here, we relax the assumption that trade costs in each country are symmetric. In particular, focusing on the threshold representing the equivalence between the FTA and MFN welfare, $\hat{\tau}$ in Eq. (3.33), we explore how the threshold value changes response to an asymmetric small change in trade costs. Assuming that each trade cost is set as $\tau_{ij} = \tau + e_m$, $\tau_{jk} = \tau + e_j$ and $\tau_{ki} = \tau + e_i$, the threshold under asymmetry is defined implicitly as follows:

$$\Delta V_i(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \geq 0 \Leftrightarrow \tau \leq \hat{\tau}_{asy}(e_m, e_i, e_j), \tag{3.34}$$

In Eq. (3.34), if the trade costs are symmetric, $e_m = e_i = e_j = 0$, then $\hat{\tau}_{asy}$ is equal to $\hat{\tau}$, as shown in Eq. (3.33). We consider three cases of trade costs: (i) $e_m = e$, $e_i = -e$ and $e_j = 0$, (ii) $e_m = e$, $e_i = 0$ and $e_j = -e$ and, (iii) $e_m = 0$, $e_i = e$ and $e_j = -e$. We investigate the effects of small changes in e on the benefits of forming

the FTA for member country i in each case.

(i) $e_m = e$, $e_i = -e$ and $e_j = 0$.

We focus on the change in costs faced by country i for trading with member country and non-member country. From Eq. (3.27), it is found that

$$\left.\frac{d\hat{\tau}_{asy}(e,-e,0)}{de}\right|_{e=0} < 0. \tag{3.35}$$

This implies that a decrease in e induces increases in $\hat{\tau}_{asy}$ and, thus, the range in which the FTA improves the member's welfare expands as the trade costs shift in opposite direction. Therefore, the benefit of concluding the FTA is amplified as the trade costs decline between the member countries and increase between the member and non-member countries. The trade cost effect in Eq. (3.27) induced by the FTA formation plays an important role in this case.

When the trade costs between country i and j reduce and those between countries i and k increase, such as shown in Eq. (3.35), imports from the member country increase and those from the non-member decrease. In addition, its effects are larger under the MFN principle than the FTA since the reduction of e in this case induces the external tariff to decrease in order to increase imports from the non-member country while the MFN tariff is constant. Given these shifts of trade structure for country i, we consider the effects of trade costs on the benefits of the FTA. Such changes increase payment of trade costs under the MFN relative to the FTA, which improve benefits of FTA formation. Thus, the threshold $\hat{\tau}_{asy}$ increases as the trade costs decline between members and increase between the member and non-member countries.

However, there are some channels in which benefits are not improved. The third-country effects (ΔIM_{ki}) change to become discouraging from concluding the FTA since the member country reduces the external tariff and, thus, the payment to the non-member country under the FTA is more expensive than under the MFN. Furthermore, the gross utility effects (ΔU_i) and the direct trade surplus effects (ΔNE_i) are ambiguous for the benefits of the FTA and depend on the degree of substitutability between the manufacturing goods. Provided the small γ, there are small substitution effects, so that an increase of country i's import from the partner country (country j) caused by the reduction in trade costs between country i and the non-member country (country k) is suppressed. Thus, the decrease in e tends to shrink the gross utility effect (ΔU_i) and expand the direct trade surplus effects (ΔNE_i) under the small γ. Despite such negative effects on the FTA benefits, the trade cost effects that positively influence the FTA dominate the other negative

effects under an environment of demand linearity and quasi-linear utility.

(ii) $e_m = e$, $e_i = 0$ and $e_j = -e$.

Consider the case of change in costs between members, countries i and j, and between country j and the non-member country. We obtain the following equation in a similar way to the previous case.

$$\left.\frac{d\hat{\tau}_{asy}(e,0,-e)}{de}\right|_{e=0} < 0. \tag{3.36}$$

Eq. (3.36) shows that reduction in trade costs between members (country i and j) and increases in trade costs between the partner and non-member country (country j and k) induce the threshold, $\hat{\tau}_{asy}$, to shift upward. This means that such trade cost change represented by e amplifies the benefits of concluding the FTA between country i and j.

In contrast to case (i), the trade costs between the member (country i) and non-member (country k) are constant, so that the tariff rate set by country i is influenced only by the trade costs between members. Thus, the external tariff on the non-member country is induced to decrease by the reduction in e, but it is ambiguous for the MFN tariff. Such a change in tariff rates affects country i's imports from both counties. The reduction in the external tariff causes imports from the non-member to increase, and thus, an increase of imports under the FTA is larger compared with the situation under the MFN principle. This is because the tariff imposed by country i on country k has a greater response to change in e under the FTA than the MFN, that is, $dt_{ki}^{FTA}/de < dt_i^{MFN}/de < 0$. On the other hand, imports from the partner country lead to a decrease by trade cost reduction between them under both regimes. Due to the ambiguity of the trade cost effects on the MFN tariff, it is not clear in which regime imports from the partner country decrease more than the other.

Given such shifts in the trade structure caused by trade costs between members and the tariff set by country i, it is found that Eq. (3.36) is not explained only by the trade cost effects ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$). When the trade costs τ are sufficiently large, the expenditure for trade costs increases by reducing trade costs between members. However, we can understand this case by considering the gross utility effect (ΔU_i) and trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$) simultaneously. Actually, under high trade costs τ, the gross utility effects work to improve the FTA benefits for country i and exceed the negative trade cost effects. On the other hand, the low trade costs τ indicate the trade cost effects enhance the FTA benefits. Although the gross utility effect could decline as the trade costs between

members decrease owing to substitution effects, positive trade cost effects outweigh that. These effects, the gross utility effect and trade cost effect, create positive effects for the FTA benefits when trade costs between members decline and when trade costs between the partner and non-member increase from symmetric equilibrium.

Furthermore, in this case, the effects cause FTA benefits to decline. Due to the higher tariff on the non-member country employed in the FTA than under the MFN, country i has larger imports than the non-member when the FTA is formed. Hence, the third-country effect ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$) in this case shifts negatively with an increase in the payment to the non-member country. In addition, country i's trade structure is affected by the change in trade costs between the partner and non-member countries. An increase in those trade costs induces the partner country to substitute imports from the non-member country for those from country i, by which exports from country i to country j are expanded. Thus, the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$) are likely to strengthen the benefits of country i forming the FTA with country j. However, as mentioned above, country i's payments for imports from country j (the partner for country i) could also increase as the trade costs between members decline. Two such conflicting directional effects about trade between members make it ambiguous whether the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$) are encouraging for forming the FTA. However, supposing demand linearity and quasi-linear utility, these effects that could be negative are dominated by positive effects, the gross utility effect (ΔU_i) and trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$).

(iii) $e_m = 0$, $e_i = e$ and $e_j = -e$.

Here, we consider the effects of the costs faced by each member when they trade with the non-member. However, it is not clear whether the FTA benefit improves with the change in e, unlike in the other two cases. In this case, the trade costs between members remain constant, so that the trade cost effects ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$) are influenced indirectly from the trade costs with the non-member country. Thus, the influence from the non-member are mitigated relative to the previous two cases, resulting in the effect of trade cost reduction on the FTA benefits remaining unclear.

Given the reduction of costs for trading with country k, the external tariff imposed by country i on country k (non-member country) increases while the effects on the MFN tariff are obscured. The decrease in trade costs between country i and k enhances their trading and, by contrast, country i could employ the higher tariff in both regimes so as to prevent such enhanced trade and to save payments to the non-member. The change of the external tariff is large enough to dominate the MFN tariff's change, but both tariff changes are not as large as the trade cost

reduction. This indicates that country i, under the MFN, increases imports from country k more than under the FTA formation. On the other hand, the trade structure between members is affected from two aspects: the change in the trade costs between country i and k, and between country j and k. When the imports from the non-member country (country k) increase with the reduction in trade costs between countries i and k, this leads consumers in country i to substitute imports from country k for those from country j in both regimes. In addition, the consumers in country j are induced by an increase in trade costs between country j and k to substitute imports from country k for those from country i, which brings about an increase in exports of manufacturing firms in country i.

From the changes of trade structure caused by the reduction in trade costs between country i and k, we explain the effects on FTA benefits in respect of gross utility effects (ΔU_i), third-country effects ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$), and trade cost effects ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$). As trade costs decrease between country i and k, the gross utility effects (ΔU_i) is negative on the FTA benefits since country i under the MFN can achieve unbiased consumption relative to the FTA. Considering the third-market effects ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$), an increase in country i's import value from country k caused by their trade costs declining is larger under the MFN than under an FTA. Thus, in this case, the third-country effects ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$) work to enhance the FTA. Next, we consider the trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$). The large γ induces the large increase in external tariff as e declines and, thus, country i under the MFN can save payments for trade costs more than when country i forms the FTA with country j. Consequently, a reduction in trade costs generating the substitution effects increases payments of trade costs under the FTA relative to the MFN and, thus, does not improve the FTA benefit in this case.

In order to show the intuition about the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$), we need to focus on the effects on trade structure between members yielded by the trade costs faced by each member countries via trading with the non-member country. Based on the shift of trade structure as mentioned above, a reduction in e causes the two opposing effects to country i's trade surplus with country j. Hence, it is unclear whether the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$) work on the FTA benefit because of the change in trade costs denoted by e in this case.

In the previous two cases, the FTA benefits are improved with reduced trade costs, even if there are ambiguous or negative effects. However, the change in e has ambiguous effects on the FTA benefits in the case that we focus on the trade costs faced by the members when they trade with the non-member country. This is because trade costs are not affected between the member countries. Keeping trade costs between the members constant, the trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$)

is affected by the substitution effects only indirectly and works to mitigate the benefit of forming the FTA relative to the case of reducing the trade costs between the members.

3.5 Conclusion

In this chapter, we construct a simple intra-industrial trade model in the presence of international trade costs, and reveal the relationship between trade costs and tariffs, determined according to three scenarios: tariff discrimination, the MFN principle, and the FTA. Many economists state that FTA formation has beneficial effects for member countries as well as non-member countries owing to tariff complementarity effects. In contrast to previous literature, the present analysis shows that tariff complementarity effects are likely to disappear with higher trade costs between countries forming the FTA. Furthermore, welfare analysis sheds light on the negative aspects of an FTA, which may lower FTA members' welfare when each trade cost between countries is significantly large. Despite trade expansion by the FTA formation, it also increases the payment of trade costs, which leads to a decrease in national welfare. Thus, higher trade costs, especially between member countries, bring about welfare worsening under the FTA for its members.

In addition, this chapter suggests the possibility of trade costs being the factor that can influence conservative results, so that we are required to implement further analysis on FTAs in the presence of trade costs. For example, there is a puzzle in this field whether an FTA yields "building blocks" or "stumbling blocks" (Bhagwati, 1993). To approach this issue, our model should be extended to incorporate an endogenous decision about FTA formation, analyzing the relationship between the structure of trade costs and the incentive to conclude the FTA. In the next chapter, we analyze how trade cost reduction affects self-enforceability with an infinitely repeated game involving two asymmetric countries.

Chapter 4

Market Integration and Cooperation in Trade Policy

Chapter 4 explores the relationship between market integration – specifically a reduction in trade costs – and the incentive to cooperate on trade policy using an infinitely repeated game approach. We demonstrate the property of non-cooperative and cooperative tariffs on trade costs and size of domestic industry. Whether market integration encourages cooperation with trade policy depends on the asymmetry of countries represented by the size of domestic industry. If the country has a small (large) industry, market integration generates more (less) incentive for cooperation.

4.1 Introduction

The progress of globalization has induced international markets to be integrated in various forms, such as advances in transport, information technologies, electronic trading, and international legal systems. As stated by Derher (2008), who developed an index of globalization, the progress of globalization consists of three dimensions: economic, social, and cultural integration, and globalization proceeded in most countries in the period 1970–2000. Tariff reduction, among other features, has played a critical role in the promotion of market integration by removing international trade barriers.

However, tariff reduction has a distinct feature from the other driving forces of market integration. Trade policy, including tariff settings, is determined by governments according to various policy objectives, which include the protection of infant industries, securing political contributions from lobby groups, or abiding by international trade policy agreements. Actually, we can observe a difference in trends of tariff rates according to country or period, despite the progress of market integra-

tion. For example, during the 1950s and 1960s, developing countries often implemented protectionist policy in order to promote domestic industries at the expense of imports. On the other hand, more recently, numerous new free trade agreements provide evidence that governments are cooperating to reduce trade barriers under the auspices of international institutions, such as the General Agreement on Tariffs and Trade and the World Trade Organization. Such differences in government responses to market integration lead us to recognize the importance of separately treating tariff reduction and market integration without tariff reduction.

In order to characterize such different response to market integration, we construct an intra-industrial trade model with two countries that have heterogeneity in the size of domestic industry. Based on this model, we demonstrate the feature of tariffs determined in two policy regimes; cooperative and non-cooperative. In addition, we discuss the sustainability of cooperation that achieves economic efficiency. In this study, we assume that the degree of market integration is captured by the reduction of trade costs, which have been recognized widely in economic integration.[1]

The results on the tariff rate show that policy regimes matter for the response of tariff setting to market integration. In the first regime, in which all governments choose their tariff rates non-cooperatively, they choose higher tariff rates as trade costs decrease as long as the domestic industry is large relative to the foreign country. In addition, the tariff determined by the country in which the small industry is located increases with the reduction of trade costs unless the traded goods are sufficiently substitutable. In traditional trade theory, Johnson (1954) showed that uncooperative governments set inefficiently high tariffs in order to improve their terms of trade at the expense of foreign countries (this is known as terms-of-trade externality). This result also appears in our model, which focuses on intra-industry trade.[2] In addition, our analysis implies that such an externality depends on the volume of international trade and is amplified by economic integration that intensifies competition. Such amplification leads governments to employ protectionist trade policy in the form of higher tariffs with a decrease in trade costs.[3] By con-

[1]Although the extent of market integration is represented in various ways, the reduction of broadly defined trade costs is a standard way to represent market integration. According to Anderson and van Wincoop (2004), trade costs broadly refer to the costs of transport, information, contract enforcement, and adjustment to foreign standards, which are intimately related to market integration. The reduction of trade costs facilitates the expansion of international trade, which results in economic integration.

[2]The intra-industry trade model was established by Brander (1981) and Brander and Krugman (1983). Then, Gros (1987) was the first to show that according to such a model, even small countries have incentives to impose tariffs to relocate production and manipulate terms of trade.

[3]As an exception, a sufficiently high degree of substitutability between traded goods induces lower tariffs in the country with the small industry, which depends highly on imports for total

trast, in the second regime, in which all governments cooperate to set tariff rates, the results would be reversed: in the cooperative regime, trade cost reduction leads to tariff reduction regardless of the size of the domestic industry. The cooperative regime tends to pursue economic efficiency and a reduction in trade costs creates incentives to expand the volume of international trade, which could achieve tariff reduction by governments whose market integration is progressing. Consequently, governments with cooperative policy regimes tend to show favourable reactions to market integration.

Unfortunately, such cooperation is not always sustainable, however. There is no supranational authority that could enforce cooperation, so each government has incentive to defect from a cooperative agreement for the sake of instant benefit from the deviation. Thus, we should discuss self-enforcement of the cooperation and its change as the market is integrated, providing us with insights into the achievement of stable trade. Analysis on the sustainability of cooperation using a repeated game approach shows that the country with a small industry is encouraged to sustain cooperation by a decrease in the trade cost. Since the import demands of the country with the small industry account for a large proportion of consumption, the benefits of cooperation expanded by trade cost reduction favour the country with the small industry rather than that with the large industry.

Many economists have analysed intra-industry trade policy.[4] Staiger (1995) comprehensively surveyed the self-enforcement of trade agreement and the international rules for it. According to this survey, most studies in this field have explored enforceable trade policy or rules to enforce the agreement even if the government has incentives for deviation. Adopting a different approach from these studies, Collie (1993) and Collie (1997) used the export subsidy model developed by Brander and Spenser (1985) and discussed the incentive to sustain the trade agreement using the repeated game approach without trade costs. Ludema (2002), whose work is most similar to this study, examines the incentive to enforce the trade agreement with a multinational monopolistic model in the presence of trade costs and shows that the more trade costs are reduced, the more likely it is that countries will cooperate in

consumption. This is because under the high substitutability of goods traded, the effect of import price reduction caused by trade costs or tariffs dominates the motivation to protect against intense competition for the country depending on the imported goods.

[4]In particular, studies in strategic trade policy have developed the intra-industry trade model, as shown in the detailed survey of Brander (1995). Furthermore, trade costs are often treated as a factor that enables analysis of firms' distribution in the 'new economic geography'. Mai et al. (2008) differentiate trade costs from tariffs imposed by governments and explore the relationship between tariff competition and firms' distribution between countries using a quantitative approach. However, our study constructs a simpler model to characterize equilibrium analytically and explore the effect of the reduction in trade costs on the trade policy.

setting free trade policies. In contrast to Ludema (2002), our study endogenizes the tariff rate in the presence of trade costs and explores how the change in trade costs affects the tariff endogenized by the government.

The remainder of this paper is organized as follows. Section 4.2 presents our simple intra-industry trade model with trade costs. In Section 4.3, we analyse two trade policy regimes: unilateral and cooperative trade policies. The impacts of market integration on policy choices under the different regimes are then analysed. In Section 4.4, the incentive for cooperation in trade policy is explored by using the repeated game approach. We conclude in Section 4.5.

4.2 The Economy

This chapter basically follows the chapter 3's model with the exception of the number of country and the size of domestic industry. There are two countries ($r = i, j$) in the economy. In each country, two production sectors exist: agriculture and manufacturing. Consumers in both countries have identical preferences for agricultural and manufacturing goods. Assuming that each consumer supplies one unit of labour, the population size l in each country is equal to labour force endowment.

4.2.1 Settings

The agricultural sector operates under perfect competition and constant returns to scale using only labour. To produce one unit of the agricultural good, one unit of labour needs to be employed in this sector. Assuming that agricultural goods are numeraire, the price and wage rate are equal to one.

On the other hand, the production of manufacturing goods operates under imperfect competition. The manufacturing sector produces horizontally differentiated goods that are imperfectly substitutable for each other. One variety ω is produced by one manufacturing firm, which is negligibly small and does not influence the behaviour of other firms in the sector. Formally, the manufacturing firms in the economy are represented by a continuum Ω denoting the set of all varieties of manufacturing goods in the economy. In addition, we assume that the set of firms located in country r is written as $\Omega_r \subset \Omega$ and its size $|\Omega_r|$ is equal to s_r. Assuming no entry to this sector, we normalize the size of the set of the total manufacturing firms, $s_i + s_j = 1$. In our model, the measure s_r reflects the size of manufacturing firms in country r as well as the variety of manufactured goods that is able to be produced in country r. From this, we can consider s_r as the level of industrialization of country r.

Preference

All consumers in the economy are assumed identical. We formulate the preferences of consumers with a quadratic utility function as follows:

$$\begin{aligned} & u(q(\omega), q_0; \omega \in \Omega) \\ &= \int_\Omega q(\omega)d\omega - \frac{1-\gamma}{2}\int_\Omega q(\omega)^2 d\omega - \frac{\gamma}{2}\left(\int_\Omega q(\omega)d\omega\right)^2 + q_0, \end{aligned} \tag{4.1}$$

where $q(\omega)$ (q_0) is the amount of manufacturing (agricultural) goods consumption and γ denotes the degree of substitutability between manufacturing goods. A lower γ means that consumers recognize manufacturing goods as more differentiated. If $\gamma = 0$, manufacturing goods are perfectly different from one another. If $\gamma = 1$, every manufacturing good is recognized as identical. Consumers in country r maximize utility subject to the following budget constraints:

$$\int_{\Omega_r} p(\omega)q(\omega)d\omega + \int_{\Omega_s} [p(\omega) + t_r + \tau]q(\omega)d\omega + q_0 = y_r, \tag{4.2}$$

for $r \neq s,\ r, s = i, j.$ y_r represents a consumer's income, including wage, rent from firm ownership, and tax distribution. In order to purchase the manufacturing goods from abroad, consumers should pay trade costs τ and tariff t_r imposed by country r in addition to the price $p(\omega)$ set by the foreign producer. While the tariffs are determined endogenously by each government along with the policy regime, we consider that the trade costs paid by consumers are constant in this model. Supposing that the transportation service is supplied in a perfectly competitive market, then the transport service is priced at marginal cost. Thus, if we assume that its marginal cost is constant, then the assumption of exogenously given trade costs is reasonable.

From the utility-maximization problem, we can deduce the demand functions for manufacturing goods as follows:

$$q_{rr}(\omega) = \frac{1}{1-\gamma}[1 - p_{rr}(\omega) - \gamma(1 - P_r)], \qquad if \ \ \omega \in \Omega_r, \tag{4.3}$$

$$q_{sr}(\omega) = \frac{1}{1-\gamma}[1 - p_{sr}(\omega) - t_r - \tau - \gamma(1 - P_r)], \quad if \ \ \omega \in \Omega_s. \tag{4.4}$$

where $q_{sr}(\omega)$ ($p_{sr}(\omega)$) represents the consumption (price) of manufacturing goods in country r, produced in country s ($r, s = i, j$). P_r is a price index defined by

$$P_r \equiv \int_{\Omega_r} p_{rr}(\omega)d\omega + \int_{\Omega_s} [p_{sr}(\omega) + t_r + \tau]d\omega. \tag{4.5}$$

This price index represents the sum of the consumer's price and average price supplied in country r as there is one firm in the economy.

Manufacturing sector

The manufacturing firm producing a variety of ω supplies to both the domestic and foreign countries with zero marginal production cost. Therefore, the operating profit $\pi_r(\omega)$ of the firm located in country r is

$$\pi_r(\omega) = lp_{rr}(\omega)q_{rr}(\omega) + lp_{rs}(\omega)q_{rs}(\omega), \quad r \neq s, \;\; r, s = i, j. \tag{4.6}$$

Each firm maximizes profit with respect to price given the price index P_r and other firms' behaviour in the economy. According to the first-order conditions of the profit-maximization problem, all the firms in country r set their own prices as follows:

$$p_{rr} = \frac{1}{2}[1 - \gamma(1 - P_r)], \tag{4.7}$$

$$p_{rs} = p_{ss} - \frac{t_s + \tau}{2}. \tag{4.8}$$

Regardless of the variety of differentiated goods, manufacturing goods are symmetrically priced by firms. Thus, hereafter, we omit an expression of the variety of ω. Domestic goods are set at a higher price than exported goods but consumers have to pay trade costs and tariffs in addition to the price, $p_{rs} + t_s + \tau$, which results in a higher price for exported goods than domestic goods. Furthermore, utilizing the definition of price index P_r, equilibrium prices are determined as follows:

$$p_{rr}(t_r, \tau, s_s) = \frac{1}{2 - \gamma}\left[1 - \gamma + \frac{\gamma s_s}{2}(t_r + \tau)\right], \tag{4.9}$$

$$p_{rs}(t_s, \tau, s_r) = \frac{1}{2 - \gamma}\left[1 - \gamma + \frac{\gamma s_r}{2}(t_s + \tau)\right] - \frac{t_s + \tau}{2}. \tag{4.10}$$

The equilibrium quantity can be obtained from the relationship $p_{rs} = (1 - \gamma)q_{rs}$, which is given by the manufacturing firms' first-order condition. From Eqs. (4.9) and (4.10), we obtain the relationship between the industrialized level and equilibrium price, which is given by

$$\frac{\partial p_{rr}(t_r, \tau, 1 - s_r)}{\partial s_r} = \frac{\partial p_{sr}(t_r, \tau, 1 - s_r)}{\partial s_r} < 0. \tag{4.11}$$

This implies that the large industry in country r brings about a lower-priced good supplied to country r owing to the intensive competition among manufacturing firms. The equilibrium prices depend on tariff rates imposed by governments. In addition,

from Eqs. (4.9) and (4.10), an increase in tariffs or trade costs has positive effects on the domestic price ($\partial p_{rr}/\partial t_r > 0$) as well as negative effects on the import price ($\partial p_{sr}/\partial t_r < 0$). This is caused by substitution effects, through which consumers demand more domestic product in place of higher-priced foreign product.

In this study, our focus is limited to cases in which international trade between countries is feasible. To ensure that the consumers in both countries have positive demand for goods from the foreign country in equilibrium, we assume that

$$\min\{q_{ji}(t_i, \tau, s_j), q_{ij}(t_j, \tau, s_i)\} \geq 0. \tag{4.12}$$

$q_{ji}(t_i, \tau, s_j)$ and $q_{ij}(t_j, \tau, s_i)$ are decreasing with an increase in trade costs or tariff, so that Eq. (4.12) shows the upper bound of trade costs or tariff at which international trade is feasible. An increase of the size of industry in country i induces more exports to country j, which allows the higher threshold of trade costs or tariffs for the feasibility of international trade from country i to country j. In addition, when the size of industry in country i is large, country i's imported goods become small and thus, the condition on trade costs or tariffs for international trade from country j to country i becomes stricter.

4.2.2 Welfare decomposition

We now characterize national welfare in equilibrium. In our model, welfare can be decomposed into gross welfare, or the values of imports and exports. Decomposed welfare helps us to explore the two different trade policy regimes and effects of market integration. Per-capita income in country i is constituted by the total of wage rate, w_i, rents of production activities, and distributed tax revenue:

$$y_i = w_i + \frac{s_i}{l}\pi_i + \frac{TR_i}{l}, \tag{4.13}$$

where the wage rate is equal to 1. In the right-hand side (RHS) of Eq. (4.13), the third term represents tariff revenue distributed by the government. The government of each country imposes a unit tax on imported manufacturing goods, so that total tariff revenue in country r is

$$TR_i = ls_j t_i q_{ji}. \tag{4.14}$$

Following Furusawa and Konishi (2004, 2007) and using Eqs. (4.6), (4.13), and (4.14), we can decompose per-capita welfare in country r. Decomposed welfare

$V_i(t_i, t_j, \tau, s_i, s_j)$ is represented by

$$V_i(t_i, t_j, \tau, s_i, s_j) = U_i(t_i, \tau, s_i, s_j) + EX_i(t_j, \tau, s_j) - IM_i(t_i, \tau, s_i), \tag{4.15}$$

where, in the RHS of Eq. (4.15), each term is defined by

$$U_i(t_i, \tau, s_i, s_j) \equiv \sum_{r=i,j} s_r q_{ri} - \frac{1-\gamma}{2}\left[\sum_{r=i,j} s_r q_{ri}^2\right] - \frac{\gamma}{2}\left[\sum_{r=i,j} s_r q_{ri}\right]^2 + 1, \tag{4.16}$$

$$EX_i(t_j, \tau, s_i) \equiv s_i p_{ij} q_{ij}, \tag{4.17}$$

$$IM_i(t_i, \tau, s_j) \equiv s_j(p_{ji} + \tau) q_{ji}. \tag{4.18}$$

Each value of production and price are evaluated by Eqs. (4.9) and (4.10). $U_i(t_i, \tau, s_i, s_j)$ represents gross utility and $EX_i(t_j, \tau, s_i)$ ($IM_i(t_i, \tau, s_j)$) denotes the value of exports to (imports from) country i. Here, we refer to the relationship between each value and the size of domestic industry. The derivative value of $U_i(t_i, \tau, s_i, s_j)$ with respect to s_i is unclear due to the substitution effects. Although an increase in the size of domestic industry expands the consumption of domestic products, it also induces consumers to decrease demand for imported goods, which decreases the level of gross utility. Under high substitutability, this effect could exceed the positive effect caused by an increase in the consumption of manufacturing goods produced domestically, so that it is ambiguous whether consumers in the highly industrialized country have high gross utility. On the other hand, the trade structure, that is $EX_i(t_j, \tau, s_i)$ and $IM_i(t_i, \tau, s_j)$, can be characterized clearly by the asymmetry in the level of industrialization. Based on Eq. (4.11), the supply of manufacturing goods to country i is large when the level of industrialization in country i is lower than that in country j. This implies that the less industrialized country has more imports and less exports than the foreign country, which is more industrialized.

4.3 Optimal Trade Policy under Trade Costs

Thus far, tariff rates are exogenously given as trade costs for consumers and firms. However, the governments impose tariffs in accordance with a trade policy regime. In this section, we explore the two types of trade policy regimes under trade costs and demonstrate that a trade cost reduction has different effects on tariffs determined by governments, depending on the regime or level of domestic industry. Hereafter, to simplify the representation of equations, a variable denoting the size of industry in country j is omitted by replacing s_j with $1 - s_i$.

4.3.1 Unilateral trade policy

In this subsection, we analyse the unilateral trade policy regime, under which each government uncooperatively determines its level of import tariff. In addition, we show the effects of trade costs on the tariffs imposed by governments and find that these effects depend on the size of domestic industry. Since there are negative externalities under this regime, the tariff levels under unilateral trade policy are higher than those under optimal trade policy. This point is discussed in detail in Subsection 4.3.2. The governments choose tariff levels to maximize national welfare. It follows that the maximization problem of the government of country i is

$$\max_{t_i} V_i(t_i, t_j, \tau, s_i). \tag{4.19}$$

From (4.15), the first-order condition of this problem is:

$$\frac{\partial U_i}{\partial t_i} - \frac{\partial IM_i}{\partial t_i} = 0. \tag{4.20}$$

In the left-hand side (LHS) of Eq. (4.20) denoting the effects of tariffs on national welfare in country i, the first term denotes the loss of gross utility and the second term refers to the reduction in expenditure of imports induced by the price increasing. These terms represent the benefit and cost, respectively, of imposing tariffs on imported goods. From Eq. (4.20), we find that the tariff level imposed by the government does not depend on the tariff level imposed by the other government, and thus, there is no strategic interdependence, as shown in Yi (1996). This feature of our formulation allows us to analyse trade policy more simply. By using Eqs. (4.16), (4.17), and (4.18), we can derive country i's tariff level under unilateral trade policy as follows:[5]

$$t_i^N = \frac{4(1-\gamma)\left[1-\gamma(1-s_i)\right] - \left[\gamma^2 s_i(2s_i-1) + 4(1-\gamma)(1-\gamma+\gamma s_i)\right]\tau}{\gamma^2\left(2s_i^2 - 7s_i + 8\right) - 4\gamma(5-2s_i) + 12}. \tag{4.21}$$

Eq. (4.21) shows that the tariff imposed under the non-cooperative policy regime is always positive owing to $\gamma \in (0,1)$, $s_i \in (0,1)$ and Eq. (4.12). Moreover, the effect of trade cost is reduced as

$$\frac{dt_i^N}{d\tau} = -\frac{\gamma^2 s_i(2s_i-1) + 4(1-\gamma)(1-\gamma+\gamma s_i)}{\gamma^2\left(2s_i^2 - 7s_i + 8\right) - 4\gamma(5-2s_i) + 12}. \tag{4.22}$$

[5]We show the case of country j in the appendix.

From Eq. (4.22), we cannot identify the effect of trade costs on the non-cooperative tariff. Although the denominator of this equation always has a positive sign, the numerator is ambiguous. When country i has a larger size of industry than country j, that is, $s_i \geq 1/2$, the numerator is sufficiently positive regardless of γ, so that Eq. (4.22) is negative. This means the trade cost reduction induces the government to employ higher tariff. On the other hand, supposing that country i is smaller than country j, that is, $s_i < 1/2$, the effects of trade costs depend on the degree of substitutability among manufacturing goods. If γ is sufficiently large, leading the numerator of Eq. (4.22) to be negative, then the sign of Eq. (4.22) becomes positive. This implies that under higher substitutability, the trade cost reduction induces the country with a small industry to reduce the tariff, even that determined non-cooperatively. These discussions are applied to the non-cooperative tariff determined by the government of country j.[6] Proposition 4.1 summarizes this discussion.

Proposition 4.1 (Unilateral trade policy) *When each government pursues trade policy unilaterally, positive tariffs are imposed on imported goods to protect the domestic industry. In this case, the effects of trade costs on tariffs depend on the size of the domestic industry:*

(i) If the country has a larger domestic industry than the foreign country, then the trade cost reduction always causes the tariff to increase.

(ii) If the country has a smaller domestic industry than the foreign country, then the trade cost reduction causes the tariff to decrease only if the manufacturing products are highly substitutable among themselves.

Under unilateral trade policy, each government imposes positive tariffs on imports. Tariff on imported goods increase domestic production and decrease foreign production, and thus, the rents of domestic firms increase at the expense of foreign firms. In addition, the governments can shift rents from foreign firms through the redistribution of tariff revenues. This is why tariffs under unilateral trade policy are always positive.

In addition, Proposition 4.1 explores the relationship between the trade cost effects on tariffs and industry size. The reduction of trade costs prompts consumers not only to increase imported goods but also to decrease domestic products, thereby reducing the rents of domestic firms. An increase in imports, which is the objective of taxation, amplifies the effects of imposing tariff, and so the governments have an incentive to increase tariffs and shift rents from the foreign country through

[6] In the appendix, we demonstrate that the tariff determined by country j non-cooperatively also has this property.

the redistribution of tariff revenues. As for the more industrialized country, since increasing tariff is relatively effective for protecting the large industry, the reduction in trade costs always brings about higher tariff on imported goods. On the other hand, an increase in tariff as trade costs decrease has negative aspects, that is, it decreases demand from the foreign country. This could be especially serious for the country with the smaller industry, since the total consumption in that country is largely dependent on imported goods. When manufacturing goods are highly substitutable, an increase in tariffs causes import demand to decline significantly. Therefore, the country in which the small industry is located employs lower tariff as trade costs reduce with sufficiently high substitutability between manufacturing goods.

4.3.2 Cooperative trade policy

We assume that each government can agree on cooperative trade policy and cooperation is enforceable. This assumption excludes the problem of deviation from a trade agreement. When governments cooperate in setting trade policy, the maximization problem is given by

$$\max_{t_i,t_j} V_i(t_i,t_j,\tau,s_i) + V_j(t_i,t_j,\tau,s_i). \tag{4.23}$$

The first-order conditions of this problem are

$$\frac{\partial U_r}{\partial t_r} + \frac{\partial EX_s}{\partial t_r} - \frac{\partial IM_r}{\partial t_r} = 0, \quad r \neq s, \;\; r,s = i,j. \tag{4.24}$$

Comparing Eqs. (4.20) and (4.24), we show that tariffs under the cooperative regime are lower than those under unilateral trade policy. From Eq. (4.24) and the derivatives of Eqs. (4.16), (4.17), and (4.18), we show that

$$\frac{\partial U_r}{\partial t_r} - \frac{\partial IM_r}{\partial t_r} = -\frac{\partial EX_s}{\partial t_r} > 0. \tag{4.25}$$

Supposing that t_i^C denotes the tariff imposed by country i under cooperative trade policy, which satisfy Eq. (4.24), it follows that $t_i^N > t_i^C$ owing to the concavity of $\partial U_r/\partial t_r - \partial IM_r/\partial t_r$. The tariff level imposed by each government has negative effects on imports and results in a loss of welfare in the other country. Under unilateral trade policy, these effects ($\partial EX_s/\partial t_r$) are not considered by the governments when they determine the tariff level and thus, a negative externality occurs. Under the cooperative policy regime, such effects are taken into account by both governments in pursuit of the welfare of the economy, as shown in Eq. (4.24). This means that

the negative externality is internalized by cooperation between governments. As a result, the tariff levels imposed under cooperative trade policy are lower than those determined under the uncooperative policy regime.

Next, we explore the features of tariffs imposed under a cooperative regime and analyse the effects of trade costs on the tariffs. Solving Eq. (4.24), the tariff level is

$$t_i^C = \frac{\left[\gamma^2(4-3s_i) - 4\gamma(2-s_i) + 4\right]\tau - 4(1-\gamma)^2}{4 - 4\gamma + \gamma^2 s_i}, \tag{4.26}$$

$$t_j^C = \frac{\left[\gamma^2(1+3s_i) - 4\gamma(1+s_i) + 4\right]\tau - 4(1-\gamma)^2}{4 - 4\gamma + \gamma^2(1-s_i)}. \tag{4.27}$$

In contrast to the uncooperative policy regime, each government can implement a subsidy on imported goods. The sign of Eqs. (4.26) and (4.27) depend on trade costs and industry size. By cooperating, each government adopts the tariff policy if the following conditions are fulfilled:

$$t_i^C \geq 0 \quad \Leftrightarrow \quad \tau \geq \frac{4(1-\gamma)^2}{\gamma^2(4-3s_i) - 4\gamma(2-s_i) + 4} \equiv \tilde{\tau}_i(s_i), \tag{4.28}$$

$$t_j^C \geq 0 \quad \Leftrightarrow \quad \tau \geq \frac{4(1-\gamma)^2}{\gamma^2(1+3s_i) - 4\gamma(1+s_i) + 4} \equiv \tilde{\tau}_j(s_i). \tag{4.29}$$

Eqs. (4.28) and (4.29) are represented in Figure 4.1, showing which trade policies, tariffs, or subsidies are applied by each country under the cooperative regime given γ. In this figure, $\tilde{\tau}_i$ ($\tilde{\tau}_j$) is the threshold characterizing the cooperative policy employed by country i (country j), and $\bar{\tau}$ is the upper bound at which international trade is feasible for both countries.[7]

Figure 4.1 enables us to understand cooperative trade policy in the presence of trade costs. In Figure 4.1, Region i (Region j) indicates the combination of industry size and trade costs under which the government of country i (country j) cooperates to employ the tariff policy. Supposing no trade cost ($\tau = 0$), a cooperative government always employs the subsidy policy, which is explained by the traditional argument. By cooperating to set the trade policy, each country is required to choose the policy in order to achieve economic efficiency. In the absence of trade costs, its only objective is to adjust the existing distortion caused by monopolistic pricing in imperfect competition. Thus, in the traditional argument without trade costs,

[7] $\bar{\tau}$ in Figure 4.1 can be derived by substituting t_i^C and t_j^C into Eq. (4.12) as follows:

$$\min\{q_{ji}(t_i^C, \tau, s_j), q_{ij}(t_j^C, \tau, s_i)\} \geq 0$$
$$\Leftrightarrow \tau \leq \bar{\tau} \equiv \min\left\{\frac{(1-\gamma)(4-3\gamma-s_i\gamma)}{(2-\gamma-s_i\gamma)^2}, \frac{(1-\gamma)[4(1-\gamma)+s_i\gamma]}{[2(1-\gamma)+s_i\gamma]^2}\right\}$$

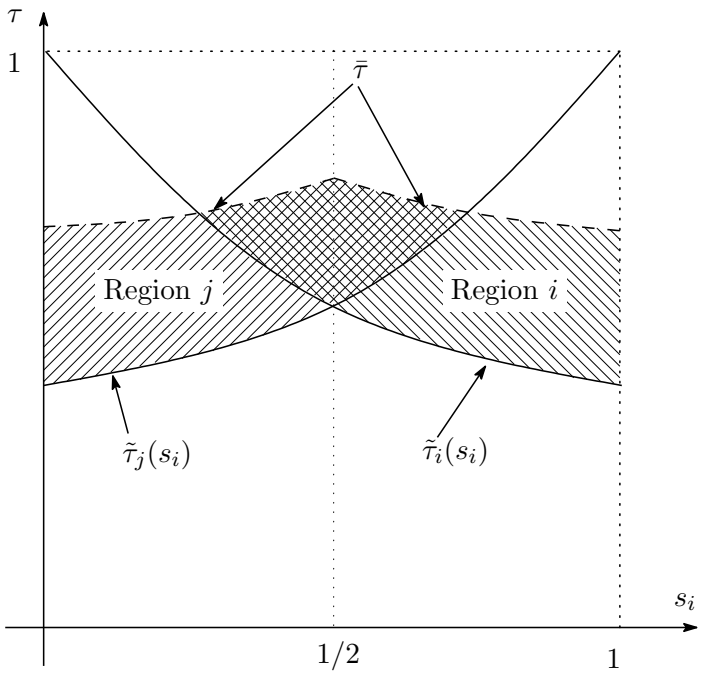

Figure 4.1: Trade policy under cooperation

cooperation in trade policy brings about a subsidy policy so as to adjust the distorted price. However, our model sheds light on another aspect of cooperative trade policy – that with trade costs. The payment of trade costs by consumers is wasted as transport costs while tariff revenue paid by them is redistributed to consumers, so that in our model, the cooperative government aims to moderate the loss owing to the payment of trade costs, in addition to adjusting the distortion of the manufacturing sector. From Figure 4.1, we obtain Proposition 4.2.

Proposition 4.2 (Cooperative trade policy) *When trade costs are sufficiently small, both governments always implement the subsidy policy. On the other hand, when trade costs are sufficiently large, at least one country implements the tariff policy. Specifically, when the countries have similar sized industries, the tariff policy is adopted by both countries.*

Proposition 4.2 states the relationship between domestic industry size and the adoption of trade policy. When trade costs are sufficiently high, the industry size in country i determines whether country i adopts tariff or subsidy policy under cooperation.

As mentioned above, there are two objectives for governments' use of trade policy: (i) to adjust distorted prices, and (ii) to moderate the loss of transport. Now,

we assume that τ is sufficiently high. When the size of industry in country s_i is sufficiently small, the government of country i provides the subsidy to promote imports from the other country. This is because the individuals in country i consume many imported goods from country j and thus, these consumers are significantly influenced by the price distortion. On the other hand, when the industrialization level in country s_i is sufficiently high, the government of country i imposes positive tariff to reduce trade, which contributes to lowering the loss of international transport. This implies that under higher trade costs, it is less important to adjust the distorted price than to mitigate the loss of trade costs concerning the decision of trade policy to maximize social welfare.

Furthermore, a reduction in trade cost affects trade policy under the cooperative regime differently than under the uncooperative regime. From Eqs. (4.26) and (4.27), we demonstrate that $dt_i^C/d\tau > 0$ and $dt_j^C/d\tau > 0$, so that the governments of both countries employ lower tariff as trade costs decline. The governments have no incentive to protect their domestic industry under the cooperative regime because the tariff effects on the foreign country are considered by each government. As long as the governments implement cooperative policy, the decrease in trade costs motivates governments to adjust distorted prices rather than mitigate losses due to international transport. As a result, cooperative policy facilitates the removal of trade barriers in order to increase efficiency. These findings lead to Proposition 4.3.

Proposition 4.3 (Impact of trade cost reduction on cooperative tariff) *As trade costs decrease, the tariff rate decreases by cooperative governments regardless of the size of its domestic industry.*

Opposite to unilateral trade policy, if the government cooperates to determine trade policy in order to achieve social welfare, then the trade cost reduction enhances bilateral trade liberalization in which both countries reduce tariffs on imports from the foreign country. This is obvious, given that cooperation in trade policy works to eliminate the negative externality caused by unilateral trade policy. The governments have incentive to increase tariffs to shift rents from the foreign country through the redistribution of tariff revenues. This produces negative impacts in the other country, implying that independent policy-making generates negative externality. By contrast, given the internalization of the negative externality through cooperation, the reduction in trade costs induces cooperative governments to adjust distorted manufacturing prices rather than mitigate losses caused by international transport in order to maximize social welfare. Therefore, as trade costs decrease, tariffs also decrease under the cooperative regime and thus, international trade is fostered.

4.4 Self-enforcing Cooperation

Thus far, we find that cooperation induces bilateral trade liberalization as trade cost decreases. However, this is obtained under the critical assumption that the cooperation is enforceable. Each government has incentive to deviate from cooperation and impose a higher tariff for the sake of its own country, so that such cooperation is not always sustainable. In this section, we relax the assumption by considering a game in which each government can choose the trade policy regime and analyse the incentive to sustain the cooperation, using the approach of an infinitely repeated game.

4.4.1 Repeated game on trade policy

Suppose there is an infinitely repeated game consisting of a stage game in which each government simultaneously selects from two policy regimes, unilateral or cooperative trade policy. The payoff matrix of the stage game is written as Table 4.1.

Table 4.1: Payoff matrix in stage game

Country i / j	t_j^N	t_j^C
t_i^N	(V_i^N, V_j^N)	(V_i^D, V_j^d)
t_i^C	(V_i^d, V_j^D)	(V_i^C, V_j^C)

In this table, the payoff corresponding to the strategies adopted by each country is represented by using superscripts, C, N, D, and d. Superscript C (N) denotes the payoff accomplished by the strategy in which both countries employ cooperative (unilateral) trade policy. Superscript D and d denote the payoff by the strategy in which either country deviates from the cooperation, specifically, D (d) means the own (partner) country defects from cooperation. In Nash equilibrium of the stage game, both governments impose the tariff because of the following relationship among payoffs:

$$V_r^D > V_r^C > V_r^N > V_r^d, \tag{4.30}$$

This study focuses on the government's incentive to continue cooperation based on trigger strategies to provide punishment for defection. Suppose the following strategy profile. At the beginning, both governments agree to employ cooperative trade policy, which enables them to achieve global efficiency and continue to do so as long as the other government cooperatively sets its tariff. If one government defects

and sets higher tariff one period thereafter, the other government also increases tariff, and they will play the strategy in the Nash equilibrium of the stage-game tariff rate (t_i^N, t_j^N) infinitely.

We evaluate the condition under which the cooperation in trade policy is sustainable based on standard trigger strategy. Each government recognizes future welfare discounted relative to the present one, which is represented discount factor $\delta_i \in (0,1)$. If the government is sufficiently patient, which is sufficiently large δ_i, then cooperation is sustained infinitely. Otherwise, the government defects from cooperation so as to obtain an instant benefit by raising tariff, which is the outcome of Nash reversion. Thus, the condition that the government of country i selects to employ cooperative trade policy is as follows:

$$\frac{1}{1-\delta_i} V_i^C \geq V_i^D + \frac{\delta_i}{1-\delta_i} V_i^N. \tag{4.31}$$

The LHS in Eq. (4.31) represents the sum of discounted welfares in future cooperation $V_i^C/(1-\delta_i)$ and the RHS represents the sum of the welfare of country i when its government deviates V_i^D and the discounted welfares in Nash equilibrium of the stage game starting one period after the deviation $\delta_i V_i^N/(1-\delta_i)$. Solving this condition for δ_i, we can reduce the following critical value δ_i^*, which is the lower bound for country i achieving sustainable cooperation.

$$\delta_i \geq \frac{V_i^D - V_i^C}{V_i^D - V_i^N} \equiv \delta_i^*(\tau, s_i). \tag{4.32}$$

This equation shows that if the government of country i has a larger discount factor than δ_i^*, then cooperative policy continues to be selected. Since lower δ_i^* indicates that the government of country i is likely to sustain cooperation even if the patience of the government is low, the critical value δ_i^* reflects the possibility of employing cooperative trade policy. In order to see how trade costs affect δ_i^*, we differentiate them with respect to τ, and then, we find the following relationship.[8]

$$\frac{\partial \delta_i^*(s_i, \tau)}{\partial \tau} \gtrless 0 \Leftrightarrow s_i \lesseqgtr \frac{1}{2} \tag{4.33}$$

This relationship leads to Proposition 4.4.

Proposition 4.4 (Trade costs and the incentive for cooperation) *Trade cost reduction encourages (discourages) the country with a small (large) domestic industry to sustain cooperation in trade policy.*

[8]See the appendix.

From Eq. (4.33), industry size has a decisive effect on change in the incentive for cooperation. In particular, if country i has a smaller domestic industry than country j, a reduction in trade costs increases the incentive for the government of country i to sustain cooperation. There following intuitions lie behind this proposition. Trade cost reduction leads consumers to demand more manufacturing goods from the foreign country as well as to save paying international transport costs. This affects the instant benefits of deviating from cooperation and the losses of falling into Nash equilibrium at the stage game after the deviation.

We now consider the effects of trade cost reduction on the temporal benefit from the deviation ($V_i^D - V_i^C$), which is divided into two parts. First, as trade costs reduce, consumers demand more imported goods, and thus, sales of domestic manufacturing goods shrink. This leads countries, regardless of their level of industrialization, to have further incentive to increase import tariffs unilaterally so as to protect domestic industry by cheating the partner country that sets the lower tariff. On the other hand, the second effect has a negative impact on the incentive to deviate. Cooperative tariff is always lower than tariff imposed when the country breaks off cooperation $\left(t_i^C < t_i^N\right)$, so that trade volumes under cooperation are larger than those under the non-cooperative regime in which countries determines tariff rate non-cooperatively. Hence, a reduction in the per-unit trade cost induces consumers to save more payments for transport under the cooperative regime than the non-cooperative regime. This implies that as trade costs decrease, there are more welfare benefits under cooperation than deviation, and thus, this reduces the incentive to deviate from cooperation. Although these conflicting effects exist, the first effect dominates the second, so that the incentive to deviate from cooperation is enhanced by a decrease in trade costs.

Next, we consider the effects of trade cost reduction on losses of deviating from cooperation ($V_i^D - V_i^N$), which is to play the game under Nash equilibrium infinitely after the deviation. Since each country faces inefficiently high tariff rate imposed by the partner country after cooperation is violated, its loss is measured by the difference between the export values under cooperative and non-cooperative tariffs. Although export value under any regime increases as trade costs are lowered, an increase in export value under cooperation is larger than that under the non-cooperative regime. Hence, reduction in trade costs increases the differences of export value, implying that the countries lose more exports by falling into Nash equilibrium. Thus, the cost of deviating from cooperation becomes large and the incentive to sustain cooperation increases as trade costs decrease.

From this discussion, since both incentive and loss of deviation increase as trade costs decrease, in general, the reduction in trade costs has ambiguous effects on

the incentive to sustain cooperation. Supposing that the industrialization level of country j is higher than that of country i, $s_i < 1/2$, we characterize the relationship between industry size and the incentive to sustain cooperation. Country i with a lower industrialization level has more imports from and less exports to country j, and thus, when trade costs decrease, country i's transport payments decrease more significantly than those of country j, implying that cooperative tariff setting is more attractive for country i. It follows that when trade costs decrease, an increase in country i's benefits of deviating from cooperation is not larger than country j's, resulting in the reduction of critical value $\delta_i^*(s_i, \tau)$.

4.5 Conclusion

We constructed an asymmetric two-country model with trade costs in which the government of each country implements tariffs. The main argument is that trade policy regime determines whether trade cost reduction results in trade liberalization. Under a unilateral trade policy regime, in which the governments determine their tariff levels independently, a reduction in trade costs does not induce bilateral trade liberalization. In this case, the governments care about the reduction of domestic rents caused by intensive competition resulting from decreased trade costs. This causes the government to impose higher tariff, so that the unilateral trade policy regime fails to achieve bilateral trade liberalization. By contrast, the cooperative trade policy regime, in which the governments implement trade policy that considers the effects on the other country, enables internalization of the negative externality. In this regime, the governments succeed in bilateral trade liberalization because the reduction of trade costs does not affect income allocation between countries, suggesting there is no incentive for protectionist policy. As a result, trade cost reduction leads both governments to reduce tariff.

Furthermore, this study analysed the issue of self-enforcing cooperation. In the static game in which each government simultaneously selects their trade policy regimes, the outcome in Nash equilibrium is that both governments choose unilateral trade policy. Once we consider the repeated interaction between the governments, a cooperative trade policy which accomplishes efficient equilibrium can be achieved if both governments are sufficiently patient. The lower bound of a government's patience which supports sustainable cooperation depends on trade costs and domestic industry size. As trade costs decrease, the critical value decreases in the less industrialized country. On the other hand, the critical value increases in the more industrialized country, suggesting that changes in trade costs have opposite impacts in the two countries.

Appendix

Proof of Proposition 4.1

Here, we explore the trade cost effects on the tariffs determined by country j in unilateral trade policy. Similarly to the case of country i, the non-cooperative tariff set by country j is deduced as

$$t_j^N = \frac{4(1-\gamma)(1-\gamma s_i) - \left[\gamma^2 (1-s_i)(1-2s_i) + 4(1-\gamma)(1-s_i\gamma)\right]\tau}{\gamma^2\left(2s_i^2+3s_i+3\right) - 4\gamma(2s_i+3)+12} \quad (4.34)$$

From Eq. (4.34), we find that country j's tariffs remain positive as long as international trade is feasible. Subsequently, the trade cost effects on these tariffs are written as

$$\frac{dt_i^N}{d\tau} = -\frac{\gamma^2 (1-s_i)(1-2s_i) + 4(1-\gamma)(1-s_i\gamma)}{\gamma^2\left(2s_i^2+3s_i+3\right) - 4\gamma(2s_i+3)+12}. \quad (4.35)$$

This equation shows that tariffs imposed by countries i and j share a common property with regard to domestic industry size. If the own industry has is large (small) relative to the foreign one, then a decrease in trade costs has clear (ambiguous) effects.

Proof of Proposition 4.4

Here, we demonstrate the effects of trade costs on the incentive to cooperate to set trade policy. According to the definition of critical discount factor characterizing whether the government can sustain the cooperative trade policy, we can write $\delta_i^*(s_i,\tau)$ and $\delta_j^*(s_i,\tau)$ as

$$\begin{aligned}
\delta_i^*(s_i,\tau) &\equiv \frac{V_i^D - V_i^C}{V_i^D - V_i^N} \\
&= \frac{(1-s_i)}{2s_i\left[2(2-\gamma)^2 - (4-\gamma)\gamma s_i + \gamma^2 s_i^2\right]\left[4(1-\gamma)(3-2\gamma) + (8-7\gamma)\gamma s_i + 2\gamma^2 s_i^2\right]} \\
&\quad \times \left\{\frac{\tau(2-2\gamma+\gamma s_i)^2 - (1-\gamma)(4-4\gamma+\gamma s_i)}{\tau(2-\gamma-\gamma s_i)^2 - (1-\gamma)(4-3\gamma-\gamma s_i)}\right\}^2 \\
&\quad \times \left\{\frac{(2-2\gamma+\gamma s_i)\left[4-4\gamma+(1-s_i)\gamma^2\right]\left[3(2-\gamma)^2 - \gamma(8-3\gamma)s_i + 2\gamma^2 s_i^2\right]}{(2-\gamma-\gamma s_i)(4-4\gamma+\gamma^2 s_i)}\right\}^2,
\end{aligned} \quad (4.36)$$

and

$$\begin{aligned}
\delta_j^*(s_i,\tau) &\equiv \frac{V_j^D - V_j^C}{V_j^D - V_j^N} \\
&= \frac{s_i}{2(1-s_i)\left[3(2-\gamma)^2 - \gamma(8-3\gamma)s_i + 2\gamma^2 s_i^2\right]\left[4(2-\gamma)(1-\gamma) + (4-3\gamma)\gamma s_i + \gamma^2 s_i^2\right]} \\
&\quad \times \left\{\frac{\tau(2-\gamma-\gamma s_i)^2 - (1-\gamma)(4-3\gamma-\gamma s_i)}{\tau(2-2\gamma+\gamma s_i)^2 - (1-\gamma)(4-4\gamma+\gamma s_i)}\right\}^2 \\
&\quad \times \left\{\frac{(2-\gamma-\gamma s_i)\left(4-4\gamma+\gamma^2 s_i\right)\left[4(1-\gamma)(3-2\gamma) + (8-7\gamma)\gamma s_i + 2\gamma^2 s_i^2\right]}{(2-2\gamma+\gamma s_i)\left[4-4\gamma+(1-s_i)\gamma^2\right]}\right\}^2 .
\end{aligned} \tag{4.37}$$

Based on these equations, we develop the effects on critical value δ_i^* induced by trade costs as follows:

$$\begin{aligned}
\operatorname{sgn}\left(\frac{\partial \delta_i^*(s_i,\tau)}{\partial \tau}\right) &= \operatorname{sgn}\left\{\frac{\partial}{\partial \tau}\left[\frac{\tau(\gamma s_i - 2\gamma + 2)^2 - (1-\gamma)(4-4\gamma+\gamma s_i)}{\tau(\gamma+\gamma s_i - 2)^2 - (1-\gamma)(4-\gamma s_i - 3\gamma)}\right]\right\} \\
&= \operatorname{sgn}\left\{(1-2s_i)\gamma(1-\gamma)[12 - 20\gamma + (8 + s_i - s_i^2)\gamma^2]\right\} \\
&= \operatorname{sgn}(1-2s_i) \\
\frac{\partial \delta_i^*(s_i,\tau)}{\partial \tau} \gtrless 0 &\Leftrightarrow s_i \lessgtr \frac{1}{2}.
\end{aligned} \tag{4.38}$$

Similarly, regarding δ_i^*, we deduce that

$$\begin{aligned}
\operatorname{sgn}\left(\frac{\partial \delta_j^*(s_i,\tau)}{\partial \tau}\right) &= \operatorname{sgn}\left\{\frac{\partial}{\partial \tau}\left[\frac{\tau(\gamma s_i - 2\gamma + 2)^2 - (1-\gamma)(4-4\gamma+\gamma s_i)}{\tau(\gamma+\gamma s_i - 2)^2 - (1-\gamma)(4-\gamma s_i - 3\gamma)}\right]^{-1}\right\} \\
&= -\operatorname{sgn}(1-2s_i) \\
\frac{\partial \delta_j^*(s_i,\tau)}{\partial \tau} \gtrless 0 &\Leftrightarrow s_i \gtrless \frac{1}{2}.
\end{aligned} \tag{4.39}$$

From Eqs. (4.38) and (4.39), we find that a change in the critical value caused by trade costs depends on the size of the domestic industry relative to the foreign one.

Chapter 5

Endogenous Transport Costs and Firm Agglomeration

Departing from the exogenous treatment of transport costs, this chapter examines endogenous transport costs and their impact on firm location in New Trade Theory. In this chapter, national governments control domestic transport costs via public infrastructure investment. Our analysis shows persuasive findings that a large country always collects more tax revenue for public investment than a small country, which results in lower domestic transport costs, and hence, the home market effect always prevails.[1]

5.1 Introduction

Based on the significant contribution of New Trade Theory (NTT) which makes it possible to discuss the location of firms, the market size, and the role of transport costs, many researchers have extended NTT models from various perspectives. In particular, focusing on the transport costs, the studies have examined intensively the conditions causing the home market effect to occur.[2] Most past studies treat transport costs as an exogenous variable and ignore a country's incentive to manipulate the location of firms by controlling transport costs. The main objective of this chapter is to endogenize domestic transport costs and, thereby, to characterize the location of firms in equilibrium within an NTT framework.

[1] This chapter is based on Tsubuku (2015)

[2] For example, Davis (1998) finds that the home market effect does not arise when there are transport costs for non-differentiated goods. Behrens et al. (2009b) point out that firms may agglomerate in a small country that has transport costs which are sufficiently lower than other countries. In both studies, transport costs play an important role in determining whether the home market effect arises.

On the one hand, free trade agreements and economic integration reduce international transport costs. On the other hand, empirical studies provide evidence that transport costs remain significant (Limão and Venables, 2001, Anderson and van Wincoop, 2004 and Combes and Lafourcade, 2005). This requires that we treat international and domestic transport costs differently. In this regard, Martin and Rogers' (1995) pioneering study clearly separates domestic transportation from international transportation. Assuming that domestic transport costs differ between two countries, they show that the smaller country, with lower transport costs, succeeds in attracting firms, even though it has a smaller population.

This chapter analyzes the location of firms when a government implements a policy to reduce domestic transport costs through public investment. A government has an incentive to make such an investment because this will improve welfare (Martin and Rogers, 1995). We formally capture this incentive for public investment and analyze its effect on firms' location. This chapter contributes to existing literature by presenting a possible reason why transport costs are at the levels assumed in related models. Prior studies that consider endogenous transport costs include Takahashi (2006), Behrens et al. (2009a), and Behrens and Picard (2011). Takahashi (2006) examines the relationship between economic geography and adopting modern transport technology. He focuses on determining interregional transport costs, which are set to be consistent with average costs in the transport sectors. In our model, transport costs are determined based on a government's incentive to improve welfare, which was not analyzed by Takahashi (2006). Behrens et al. (2009a) treat transport costs as a reward for carriers under imperfect competition. They analyze the relationship between industry location and welfare when carriers determine transport costs. In their study, endogenous transport costs prevent manufacturing firms from agglomerating in a large country.

The study of Behrens and Picard (2011) is one of the few in which transport costs are determined endogenously. In their model, firms, such as air carrier and railway companies form the transport sector, and determine the transport costs by profit maximizing behavior. While the private investment approach is plausible in a certain environment, we take an alternative approach. In our study, public sector decisions influence transport costs.

The most related work to this chapter is Mun and Nakagawa (2008), which examines the determinacy of transport costs through public investment.[3] They construct two-country model without scale economy and love of variety, and analyze the efficiency of public investment on transport sector and the welfare effects of

[3]Mun and Nakagawa (2010) discuss about alternative regimes of supplying transport service with Mun and Nakagawa (2008)'s model. Moreover they evaluate the welfare of each regime.

foreign aid. In contrast, our model is based on NTT model to endogenize transport costs, which enables us to analyze the relationship between firm agglomeration and public investment on transport sector.

The main results of this chapter are as follows. First, if we assume that domestic transport costs in a small country are sufficiently low, the home market effect may not occur. However our second result shows that, if the government controls the level of transport costs, this is not the case; the domestic transport costs in a large country are always smaller than that in a small country. In this case, the home market effect always prevails, and thus, firms agglomerate in the large country.

The remainder of the chapter is organized as follows. Section 5.2 presents the model that explicitly distinguishes between domestic and international transport costs. In Section 5.3, we analyze the effects of exogenous transport costs on firm location and the relationship between the home market effect and transport costs. Section 5.4 characterizes the equilibrium in which domestic transport costs are determined endogenously via public investment. Section 5.5 discusses our findings, and Section 5.6 concludes the chapter.

5.2 The Economy

The economy consists of two countries ($r = 1, 2$). In each country, there are two sectors, manufacturing and agriculture, and two factors, labor and capital. The manufacturing sector operates under monopolistic competition and individual firms produce differentiated goods. We term the differentiated goods as varieties. Let l_r represent the number of consumers living in country r. Each consumer owns one unit of labor and one unit of capital. All consumers are mobile within a country, but immobile between countries. Without loss of generality, we assume that the population in country 1 is larger than the population in country 2 ($l_1 > l_2$). Additionally, we assume that each country has much the same land size. Therefore, the population size, l_r also represents the population density in the country.

5.2.1 Preferences

Preferences are assumed to be identical across consumers. Following Pflüeger (2004), each consumer preference is characterized by a quasi-linear utility function over homogeneous goods produced by the agriculture sector, and differentiated goods produced by the manufacturing sector. The utility function of consumers living in country r is given as follows:

$$U_r = \alpha \ln C_{Mr} + C_{Ar}, \tag{5.1}$$

where C_{Mr} is the sub-utility from consuming varieties, and C_{Ar} is the consumption of agricultural goods. Here, $\alpha > 0$ is a preference parameter. Sub-utility C_{Mr} is expressed as

$$C_{Mr} = \left[\sum_{m=r,s} \int_0^{n_m} x_{mr}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}, \tag{5.2}$$

where n_r is the number of varieties produced in country r, and $x_{rs}(i)$ represents the consumption of variety i in country s, produced in country r $(r, s = 1, 2)$. The parameter $\sigma > 1$ measures the elasticity of substitution between any two varieties. The budget constraint is given by

$$\sum_{m=r,s} \int_0^{n_m} \tau_{mr} p_{mr}(i) x_{mr}(i) di + C_{Ar} = Y_r, \tag{5.3}$$

where the agricultural goods are the numeraire and $p_{rs}(i)$ is the price of variety i produced in country r and consumed in country s. Denoting Y_r as the per capita income in country r, we have $Y_r = w_r + r_r - g_r$, where w_r represents the wage rate, r_r the return on capital investment, and g_r the tax payment in country r.

There are no transport costs in the consumption of the agricultural goods, but there are in the case of manufactured goods. That is, the purchase of manufacturing goods produced domestically incurs domestic transport costs. Similarly, the purchase of manufactured goods produced in the foreign country incurs international transport costs, as in Martin and Rogers (1995). In Eq. (5.3), $\tau_{sr} = \tau_r$ if $r = s$, and $\tau_{sr} = \tau^*$ if $r \neq s$. Here, τ_r (τ^*) is the domestic (international) transport cost incurred when a consumer in country r purchases manufactured goods from firms locating in country r (foreign country). These transport costs are specified by the iceberg-type formulation, in which only $1/\tau$ $(\tau > 1)$ of the produced variety unit arrives for consumption (Samuelson, 1954). Therefore, the price for consuming a variety is $\tau p(i)$.

Solving the utility maximization problem, subject to Eq. (5.3), the demand function for manufacturing goods is $x_{sr}(i) = \alpha[\tau_{sr} p_{sr}(i)]^{-\sigma} P_{Mr}^{\sigma-1}$. Here, the price index in country r, P_{Mr}, is defined by

$$P_{Mr} \equiv \left\{ \sum_{m=r,s} \int_0^{n_m} [\tau_{mr} p_{mr}(i)]^{1-\sigma} \, di \right\}^{\frac{1}{1-\sigma}}.$$

Using the demand functions, the indirect utility function in each country is given by

$$V_r = -\alpha \ln P_{Mr} + Y_r + [\alpha(\ln \alpha - 1)]. \tag{5.4}$$

5.2.2 Technology

We assume that the firms' technology is symmetric across countries. Agricultural goods are produced using labor under perfect competition. Firms in the agricultural sector produce one unit of agricultural goods from one unit of labor. Therefore, in the agricultural sector, goods are priced at the wage rate. Since we assume that the agricultural goods are the numéraire and the shipment of agricultural goods incurs no transport costs, the wage rate is unity.[4]

The manufacturing firms need capital and labour for production. The production of any variety requires one unit of capital. Each variety is produced by a single firm. The production of one unit of a variety requires β units of labour. Therefore, the profit of manufacturing firms in country r is

$$\pi(i) = \sum_{m=r,s} \left[p_{rm}(i) - \beta\right] l_m \tau_{rm} x_{rm}(i) - r_r. \tag{5.5}$$

In the manufacturing sector, firms produce a variety using technology of increasing returns under monopolistic competition. Since each firm produces one type of variety, the number of firms coincides with the number of varieties.[5] Under the Chamberlinian large-group assumption, profit-maximizing prices are constant markups on marginal costs; $p_{rr}(i) = p_{rs}(i) = \sigma\beta/(\sigma - 1)$ for $r \neq s$.

Under monopolistic competition, there is free entry and exit of firms, and hence, firms' profits will always be zero. Thus, based on the demand function, the firms' profit maximizing behavior, and the zero profit condition, we have

$$r_1 = \frac{\alpha}{\sigma}\left(\frac{t_1 l_1}{t_1 n_1 + T n_2} + \frac{T l_2}{T n_1 + t_2 n_2}\right), \tag{5.6}$$

$$r_2 = \frac{\alpha}{\sigma}\left(\frac{T l_1}{t_1 n_1 + T n_2} + \frac{t_2 l_2}{T n_1 + t_2 n_2}\right), \tag{5.7}$$

where $t_r \equiv \tau_r^{1-\sigma}$, $T \equiv (\tau^*)^{1-\sigma}$, $t_r \in (0,1)$, and $T \in (0,1)$. Here, t_r and T represent

[4] Our analysis focuses on the case in which the production of agricultural goods is positive in each country.

[5] Assuming that two firms produce the same variety, price competition arises between these two firms and the price of both goods converges to the marginal cost. This implies that the profit of the two firms is negative because of fixed costs. Consequently, each firm differentiates goods against other firms.

the level of domestic and international transport infrastructure, respectively.[6] A high level of transport infrastructure implies low transport costs. Supposing that international transport costs are more than domestic transport costs, we then have $1 < \tau_r < \tau^*$. The relationship between the level of domestic and international transport infrastructure is as follows:

$$0 < T < t_r < 1.$$

5.3 Market Size and Firms Location

The capital market is integrated across countries. Accordingly, consumers invest capital in firms in countries with high interest rates. Each consumer has one unit of capital. Therefore, the capital market clearing condition is

$$n_1 + n_2 = l_1 + l_2. \tag{5.8}$$

Since each firm needs one unit of capital for production, the number of firms in the country is equivalent to the amount of capital invested in the country.

In our model, there are three possible equilibria: (i) all capital is invested in firms in country 1 ($n_1 > 0, n_2 = 0$); (ii) all capital is invested in firms in country 2 ($n_1 = 0, n_2 > 0$); and (iii) capital is invested in both countries ($n_1 > 0, n_2 > 0$). We analyze each case in turn.

(i) $n_1 > 0, n_2 = 0$.
When capital holders prefer to invest in country 1, $r_1 \geq r_2$ should hold. From Eqs. (5.6) and (5.7), $r_1 \geq r_2$ indicates

$$\frac{l_1}{n_1} + \frac{l_2}{n_2} \geq \frac{Tl_1}{t_1 n_1} + \frac{t_2 l_2}{T n_2} \Leftrightarrow \frac{l_1}{l_2} \geq \frac{t_1(t_2 - T)}{T(t_1 - T)} \equiv \phi^{upper}.^7 \tag{5.9}$$

Eq. (5.9) is likely to hold when the market size of country 1 is sufficiently large relative to that of country 2, or the level of transport infrastructure in country 1 is sufficiently high relative to that in country 2. Under Eq. (5.9), full agglomeration in country 1 emerges.

[6] t_r (T) can be interpreted as reflecting the freeness of domestic (international) trade, which is defined by the decreasing function of domestic (international) transport costs.

[7] The return for capital invested in the country that no firm is located in is represented by the operating profit obtained by one manufacturing firm relocates to the country while all other firms stay at another country.

(ii) $n_1 = 0, n_2 > 0$.

When all capital is invested in firms in country 2 in equilibrium, $r_1 \leq r_2$ holds. Then, from Eqs.(5.6) and (5.7), we have

$$\frac{t_1 l_1}{T n_1} + \frac{T l_2}{t_2 n_2} \leq \frac{l_1}{n_1} + \frac{l_2}{n_2} \Leftrightarrow \frac{l_1}{l_2} \leq \frac{T(t_2 - T)}{t_2(t_1 - T)} \equiv \phi^{lower}. \tag{5.10}$$

Here, Eq. (5.10) is likely to hold when the level of transport infrastructure in country 2 is large relative to country 1. In this case, all firms relocate to country 2.

(iii) $n_1 > 0, n_2 > 0$.

In this case, $r_1 = r_2$ holds in equilibrium. From Eqs. (5.6) and (5.7), we have

$$\begin{aligned} &\frac{t_1 l_1}{t_1 n_1 + T n_2} + \frac{T l_2}{T n_1 + t_2 n_2} = \frac{T l_1}{t_1 n_1 + T n_2} + \frac{t_2 l_2}{T n_1 + t_2 n_2} \\ \Leftrightarrow \quad &[(t_1 - T)T l_1 - (t_2 - T)t_1 l_1] n_1 - [(t_2 - T)T l_2 - (t_1 - T)t_2 l_1] n_2 = 0. \end{aligned} \tag{5.11}$$

To satisfy Eq. (5.11), the following conditions are required: $(t_1 - T)T l_1 - (t_2 - T)t_1 l_2 < 0$ and $(t_2 - T)T l_2 - (t_1 - T)t_2 l_1 < 0$. These conditions can be reduced to[8]

$$\frac{T(t_2 - T)}{t_2(t_1 - T)} < \frac{l_1}{l_2} < \frac{t_1(t_2 - T)}{T(t_1 - T)} \Leftrightarrow \phi^{lower} < \frac{l_1}{l_2} < \phi^{upper}. \tag{5.12}$$

When the relative market size is positioned between ϕ^{lower} and ϕ^{upper}, capital is invested in both countries, and firms are also located in both countries. We can derive the relative number of firms between the two countries as follows:

$$\frac{n_1}{n_2} = \frac{(t_2 - T)T l_2 - (t_1 - T)t_2 l_1}{(t_1 - T)T l_1 - (t_2 - T)t_1 l_2}. \tag{5.13}$$

In this case, it is not necessary that the home market effect prevails, even if $l_1/l_2 > 1$. From Eq. (5.13), $n_1/n_2 > l_1/l_2$ indicates that

$$\frac{(t_2 - T)T l_2 - (t_1 - T)t_2 l_1}{(t_1 - T)T l_1 - (t_2 - T)t_1 l_2} > \frac{l_1}{l_2} \Leftrightarrow \frac{l_1}{l_2} > \frac{t_2 - T}{t_1 - T} \equiv \phi^{HME}. \tag{5.14}$$

which implies that the home market effect arises if Eq.(5.14) is satisfied. The above discussion is summarized in Figure 5.1.

Figure 5.1 presents the relationship between the market size and the location of firms. The horizontal axis represents the market size, and ϕ^{lower}, ϕ^{HME}, and ϕ^{upper}

[8] When $(t_1 - T)T l_1 - (t_2 - T)t_1 l_2 > 0$, and $(t_2 - T)T l_2 - (t_1 - T)t_2 l_1 > 0$ hold, Eq.(5.11) is satisfied. Under these conditions, $T < t_r$ is violated.

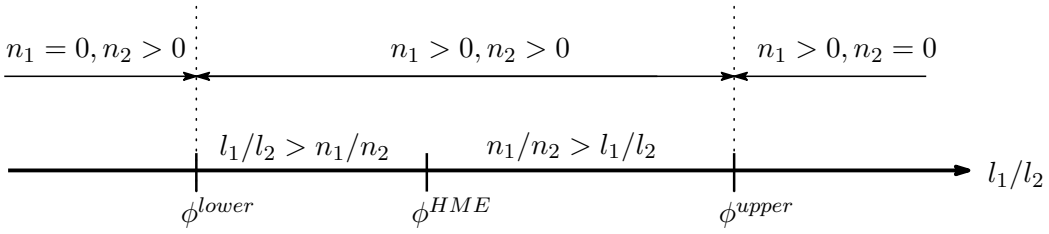

Figure 5.1: Market Size and Firm Distribution

are the thresholds that characterize the location of firms. Note that, when ϕ^{lower} and $\phi^{HME} > 1$, although the market size of country 1 is larger than that of country 2, there are fewer firms located in country 1. This is because the domestic transport costs in country 2 are lower than in country 1.

To conclude this section, we refer to the government's incentive to reduce domestic transport costs. From the market clearing condition, we can derive the number of firms in case (iii) as follows:

$$n_r = \frac{t_s}{t_s - T} l_r - \frac{T}{t_r - T} l_s, \quad r \neq s. \tag{5.15}$$

These equations indicate that the number of firms located in the country increase as domestic transport costs decrease ($\partial n_r / \partial t_r > 0$). This implies that the government has an incentive to increase the level of transport infrastructure, as this will attract more firms.

5.4 Endogenous Transport Costs

Until now, we have treated transport costs as exogenous variables. We now relax this assumption and endogenize transport costs. In this chapter, the welfare-maximizing government of each country is supposed to impose a tax on the consumer and control the domestic transport costs by public investment. The budget constraint of each government can be expressed as

$$l_r g_r = c(t_r), \tag{5.16}$$

where $c(t_r)$ is the amount of public investment required to achieve the level of transport infrastructure at t_r. We assume that $c'(t_r) > 0$,$c''(t_r) > 0$, and $\lim_{t_r \to 1} c(t_r) = \infty$. The function $c(\cdot)$ is symmetric between countries because of assumption that each country has much the same land size. This implies that if two countries invest

in the same quantity of transport infrastructure, the impact on the level of transportation will be the same in the both countries. The objective function of each government is given by Eq. (5.4).[9] The first-order conditions for welfare maximization are

$$\frac{\partial V_r}{\partial t_r} = \frac{\alpha}{\sigma - 1}\frac{t_s}{t_r t_s - T^2} - \frac{c'(t_r)}{l_r} = 0, \quad r \neq s. \tag{5.17}$$

To compare the levels of t_1 and t_2 that satisfy Eq. (5.17), we evaluate these conditions at the same infrastructure level, given by

$$\left.\frac{\partial V_1}{\partial t_1}\right|_{t=t_1=t_2} - \left.\frac{\partial V_2}{\partial t_2}\right|_{t=t_1=t_2} = \frac{c'(t)(l_1 - l_2)}{l_1 l_2} > 0. \tag{5.18}$$

Since Eq. (5.17) is a monotonic decreasing function, under Eq. (5.18), the level of domestic transport infrastructure satisfies $t_1^* > t_2^*$ in equilibrium.[10] The government in a large country can attain a higher level of domestic transport infrastructure than the government in a small country when each government publicly invests in the transport sector to improve national welfare. This is simply because the government in a large country can collect tax revenue from a larger population. As a result, public investment is conducted on a larger scale, and the country achieves a higher level of infrastructure. This result can be interpreted from another perspective as well. Each country can improve national welfare by choosing the level of public investment. In our model, the cost of public investment, $c(\cdot)$, increases at a slower rate than the population size l_r,. Therefore, the per-capita cost of the infrastructure in the large country is less than that of in small country. In other words, in contrast to the small country, the government in the large country can provide an arbitrary level of transportation service with a lower tax burden. Recall that this assumes both countries have identical land size, which makes $c(\cdot)$ symmetric between the two countries.[11]

Next, we analyze the firm distribution across countries when the government determines the level of domestic transport infrastructure. On the premise that the level of domestic transport infrastructure fulfills Eq. (5.17), Eq. (5.14) shows that

[9] In this paper, we limit the discussion to case (iii). In the cases of firms being located in only one country, that is, cases (i) and (ii), it is likely that the government of the country in which no firms are located will set the infrastructure level of domestic transport costs to zero.

[10] Differentiating Eq. (5.17), we have

$$\frac{\partial^2 V_r}{\partial t_r^2} = -\frac{\alpha}{\sigma - 1}\left(\frac{t_s}{t_r t_s - T^2}\right) - \frac{c''(t_r)}{l_r} < 0, \quad r, s = 1, 2, \quad r \neq s.$$

[11] If each country has a different land size, the cost of public infrastructure $c(\cdot)$ may be asymmetric. In this case, the transport costs in each country are determined by the population size, and the efficiency of public investment depends on the land size.

$\phi^{HME} < 1$. Hence, if country 1 has a larger market than country 2 ($l_1/l_2 > 1$), then the relative market size is more than ϕ^{HME}. This result is summarized in the following proposition.

Proposition 5.1 (Public investment and home market effects) *When the government determines the level of domestic transport infrastructure to maximize national welfare, the home market effect occurs and the large market country has more firms than the small country.*

Proposition 5.1 shows that if the government of each country endogenously determines its domestic transport costs by public investment, the home market effect will always prevail in equilibrium.[12] The result can be understood intuitively as follows. In our model, more consumers live in country 1 than in country 2, and consequently, the government in country 1 is able to collect more tax revenue than that in country 2. Under such circumstances, the large country invests more in its transport sector, and achieves a higher level of transport infrastructure than the small country ($t_1^* > t_2^*$). Consequently, manufacturing firms have more incentive to locate in country 1 than in country 2, because of both the larger market and the higher level of transport infrastructure. This, in turn, reinforces the home market effect. In other words, by locating in country 1, manufacturing firms earn more profit from the larger market and save on domestic transport costs by using the better transport infrastructure.

In the analysis of Behrens and Picard (2011), private firms in the transport sector offer higher freight rates to manufacturing firms located in large countries. Therefore, the advantage of manufacturing firms being located in a large country vanishes. In contrast, in this chapter, the government determines the transport costs. A benevolent government invests in the transport sector to attract manufacturing firms. As a result, firms agglomerate in large countries that can collect more tax revenue for public investment.

5.5 Discussions

In this section, we discuss some of the issues that apply to our model. First, our results depend on existence of a manufacturing sector that uses the domestic transport infrastructure to supply distant consumers. However, developing countries may have a less-developed manufacturing sector owing to a lack of modern technology.

[12]Proposition 1 also implies that the large market country becomes a net exporter of the differentiated goods, as described by Krugman (1980) and Helpman and Krugman (1985).

In addition, most firms are traditional in the sense that they do not require a transport infrastructure. In this case, the government of the developing country has no incentive to invest in the transport sector, since the transport infrastructure cannot improve national welfare. Therefore, while our results apply more to developed countries with modern technology than to developing countries, our results do provides a possible reason why a government in a developing country has less incentive to improve domestic transportation.

Second, there is some room for discussion on the role of private investment in terms of the domestic transport infrastructure. Here, we briefly mention an extension to our model to include private investment rather than public investment. Private investment includes toll roads, railways, and air transport. If a private monopoly rather than the government chooses the level of domestic transport infrastructure, the firm charges a user fee, u_r to consumers who use the transport infrastructure. Consumers use the transport infrastructure if the following condition holds:

$$u_r \leq \bar{\tau} \int_0^{n_r'} p_{rr}'(i) x_{rr}'(i) di - \tau_r \int_0^{n_r} p_{rr}(i) x_{rr}(i) di \tag{5.19}$$

where $\bar{\tau}$ is domestic transport costs without the transport infrastructure investment, and a the prime symbol represents the variable under transport costs $\bar{\tau}$. The left-hand side of Eq.(5.19) denotes the user fee paid by consumers for the use of the transport infrastructure. The right-hand side represents the benefit to consumers in the sense that they save the expenditure for domestic consumption, which is induced by the reduction in transport costs through infrastructure investment. If this inequality is violated, consumers never use the transport infrastructure. In this case, the private firm is forced to set the user fee such that Eq. (5.19) holds. With Eq. (5.19), the firm maximizes its profit as follows:

$$\Pi_r = l_r u_r - c(t_r) \tag{5.20}$$

with respect to the user fee and the level of transport infrastructure. Under this setting, the firm investing in the domestic transport sector in a large country can collect more user fees than in a small country, simply because they have more consumers using transport infrastructure. This enables the firm in large country to invest more in the infrastructure, which increases the level of domestic transport infrastructure in the large country. Hence, our main arguments are still valid if the investment in the transport infrastructure is implemented by a private monopoly.

5.6 Conclusion

In this chapter, we constructed a model in which the government in each county determines domestic transport costs via public investment, and examined the relationship between endogenous transport costs and firm location. Martin and Rogers (1995) showed that the number of firms located in a country increases as domestic transport costs decrease. However, they did not consider the relationship between market size and firm location. We analyzed the relationship between market size and firm location in cases where domestic transport costs are incurred. We were able to show that, when domestic transport costs in a small country are sufficiently lower than that in a large country, firms tend to agglomerate in the small country, as they can save money when supplying goods to their consumers.

However, this result depends on the assumption that transport costs are exogenous. It is clear that decreasing domestic transport costs improves national welfare, which leads governments to reduce domestic transport costs. This chapter examines firm location when domestic transport costs are determined by a welfare-maximizing government. The main finding is that the home market effect induces more firms to be located in a larger country, since the government in the larger country can achieve lower domestic transport costs to a greater extent than the government in a small country. This leads us to conclude that when a government determines domestic transport costs to maximize national welfare, firms agglomerate in the large country, unlike in the case of exogenous transport costs, where more firms can be located in the small country.

Chapter 6

Conclusion

In this dissertation, we have shown three modes of analyzing public policy in the presence of trade costs. In conclusion, we review the above discussions and propose certain issues remaining for a future research.

Chapter 3

In this chapter, we discuss the limitation of trade costs in a simple three-country model of imperfect competition and explore how trade costs affect the desirability of free trade agreements. We investigate the tariff determined under three policy regimes: tariff discrimination, the most-favored nation principle, and FTA.

Numerous researchers in international economics have insisted that FTA has beneficial effects for both member and non-member countries due to tariff complementarity effects. We incorporate trade costs in this chapter and show the possibilities where tariff complementarity effects do not appear. When the trade costs between countries of an FTA are sufficiently large, member countries have an incentive to impose higher external tariff after signing the FTA so as to encourage imports from the partner country. Furthermore, a welfare analysis shows that formation of FTA may lower the welfare of members with high trade costs. A tariff reduction following the formation of an FTA induces its members to trade with foreign countries. The expansion of international trade under FTA not only increases the member countries ' welfare but also leads to the loss of welfare in the presence of trade costs. It is welfare loss when the consumer has to make more payment for trade costs . Therefore, if higher trade costs generate greater loss in international trade between member countries, the welfare loss would exceed the gains induced by trade expansion.

In addition, this chapter proposes the possibility of trade costs leading to conservative results and thus suggests further analysis of FTAs in the presence of trade

costs. One direction of the extension could be to analyze multi-country economies. Numerous countries in the real world are expanding their scale of FTA, such as the Association of South-East Asian Nations FTA or the on-going Trans-Pacific Partnership. Thus, we have several extensions to analyze the relationship between the size of FTA and trade costs.

Chapter 4

In Chapter 4, we propose an intra-industrial trade model consisting of two countries with heterogeneously sized domestic industries and show how tariffs determine the two policy regimes: cooperative and non-cooperative regimes. Additionally, the chapter investigates the sustainability of cooperation achieving economic efficiency with the infinitely repeated game approach.

The results indicate that the response of tariff to trade costs depends on the policy regimes. In the first regime, where all governments independently choose their tariff rates, they choose higher tariffs as the trade costs decrease as long as the domestic industry is large relative to the foreign country industry. The tariff employed by the country with small industry also becomes less with the reduction of trade costs unless the traded goods are highly substitutable. The intensive competition with foreign firms from a decrease in trade costs encourages governments to employ higher tariffs. In contrast, in the second regime, where both governments cooperate in setting tariff rates, the results would be opposite to the above: under cooperation, a decrease in trade costs induces a tariff reduction regardless of size of domestic industry. The cooperative regime tends to achieve economic efficiency and the governments are thus spurred to expand international trade as the trade costs decrease, achieving tariff reduction. Consequently, cooperative governments tend to favor market integration. Unfortunately, such cooperation is not always sustainable. Thus, we should discuss the self-enforcement of cooperation and the changes as the trade costs decline. The analysis with the repeated game approach demonstrates that a less (more) industrialized country is encouraged (discouraged) to sustain cooperation as the trade costs decrease.

This chapter analyzes the relationship between the size of industry and tariff policy in the presence of trade costs. However, the analysis pays less attention to the mobility of firms, which is important for long-run analysis. As the NTT model shows, firms can relocate its production base in the long run, and so governments should consider firm mobility. Previous studies have shown that tariff jumps cause governments to attract firms by increasing import tariffs since relocation to that country would enable firms to save the payment of tariff. Thus, we can predict that mobility of firms generates additional externality, which has a negative effect on the

foreign country by decreasing the number of firms locating there. The incorporation of internationally mobile firms will induce governments to employ higher tariffs relative to the present model.

Chapter 5

Chapter 5 departs from the exogenous treatment of transport costs and examines endogenous transport costs and their impact on firm location in NTT. The governments in particular control domestic transport costs via public infrastructure investment. This chapter persuasively shows that a large country always collects more tax revenue for the investment than a small country and thus can have lower domestic transport costs. This implies that the home market effect always prevails.

Although transport costs have an important role in characterizing the outcome of the equilibrium in NTT, many studies consider transport costs as exogenously given. Thus, to refine the previous outcomes more convincingly, we incorporate the structure with endogenous transport costs. Transport costs are jointly determined by various factors. The chapter focuses on public investment to improve the level of transport infrastructure that affects transport costs. Under exogenous transport costs, the home market effect may disappear depending on the domestic and international transport costs. In contrast, we demonstrate that endogenous transport costs result in home market effects.

For a future research related to this chapter, we propose the possibilities of endogenizing international transport costs. In this chapter, domestic transport costs are endogenized through public investment by governments but international transport costs remain the exogenous variable. Assuming that public investment in the domestic transport sector partly influences international transport costs, we propose the following conjecture. In the NTT model, a decrease in international transport costs induces more firms to locate in a country with a large market and the country with the large market may have more incentives to implement public investment.

In the NTT or NEG model, transport costs are critical in determining the location of economic activities. However, existing studies show little interest in how the level of transport costs is determined. Transport costs include the compensation to firms in the transport sector as well as the costs inherent in the variables, such as tariffs, the law system, and geographical barriers. Thus, governments have an incentive to affect the level of transport costs and bring in competition for mobile firms and residents. While this study attempted to present a model with endogenous transport costs, the continuous analysis of the transportation sector would advance our knowledge of firm location in trade theory.

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