Trade Liberalization and Horizontal Merger
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Abstract

Trade Liberalization and Horizontal Merger

Trade liberalization implies increased international competition between firms and increased opportunities for foreign market access. Firms can choose to meet increased international competition by merging horizontally, either domestically or cross-border. Foreign firms can also choose horizontal merger as a way to access foreign markets.

In this thesis we analyse theoretically how trade liberalization affects incentives for (domestic versus international) mergers and the corresponding welfare implications of trade liberalization. The analytical framework is a two-stage model with endogenous merger formation among domestic and foreign owners prior to Cournot competition in the domestic market. We also assume that there are different sources of cost synergies that can be realized through various types of horizontal merger. We find that international mergers arise in equilibrium only if trade costs are sufficiently high. On the other hand, the fully decentralized market structure (without any mergers) arises only if foreign firms are sufficiently more cost efficient that domestic firms. The welfare analysis shows that equilibrium market structures and the market structures that maximize domestic welfare do not always coincide.
Resumo

**Liberalização do Comércio e Fusão Horizontal**

A liberalização do comércio implica o aumento da concorrência internacional entre empresas e o aumento das oportunidades de acesso ao mercado externo. As empresas podem escolher a fusão horizontal ao invés do nível nacional ou internacional para enfrentar o aumento da concorrência internacional. As empresas estrangeiras também podem escolher fusão horizontal, como forma de acesso aos mercados estrangeiros.

Nesta tese, iremos analisar teoricamente como a liberalização do negócio afeta os incentivos (autóctone versus internacional), as fusões e as implicações sociais correspondentes de liberalização do comércio. O quadro analítico é um modelo de dois estágios com a formação endógena de fusão entre os proprietários nacionais e estrangeiros antes da competição Cournot no mercado doméstico. Assumimos também que existem diferentes fontes de sinergias de custos que podem ser realizados através de vários tipos de fusão horizontal. Nós achamos que as fusões internacionais surgem em equilíbrio somente se os custos de comércio são suficientemente elevados. Por outro lado, a estrutura de mercado totalmente descentralizada (sem fusões) surge apenas se as empresas estrangeiras forem suficientemente mais eficientes que as empresas nacionais. A análise de bem-estar mostra que as estruturas do mercado de equilíbrio e as estruturas de mercado que maximizam o bem-estar doméstico nem sempre coincidem.
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List of Abbreviations

CS  Consumer Surplus
D  Domestic
DW  Domestic Welfare
EMS  Equilibrium Market Structure
F  Foreign
FOC  First Order Condition
PCS  Production Cost Saving
Ps  Producer surplus
SEE  Scale Economies Effect
TCS  Trade Cost Saving
1. Introduction

*Trade liberalization* plays an important role in the process of economic globalization. It is an inevitable choice for development of international trade, and remains to be the mainstream despite the existence of many kinds of trade protectionism. In some sense, economic globalization is a procedure of trade and investment liberalization.

The term of “trade liberalization” has been very common in the economics literature. The earliest theoretical research on this concept is probably Bhagwati and Kruger (1973), who study trade protectionism of developing countries. The most common interpretation of this concept implies a process in which a government gradually reduces administrative intervention and relaxes the restrictions on trade, by legislations and international agreements, in order to rationalize and optimize the allocation of resources, and capture the maximum economic benefit from external trade.

Hence, we can define trade liberalization as a process in which a country gradually reduces the restrictions on (goods or services) imports. It implies that the international competition increases and it gives more opportunities for foreign market access because of trade cost reductions. As a consequence of trade liberalization, tariff and non-tariff barriers are minimized or even abolished, which is also a common aim for both the “General Agreement on Tariff and Trade” (GATT) and the “World Trade Organization” (WTO).

The development of the world’s economy presents the trend of globalization, which is mostly pushed by the increase in foreign direct investment (FDI). In the last twenty years, FDI has exceeded both international trade and international technology transfer in terms of growth rates. *International mergers* are characterized as a combination of merger and FDI, and are viewed as an efficient way to induce business expansion and enter the international market. Recently they accounted for more than 50 percent of FDI (UNCTAD, 2011). International mergers mainly take place among firms in developed countries but are also extending to developing countries. In other words, international mergers arise in almost all economic hotspots and have become an investment vehicle that can be employed by firms.
The most authoritative definition of merger is by “The New Encyclopedia Britannica”: “A merger may be treated as either a purchase or a pooling of interests... In a pooling of interests, the merged firms are usually about the same size; both managements carry on important functions after the merger; and common stock, rather than cash or bonds, is used in payment.” It shows that a merger emphasizes restructuring, which is always accompanied by transactions of control.

The strategic coalition is similar to this concept. Yashino and Rangan (1995) define three necessary conditions for a strategic coalition: first, two or more firms devote themselves to a common objective, and all of them still remain independent inside the coalition; second, cooperative firms share gains of the coalition and control characteristic business performance, respectively; third, cooperative firms keep making contributions to one or more key strategic areas. The strategic coalition, in which members are independent and equal to each other, emphasizing cooperation and comprehensive compatibility among members, and seeking for a common economic interest and complementary advantages, is a “win-win” strategy. In the process of forming a coalition, equity transactions may exist, but without control transaction. Therefore, the main distinction between merger and strategic coalition is whether control transactions arise.

This thesis focuses on exploring the effects of trade liberalization on merger incentives. Because the control, which is transferred between firms, does not influence this purpose, we will ignore the control transaction problem, and never distinguish between merger and strategic coalition in the following. Firms can either control other firms by processing equity exchanges, or gain higher economic profits and market shares by forming strategic coalition with other firms. Regardless of which approach would be chosen, this kind of behavior will be regarded as merger in the model analysis.

The rapid development of economic globalization in the world leads to increased market competition, although it also brings more business opportunities for the international firms. In this economic context, should a firm participate in an international merger? If yes, which incentives induce an international merger? Which kind of policies should authorities
introduce in order to safeguard public interests? Do private incentives always coincide with social ones? How does trade liberalization affect the private and social incentives for domestic versus international mergers?

After defining the concepts of “trade liberalization” and “merger”, we proceed to discuss which incentives induce a merger during trade liberalization. We try to build a simple model, which includes different cost disadvantages for each country, to examine the effects of trade liberalization on merger incentives. In the two-country model, all firms compete in the domestic market only. Domestic firms suffer a higher production cost while foreign firms must pay trade cost if they plan to enter the market by exporting. Because of the explicit assumption that firms never exit the domestic market, trade costs are assumed to be below the prohibitive levels. Hence, we consider three possible market structures: (i) the (domestic) market is supplied by domestic plants only; (ii) the market is supplied by foreign plants only; (iii) the market is supplied by both foreign and domestic plants.

The aim of this thesis includes three aspects: (i) to show the effects of trade liberalization on market structures when countries have different cost disadvantages; (ii) to analyze the influences of trade liberalization on merger incentives; (iii) to explore the domestic welfare consequences and compare the private and social incentives of trade liberalization. In order to achieve this aim, we organize the thesis as follows. We present a two-country Cournot oligopoly model in Section 3. Assuming the cost functions are different in two countries, if firms engage in an international merger, they can produce only in one country to avoid the higher costs (either production costs or trade costs), or produce in both countries to reduce losses from diseconomies of scale.

In Section 4 we derive the subgame perfect Nash equilibrium of the following two-stage game: In the first stage, firms decide (cooperatively) whether to merge, either nationally or internationally, or not. In the second stage, the firms compete (non-cooperatively) in the domestic market. We analyze outcomes in each possible market structure to make them easy to understand, and then discuss how new firms are formed and characterize the equilibrium market structures. We find that international mergers will
arise at medium levels of trade costs if the production cost difference between countries is low, and also arise at high trade cost levels if production cost differences are high. This finding is significantly different from Calmette (2008), who demonstrated that international mergers arise only at low levels of synergies.

In Section 5 we focus on the effects of trade liberalization on merger incentives, consumer surplus, and welfare consequences. In this section we find the following three interesting results. First, in the case of low production cost differences we find that moderate trade barriers cause international mergers, which is different from the case of high production cost differences, where international mergers only arise when barriers are high. Second, in the case of low production cost differences, we find that trade liberalization reduces social welfare. On the other hand, if production cost differences are high, trade liberalization affects social welfare in a non-monotonic way. Third, we find that the privately and socially preferred market structures are always different if trade costs are close to the difference in production costs.

Finally, we offer some concluding remarks in Section 6.
2. Literature Review

In recent decades, topics about merger incentives and welfare effects have become a hot issue in economics. The early economics literature mainly focuses on whether the merger behavior leads to increased concentration in an industry and whether it affects incentives for collusion. Since 1980s, through the development of game theory, however, research based on the assumption of non-cooperate game theory became a mainstream direction, which mainly focus on the unilateral effect analysis. According to the difference of market competition patterns, horizontal merger models can be classified as Cournot models, in which all firms produce a homogenous product, and Bertrand models, with some level of product differentiation among firms. This thesis will apply the former one to explore merger incentives and welfare effects.

There are large differences between Cournot and Bertrand models. For example, under Bertrand competition, firms’ competitive strategies (prices) are strategic complements and their response functions are increasing; however under Cournot competition, firms’ competitive strategies (quantities) are strategic substitutes and response functions are decreasing. Therefore, there are differences between the research conclusions based on Bertrand and Cournot models, respectively. Deneckere and Davidson (1985) studied the incentives for mergers in a market with differentiated products using a Bertrand model and get a reverse result from Salant et.al (1983), who studied merger incentives under Cournot competition.

Salant et al. (1983) analyzed the incentives for horizontal merger by assuming that there are N firms competing in Cournot fashion. They conclude that in most cases, firms don’t have merger incentives. This model has caused a wave of in-depth study on the merger behavior by unilateral effects analysis, and became a basis of follow-up study. Nevertheless, it has an obviously imperfection. They assume that the N-1 firms will remain symmetrical after the merger, but ignore the asymmetry among firms induced by the merger behavior. Perry and Porter (1985) tried to improve this model by applying quadratic cost functions and introducing asset factors to express firm size. They found that
in the case of asymmetry, small-sized firms have incentives for horizontal mergers to expand their scale since mergers are able to reduce marginal costs and bring economic scale effects. This result reversed the conclusion of Salant et al. (1983). Based on Perry and Porter’s work, MacAfee and Williams (1992) further studied the impact of merger on welfare, and they found that the higher concentration of non-merger assets, the more likely the merger improves welfare. Reversely, the merger is harmful to welfare if it generates a maximum firm or enlargers the size of the largest firm.

Not only Salant et al. (1983) but also Perry and Porter (1985) make specific assumptions, such as the linear demand function, therefore their conclusions are not necessarily universal. Farrell and Shapiro (1990) applied more general demand and cost functions, and systematic and comprehensive studied welfare in asymmetric Cournot oligopoly markets. They built the model based on two weak assumptions: first, the market demand curve slopes downward; second, each firm’s residual demand curve intersects with its marginal cost curve. They found that mergers would increase prices in the absence of synergy effects. Their study provides sufficient evidence to determine whether horizontal mergers improve welfare, or not. Because their conclusion is based on general assumptions, it has some universality. However, it is still inadequate, even though it provides a basic framework for the follow-up research on horizontal mergers. The follow-up research modifies and expands mainly on the following two aspects:

Firstly, Farrell and Shapiro (1990) assumed that all firms compete in Cournot fashion after the merger and they do not consider the effect of mergers on firms’ behavior. Because mergers are able to reduce the number of firms in the market and for the convenience of firms’ collusion, it may improve the incentive for cooperation among firms. Levin (1990) relaxed the restriction on the behavior pattern of firms that involved in horizontal mergers by using conjectural variation, and based on the assumption that firms always compete in Cournot fashion both pre- and post- merger. He demonstrated that in the case with a certain level of demand and cost, no matter what behavior chosen by firms, as long as a merger leads to an increase in the combined profit of merged firms and their output is less
than half of the total industry output, then social welfare must be enhanced. This result strengthens the conclusion of Farrell and Shapiro.

Secondly, Farrell and Shapiro (1990) proposed a single-stage static model, which is difficult to be used in the long-term effect analysis of mergers. The impact of horizontal mergers on profits, welfare, and market structure is a changing dynamic process. In a short term, due to the restrictions from some factors (such as production scale), the response from the market tends to be very small. In a longer term response to the merger behavior, firms excluded from mergers may able to improve their competitive advantage by adjusting production scale or technical innovation. Besides the short-term case, Polasky and Mason (1998) also took the case of long term into account, where firms have opportunities to readjust production scale when their rivals undertake horizontal mergers. They introduced a five-stage dynamic game model, and compared the long- and short-term merger effects in a homogenous Cournot market. In the short term, horizontal mergers are more likely to reduce social welfare due to the restriction of production scale; in the long term, horizontal mergers are able to improve social welfare if one of the merged firms has lower production efficiency compared to the market level.

Trade costs and trade liberalization are not the focus in any of the above-mentioned studies. Since 1990s, economic globalization and the information technology revolution intensified international competition and consequently induced the fifth global wave of mergers. More and more economists have turned to focus on the effects trade liberalization on merger incentives and welfare from then on. A representative paper is Horn and Persson (2001b) who applied a theory of endogenous merger formation to international trade and then determined the equilibrium ownership structures in an international oligopoly market, showing that low trade costs tend to induce firms to merge internationally and high trade costs tend to induce firms to merge domestically. They also demonstrated that private and social incentives for mergers tend to differ as long as levels of cost savings and synergies are low, but converge if there are more significant synergies. They built a minimal symmetric model with two symmetric countries to examine the incentives for mergers,
either international or national. Result shows that the equilibrium pattern of ownership depends on production and trade costs.

This approach was recently employed by Yildiz (2003). In order to overcome the non-existence problem\(^1\) that arises following trade liberalization, Yildiz assumed that firms’ strategic variable is price instead of quantity and came to a similar result that contrasts with the intuition of the tariff jumping argument in the FDI literature.

Comparing with Horn and Persson (2001b)’s cooperate game theory, Rodrigues (2001) employed a non-cooperate game to explore incentives for mergers. He assumed that in an industry with low concentration, if the anticipated competition is sufficiently strong and the cost savings from merger are finite, the non-cooperate endogenous merger has a positive effect on social welfare.

More recently, Calmette (2008) also applied the Horn and Persson (2001b) framework to analyze the welfare consequences of trade liberalization with endogenous mergers. She demonstrated that merger behavior can significantly alter any gains from liberalization, but trade liberalization is not necessarily pro-competitive in countries with a competitive advantage, even if trade costs are completely abolished. My thesis will be very close to this framework. In addition, her efforts on exploring the effect of trade liberalization on merger incentives are based on two assumptions. One, trade costs are starting from prohibitive levels, which may induce firms to exit. Two, firms compete in both foreign and domestic markets. In this thesis, we also employ the framework of Horn and Persson, but relax the assumptions that firms compete in both markets and that trade costs are starting from prohibitive levels.

\(^1\) Horn and Persson (2001b) indicated that there is no equilibrium as bilateral trade liberalization occurs, in both Fixed Cost Saving Model and Variable Cost Synergies Model.
3. The Model Analysis

Considering a two-country Cournot model with four firms symmetrically locates in two countries: D (Domestic) and F (Foreign). These firms are respectively held by four owners to produce a homogeneous good, where the production of one product requires one unit of an asset. Comparing two countries, country F has a certain level of advantage in production costs. More specifically, firms in two countries face different production costs: domestic ones need to pay more $0 < d < 1$ per unit of output than foreign ones. Many factors can lead to this kind of advantage for country F. It may be due to more excellent technology, a lower-tax environment, cheaper labor, etc. Since holding this advantage, owners of foreign firms decide to participate in the domestic market competition. Assuming the demand is linear. The inverse demand function is given by:

$$P = 1 - Q$$  \hspace{1cm} (3-1)

where $P$ is the unit price of an indivisible product and $Q = \sum_{i=1}^{4} q_i$ is total output.

Note that in this model, firms will compete in the domestic market only. That is, the homogeneous goods are only supplied for the domestic consumers. Those foreign firms have three ways to enter the domestic market: first, being a single competitive unit and pay a trade cost, $0 < f < 1$, per unit of goods by exporting these goods to the country D directly; second, forming an national coalition (merge with each other) and also export their goods directly to country D; third, forming an international coalition with a domestic firm to avoid part (produce in both plants) or even all (produce only in the domestic plant) of trade costs but endure a higher production cost, or to exterminate the domestic firm (produce in the foreign plant only). Note that the trade cost, $f$, is not explicitly specified what it includes. In fact, it may refer to market accessibility, tariff or non-tariff trade barriers, transport and distribution costs, etc. Hence, the ultimate size of trade cost depends on many elements even though a trade liberalization agreement can reduce it by removing tariff or non-tariff trade barriers between two countries.
Domestic firms also have three options: first, remaining as a single competitive unit; second, forming a national merger (merge with each other); third, forming international mergers (merge with a foreign firm). Similarly, domestic owners face a trade-off among trade costs saving, production costs saving, and scale economies effect if they decide to take part in an international merger. They can serve the domestic market by producing only in the domestic plant and avoiding trade costs, or by producing only in the foreign plant and avoiding high production costs but paying trade costs, or by producing in both plants (domestic and foreign).

3.1. Cost Function

The total cost is described as the overall cost of production in a period. In general, the total cost can be divided into two kinds: long-run cost and short-run cost. In the short term, some input factors, such as plants and machinery, are fixed. Moreover, input factors have the feature of indivisibility. Therefore, the production scale of a firm is limited in the short term. They need to produce in the minimal cost level under the scale limitation. In the long term, firms are able to adjust their production scale by changing all input factors, and then minimize the overall cost. It results that in the allowable market capacity, firms are able to choose an optimal production scale in which the long-run total cost is minimized and the profit is maximized.

In this model, we interpret the cost function as reflecting long-term costs, where firms can maximize their profits by adjusting their production scale. For simplicity, the cost functions of firms are assumed as quadratic functions, which are given by:

\[ C_D(q_i) = (q_i)^2 + d \times q_i, \text{ where } i = 1 \]  \hspace{1cm} (3-2)

and

\[ C_F(q_j) = (q_j)^2 + f \times q_j, \text{ where } j = 3,4 \]  \hspace{1cm} (3-3)
3.2. **Production Strategies**

In this model, merged firms may have three cost saving strategies. First, internationally merged firms may allocate all their production in the foreign plant and serve the domestic market only by exporting. This strategy is called “production cost saving (PCS)”. Second, by producing in the domestic plant only and serving the market directly, an internationally merged firm can avoid trade costs. This strategy is called “trade cost saving (TCS)”. Finally, by producing at all available plants, merged firms can achieve some cost synergies due to reduced diseconomies of scale. This will be referred to as a “scale economies effect (SEE)” strategy.

### 3.2.1. Production Cost Saving

Calmette (2008) describes the “production cost saving” as: firms who are participating in international mergers can avoid high production costs by choosing to produce only in the foreign country and exporting to the domestic market. When trade costs are high compared to the difference in production costs between two countries, i.e. $d > f$, owners of an international firm prefer to get some savings from production cost by paying more trade cost. The optimal option for the merged firm may therefore be to shut down its domestic plant. Note that before owners make production decisions, they need to consider whether the gain from a composite effect, by taking a weighted average of the saving on production cost and the losing on trade cost, is higher or lower than the one from the scale economies effect.

### 3.2.2. Trade Cost Saving

Having a certain level of production advantage in the foreign country is an inducement that stimulates foreign firms to join the competition in the domestic market. There are
many drivers that may induce foreign firms to cooperate with a domestic firm. Those drivers may include eliminating competition, avoiding high trade barriers, seizing more market shares, or a combination of all those things. Taking the case of high trade barriers, which protect domestic firms, owners of international firms may prefer to produce in their domestic plants in order to save trade costs. Of course, those international firms’ owners will be facing higher production costs.

3.2.3. Scale Economies Effect

In our model, we assume that there are plant-specific diseconomies of scale for each firm at the initial stage. Firms are able to enjoy scale economies effects by increasing the number of available plants, i.e., to participate in a merger (either internationally or nationally).

Diseconomies of scale refer to the effect that plant’s average cost raises as its production increases. This effect may be caused by many factors, such as more complicated internal organization as the scale of production increases, which may consume internal resources to an increasing degree. With an increasing scale of production, the plant should set up complex management layers, and design numerous incentives and monitoring mechanisms, which will inevitably increase the number of non-production employees and devices, resulting in higher costs.

Apparently, first two production strategies are unavailable for firms that engage in a national merger, who are only able to get cost synergies by executing the last strategy. Achieving a scale economies effect is also an incentive to undertake a national merger. Note that if nationally merged firms decide to choose the strategy of SEE their production will be evenly arranged in two plants, irrespective of the values of $d$ and $f$.\(^2\)

In terms of international firms, however, they can adjust their production strategy

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\(^2\) For instance, if two domestic firms engage in a national merger, the total cost of the merged firm is given by: $C = (q_1 + q_2)^2 + d(q_1 + q_2)$ if produces in one plant only, and $C = q_1^2 + q_2^2 + d(q_1 + q_2)$ if it produces at both plants. It is straightforward to see that the total cost function is a strictly convex function, $\frac{d^2 C}{dq^2} = 2 > 0$. Due to symmetry, the same analysis will apply for the foreign merger.
depending on the variations of $d$ and $f$. In different ranges of $(d, f)$, their incentives for cost savings are diverse, so they need to make a trade-off among three strategies and then choose the optimal one. A more detailed analysis on making this trade-off will be shown in Section 4.2.1.

3.3. Two-Stage Interaction

The interaction occurs in two stages. In the first stage, owners make decision to merge (internationally or domestically) or remain as single competitive units, and then form an equilibrium market structure (henceforth EMS). These decisions are assumed to be made cooperatively and the merger formation process is represented as a cooperative game of coalition-making.

In the second stage, firms formed in the first stage compete in non-cooperate Cournot fashion in the domestic market. We assume that all firms are profit maximizers. Thus, we will evaluate their equilibrium profits for each possible structure which may arise in the second stage, and then discuss the effects of trade liberalization on firms’ behavior in the first stage. We will also evaluate consumer surplus and national (domestic) welfare when calculating each equilibrium point of market structures.

In the merger formation process, we make two basic assumptions on payoff distribution. Any payments across coalitions are forbidden, and firms who participate in a merger can choose any distribution ratio inside the coalition but the sum of distributed payoff must be equal to the formed coalition’s total profit that is received in the second stage. And for an internationally merged firm, owners should make an optimal trade-off among PCS, TCS and SEE, which affects the merged firm’s production distribution.
4. The Subgame Perfect Cournot Nash Equilibrium

We solve the game by backwards induction, analyzing first the second stage before turning to the first stage of the game.

4.1. Stage 2: Competition in The Domestic Market

In this section, we will specify the equilibria of all feasible structures, which constitute the basis for evaluating the EMS. Considering the restrictions from antitrust legislation, highly concentrated market structures are excluded. More specifically, we only allow for two-firm mergers. Thus, an international merger including four firms, \{1234\}, or one including three firms, for example, \{123,4\} or \{1,234\}, are not permitted. This restriction leaves us with 6 feasible market structures that are, respectively, superscripted with “0”, “D”, “F”, “N”, “T”, and “I”:

1. The fully decentralized market structure (no mergers): \(M^0 = \{1, 2, 3, 4\}\);
2. The domestic triopoly market structure (only domestic merger): \(M^D = \{12, 3, 4\}\);
3. The foreign triopoly market structure (only foreign merger): \(M^F = \{1, 2, 34\}\);
4. The national duopoly market structure (two national mergers): \(M^N = \{12, 34\}\);
5. The international triopoly market structure (only one international merger): \(M^T = \{13, 2, 4\}, \{14, 2, 3\}, \{1, 4, 23\}, \text{or} \{1, 3, 24\}\);
6. The international duopoly market structure (two international mergers): \(M^I = \{13, 24\}, \text{or} \{14, 23\}\).

4.1.1. The decentralized market structure

In this structure all owners of firms decide to remain as single competitive units, i.e. no mergers occur among firms. Both foreign firms choose the way of exporting goods directly to the domestic market and paying trade costs, while domestic firms do not process any response measures. In the decentralized market, each firm chooses its quantity to maximize the profit, taking other firms’ quantities as given:
max $\pi_i = (1 - Q) \times q_i - (q_i)^2 - d \times q_i, i = 1,2$ \hspace{1cm} (4-1)

and

$max \pi_j = (1 - Q) \times q_j - (q_j)^2 - f \times q_j, j = 3,4$ \hspace{1cm} (4-2)

The first-order conditions are given by:

$$\frac{\partial \pi_i}{\partial q_i} = 1 - Q - 3q_i - d, i = 1,2$$ \hspace{1cm} (4-3)

$$\frac{\partial \pi_j}{\partial q_j} = 1 - Q - 3q_j - f, j = 3,4$$ \hspace{1cm} (4-4)

Solving these FOCs yields the following equilibrium quantities ($q_i$), price ($P$), and profits ($\pi_i$), which are superscripted with “0”:

$q_1^0 = q_2^0 = \frac{1}{23}(3 - 5d + 2f)$ \hspace{1cm} (4-5)

$q_3^0 = q_4^0 = \frac{1}{23}(3 + 2d - 5f)$ \hspace{1cm} (4-6)

$P^0 = \frac{1}{7}(3 + 2d + 2f)$ \hspace{1cm} (4-7)

$\pi_1^0 = \pi_2^0 = \frac{1}{441}[30(d - 1)^2 - 12(f - 1)^2 + 20(d - f)^2]$ \hspace{1cm} (4-8)

$\pi_3^0 = \pi_4^0 = \frac{1}{441}[30(d - 1)^2 - 12(d - 1)^2 + 20(d - f)^2]$ \hspace{1cm} (4-9)

Following the standard concept of total national surplus, the social welfare ($W^0$) is evaluated as the sum of consumer surplus ($CS^0$) and profits of domestic firms$^3$:

$CS^0 = \frac{(1 - P^0)^2}{2} = \frac{2}{49}(2 - d - f)^2$ \hspace{1cm} (4-10)

$W^0 = CS^0 + \sum_{i=1}^2 \pi_i^0 = \frac{2}{441}[48(d - 1)^2 + 6(f - 1)^2 + 11(d - f)^2]$ \hspace{1cm} (4-11)

Equilibrium existence requires that output from domestic firms is non-negative:

$^3$ We have assumed that firms compete in the domestic market only. Thus, we will focus on the domestic welfare when we analyze the welfare consequences of trade liberalization. The following welfare analysis will exclude profits generated at foreign plants.
Similarly, for each foreign firms, rational output is positive if

\[ q_i^0 > 0 \iff f > \underline{f}_3 := \frac{5}{2} d - \frac{3}{2} \]  

(4-12)

Notice that: \( \overline{f}_3 > f_3 \) for all \( d \in (0,1) \).

Thus, in this market structure the equilibrium exists for the parameter set \( f_3 < f < \overline{f}_3 \), which is illustrated in Figure 1.
4.1.2. The domestic triopoly market structure

The aggregate profits of a coalition can be divided in any proportion among owners. Any costs from forming the coalition are excluded in this model. When domestic firms decide to form a national coalition, we have an asymmetric triopoly.

The merged firm is denoted by “m”, and its profit is the sum of two plants’ profits. The profit maximization problems are given by:

\[
\begin{align*}
\text{Max } \pi_m &= (1 - Q) \ast (q_1 + q_2) - C_D(q_1) - C_D(q_2) \\
\text{Max } \pi_j &= (1 - Q) \ast q_j - C_F(q_j), \text{where } j = 3,4
\end{align*}
\]

(4-14)  
(4-15)

For the merged firm, the optimal output in each plant is determined by its partial derivative of the aggregate profit. For the merged firm, the first-order conditions are given by:

\[
\frac{\partial \pi_m}{\partial q_i} = 1 - Q - 3q_i - q_k - d = 0, k \neq i = 1,2
\]

(4-16)

and the first-order conditions of foreign firms are given by:

\[
\frac{\partial \pi_j}{\partial q_j} = 1 - Q - 3q_j - f = 0, j = 3,4
\]

(4-17)

Solving the above first-order conditions yields the following candidate equilibrium variables, which are superscripted with “D”:

\[
\begin{align*}
q_1^D &= q_2^D = \frac{1}{26} (3 - 5d + 2f) \\
q_3^D &= q_4^D = \frac{1}{13} (2 + d - 3f) \\
P^D &= \frac{1}{13} (6 + 3d + 4f) \\
\pi_m^D &= \frac{3}{338} (3 - 5d + 2f)^2
\end{align*}
\]

(4-18)  
(4-19)  
(4-20)  
(4-21)
In this scenario, the national welfare is evaluated as the sum of consumer surplus and aggregate profit of the merged firm (denoted as \(\pi^D_m\)):

\[
CS^D = \left(1 - \frac{\rho^D}{2}\right)^2 = \frac{1}{338} (7 - 3d - 4f)^2
\]

\[
W^D = CS^D + \pi^D_m = \frac{1}{169} [33(d - 1)^2 + 5(f - 1)^2 + 9(d - f)^2]
\]

For the merged firm, rational output is positive if \(q^D_m = q^D_1 + q^D_2 > 0 \iff f > \frac{1}{3}
\)

For each foreign firm, rational output is positive if

\[
q^D_j > 0 \iff f < f_2^* = \frac{1}{3} d + \frac{2}{3}
\]
Notice that $\bar{f}_2 > f_3$ for all $d \in (0,1)$.

Thus, in this market structure the equilibrium exists for the parameter set $f_3 < f < \bar{f}_2$, which illustrated in Figure 2.

### 4.1.3. The foreign triopoly market structure

The alternative national triopoly structure is one with a foreign merger between firm 3 and 4, whereas domestic firms 1 and 2 remain as single competitive units. Similarly, the foreign merged firm’s profit is equal to the total profit of two plants. The profit maximization problems are given by:

\[
\begin{align*}
\text{Max } \pi_i &= (1 - Q) \cdot q_i - C_D(q_i), \text{ where } i = 1,2 \\
\text{Max } \pi_m &= (1 - Q) \cdot (q_3 + q_4) - C_F(q_3) - C_F(q_4)
\end{align*}
\] (4-26)

First-order conditions of domestic firms are given by:

\[
\frac{\partial \pi_i}{\partial q_i} = 1 - Q - 3q_i - d = 0, i = 1,2
\] (4-28)

and the first-order conditions for the merged (foreign) firm are:

\[
\begin{align*}
\frac{\partial \pi_m}{\partial q_3} &= 1 - Q - 3q_3 - q_4 - f \\
\frac{\partial \pi_m}{\partial q_4} &= 1 - Q - q_3 - 3q_4 - f
\end{align*}
\] (4-29)

Solving above first-order conditions yields equilibrium outputs ($q_i$), price ($P$), and profits ($\pi_i$), which are superscripted with “F” (and merged firm is denoted with “m”):
Consumer surplus and domestic national welfare are given by:

\[ CS^F = \frac{(1-p^F)^2}{2} = \frac{1}{338}(7-4d-3f)^2 \]  

\[ W^F = CS^F + \pi_1^F + \pi_2^F = \frac{1}{338}[76(d-1)^2 + 5(f-1)^2 + 12(d-f)^2] \]

For domestic firms, rational outputs are positive if

\[ q_1^F > 0 \iff f > f_2^* = 3d - 2 \]  

For the merged firm, rational output is positive if

\[ q_m^F = q_3^F + q_4^F > 0 \iff f < \overline{f}_3 = \frac{2}{5}d + \frac{3}{5} \]

Notice that: \( \overline{f}_3 > f_2^* \) for all \( d \in (0,1) \).

Thus, in this market structure the equilibrium exists for the parameter set \( f_2^* < f < \overline{f}_3 \), which is illustrated in **Figure 3**.
4.1.4. The national duopoly market structure

The national duopoly structure is the last one that involves national mergers, in this case both foreign and domestic national merger. We mark this structure as “$M^N$”, and the domestic merged firm is denoted with “d” and the foreign merged firm is denoted with “f”. In this scenario, plants of each firm are located in the same country. Therefore, firms are able to get some cost savings from the scale economies effect by participating in national mergers. Their profit maximization problems are given by:

\[
\begin{align*}
Max \pi_d &= (1 - Q) * (q_1 + q_2) - C_D(q_1) - C_D(q_2) \\
Max \pi_f &= (1 - Q) * (q_3 + q_4) - C_F(q_3) - C_F(q_4)
\end{align*}
\] (4-40)

The first-order conditions are:
\[
\frac{\partial \pi_d}{\partial q_1} = 1 - Q - 3q_1 - q_2 - d = 0 \quad (4-42)
\]
\[
\frac{\partial \pi_d}{\partial q_2} = 1 - Q - q_1 - 3q_2 - d = 0 \quad (4-43)
\]
\[
\frac{\partial \pi_f}{\partial q_3} = 1 - Q - 3q_3 - q_4 - f = 0 \quad (4-44)
\]
\[
\frac{\partial \pi_f}{\partial q_4} = 1 - Q - q_3 - 3q_4 - f = 0 \quad (4-45)
\]

Superscripting equilibrium quantities \((q_i)\), price \((P)\), and profits \((\pi_i)\) with “\(N\)”, the solution to the above first-order conditions is:

\[
q_1^N = q_2^N = \frac{1}{16} (2 - 3d + f) \quad (4-46)
\]
\[
q_3^N = q_4^N = \frac{1}{16} (2 + d - 3f) \quad (4-47)
\]
\[
P^N = \frac{1}{4} (2 + d + f) \quad (4-48)
\]
\[
\pi_d^N = \frac{3}{128} (2 - 3d + f)^2 \quad (4-49)
\]
\[
\pi_f^N = \frac{3}{128} (2 + d - 3f)^2 \quad (4-50)
\]

Consumer surplus and national welfare are then given by:

\[
CS^N = \frac{1}{32} (2 - d - f)^2 \quad (4-51)
\]
\[
W^N = CS^N + \pi_d^N = \frac{1}{128} [26(d - 1)^2 + 2(f - 1)^2 + 5(d - f)^2] \quad (4-52)
\]

For the domestic merged firm, rational output is positive if

\[
q_i^N > 0 \iff f > f_i^2 := 3d - 2, \ i = 1,2 \quad (4-53)
\]

Similarly, for the foreign merged firm, rational output is positive if
Notice that \( q_j^N > 0 \iff f < f_2: = \frac{1}{3} d + \frac{2}{3} I = 3,4 \) \hspace{1cm} (4.54)

Notice that \( f_2 > f \) for all \( d \in (0,1) \).

Thus, in this market structure the equilibrium exists for the parameter set \( f_2 < f < \overline{f}_2 \), which is illustrated in Figure 4.

### 4.1.5. The international triopoly market structure

For firms that willing to engage in international mergers, their owners always have incentives to reduce their costs and then obtain higher profits. In order to achieve this goal, they need to choose an optimal production distribution plan between plants, which are
locates in different countries. The internationally merged firm has three alternative production strategies to choose from: PCS, TCS, and SEE. According this, we can separate the international triopoly market structure into three sub-structures that are denoted as: $M_{Tf}, M_T, M^{Td}$. And the international duopoly market structure also can be separated into three sub-structures: $M^{ld}, M^{lf}, M^l$.

Now, let’s turn attention to the international triopoly structure with one international merger. There are 4 different ownership structures that correspond to this market structure: $\{13,2,4\}$, $\{14,2,3\}$, $\{23,1,4\}$, and $\{24,1,3\}$. Due to symmetry, these four ownership structures are completely equivalent and we only need to consider one of them. Thus, we assume that the merger is formed between firm 1 and 3 here.

(i) *International triopoly with a scale economies effect*

First, assume that the international firm decides to produce in both plants, which means that the firm produces partly in the domestic plant and serves the market directly, and another part of output is served to the market by exporting. The incentive for this firm to keep producing in both plants is the scale economies effect.

In the post-merger game, the profit maximization problems are given by:

\[
\pi_m = (1 - Q) * (q_1 + q_3) - C_D(q_1) - C_F(q_3) \tag{4-55}
\]

\[
\pi_2 = (1 - Q) * q_2 - C_D(q_2) \tag{4-56}
\]

\[
\pi_4 = (1 - Q) * q_4 - C_F(q_4) \tag{4-57}
\]

Consider that the international firm has two plants, which are located in different countries. Thus, the firm can decide the optimal outputs of two plants by partial derivative of its aggregate profits with respect to each plant’s quantity. The first-order conditions are therefore:
\[ \frac{\partial \pi_m}{\partial q_1} = 1 - Q - 3q_1 - q_3 - d = 0 \quad (4-58) \]

\[ \frac{\partial \pi_m}{\partial q_3} = 1 - Q - q_1 - 3q_3 - f = 0 \quad (4-59) \]

The first-order conditions of the firms that do not merge are given by:

\[ \frac{\partial \pi_2}{\partial q_2} = 1 - Q - 3q_2 - d = 0 \quad (4-60) \]

\[ \frac{\partial \pi_4}{\partial q_4} = 1 - Q - 3q_4 - f = 0 \quad (4-61) \]

Solving the first-order conditions yields the following candidate equilibrium variables, which are superscripted with “T”:

\[ q_1^T = \frac{1}{26} (3 - 8d + 5f) \quad (4-62) \]

\[ q_2^T = \frac{1}{78} (12 - 19d + 7f) \quad (4-63) \]

\[ q_3^T = \frac{1}{26} (3 + 5d - 8f) \quad (4-64) \]

\[ q_4^T = \frac{1}{78} (12 + 7d - 19f) \quad (4-65) \]

\[ p^T = \frac{1}{26} (12 + 7d + 7f) \quad (4-66) \]

\[ \pi_m^T = \frac{1}{676} [27(d - 1)^2 + 27(f - 1)^2 + 71(d - f)^2] \quad (4-67) \]

\[ \pi_1^T = \frac{1}{1352} [105(d - 1)^2 - 51(f - 1)^2 + 71(d - f)^2] \quad (4-68) \]

\[ \pi_3^T = \frac{1}{1352} [-51(d - 1)^2 + 105(f - 1)^2 + 71(d - f)^2] \quad (4-69) \]

\[ \pi_2^T = \frac{1}{3042} (12 - 19d + 7f)^2, \quad \pi_4^T = \frac{1}{3042} (12 + 7d - 19f)^2 \quad (4-70) \]

Following the standard concept of national welfare, the national welfare is evaluated as the sum of consumer surplus (CS^T) and profit of the domestic firm plus the part of the international firm’s profits which is received by its domestic owners. However, we don’t
know what proportion of the aggregate profit will be distributed to domestic owners. Therefore we assume that domestic owners will receive the part that is generated at the domestic plant.

\[
CS^T = \frac{(1-p^T)^2}{2} = \frac{49}{1392}(2 - d - f)^2 \tag{4-71}
\]

\[
W^T = CS^T + \pi_1^T + \pi_2^T
\]

\[
= \frac{1}{12168}[2739(d - 1)^2 + 87(f - 1)^2 + 730(d - f)^2] \tag{4-72}
\]

For the international firm, optimal output at the domestic plant is positive if

\[
q_1^T > 0 \iff f > f_5 := \frac{9}{5}d - \frac{3}{5} \tag{4-73}
\]

While optimal output at the foreign plant is positive if

\[
q_3^T > 0 \iff f < \bar{f}_5 := \frac{5}{8}d + \frac{3}{8} \tag{4-74}
\]

Notice that \( \bar{f}_5 > f_5 \) for all \( d \in (0,1) \).

Thus, the equilibrium exists for the parameter set of \( f_5 < f < \bar{f}_5 \). It is straightforward to see that \( q_2^T > 0 \) and \( q_4^T > 0 \) if \( f_5 < f < \bar{f}_5 \). For this parameter set, the international firm can yield the largest cost synergies through the scale economics effect.

(ii) International triopoly with production cost savings

In this case the international firm is willing to incur trade cost in order to obtain production cost savings by locating all production to the low-cost (foreign) country. This means that the merged firm’s output is zero in its domestic plant \( (q_1^T = 0) \) and the domestic
market is served market by exports only. Thus, profit functions are given by:

\[ \pi_T = (1 - Q^T) * q_T - C_F(q_T) \]  
(4-75)

\[ \pi_2 = (1 - Q^T) * q_2 - C_D(q_2) \]  
(4-76)

\[ \pi_4 = (1 - Q^T) * q_4 - C_F(q_4) \]  
(4-77)

Solving the profit maximization problems by FOCs yields equilibrium quantities \((q_i^T)\), price \((P^T)\), and profits \((\pi_i^T)\) that are given by:

\[ q_T = \frac{1}{18} (3 + d - 4f) \]  
(4-78)

\[ q_2 = \frac{1}{18} (3 - 5d + 2f) \]  
(4-79)

\[ q_4 = \frac{1}{18} (3 + d - 4f) \]  
(4-80)

\[ P_T = \frac{1}{6} (3 + d + 2f) \]  
(4-81)

\[ \pi_T = \frac{1}{162} (3 + d - 4f)^2 \]  
(4-82)

\[ \pi_2 = \frac{1}{162} (3 - 5d + 2f)^2 \]  
(4-83)

\[ \pi_4 = \frac{1}{162} (3 + d - 4f)^2 \]  
(4-84)

Since the international firm’s domestic plant is closed, the national welfare is counted as the sum of consumer surplus \((CS^T)\) and profit of the domestic firm\(^4\). The first two variables are given by:

\(^4\) In this case, foreign firms have comparatively high competitive advantage. Hence, in the international coalition, the foreign owner holds a larger bargaining power and the domestic owner will receive very little part of profits. For the purpose of simplifying, total profits of the international firm is excluded in the calculation of national welfare. It also applies for the TCS case of the international duopoly. However, for the PCS case, in both the international duopoly and triopoly we should take total profits into account when calculating national welfare.
\[ CS^{Tf} = \frac{(1-p^{Tf})^2}{2} = \frac{1}{72} (3 - d - 2f)^2 \]  

\[ W^{Tf} = CS^{Tf} + \pi_2^{Tf} = \frac{1}{648} [87(d - 1)^2 + 30(f - 1)^2 + 22(d - f)^2] \]

We see that \( q_2^{Tf} > 0 \) if \( f > f_3^* = \frac{5}{2}d - \frac{3}{2} \), and \( q_m^{Tf} > 0 \) if \( f < f_1^* = \frac{1}{4}d + \frac{3}{4} \).

Notice that \( f_3^* < f_5^* < f_1^* \) for all \( d \in (0,1) \).

(iii) International triopoly with trade cost savings

If the international firm is in pursuit of trade cost savings, the firm’s owners decide to distribute their production in the domestic plant only and serve the market from local production. By this way, they should incur a higher production cost. Then profit functions are given by:

\[ \pi_m = (1 - Q) * q_m - C_D(q_m) \]  

\[ \pi_2 = (1 - Q) * q_2 - C_D(q_2) \]  

\[ \pi_4 = (1 - Q) * q_4 - C_F(q_4) \]

Solving these profits functions’ FOCs yields equilibrium quantities \( (q_i) \), price \( (P) \), and profits \( (\pi_i) \), which are listed as follows:

\[ q_m^{Td} = \frac{1}{18} (3 - 4d + f) \]  

\[ q_2^{Td} = \frac{1}{18} (3 - 4d + f) \]  

\[ q_4^{Td} = \frac{1}{18} (3 + 2d - 5f) \]  

\[ P^{Td} = \frac{1}{6} (3 + 2d + f) \]  

\[ \pi_m^{Td} = \frac{1}{162} (3 - 4d + f)^2 \]
In this case, the international firm allocates their production entirely in their domestic plant. Thus, the national welfare needs to account total profit of this firm. Then, consumer surplus and national welfare are given by:

\[
\pi_2^{Td} = \frac{1}{162} (3 - 4d + f)^2
\]

\[
\pi_4^{Td} = \frac{1}{162} (3 + 2d - 5f)^2
\]

\[
\sigma^T_d = \frac{(1 - \rho_d)^2}{2} = \frac{1}{72} (3 - 2d - f)^2
\]

\[
W^T_d = \sigma^T_d + \pi_m^{Td} + \pi_2^{Td} = \frac{1}{648} [14(d - 1)^2 + 7(f - 1)^2 + 6(d - f)^2].
\]
We see that $q_4^{T_d} > 0$ if $f < \overline{f}_3 = \frac{2}{5}d + \frac{3}{5}$, and $q_4^{m_d} > 0$ if $f > \underline{f}_1 = 4d - 3$.

Notice that: $\overline{f}_3 > \overline{f}_5 > \overline{f}_5 > \underline{f}_1$ for all $d \in (0,1)$.

**Proposition 1.** In the international triopoly market structure, the preferred strategy for the international firm is:

1. **TCS**, if $\overline{f}_5 < f < \overline{f}_3$.
2. **SEE**, if $\overline{f}_5 < f < \overline{f}_5$.
3. **PCS**, if $\overline{f}_3 < f < \overline{f}_5$.

Intuitively, when the trade cost is sufficiently high but still not above the prohibitive level (i.e., $\overline{f}_5 < f < \overline{f}_3$), an international firm will shut down its foreign plant and give up possible gains from scale economies effect in order to avoid the higher trade cost. On the other hand, if the production cost difference is very large (i.e., $\overline{f}_3 < f < \overline{f}_5$), the international firm will rearrange its production to the foreign plant and forego the lower marginal cost that obtained by the scale economies effect. Moreover, if two parameter values are sufficiently close, i.e., $\overline{f}_5 < f < \overline{f}_5$, the scale economies effect will become more prominent as a source of cost synergy than the other two cost saving strategies.

**4.1.6. The international duopoly market structure**

Another structure with international mergers is denoted as “$M^I$”, which consists of two international mergers. In other words, all firms are involved in international mergers, and ultimately forming a symmetric duopoly. If owners decide to join an international merger, choosing which firm to be their partner is random. Certainly, their partner should be located in another country. Therefore, there are two homogeneous structures, \{13,24\} and \{14,23\}. We know that in a structure which has one or two international mergers, there exists a trade-off among cost saving (or synergy) strategies. Hence, here we still divide the
market structure analysis into three parts.

(i) *International duopoly with a scale economies effect*

Initially we assume that internationally merged firms produce in both plants. Therefore, their profit maximization problem is given by:

\[
\begin{align*}
\text{Max } \pi_m^1 &= (1 - Q) \cdot (q_1 + q_3) - C_D(q_1) - C_F(q_3) \\
\text{Max } \pi_m^2 &= (1 - Q) \cdot (q_2 + q_4) - C_D(q_2) - C_F(q_4)
\end{align*}
\]  

(4-99)  

(4-100)

Then, first-order conditions are given by:

\[
\begin{align*}
\frac{\partial \pi_m^1}{\partial q_1} &= 1 - Q - 3q_1 - q_3 - d = 0 \\
\frac{\partial \pi_m^1}{\partial q_3} &= 1 - Q - q_1 - 3q_3 - f = 0 \\
\frac{\partial \pi_m^2}{\partial q_2} &= 1 - Q - 3q_2 - q_4 - d = 0 \\
\frac{\partial \pi_m^2}{\partial q_4} &= 1 - Q - q_2 - 3q_4 - f = 0
\end{align*}
\]

(4-101)  

(4-102)  

(4-103)  

(4-104)

Solving the FOCs yields equilibrium variables as follows, which are superscripted with “I”:

\[
\begin{align*}
q_1^I &= q_2^I = \frac{1}{16} (2 - 5d + 3f) \\
q_3^I &= q_4^I = \frac{1}{16} (2 + 3d - 5f) \\
P^I &= \frac{1}{4} (2 + d + f) \\
\pi_1^I &= \pi_2^I = \frac{1}{256} [22(1 - d)^2 - 10(f - 1)^2 + 13(d - f)^2] \\
\pi_3^I &= \pi_4^I = \frac{1}{256} [-10(d - 1)^2 + 22(f - 1)^2 + 13(d - f)^2]
\end{align*}
\]

(4-105)  

(4-106)  

(4-107)  

(4-108)  

(4-109)
\[ \pi_{m1}^I = \pi_{m2}^I = \frac{1}{128} [6(d - 1)^2 + 6(f - 1)^2 + 13(d - f)^2] \]  

(4-110)

The corresponding consumer surplus (\(CS^I\)) and national welfare (\(W^I\)) are given by:

\[ CS^I = \left( \frac{1-p^I}{2} \right)^2 = \frac{1}{32} (2 - d - f)^2 \]  

(4-111)

\[ W^I = CS^I + \pi_1^I + \pi_2^I = \frac{1}{128} [30(d - 1)^2 - 2(f - 1)^2 + 9(d - f)^2]. \]  

(4-112)

Having assumed that international firms hold all plants’ productions, therefore outputs at domestic plants should be subject to

\[ q_1^I > 0 \text{ and } q_2^I > 0 \iff f > \underline{f}_4 := \frac{5}{3} d - \frac{2}{3} \]  

(4-113)

while outputs at foreign plants should be subject to

\[ q_3^I > 0 \text{ and } q_4^I > 0 \iff f < \overline{f}_4 := \frac{3}{5} d + \frac{2}{5} \]  

(4-114)

Hence, international firms will optimally pursue the scale economies effect only in the parameter range \( \underline{f}_4 < f < \overline{f}_4 \).

(ii) International duopoly with production cost savings

Now let’s turn to the case of production cost savings. In this case, both international firms shut down their domestic plants and only serve the market by exporting, implying that outputs of domestic plants are zero. Note that in this structure, the two international firms are symmetric, so their profit maximization problem is given by:
The first-order conditions are:

\[
\frac{\partial \pi_{mi}}{\partial q_{mi}} = 1 - Q - 3q_{mi} - f = 0, \quad i = 1, 2
\]  

Solving the FOCs yields equilibrium outputs \((q_{i}^{If})\), price \((P^{If})\), and profits \((\pi_{i}^{If})\), which are superscripted with “\(If\)”: 

\[
q_{m1}^{If} = q_{m2}^{If} = \frac{1}{5} (1 - f) 
\]  

\[
P^{If} = \frac{1}{5} (3 + 2f) 
\]  

\[
\pi_{m1}^{If} = \pi_{m2}^{If} = \frac{2}{25} (1 - f)^2 
\] 

In this scenario, domestic plants have zero output. Therefore, national welfare \((W^{If})\) in the domestic country is equal to consumer surplus \((CS^{If})\): 

\[
W^{If} = CS^{If} = \frac{(1-P^{If})^2}{2} = \frac{2}{25} (1 - f)^2 
\]

It is straightforward to see that firms’ outputs are always being positive for all 
\(f \in (0,1)\).

(iii) **International duopoly with trade cost savings**

The last scenario is when international firms pursue trade cost savings by serving the market from production at domestic plants only. This implies that output at foreign plants is zero. Hence, their profit maximization problem is given by:
\[ Max \pi_{mi} = (1 - Q) \cdot q_{mi} - C_F(q_{mi}), i = 1,2 \quad (4-121) \]

First-order conditions are given by:

\[ \frac{\partial \pi_{mi}}{\partial q_{mi}} = 1 - Q - 3q_{mi} - d, i = 1,2 \quad (4-122) \]

Solving the FOCs yields equilibrium outputs \((q_{mi})\), price \((P)\), and profits \((\pi_{mi})\), which are superscripted with “\(Id\)”:

\[ q_{m1}^{Id} = q_{m2}^{Id} = \frac{1}{5}(1 - d) \quad (4-123) \]
\[ P^{Id} = \frac{1}{5}(3 + 2d) \quad (4-124) \]
\[ \pi_{m1}^{Id} = \pi_{m2}^{Id} = \frac{2}{25}(1 - d)^2 \quad (4-125) \]

Thus, the national welfare \((W^{Id})\) equals consumer surplus \((CS^{Id})\) plus aggregate profits of two international firms:

\[ CS^{Id} = \frac{(1 - P^{Id})^2}{2} = \frac{2}{25}(1 - d)^2 \quad (4-126) \]
\[ W^{Id} = CS^{Id} + \pi_{m1}^{Id} + \pi_{m2}^{Id} = \frac{6}{25}(1 - d)^2. \quad (4-127) \]

It is straightforward to see that firms’ outputs are always being positive for all \(d \in (0,1)\).
Proposition 2. In the international duopoly market structure, the preferred strategy for international firms is:

1. TCS, if \( f > f_4 \).
2. SEE, if \( f_4 < f < f_4 \).
3. PCS, if \( f < f_4 \).

Proposition 2 is graphically illustrated in Figure 6. The top curve is \( f_4 \), while the bottom curve is \( f_4 \). Starting from \( f = 1 \) until \( f \) reaches \( f_4 \), international firms are facing such high trade cost that they choose to serve the market directly by producing only at domestic plants. At levels of \( f \) lower than \( f_4 \), the firms optimally use plants in both countries to serve the domestic market, because the trade cost level is so close to the
production cost difference that cost savings from either PCS or TCS strategy is less than the cost synergy obtained by SEE. At \( f \) below \( f_4 \), firms are able to profit more from the PCS strategy and will consequently produce only in foreign plants and serve the domestic market exclusively by exports.

4.1.7. Summary

![Figure 7: Upper and Lower Bounds of Possible Market Structures](image)

Figure 7: Upper and Lower Bounds of Possible Market Structures

For all candidate equilibrium market structures, their feasible regions are different. All the feasible regions of the candidate equilibrium structures are summarized in Table 1, with all boundaries graphically illustrated in Figure 7. Observing Table 1, we can find an interesting phenomenon. For a given type of merger (either international or national), a more concentrated market structure is consistent with a larger feasible parameter region.
In Section 4.1, we have introduced how firms compete in the domestic market with respect to each possible market structure. In this section, we will analyze how the trade cost level and the production cost differences in combination affect the owners’ merger decisions, which includes being a single competitive unit or participating in a merger (nationally or internationally).

The framework of this model is basically developed in Horn and Persson (2001b). They supposed that in a minimal symmetric model, owners are free to communicate and enter into binding contracts with other owners. The merger formation process is always treated as a cooperative game of coalition formation. In order to illustrate the intelligibly determine the process of reaching an equilibrium ownership pattern, they employed two important concepts introduced in Horn and Persson (2001a): dominance relation and decisive group. Furthermore, their merger model is composed of three basic components: a specification and two criterions. The specification is about owners determining whether one structure dominates another one, and one criterion is used to determine when owners prefer the former structure to the latter, and another criterion is used to pick out equilibrium ownership structures on the basis of all pairwise dominance rankings for the merger formation game.

<table>
<thead>
<tr>
<th>Parameter Set of Each Possible Market Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M^0: \overline{f_2} &lt; f &lt; \overline{f_3}$</td>
</tr>
<tr>
<td>$M^D: \overline{f_3} &lt; f &lt; \overline{f_2}$</td>
</tr>
<tr>
<td>$M^F: f_2 &lt; f &lt; \overline{f_3}$</td>
</tr>
<tr>
<td>$M^N: f_2 &lt; f &lt; \overline{f_2}$</td>
</tr>
</tbody>
</table>
4.2.1. Decisive Groups

In the first stage of interaction, decisive group choose a satisfactory ownership pattern for all parties who belong to this decisive group. Which owners should be involved in the decisive group? Horn and Persson (2001a) defined that owners who are involved in a “decisive group” should be expected to be able to exert influence between two structures and determine whether one dominates another one. This kind of relation between those two structures is named “dominance”. Similarly, Calmette (2008) identified “decisive owners” as “those who are not indifferent to alternative firm coalitions”. More specifically, a “decisive group” consists of owners who belonged to a coalition before or after a structural change and there is a link among them. Hence, we build a Decisive Groups table according to the description of decisive owners of Calmette. In some sense, all owners who participate in forming and disbanding coalitions between two structures prefer the dominative structure to the others.

Due to the limit size of the table, we let $M^T = \{13,2,4\}$ represents all structures with only one international merger, and $M^I = \{13,24\}$ represents all structures with two international mergers. Observing all pairs of market structures, we can find that there may exist one or two decisive groups. Concentrating on the situation with one decisive group, for instance, between the fully decentralized market structure $M^0 = \{1,2,3,4\}$ and the domestic triopoly market structure $M^D = \{12,3,4\}$, firm 3 and 4 do not affect whether the market structure will be changed from the former to the latter (or from the latter to the former), because they constantly stay away from any mergers. On the other hand, firm 1 and 2 will prefer to form a coalition by moving from $M^0$ to $M^D$, since the former market structure is dominated by latter, of which condition is two domestic firms should make sure that they could profit more from a national merger than from the decentralized market structure. Hence, we say that firm 1 and 2 are involved in the same decisive group, denoted by $S^{0D} = \{1,2\}$ ($S$ is the acronym for “the set of decisive firms”), with respect to a dominance ranking between two market structures $M^0$ and $M^D$. 
Table 2: Decisive Groups

<table>
<thead>
<tr>
<th>$M^0{1,2,3,4}$</th>
<th>$M^I{13,24}$</th>
<th>$M^N{12,34}$</th>
<th>$M^T{13,2,4}$</th>
<th>$M^F{1,2,34}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1,2}</td>
<td>{1,2,3,4}</td>
<td>{3,4}</td>
<td>{1,2,3}</td>
<td>{1,2} and {3,4}</td>
</tr>
<tr>
<td>{3,4}</td>
<td>{1,2,3,4}</td>
<td>{1,2}</td>
<td>{1,3,4}</td>
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<tr>
<td>{1,3}</td>
<td>{2,4}</td>
<td>{1,2,3,4}</td>
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<td>{1,2} and {3,4}</td>
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<td>{1,2,3,4}</td>
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<td>{1,3} and {2,4}</td>
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</tr>
</tbody>
</table>

Now, turning to the situation with two decisive groups, for example, between the decentralized market structure $M^0 = \{1,2,3,4\}$ and the national duopoly market structure $M^N = \{12,34\}$, it is required that all firms prefer $M^N$ to $M^0$. But there is no link between domestic and foreign firms. Further more, firm 1 may prefer to persuade firm 2 to merge with it nationally if it is adversely affected by market structure $M^0$. Maybe firm 3 is also adversely affected by the structure $M^0$, and then it employs a similar strategy to suggest a national merger with firm 4. In these two negotiations, domestic and foreign firms will not interfere with each other, and, hence, there are two decisive groups, $S_1^{0N} = \{1,2\}$ and $S_2^{0N} = \{3,4\}$. Thus, we can generate two features for a dominance ranking with two decisive groups: (i) firms belong to different coalitions in the two structures; (ii) there is no link between two groups and they cannot transfer any resources between them.

4.2.2. Dominance

Having specified which owners should be involved in a decisive group, now we need to solve the question: when does a decisive group prefer one structure to another? Horn and Persson (2001a) show that this depends on the combined profit of a decisive group. So this question should be divided into two situations: one or two decisive groups. If there is only one decisive group, we can say that $M^x$ dominates $M^y$ if and only if the combined profit of the decisive group is larger in former structure than in latter. If there are two decisive groups, the dominance relation should be qualitatively similar for the two groups.
This implies that $M^x$ dominates $M^y$ only if two premises are simultaneously satisfied: the combined profit of decisive group 1 is larger in $M^x$ than in $M^y$, and the same is true for decisive group 2. Note that the dominance relation is not transitive. For instance, if $M^x$ dominates $M^y$ and $M^y$ dominates $M^z$, it cannot be automatically inferred that $M^x$ dominates $M^z$. The reason is that decisive group(s) with respect to $M^x$ and $M^y$ may not identical with decisive group(s) of $M^y$ and $M^z$.

4.2.3. Equilibrium Market Structure

Having identified the decisive group(s) for each pair of market structures, and having also specified the criterion for dominance relation, the equilibrium market structure, if it exists, is defined as one that is undominated by any other feasible market structure.

In the analysis of Calmette (2008), firms that participate in an international merger may be able to achieve two kinds of cost synergies: trade cost savings or production cost savings. In our model, in contrast, merged firms are also able to achieve synergies by a scale economies effect. In addition, firms compete only in the domestic market and exit from the market is not considered. The latter assumption implies that we restrict the parameter set to $f_3 < f < \overline{f}_3$, which enables us to make a relevant comparison between all the potential (feasible) market structures.

The pattern of equilibrium market structures is characterized as follows:

Proposition 3.

1. There exists an $f_a$, such that for $f_a < f < \overline{f}_3$, the EMS is an international duopoly ($M^I$). The optimal choice of production strategy (TCS or SEE) for internationally firms depends on how the trade cost level compares to the production cost difference. The critical trade cost level, where internationally merged firms are indifferent between the two strategies is given by $\overline{f}_a$. 

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When $b$, the fully decentralized structure ($M^0$) is the EMS.

Figure 8 graphically summarizes the equilibrium market structures in the domestic market for the parameter set of $(d,f)$. By holding the production cost difference at a relatively low level (i.e., it locates in the left side of $f_b$), the international duopoly structure occurs if and only if the trade cost is at intermediate levels ($f_a < f < f_\bar{b}$). Note that $f_\bar{a}$ is the threshold line with respect to the international firms’ decisions on their production strategies. More specifically, if the trade cost level is higher than $f_\bar{a}$, international firms will produce only in their domestic plants; otherwise, they prefer to keep productions at both domestic and foreign plants. However, if trade costs are lower than $f_a$, no market structure is undominated and, therefore, no equilibrium market structure exists.

![Figure 8: Equilibrium Market Structures (EMSs)](image)
In contrast, when holding the production cost difference at a relatively high level, which refers to the right side of $f_b$, the equilibrium market structure remains the international duopoly if trade costs are sufficiently high; the fully decentralized structure dominates any other structures if the trade cost is relatively low; there is no equilibrium structure when the trade cost in intermediate levels.

These results differ greatly from Calmette (2008), who found that in the case of low marginal cost of production, at least one national merger occurs in two countries when the trade cost is high and international mergers always occur when the trade cost is low; in the case of high marginal cost of production, foreign firms are able to induce domestic firms exit. What leads to these differences? First, we have modified two basic assumptions: firms compete in the single market (domestic) and trade costs do not start from prohibitive levels. Moreover, we implicitly assumed that firms incur diseconomies of scale. The combination all these modifications results in those distinct findings.
5. Trade Liberalization

In this section we will analyze the effects of trade liberalization on merger incentives, consumer surplus, and social welfare in the following.

5.1. Merger Incentives

What is the merger incentive in the domestic market along with trade liberalization? In order to identify merger incentives for firms, both foreign and domestic, we will discuss firms’ profits across countries by fixing production cost differences at a certain given value.

Figure 9a and 9b show profit consequences of domestic and foreign firms following liberalization at different levels of production cost differences. And the black line represents profits that are generated by a domestic plant, while the red line represents profit of a foreign plant.

Figure 9a: Foreign and Domestic Owners’ Profits During Trade Liberalization ($d = 0.2$)
Consider first Figure 9a, where the production cost difference is low. For the range \((\bar{f}_4, \bar{f}_3)\), international firms forego importing from their foreign plants and serve the domestic market by using domestic plants only. They will have a constant profit as a result of liberalization. However, domestic owners will not take the constant profit entirely. Because they need to share part of profit with foreign owners in order to keep their market power.

At \(f\) below \(\bar{f}_3\), domestic firms will be unable to prevent foreign firms from entering the market. The best strategy for them is to merging internationally to reduce the competition of market. More specifically, domestic firms are the largest competitors for each other. The new entrants may to be their potential partners since they realize that the competitive threat from foreign firms is weak. On the other hand, the advantages from protective trade policies are not enough to offset the negative effects (which may involve losses in market share, reduction of profit, falling of price, or combination all of these) brought by new competitors. Moreover, the threat of competition from foreign firms still is able to undo the domestic national merger. Because domestic firms take almost all market
shares, the merger paradox will occur if they engage in a national merger. In terms of foreign firms, because of the relatively high trade cost, they need to decrease their disadvantage and reinforce competitiveness by persuading domestic firms to join international coalitions. So, forming international coalitions is the best option for all firms.

To the left side of \( f_a \), foreign firms are facing the upward tendency of profits. Their disadvantage is weakened following trade liberalization, but still distinct. So, internationally merging with a domestic firm remains to be the best strategy for them. Domestic firms’ profits show a downward tendency, which induces them to make effort to slow down the tendency. They can do this by the scale economies effect.

Following trade liberalization, if \( f < f_a \), neither domestic nor foreign firms hold any clear cost advantage and the market is unable to reach equilibrium. On the one hand, competition increases, which may induce firms (who hold a slight competitive advantage) to drop out of international coalitions. At this point, firms prefer to be decentralized regardless of the behavior of another country’s firms. For instance, if foreign firms decide to merge nationally, domestic firms are willing to stay out of a merger because they can benefit from the free-rider effect. If foreign firms change their decision to undo the national merger, domestic firms also remain to be decentralized because they need to prevent any losses due to the merger paradox. However, for both foreign and domestic sides, the gain from the fully decentralized structure is always less than the national duopoly structure. That is a classic prisoner’s dilemma problem.

The market will remain in a no-equilibrium state until \( f_b \). Figure 9b shows the profits during liberalization when production cost differences between two countries are high. The first two stages of trade liberalization show the same pattern compare to the low \( d \) case.

As trade costs decrease below \( f_b \), foreign firms hold an obvious cost advantage and are unwilling to merge internationally to share the benefits with domestic competitors. They also have less incentive to merge nationally, because there is an incentive to remain single units to enjoy benefits from free-rider effect for both sides, if firms from the same country believe that firms from another country may be involved in a national merger.
Domestic firms, as the defensive side, the best strategy is to make great efforts to keep their market shares. Hence, the only way, which would meet desires of both sides, is decentralizing.

Now we are able to summarize our results about merger formation during trade liberalization. Foreign firms have strong incentives to avoid high trade cost by internationally merging, by which way domestic firms will be able to profit from the decrease of market competition. However, along with trade liberalization, firms will run into a prisoner’s dilemma except if there is sufficiently large production cost differences between the two countries.

5.2. Consumer Surplus

According to the discussion above, we know that firstly firms’ behaviors in the industry are influenced by the degree of trade liberalization, and then the market structure may be changed, thereby consumer interests and social welfare will be affected. In this process, the effects of trade liberalization on consumer interests and social welfare are indirect. Here the indicator of consumer interests reflects the impacts of variations of market price and output (which resulting from mergers) on consumer interests. The indicator of social welfare is an overall evaluation index on various social effects of mergers. These two indicators are including: consumer surplus and domestic welfare. Note that in this thesis, firms only compete in the domestic market. Hence, the social welfare is defined as the sum of consumer surplus, aggregate profits earned by firms located at the domestic market, and some percent of total profits generated by international firms are received by domestic owners and are therefore part of domestic profits. 5

First of all, let’s focus attention on the effects of trade liberalization on consumer surplus. The market price will be reduced in line with trade liberalization. We know that there is a direct link between consumer surplus and market price. If price decreases, the

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5 Tariff revenue is excluded from the social welfare, because we do not explicitly define what the trade cost includes.
consumer surplus will increase sharply.

By setting $d = 0.2$, Figure 10a illustrates the consequences for consumer surplus and market price during trade liberalization. Apparently, when international firms only produce in their domestic plants both consumer surplus and market price will remain at a constant level. Because the domestic demand is completely supplied by domestic plants and the trade cost level is unable to exert influence to the market price.

However, along with trade liberalization, international firms adjust their production strategy to restart their foreign plants according to their own-interest needs. At this moment, the price decreases with respect to the reduction of trade cost. Domestic consumers will enjoy the benefit from the lower price.

Let us now turn to the case of high production cost differences ($d = 0.7$), which is graphical illustrated in Figure 10b. In the first two stages of trade liberalization, both consumer surplus and market price show a similar pattern compared to Figure 10a, even though it is for a smaller range of trade cost. When the trade cost decreases below $f_b$, the degree of market competition is high, which can be measured by the price. Domestic consumers will gain from this.

The above findings also partly confirm Calmette (2008)’s results about the evolution of competitiveness following trade liberalization. She also introduced the price to measure the degree of market competitiveness and identified discontinuities in the sense that the market price is not linear with respect to the trade cost level.

![Figure 10a: Consumer Surplus (CS) and Market Price at Different Stages of Trade Liberalization ($d = 0.2$)](image)
5.3. Welfare

To explore the effects of trade liberalization on welfare, by holding the difference of production costs to be fixed, we compare the sum of consumer surplus and domestic firms’ profits at different stages of trade liberalization. The degree of production cost differences greatly influences domestic welfare consequences. If these differences are low, the high-cost country (domestic) firms are more competitive but an international merger may occur. On the other hand, when these differences are high, it is less attractive to produce in the domestic country.

The domestic welfare consequences of trade liberalization are illustrated in Figure 11a and 11b, where the former figure shows the case of little difference between production costs ($d = 0.2$) and the latter shows the case of huge difference ($d = 0.7$).

Consider first the case of low production cost differences. When the trade cost $f$ is lower than $f_3$, the domestic market becomes more competitive. Regardless of which behaviors will be chosen by domestic firms, foreign firms are able to enter the market and enjoy positive profits. In order to hold on to market shares, the best strategy for domestic firms is to merge internationally. On the other hand, there is an incentive to avoid the high trade cost for foreign firms. They can do this by merging internationally with a domestic firm. Because the domestic demand is supplied by domestic plants only, the trade liberalization is unable to influence the domestic welfare, which remains in a fixed level.
Figure 11a: Domestic Welfare at Different Stages of Trade Liberalization (d = 0.2)

Figure 11b: Domestic Welfare at Different Stages of Trade Liberalization (d = 0.7)
In Figure 8, $\overline{f}_4$ is the boundary in where international firms are indifferent between the strategies of TCS and SEE. When $f$ is below $\overline{f}_4$, the SEE is the preferred strategy. Therefore, as a result of trade liberalization, international firms tend to rearrange part of production to their foreign plants, which leads to the decline of domestic plants' outputs. It follows that the domestic producer surplus decreases. Although there is an increase in consumer surplus, the increment is still less than the reduction of the domestic producer surplus, so the domestic welfare decreases.

Turning to the case of a high production cost difference, $d = 0.7$, the domestic welfare consequences are illustrated in the Figure 11b. Starting from $f = \overline{f}_3$ again, the first two degrees of trade liberalization present the similar pattern of domestic welfare effects as discussed above. However, foreign firms are able to enter the market at a higher trade cost level relative to the low $d$ case, and the effective regions of those EMSs are narrower. As the trade liberalization goes on, the fully decentralized structure $M^0$ appears as the EMS after $f$ reaches $f_b$. Firms will take part in the competition of the domestic market by competing as single units because they are all in preference to enjoy the free-rider effect. The domestic producer surplus increases and will be less sensitive with respect to trade liberalization as long as $f$ is higher than $f_3$. The domestic consumer surplus shows a similar tendency. The combination of these two increments induces the domestic welfare jumps.

Obviously, firms consider more on their own interests when making decision on their behavior. This suggests a question: whether the EMSs found above are the most preferred ones in the point of view of social welfare? The most preferred market structures, with respect to different values of $d$ and $f$, are illustrated in Figure 12. For the third stage of trade liberalization ($f_y < f < f_x$), the maximal domestic welfare arises after foreign firms broke down their international coalition to engage in a national merger ($M^F$). Figure 8,

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6 To explore how the change in trade cost affects the change in producer surplus (or consumer surplus), given $d$, we can evaluate the trade cost elasticity of producer surplus (or consumer surplus). The detailed calculations are shown in the Appendix.
however, shows that the preferred structure for firms is not the foreign triopoly structure but the one with two international mergers.

When $f_a < f < f_y$, firms prefer the duopoly with two international mergers, in contrast to the socially preferred one, which is the structure $M^0$. During liberalization in this range, the difference between $d$ and $f$ decreases, and the domestic market becomes more and more competitive. From the social point, the more competitive market the better. In contrast, firms merge all the way to grab as many market shares as possible. That is the most conflict between private and public.

Since the values of $(d, f)$ at the medium level (i.e., that $f_b < f < f_a$), firms run into a prisoner’s dilemma problem (i.e., no structure is able to dominate all the others). In contrast, the socially optimal structure remains the fully decentralized.

Although there are situations where firms’ preferred structure contrasts with the socially optimal one, there also exist situations where the privately and socially preferred structures coincide. For instance, in the extreme (far-right sides of Figure 8 and 12), when the difference of production costs between two countries is sufficiently large, the EMS is $M^0$, corresponding to the socially preferred one.

The above analysis might also give some guidelines with respect to antitrust policy. In general, since the socially preferred structures do not always correspond to the equilibrium market structures, there is scope for authorities to issue welfare-enhancing anti-trust policies. For example, when the trade cost level is close to the difference in production costs between two countries, the socially preferred structure may is $M^0$. An optimal policy might then be to forbid national mergers, which might induce firms to choose the fully decentralized structure.
Figure 12: The Most Preferred Structures From a Welfare Point of View
6. Conclusion

Following the development of economic globalization in the world, more and more international mergers arise in economic hotspots, such as Europe, Asia, and America. International merger has been one of the most popular investment vehicles. The effects of trade liberalization on merger incentives have become a hotspot in economics.

In this thesis, first we have shown the effects of trade liberalization on market structures by assuming that countries have different cost disadvantages and all firms compete in the single market (domestic). We find that trade liberalization may lead to increments of competition regardless of the differences in production costs between two countries. We also find that the fully decentralized structure arises only if foreign firms hold some competitive advantages: comparatively high production cost difference between countries. International mergers arise only if domestic firms hold some competitive advantages: comparatively high trade costs. The welfare analysis helps us to understand the consequences of trade liberalization. We find that private interests do not always coincide with social interests.

Therefore, from the long-term development perspective of a firm, the best option is to make an effective strategy to adapt to changes in external environments and try hard to make own interests coincides with interests of consumers and society. In terms of social welfare, governments should formulate policies on the premise of protecting the domestic consumers’ interests, such as reducing the production difference with other countries by issuing more generous tax laws, creating a more deregulated business environment, encouraging technical innovation, improving quality of labor, cutting down financing costs of firms, moderately lowering tariff levels and easing quota control and so on.

In this thesis we sketchily describe the effects of trade liberalization on merger incentives and social welfare. The deeper investigation on merger incentives of trade liberalization is expected and we will continue to work in this field in the near future.
7. Appendix

The supporting calculations and proofs not provided in earlier sections are given in this section.

7.1. Proof of Proposition 1

From the discussion above we can find that the internationally merged firm produces at both plants (i.e., that their outputs are non-negative) if $f_5 < f < f_5$. Due to the scale economies effect, the optimal strategy for the merged firm is to keep productions at both plants. We assume first that $f < f_5$. This implies that the internationally merged firm’s domestic plant has a negative output. The best strategy for the merged firm is to shut down the negative-output plant and produce only at the foreign plant (“production cost savings”). By solving the equilibrium problem, both domestic firm and the merged firm have non-negative outputs if $f < f_1$ and $f > f_3$. The first inequality always holds for $f < f_5$ (since $f_5 > f_1$), while the second one places the lower limit on $f$. Thus, we can conclude that the “production cost savings” arises for $f_3 < f < f_5$.

On the other hand, if we suppose that $f > f_5$, output of the merged firm’s foreign plant will be negative. The best solution is to produce only at the domestic plant. Still by solving the equilibrium problem, outputs (both foreign and internationally merged firm) are non-negative if $f < f_3$ and $f > f_1$. The first inequality places the upper limit on $f$, while the second one always holds for $f > f_5$ (since $f_5 < f_1$). Thus, we can conclude that the “trade cost savings” occurs for $f_5 < f < f_3$.

Hence, we can summarize the equilibrium outcomes in this market structure as:
\( q_m^T = \begin{cases} 
\frac{1}{18}(3 + d - 4f), & f_3 < f < f_5 \\
\frac{1}{18}(3 - 4d + f), & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{26}(6 - 3d - 3f), & f_5 < f < \overline{f_5} 
\end{cases} \quad (7-1) 
\)

\( q_2^T = \begin{cases} 
\frac{1}{18}(3 - 5d + 2f), & f_3 < f < f_5 \\
\frac{1}{18}(3 - 4d + f), & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{78}(12 - 19d + 7f), & f_5 < f < \overline{f_3} \end{cases} \quad (7-2) 
\)

\( q_4^T = \begin{cases} 
\frac{1}{18}(3 + 2d - 5f), & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{78}(12 + 7d - 19f), & f_5 < f < \overline{f_3}, \quad (7-3) 
\end{cases} 
\)

\( P^T = \begin{cases} 
\frac{1}{6}(3 + d + 2f), & f_3 < f < f_5 \\
\frac{1}{6}(3 + 2d + f), & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{26}(12 + 7d + 7f), & f_5 < f < \overline{f_3} \end{cases} \quad (7-4) 
\)

\( \pi_m^T = \begin{cases} 
\frac{1}{676}[27(d - 1)^2 + 27(f - 1)^2 + 71(d - f)^2], & f_5 < f < \overline{f_5} \\
\frac{1}{162}(3 - d - 2f)^2, & f_3 < f < f_5 \\
\frac{1}{162}(3 - 4d + f)^2, & \overline{f_5} < f < \overline{f_3} \end{cases} \quad (7-5) 
\)

\( \pi_2^T = \begin{cases} 
\frac{1}{162}(3 - 5d + 2f)^2, & f_3 < f < f_5 \\
\frac{1}{162}(3 - 4d + f)^2, & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{3042}(12 - 19d + 7f)^2, & f_5 < f < \overline{f_3} \end{cases} \quad (7-6) 
\)

\( \pi_4^T = \begin{cases} 
\frac{1}{162}(3 + 2d - 5f)^2, & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{162}(12 + 7d - 19f)^2, & f_5 < f < \overline{f_3} \end{cases} \quad (7-7) 
\)

\( CS^T = \begin{cases} 
\frac{1}{72}(3 - 2d - f)^2, & f_3 < f < f_5 \\
\frac{49}{1352}(2 - d - f)^2, & f_5 < f < \overline{f_3} \end{cases} \quad (7-8) 
\)

\( DW^T = \begin{cases} 
\frac{1}{648}[87(d - 1)^2 + 30(f - 1)^2 + 22(d - f)^2], & f_3 < f < f_5 \\
\frac{1}{648}[150(d - 1)^2 + 3(f - 1)^2 + 14(d - f)^2], & \overline{f_5} < f < \overline{f_3} \\
\frac{1}{12168}[2739(d - 1)^2 + 87(f - 1)^2 + 730(d - f)^2], & f_5 < f < \overline{f_3} \end{cases} \quad (7-9) 
\)
7.2. Proof of Proposition 2

In line with the logic of section 5.1, the best strategy for internationally merged firms is to produce at both (foreign and domestic) plants if \( f_4 < f < \bar{f}_4 \). However, if \( f < f_4 \), which signifies that domestic plants’ outputs are negative, the equilibrium is a corner solution where merged firms produce only at foreign plants (“production cost savings”). Conversely, if \( f > \bar{f}_4 \), which implies that outputs of foreign plants are negative, the equilibrium is another corner solution where merged firms produce only at domestic plants (“trade cost savings”). In either corner solutions we find that outputs are non-negative for all \( f \in (0,1) \) or \( d \in (0,1) \). Thus we can conclude that the “scale economies effect” occurs for \( f_4 < f < \bar{f}_4 \); the “production cost savings” occurs for \( f < f_4 \); the “trade cost savings” occurs for \( f > \bar{f}_4 \).

Thus, we can sum up the equilibrium outcomes in this market structure as follows:

\[
q^I = \begin{cases} 
\frac{1}{5} (1 - f), & f < f_4; \\
\frac{1}{5} (1 - d), & f > \bar{f}_4; \\
\frac{1}{8} (2 - d - f), & f_4 < f < \bar{f}_4;
\end{cases}
\quad (7-10)
\]

\[
P^I = \begin{cases} 
\frac{1}{5} (3 + 2f), & f < f_4; \\
\frac{1}{5} (3 + 2d), & f > \bar{f}_4; \\
\frac{1}{4} (2 + d + f), & f_4 < f < \bar{f}_4;
\end{cases}
\quad (7-11)
\]

\[
Q^I = \begin{cases} 
\frac{1}{4} (2 - d - f), & f_4 < f < \bar{f}_4;
\end{cases}
\quad (7-12)
\]

\[
\pi^I = \begin{cases} 
\frac{1}{128} [6(d - 1)^2 + 6(f - 1)^2 + 13(d - f)^2], & f_4 < f < \bar{f}_4;
\end{cases}
\quad (7-13)
\]

\[
CS^I = \begin{cases} 
\frac{2}{25} (1 - f)^2, & f < f_4; \\
\frac{2}{25} (1 - d)^2, & f > \bar{f}_4; \\
\frac{1}{32} (2 - d - f)^2, & f_4 < f < \bar{f}_4;
\end{cases}
\quad (7-14)
\]
\[ DW^l = \begin{cases} 
\frac{2}{25}(1-f)^2, & f < \overline{f}_4; \\
\frac{6}{25}(1-d)^2, & f > \overline{f}_4; \\
\frac{1}{128}[30(d-1)^2 - 2(f-1)^2 + 9(d-f)^2], & \overline{f}_4 < f < \overline{f}_3. 
\end{cases} \tag{7-15} \]

7.3. Proof of Proposition 3

Because of differences of feasible regions of possible market structures, it suffices to show which structure dominates another structure in the respectively range of \((d, f)\).

(i) Consider now the range \(\overline{f}_4 < f < \overline{f}_3\), where all firms are surviving. In this region, the best production strategy for firms, which be involved in an international merger, is TCS. Because the trade cost is sufficiently high compare to the difference of production costs. Firstly, to explore the conditions of \(M^{ld}\) dominates all the other structures:

1. One decisive group \{2, 4\}: \(M^{ld}\) dominates \(M^{Td}\) for all \(\overline{f}_4 < f < \overline{f}_3\).

2. One decisive group \{1, 2, 3, 4\}: \(M^{ld}\) dominates \(M^N\) for all \(\overline{f}_4 < f < \overline{f}_3\).

   And dominates \(M^D\) for all \(\overline{f}_4 < f < \overline{f}_3\).

   And dominates \(M^F\) for all \(\overline{f}_4 < f < \overline{f}_3\).

3. Two decisive groups \{1, 3\} and \{2, 4\}: \(M^{ld}\) dominates \(M^0\) for all \(\overline{f}_4 < f < \overline{f}_3\).

   It is straightforward to see that \(M^{ld}\) dominates all the other structures for all \(\overline{f}_4 < f < \overline{f}_3\).

(ii) When \(\overline{f}_5 < f < \overline{f}_4\), the optimal choice of production strategy for international firms, depends on the market structure. In the international duopoly, the merged firms change their production strategy from TCS to SEE. However, the merged firm in the international triopoly remains to take TCS to avoid the trade cost. To evaluate the dominance relation as follows:
(1) One decisive group {2, 4}: \( M^I \) dominates \( M^{T_d} \) for all \( \overline{f}_5 < f < \overline{f}_4 \).

(2) One decisive group {1, 2, 3, 4}: \( M^I \) dominates \( M^N \) for all \( \overline{f}_5 < f < \overline{f}_4 \).

And dominates \( M^D \) for all \( \overline{f}_5 < f < \overline{f}_4 \).

And dominates \( M^E \) for all \( \overline{f}_5 < f < \overline{f}_4 \).

(3) Two decisive groups {1, 3} and {2, 4}: \( M^I \) dominates \( M^0 \) for all \( \overline{f}_5 < f < \overline{f}_4 \).

It is straightforward to see that \( M^I \) dominates all the other structures for all \( \overline{f}_5 < f < \overline{f}_4 \). And note that \( \overline{f}_4 \) is the line where internationally merged firms (which arise in the international duopoly structure) are indifferent between TCS and SEE.

(iii) With the development of trade liberalization \( f \leq \overline{f}_5 \), and the increment of difference between production costs but not too larger over than \( \overline{f}_5 \), the internationally merged firm in the international triopoly also achieves an incentive to move their production strategy to SEE to enjoy more combined profits. In the range \( \overline{f}_5 < f \leq \overline{f}_5 \), dominance relation are as follows:

(1) One decisive group {2, 4}: \( M^I \) dominates \( M^T \) if

\[
\overline{f}_5 \leq f < \frac{-90+2749d}{2659} - \frac{312\sqrt{5(1-2d+d^2)}}{2659}
\]

or

\[
\frac{-90+2749d}{2659} + \frac{312\sqrt{5(1-2d+d^2)}}{2659} < f \leq \overline{f}_5
\]

(2) One decisive group {1, 2, 3, 4}: \( M^I \) dominates \( M^E \) and \( M^D \) for all \( \overline{f}_5 \leq f \leq \overline{f}_5 \)

And dominates \( M^N \) if \( \overline{f}_5 \leq f < d \) or \( d < f \leq \overline{f}_5 \)

(3) Two decisive groups {1, 3} and {2, 4}: \( M^I \) dominates \( M^0 \) if

\[
\frac{5034-613d}{4421} - \frac{160\sqrt{1005(1-2d+d^2)}}{4421} < f \leq \overline{f}_5.
\]
Note that for all $d \in (0, 1)$, \[
\frac{-90 + 2749d}{2659} + \frac{312\sqrt{5}(1-2d+d^2)}{2659} > \frac{5034-613d}{4421} - \frac{168\sqrt{1005(1-2d+d^2)}}{4421} > d > \frac{-90 + 2749d}{2659} - \frac{312\sqrt{5}(1-2d+d^2)}{2659}.
\] It results that $M'$ dominates all the other structures if $f_5 \leq f \leq \bar{f}_5$ for $f > f_a$, where $f_a = \frac{-90 + 2749d}{2659} + \frac{312\sqrt{5}(1-2d+d^2)}{2659}$. In Proposition 3, we have specified that structures with national merger will never be the EMS for the range $f_3 < f < \bar{f}_3$. Thus, there are two remaining possible market structures $M^T$ and $M^0$.

(4) One decisive group {2, 4}: $M^T$ dominates $M'$ if \[
\frac{312\sqrt{5}(1-2d+d^2)}{2659} < f < \frac{-90 + 2749d}{2659} + \frac{312\sqrt{5}(1-2d+d^2)}{2659}.
\]

(5) One decisive group {1, 3}: $M^T$ dominates $M^0$ if \[
\frac{28653-4271d}{24382} - \frac{819\sqrt{1205(1-2d+d^2)}}{24382} < f \leq \bar{f}_5.
\]

(6) One decisive group {1, 2, 3}: $M^T$ dominates $M^F$ if $f_5 \leq f < d$ or $\frac{1}{58}(33 + 58d) < f \leq \bar{f}_5$.

(7) One decisive group {1, 3, 4}: $M^T$ dominates $M^D$ if $f_5 \leq f < \frac{1}{58}(-33 + 91d)$ or $d < f \leq \bar{f}_5$.

(8) One decisive group {1, 2, 3, 4}: $M^T$ is dominated by $M^N$ completely. It is straightforward to see that $M^T$ does not dominate all the other structures.

(9) One decisive group {1, 3}: $M^0$ dominates $M^T$ if $f_5 \leq f < \frac{28653-4271d}{24382} - \frac{819\sqrt{1205(1-2d+d^2)}}{24382}$.

(10) One decisive group {1, 2}: $M^0$ dominates $M^D$ if $f_5 \leq f < \frac{14109+145d}{14254} - \frac{5733\sqrt{6(1-2d+d^2)}}{14254}$.

(11) One decisive group {3, 4}: $M^0$ dominates $M^F$ for all $f_5 \leq f \leq \bar{f}_5$.

(12) Two decisive group {1, 3} and {2, 4}: $M^0$ dominates $M'$ if $f_5 \leq f <
(13) Two decisive group \{1, 2\} and \{3, 4\}: \(M^0\) is dominated by \(M^N\) completely. Hence, we can summarize that in the range \(f_\alpha \leq f \leq f_5\), the only EMS is \(M^{Id}\) for \(f > f_\alpha\).

(iv) In the range of \(f_4 \leq f < f_5\), the merged firm in the international triopoly have an incentive to change their production strategy to PCS to earn highest combined profits. Then to explore the dominance relation as follows:

1. One decisive group \{1, 3\}: \(M^0\) dominates \(M^T\) for all \(f_4 \leq f < f_5\);
2. One decisive group \{1, 2\}: \(M^0\) dominates \(M^D\) for all \(f_4 \leq f < f_5\);
3. One decisive group \{3, 4\}: \(M^0\) dominates \(M^F\) for all \(f_4 \leq f < f_5\);
4. Two decisive groups \{1, 3\} and \{2, 4\}: \(M^0\) dominates \(M^{I_f}\) for all \(f_4 \leq f < f_5\).
5. Two decisive groups \{1, 2\} and \{3, 4\}: \(M^0\) is dominated by \(M^N\) for all \(f_4 \leq f < f_5\). However, the structure \(M^N\) is not able to dominate all the other structures. It has been verified in Proposition 3.

It follows that there is no EMS for all \(f_4 \leq f < f_5\).

(v) When \(f_3 < f < f_4\), the internationally merged firms in the international duopoly also find an incentive to alert their production strategy to PCS strategy. To explore conditions of \(M^0\) dominates all the other structures as follows:

1. One decisive group \{1, 3\}: \(M^0\) dominates \(M^{T_f}\) for all \(f_3 < f < f_4\);
2. One decisive group \{1, 2\}: \(M^0\) dominates \(M^D\) for all \(f_3 < f < f_4\);
3. One decisive group \{3, 4\}: \(M^0\) dominates \(M^F\) for all \(f_3 < f < f_4\);
4. Two decisive groups \{1, 3\} and \{2, 4\}: \(M^0\) dominates \(M^{I_f}\) for all \(f_3 < f < f_4\).
Two decisive groups \{1, 2\} and \{3, 4\}: \( M^0 \) dominates \( M^N \) if \( f < \frac{-258+1151d}{893} - \frac{336\sqrt{6(1-2d+d^2)}}{893} \).

It results that in the range \( f_3 < f < f_4 \), \( M^0 \) dominates all the other structures for \( f < f_b \), where \( f_b = \frac{-258+1151d}{893} - \frac{336\sqrt{6(1-2d+d^2)}}{893} \). And for \( f > f_b \), there is no equilibrium market structure existing.

### 7.4. Elasticity

Given elasticity function as:

\[
E_{f,k}^i = \frac{\partial k}{\partial f} \frac{f}{k} 
\]

Where \( i = M^i \) and \( k = Cs \) (consumer surplus) or \( Ps \) (domestic producer surplus).

(i) Given \( d = 0.2 \):

a) For \( \frac{13}{25} < f < \frac{27}{25} \), \( E_{f,Ps}^{M^id} = 0 \) and \( E_{f,Cs}^{M^id} = 0 \), in this range of \( f \), both consumers surplus and producer surplus are indifferent to the variation of trade liberalization.

b) For \( \frac{2299+1248\sqrt{5}}{13295} < f \leq \frac{13}{25} \),

\[
\frac{\partial Ps}{\partial f} = \frac{14.8+6f}{128} > 0,
\]

which implies that the producer surplus is on the rise with respect to \( f \); 

\[
E_{f,Ps}^{M^i} = 2 - \frac{4.6}{f+4.6} - \frac{1}{3f+1} > 0. 
\]

And \( \frac{\partial Cs}{\partial f} = \frac{-1.8+f}{16} < 0 \), which implies that the consumer surplus is in a downtrend with respect to the trade cost;

\[
E_{f,Cs}^{M^i} = 2 - \frac{3.6}{1.8-f} < -1. 
\]
(ii) Given \( d = 0.7 \):

a) For \( \frac{41}{50} < f < \frac{22}{25} \): \( E_{f,PS}^{M^d} = 0 \) and \( E_{f,CS}^{M^d} = 0 \);

b) For \( \frac{19153 + 936\sqrt{5}}{26590} < f \leq \frac{41}{50} \):

\[
\frac{\partial P_s}{\partial f} = \frac{1.8 + 6f}{128} > 0, \quad E_{f,PS}^{M^l} = 2 + \left( \frac{1}{2f-1} - \frac{1.1}{f^{1.1}} \right) > 2;
\]

And \( \frac{\partial C_s}{\partial f} = -\frac{1.3 + f}{16} < 0, \quad E_{f,CS}^{M^l} = 2 - \frac{2.6}{1.3-f} < -1; \)

And \( \frac{\partial C_s}{\partial f} = -\frac{1.3 + f}{16} < 0, \quad E_{f,CS}^{M^l} = 2 - \frac{2.6}{1.3-f} < -1; \)

c) For \( \frac{1}{4} < f < \frac{5477 - 1008\sqrt{6}}{8930} \):

\[
\frac{\partial P_s}{\partial f} = -\frac{8(1-2f)}{441} < 0, \quad E_{f,PS}^{M^0} = 2 - \frac{1.76}{0.88-f} < 0;
\]

And \( \frac{\partial C_s}{\partial f} = \frac{4}{49} (-1.3 + f) < 0, \quad E_{f,CS}^{M^0} = 2 - \frac{2.6}{1.3-f} < -1. \)
8. References


