Examining a Link between Trade and Competition Policies

by

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Abstract

This paper examines a linkage between trade and merger policies and benefits of international policy coordination in a simple two-good-two-country model that incorporates specialized production. The present paper is distinguished from the mainstream literature in two major ways. First, it avoids the typically assumed Cournot competition and instead considers differentiated product Bertrand competition. Second, unlike the mainstream researches which consider only trade and merger policies, it introduces an additional domestic sales tax variable into the analysis. The results of the analysis document that the countries have incentives to use their merger policies as strategic trade policies when trade is liberalized. For trade liberalization of a large magnitude, the countries have motives to merge their firms into monopolies. The removal of the domestic sales tax from the analysis greatly reduces the countries' incentives for mergers in case of trade liberalization. It is shown that a coordination of merger policies following the trade liberalization can improve both countries' welfare regardless of the presence of the domestic sales tax.

1 Introduction

In an open economy, any national law or policy affecting domestic production and consumption is likely to interact in important ways with the country's trade policies. Competition policy is one such article of concern. With the advancements in communication and transportation technology and reductions in trade barriers, geographic boundaries between national markets are disappearing at a rapid pace. In this increasingly global economy, the diversity in the form and degree of enforcement of competition policies among different nations has "more marked international consequences, underscoring the importance of mutually-supportive trade and competition policies."[1]

In recent years, there have been many movements for the development of multilateral disciplines on competition policy in international fora. For example, the Singapore Ministerial Meeting of the WTO in 1996 established a working group on competition policy and mandated that the working group submit its report to the General Council by the end of 1998. Since its establishment, the working group has received more than 60 national submissions on the subject of trade and competition policies. In their discussions, many members have noted competition policy laws as an essential part of their development strategies, especially as a complement to trade liberalization.[2]

Similarly, at the 1995 APEC Osaka Meeting, competition policy was designated as one of 15 areas that require international coordination by the member nations, and the agreement to establish appropriate cooperation arrangements was incorporated in their Action Plan.[3] Also, in the European Union, the promotion of a series of bilateral, trilateral and multilateral initiatives to ensure effective international competition has been one of the Community priorities over the past few years.[4]

The formulation of an effective multilateral discipline mechanism for competition policy undoubtedly requires an accurate understanding of the linkage between trade and competition policies in an open economy. The current research focuses on one particular type of

[1]The WTO Press Pack [16], *Progress on Singapore Initiatives.*
[2]The WTO Press Pack [16], *Progress on Singapore Initiatives.*
[3]Lloyd [10], p. 3.
[4]Jacquemin [7], p. 781.

competition policy, namely merger policy, and examines its interaction with an export tax policy as well as welfare implications of international coordination of merger policies in a simple two-good-two-country model that incorporates specialized production.

This paper utilizes many features of existing works, especially that of Horn and Levinsohn [6]. As in other papers, this paper retains the exogeneity of a merger process, i.e. the model specifies that each country's government can directly choose the number of firms to merge, and assumes some degree of symmetry among firms and countries as needed. However, it is distinguished from the existing literature in two major aspects.

First, this study assumes that the mode of competition in the market is Bertrand with horizontally differentiated products. Most of the existing papers consider homogeneous products and assume that firms compete in Cournot fashion. As Salant, Switzer and Reynolds [14] point out, this kind of setup requires very concentrated industries in equilibrium for the proposed merger to be profitable. However, it in turn effectively limits the scope of interaction between trade and merger policies. The present research does away with this shortcoming by assuming an alternative form of market conduct.[5]

Second, in this paper, an additional policy variable is introduced into the analysis. All of the existing works allow only two policy variables for each government, trade and merger policies. However, in reality, countries commonly employ multiple policy tools, and these policies surely all interact with each other. Therefore, it is plausible to assume that the linkage between trade and merger policies will be affected by the presence of an additional policy. This possibility is investigated in the case that a country can impose a sales tax on domestic brands sold in the domestic market (Throughout the paper, it will be often abbreviated as a domestic sales tax).[6]

The present analysis finds that there exist explicit relationships between each country's

[5]This paper adopts the framework of Davidson and Deneckere [4] which shows that a merger of any size is beneficial for the merging firms and is increasingly so with the merger size. However, one must note that it does not eliminate what is known as the "hold up" problem in the endogenous merger literature. The basic point of the "hold up" problem is that, when mergers are endogenized, a merger to a monopoly may not be feasible because firms have incentives to stay outside the merging coalition and benefit from the externality generated by the merger. For more details on this, readers are referred to Kamien and Zang [8]. The endogenous merger and "hold up" problem are not treated in this paper but are items for future research.

[6]The issue of multiple policies was brought up by Professor Stephen W. Salant in the international trade conference held at the University of Michigan, Ann Arbor, in December 1997. He suggested the introduction of a domestic production subsidy in the case of Cournot competition.

export tax policy and merger policy, and also between its domestic sales tax policy and merger policy. It is shown that both taxes are monotonically decreasing functions of the country's merger policy.

The analysis also finds that, if countries set their trade and merger policies independently, the welfare maximizing merger policy for each country is to have no merger in its domestic industry. However, if they are constrained by an international agreement in setting their export taxes, each country uses its merger policy as a strategic trade policy to shift rents from its trading partner. If there is trade liberalization to a large degree, the countries have incentives to merge their firms to monopolies.

If the domestic sales tax variable is removed from the model, the countries' incentives to use their merger policies as strategic trade policies are greatly reduced. Even if trade is completely liberalized, i.e. zero export tax, it is never welfare maximizing for the countries to merge their domestic firms to monopolies. It is shown that, regardless of the presence of the domestic sales tax, a coordination of national merger policies following trade liberalization can improve both countries' welfare.

The rest of the paper is organized as follows. Section 2 briefly examines a selected number of related works on the topic. Section 3 lays out a model, and section 4 provides a list of additional assumptions needed to facilitate the analysis. In section 5, the results of the analysis are summarized. In section 6, the core analysis is repeated with the domestic sales tax variable removed. Finally, section 7 concludes the paper.

2 Literature Survey

This section provides a brief survey of the existing papers that consider the relationship between trade and competition policies and/or the coordination of competition policies. Readers must be advised that the list provided here is by no means exhaustive.

In a two-country Cournot oligopoly model, Dixit [5] shows how home country's welfare depends on the numbers of home and foreign firms and its various tax/subsidy policies. He illustrates that home country's optimal export subsidy is a function of both the number of home firms and the number of foreign firms; however, he does not treat the firm numbers as

the countries' choice variables.

Rysman [13] demonstrates the role of a domestic merger policy as a strategic trade policy in the framework of Brander and Spencer [3]. He shows that the home government's merger/divestiture policy can work just like an export subsidy. Each government has an incentive to increase the size of its domestic industry to achieve Stackelberg leadership in the third country market, and, as a consequence, the total number of firms in the third country approaches infinity.

Levinsohn [9] explores the interaction between trade and competition policies in various settings and, using graphical tools, also considers the harmonization of competition policies between two countries when one of them has price-fixing cartels. He finds that, if the countries' competition policy standards are different in their strictness, both countries can improve their welfare by harmonizing their policies towards the stricter standard of the two.

A number of papers use some variants of the reciprocal dumping model to consider the coordination of competition policies. Examples in this category include Bliss [1], Lloyd [10] and Horn and Levinsohn [6].

In a simple multi-country cross-hauling model, Bliss [1] shows how each country has an incentive to use its merger policy for shifting rents from its trading partners, creating possible trade torts in some cases. Nevertheless, the author argues that competition policy should be left outside trade laws since much of the ground can be covered by the existing trade codes.

Lloyd [10] discusses some of the problems and principles in the harmonization of competition policies among the APEC countries. To illustrate how the harmonization would affect competition and world welfare, he provides some examples, including a two-country cross-hauling model that incorporates increasing returns. In this model, it is shown that, for small economies of scale, the harmonization towards the more pro-competitive standard improves the world welfare even though one of the two countries may lose from the move.

The paper that is most relevant to the current research is Horn and Levinsohn [6]. They develop a two-country partial equilibrium model and consider several scenarios of trade and merger policy coordination using a variety of merger models and trade policies. It is shown that, even with a linear demand and symmetric countries, there generally does not exist a specific relationship between international trade liberalization and the equilibrium degree of

concentration. Instead, the relationship depends on the specifics of the situation.

Other papers such as Bond [2] and Richardson [12] deal with the coordination of competition policies within the context of customs unions. These papers also typically assume homogeneous product Cournot competition.

Employing a political economy framework, Bond [2] examines price-fixing and horizontal mergers in a customs union. The outcome of a policy set at the union level is compared with that set by the member countries. The model is applied to the division of merger authority between the states and the federal government in the US right after the passage of the Sherman Act. The author shows that the model is helpful in explaining the existence of regional differences in the strictness and enforcement of antitrust laws in this period.

Richardson [12] studies the effect of competition policy coordination in a two-country and a three-country customs union models. For the two-country case, he shows that the formation of a customs union initially leads to tighter competition policies, i.e. an increase in the number of firms, but the subsequent coordination of competition policies results in less competitive outcomes and may even involve disharmonization. If a third non-member country is added to the model, its reaction to the union's formation makes disharmonization a more likely outcome for the members.

Lloyd and Richardson [11] consider a two-country differentiated product Cournot oligopoly model that incorporates multinational corporations. The authors find that, if the number of firms is fixed exogenously, the convergence of competition policies towards the more pro-competitive country's standard does not generally increase both countries' welfare. If the countries choose the number of firms optimally, the non-cooperative choices of competition policy tend to involve excess competition relative to the cooperative choices.

The papers surveyed above share a common theme which can be summarized as the following. Suppose that home and foreign countries liberalize their bilateral trade by completely removing their tariffs (export subsidies). With Cournot competition as market conduct, to help its domestic firms establish Stackelberg leadership in the home (foreign) market after trade liberalization, home government wishes to increase its domestic industry's production. Absent the availability of domestic production subsidy, home country achieves the goal by increasing the number of home firms through its merger/divestiture policy.

However, one must note that individual firms generally do not have the same incentive for divestiture as their government. Ceteris paribus, the divestiture does increase total domestic output, but each individual firm's output decreases with the policy, causing a reduction in its profit. Hence, the commonly assumed framework of homogeneous product Cournot competition produces a conflict of interest between the government and its constituents with regard to a merger policy.

This paper removes the aforementioned problem by changing the market conduct to differentiated product Bertrand competition. As will be shown later, with price as a strategic variable, each government's incentive for rent shifting requires firms to merge rather than to divest following trade liberalization. Moreover, unlike the Cournot case, Bertrand competition does not necessitate very concentrated industry structures for a proposed merger to be profitable. Because a merger of any size increases the participants' profits with Bertrand competition, there is no conflict of interest between private firms and their government.

Another noticeable common feature of the surveyed papers is the limited number of policies available to governments. Namely, these papers allow only one kind of trade policy and a merger policy in their analyses. This paper will demonstrate that it is important to consider other policy variables in studying the relationship between trade and merger policies. It will be shown that an introduction of a domestic sales tax on home brands greatly reduces the merger incentive in the event of trade liberalization.

3 The Model

3.1 Basic Framework

Consider the following two-country-two-good partial equilibrium set up. The two countries are denoted as country A and B. Both countries produce and consume a wide range of goods, but, among these goods, there are two particular products which require specialized production by the two countries. To be specific, country A specializes in the production of good x and country B in good y. [7]

[7] As will be explained shortly, the paper assumes that the market conduct is differentiated product Bertrand competition. It is well known that the analysis can get very complicated with this particular

In these two countries, there are demands for both goods x and y. Therefore, country A consumes a portion of its good x production and exports some to country B. Country B acts in the same manner with its specialized production of good y. The markets for both goods are segmented, and there is no transportation cost.

Countries A and B also trade many goods with other countries which are not modeled explicitly in the analysis. Because this is a partial equilibrium analysis, the model does not deal with the problem of balance of payments. In addition, the model assumes that the exchange rate between country A's and country B's currencies is fixed at an one-to-one ratio. For convenience, other consumption commodities besides goods x and y in country A and B are aggregated together into composite goods z^A and z^B.

In country A, there are N_A symmetric firms, each producing a different brand of good x, and, in country B, there are N_B symmetric firms producing different brands of good y. Different brands of the same good are substitutes (but not perfect substitutes) for each other, and firms compete in Bertrand fashion. However, goods x and y are two distinct products that are neither substitutes nor complements in consumption.

Each country has three policy instruments, an export tax, a sales tax on domestic brands sold in the domestic market (hereafter abbreviated as a domestic sales tax) and a merger policy.[8] [9] It is assumed that each country uses these policy tools to maximize its objective function, the unweighted country welfare equation. The merger policy is modeled as the government's direct control of the number of merging firms, i.e. each government sets explicitly the number of firms to merge in its domestic market. For simplicity, the possibility of international merger is assumed away at this stage.

This paper does not examine strategic interactions of the two governments with their policy variables in the tradition of game theory. Rather, it focuses on investigating the

mode of competition. The analysis of an earlier trial version of the model that assumed two-way trade of the same commodity suggests that the assumption of specialized production is needed to have a sensible working model.

[8] When these taxes take on negative numbers, they are equivalent to subsidies.

[9] Note that this domestic sales tax on domestic brands is neither an ordinary consumption nor production tax for it does not affect consumption or production of all brands in the domestic market. Since the export tax affects the sales of domestic brands in the export market only, the domestic sales tax is specifically designed to influence the domestic brands' home sales only. This form of domestic sales tax is not uncommon in the economics literature. For example, Dixit [5] considers a sales subsidy on home firms' home sales in a two-country cross-hauling model.

relationship between trade and merger policies and studying the welfare implications of international policy coordination under three exogenously constructed scenarios following Horn and Levinsohn [6].

The three scenarios of concern are as follows. The first case deals with the situation in which each country sets its trade and merger policies independently, our benchmark case. The second case examines the results of independently set merger policies in the presence of trade liberalization. The trade liberalization is modeled as an international agreement that exogenously constrains the signatories' trade policies. Finally, in the third case, trade liberalization is followed by the coordination of merger policies. Again, the merger policy coordination is modeled as an agreement that constrains the individual country's merger standard to some exogenous level.

It is assumed that, in each country, the government's tax and merger policies are set prior to firms' production and export activities. As for the timing of the merger and various tax policies, the model stipulates that the merger policy be set first and followed by the simultaneous determination of export and domestic sales taxes. In the case of international policy coordination, each country by construction loses its control over the policy being coordinated.

3.2 Details of the Model

This subsection lays out the assumptions of the model and examines the objective functions of consumers, firms and governments in detail. A few words on notational convention are in order. Throughout the paper, with the exception of N_i and K_i for $i = A, B$, the superscript on each variable represents the country index, and the subscript denotes the firm/product index. In both countries, the price of good x is represented by p with appropriate country and firm indices, and the price of good y by r with indices.

3.2.1 Consumers

In country j, for $j = A, B$, there are l^j consumers. These individuals consume a composite good z^j and all brands of goods x and y. The composite good is taken to be a numeraire good

in each country. It is assumed that citizens of country A and B have the same functional form of preferences and, in addition, identical utility-function-parameters for their good x and y consumption.

The model also assumes that, within a country, individuals are identical with respect to their preferences. Therefore, for the analysis, it suffices to consider the utility function of a representative consumer in one country. For the remainder of this subsection, the analysis concentrates on country A.

A typical consumer in country A with income m^A maximizes the following utility function subject to a budget constraint.[10]

$$\begin{aligned} u^A(x_1^A, \cdots, x_{N_A}^A, y_1^A, \cdots, y_{N_B}^A, z^A) &= \nu^A(x_1^A, \cdots, x_{N_A}^A) + \mu^A(y_1^A, \cdots, y_{N_B}^A) + z^A \qquad (1) \\ s.t.\ \textstyle\sum_{i=1}^{N_A} p_i^A x_i^A + \sum_{j=1}^{N_B} r_j^A y_j^A + z^A &= m^A \\ where \quad \nu^A = \alpha \textstyle\sum_{i=1}^{N_A} x_i^A - \frac{1}{2(1+\gamma)}[\sum_{i=1}^{N_A}(x_i^A)^2 + \frac{\gamma}{N_A}(\sum_{i=1}^{N_A} x_i^A)^2] \\ \mu^A = \beta \textstyle\sum_{j=1}^{N_B} y_j^A - \frac{1}{2(1+\delta)}[\sum_{j=1}^{N_B}(y_j^A)^2 + \frac{\delta}{N_B}(\sum_{j=1}^{N_B} y_j^A)^2]. \end{aligned}$$

From this constrained utility maximization problem, one may derive a demand function for each brand of good x and y. Since the utility function is additively-separable and quasi-linear, the demand functions for these differentiated products do not depend on income. To elaborate, the demands for a typical brand i of good x and j of y may be represented as

$$x_i^A(p_1^A, \cdots, p_{N_A}^A) = \alpha - p_i^A - \gamma(p_i^A - \tfrac{1}{N_A}\textstyle\sum_{k=1}^{N_A} p_k^A), \quad i = 1, ..., N_A, \qquad (2)$$

$$y_j^A(r_1^A, \cdots, r_{N_B}^A) = \beta - r_j^A - \delta(r_j^A - \tfrac{1}{N_B}\textstyle\sum_{k=1}^{N_B} r_k^A), \quad j = 1, ..., N_B. \qquad (3)$$

Substituting these demand functions into equation 1, and using the budget constraint, we can derive the indirect utility function as follows.

$$\begin{aligned} & v^A(p_1^A, \cdots, p_{N_A}^A, r_1^A, \cdots, r_{N_B}^A, m^A) \qquad (4) \\ = \quad & [\nu^A(p_1^A, \cdots, p_{N_A}^A) - \sum_{i=1}^{N_A} p_i^A x_i^A(p_1^A, \cdots, p_{N_A}^A)] + \end{aligned}$$

[10] The utility function used in this paper is a modified version of the setup in Shubik [15], p. 132.

$$
\begin{aligned}
& [\mu^A(r_1^A, \cdots, r_{N_B}^A) - \sum_{j=1}^{N_B} r_j^A y_j^A(r_1^A, \cdots, r_{N_B}^A)] + m^A \\
= \; & [\alpha(\frac{1}{2}N_A\alpha - \sum_{i=1}^{N_A} p_i^A) + \frac{1}{2}(1+\gamma)\sum_{i=1}^{N_A}(p_i^A)^2 - \frac{\gamma}{2N_A}(\sum_{i=1}^{N_A} p_i^A)^2] + \\
& [\beta(\frac{1}{2}N_B\beta - \sum_{j=1}^{N_B} r_j^A) + \frac{1}{2}(1+\delta)\sum_{j=1}^{N_B}(r_j^A)^2 - \frac{\delta}{2N_B}(\sum_{j=1}^{N_B} r_j^A)^2] + m^A \\
= \; & cs_x^A(p_1^A, \cdots, p_{N_A}^A) + cs_y^A(r_1^A, \cdots, r_{N_B}^A) + m^A
\end{aligned}
$$

where cs_x^A and cs_y^A denote the representative consumer's surpluses from good x and y respectively.

Since consumers in countries A and B have the same structure of preferences, the representative consumer's demands for various brands of good x and y in country B and his consequent indirect utility function can be derived by simply changing superscripts of variables in the equations 1 - 4 to B.

3.2.2 Producers

This subsection derives firms' profit functions and delineates the merger process. In order to derive the firms' profits, it is necessary to specify the structure of production costs and various taxes. For convenience, it is assumed that firms produce at a constant marginal cost, and the marginal cost is identical for firms from the same country. There is no fixed fee required for operation.

All taxes are assumed to be specific taxes. Note that the timing of the policy formulation in each country makes all taxes functions of that country's merger policy. To conserve notation and space, the arguments of the tax functions are suppressed in the remainder of this section.

Given the symmetry between the two countries, this subsection concentrates on country A for the derivation of profit functions. The firms from country A need to pay their government a sales tax in order to sell their products in their domestic market. If we let π_i^A represent the profit from domestic sales of firm i from country A, it can be written as

$$
\pi_i^A(p_1^A, \cdots, p_{N_A}^A) = l^A(p_i^A - s^A - c^A)[\alpha - p_i^A - \gamma(p_i^A - \frac{1}{N_A}\sum_{k=1}^{N_A} p_k^A)] \tag{5}
$$

where s^A denotes the domestic sales tax in country A and c^A denotes the marginal cost pertinent to the firms from country A. Notice that, to find the aggregate demand in country A for firm i's product, the representative consumer's demand is multiplied by the population size.

Next, let us consider the profit that firm j from country B makes by selling its brand j of good y in country A. To export its products to country A, the firm j must pay its home government an export tax e^B on each unit of its export. Then, the firm j's profit may be written as

$$\phi_j^A(r_1^A, \cdots, r_{N_B}^A) = l^A(r_j^A - e^B - c^B)[\beta - r_j^A - \delta(r_j^A - \frac{1}{N_B}\sum_{k=1}^{N_B} r_k^A)] \tag{6}$$

where c^B stands for the marginal cost of the firms from country B.

In a similar fashion, the firm i's profit from exporting its products to country B and the firm j's profit from its domestic sales can be derived as follows.

$$\pi_i^B(p_1^B, \cdots, p_{N_A}^B) = l^B(p_i^B - e^A - c^A)[\alpha - p_i^B - \gamma(p_i^B - \frac{1}{N_A}\sum_{k=1}^{N_A} p_k^B)] \tag{7}$$

$$\phi_j^B(r_1^B, \cdots, r_{N_B}^B) = l^B(r_j^B - s^B - c^B)[\beta - r_j^B - \delta(r_j^B - \frac{1}{N_B}\sum_{k=1}^{N_B} r_k^B)] \tag{8}$$

The form of merger used in this paper is a modified version of the single partnership model in Davidson and Deneckere [4]. The original merger process is such that, when a subset of firms in the industry merge, they all engage in production activities and maximize their joint profits by charging the same price. As the merger size increases, the equilibrium prices charged by the merging coalition and outsiders all increase. With this setup, the authors show that a merger of any size is profitable for the merging firms and is increasingly so with the merger size. It is also shown that, for any merger, outside firms take a free ride and earn larger profits than do the participating firms.[11]

The results of Davidson and Deneckere are derived with a constant marginal cost only, but the present setup incorporates the domestic sales and export taxes. As noted at the

[11] Davidson and Deneckere [4], theorems 1 and 2, p. 477-478.

beginning of this subsection, these taxes are not constant but vary depending on the value of merger policy. As a result, the marginal cost of production net of taxes also varies with the merger size. Nevertheless, it can be easily verified that the results of Davidson and Deneckere still apply to our modified model. [12]

To elaborate on the merger process, suppose that a subset of firms in the product x industry merge as the result of the government A's merger policy. Let K_A denote the size of this subset of firms, and, without loss of generality, assume that the first K_A of N_A firms belong to this coalition. Then, the profit maximization problem of a typical firm h of the coalition in its domestic market is

$$\begin{aligned} \underset{p_h^A}{max} \quad & \textstyle\sum_{g=1}^{K_A} l^A (p_g^A - s^A - c^A)[\alpha - p_g^A - \gamma(p_g^A - \frac{1}{N_A}\sum_{k=1}^{N_A} p_k^A)] \\ & s.t.\ p_1^A = \cdots = p_{K_A}^A = p_M^A \end{aligned} \tag{9}$$

where p_M^A denotes the common price which the merging firms charge. Let x_M^A and π_M^A represent the per member output and profit of this coalition.

The firm that does not participate in the merger maximizes the profit function specified in equation 5. Because firms are symmetric by construction, in a Bertrand Nash-equilibrium, the non-participating firms also charge identical prices, that is $p_{K_A+1}^A = \cdots = p_{N_A}^A = p_O^A$. Let us denote each outsider's output and profit as x_O^A and π_O^A.

By solving the first order conditions of equation 9 and 5 simultaneously, it is possible to find p_M^A and p_O^A as functions of exogenous parameters of the model and variables representing various government taxes. The equilibrium outputs x_M^A and x_O^A can also be derived as functions of the same parameters by substituting the equilibrium prices into the demand function 2 and multiplying the result by the population parameter l^A. The substitution of these prices into the profit function 5 produces the equilibrium profits π_M^A and π_O^A. These equilibrium prices, quantities and profits are presented explicitly in Appendix A.1.

The firms in the coalition will also jointly maximize their profits when they export their goods to country B. Let p_M^B represent the common price they charge in country B, and let

[12] To conserve space, the proof of this claim is not presented here but is available from the author upon request.

x_M^B and π_M^B be the per member output and profit. Because the outside firms are symmetric, their prices in the export market will be identical as well. Let the representative outsider's price in country B be denoted by p_O^B, and his output and profit by x_O^B and π_O^B. These prices, outputs and profits can be derived as functions of exogenous parameters of the model in a Bertrand Nash-equilibrium by solving appropriate first order conditions simultaneously.

The above merger process and symmetry argument on the outside firms are applied to the firms in country B which produce different varieties of good y. The prices which the firms in the coalition charge in country A and B are represented as r_M^A and r_M^B respectively. Similarly, the outside firms' prices in country A and B are denoted as r_O^A and r_O^B respectively. The same notational convention holds for outputs and profits of these firms in both markets.

3.2.3 National Welfare

The national welfare function in each country is constructed as an unweighted sum of consumers' surpluses, producers' surpluses and revenues from various taxes. Because the countries are symmetric, again, this subsection concentrates on country A.

Let cs_{xm}^A and cs_{ym}^A represent the representative individual's consumer surpluses from good x and y in country A evaluated at the post-merger Bertrand Nash-equilibrium prices. Then, ignoring the arguments of each function, country A's welfare equation can be summarized as

$$\begin{aligned} w^A &= l^A cs_{xm}^A + l^A cs_{ym}^A + (\sum_{i=1}^{K_A} \pi_M^A + \sum_{i=K_A+1}^{N_A} \pi_O^A) + (\sum_{i=1}^{K_A} \pi_M^B + \sum_{i=K_A+1}^{N_A} \pi_O^B) + \\ &\quad s^A(\sum_{i=1}^{K_A} x_M^A + \sum_{i=K_A+1}^{N_A} x_O^A) + e^A(\sum_{i=1}^{K_A} x_M^B + \sum_{i=K_A+1}^{N_A} x_O^B) \\ &= w_x^A + l^A cs_{ym}^A. \end{aligned} \tag{10}$$

where w_x^A denotes the part of its welfare related to good x brands.

Note that, to simplify the analysis, the term representing individual income, m^A, has been omitted from the welfare calculation.[13] The parameters that represent population sizes

[13] Also, note that the firm profits from markets other than B do not appear in the welfare function for they are not modeled explicitly in the analysis.

do not appear in the producers' surpluses and market demands because they have been already taken into account as illustrated in subsection 3.2.2.

4 Additional Assumptions

The analysis can be made quite complicated when the market conduct is assumed to be differentiated product Bertrand competition. Hence, to simplify the subsequent analysis, some additional assumptions on the exogenous parameters of the model are made in this section.

First, it is assumed that the population sizes in country A and B are equal, i.e. $l^A = l^B = l$. Next, the constant marginal cost of production in each country is taken to be strictly positive but sufficiently small such that $c^A < \alpha$ and $c^B < \beta$.

To be realistic, the total number of firms in the industry and the merging coalition, N_i and K_i respectively for $i = A$ and B, need to be positive integers. However, as it will be made clear shortly, treating these variables as continuous numbers facilitates the analysis greatly. Therefore, the integer constraint is suppressed in the derivation of certain mathematical expressions but is taken into consideration in the numerical evaluation and interpretation of these equations.

There must be enough firms in each country's industry for the merger policy to have any implication. With the integer constraint in place, the minimum required number of firms is two. In interpreting the results, the model assumes that the total number of firms in each country, N_i, is greater than or equal to two but less than infinity. Note that, under the current setup, each country's merger policy variable, K_i is bounded by one from below and by N_i from above.[14]

The parameters γ and δ in the demand functions for good x and y measure the degree of substitution between different brands of the good. As they approach infinity, different brands become perfect substitutes for each other. When they are set to zero, all brands become totally unrelated in consumption. Since products are assumed to be differentiated

[14]If K_i is equal to N_i, it means that the country i wishes to create a monopoly in its domestic industry. If K_i is equal to one, it corresponds to no merger solution.

substitutes in the present analysis, these parameters must be strictly greater than zero. For convenience, this paper assumes that γ and δ are also bounded from above by some positive numbers. In particular, the model takes the numbers of firms in the respective industries as the upper bounds. That is, $0 < \gamma \leq N_A$ and $0 < \delta \leq N_B$. [15]

5 Results of the Model

Since countries A and B are symmetric, the remainder of the paper will concentrate on country A to conserve space.

5.1 Autonomous Policy Determination

This section considers the benchmark case in which the countries set their trade and merger policies unilaterally. The timing of each government's policy formulation makes the domestic sales tax and export tax be functions of that country's merger policy. To elaborate, if we let Ψ denote a vector of exogenous parameters of the model related to good x, the equilibrium tax functions in country A can be summarized as follows.[16]

$$s^A = s^A(K_A; \Psi) \; and \tag{11}$$

$$e^A = e^A(K_A; \Psi). \tag{12}$$

Similarly, country B's domestic sales and export taxes can be derived as functions of its merger policy variable K_B and a vector of exogenous parameters for good y, Ω.[17]

One can easily verify that, under the assumptions made in section 4, $e^A > 0$ and $s^A < 0$ for all industry sizes N_A, i.e. country A wishes to subsidize the domestic consumption of good x brands but tax the exports. Also, with little effort, the relationships between country A's tax functions and its merger policy variable, K_A, can be derived as follows.

[15] The rationale behind this particular choice of the upper bounds is that it is likely to be easy for firms to differentiate their products when the total number of brands in the industry is small.

[16] The derivation of all equations and the numerical simulation were done on IPX machines using *Mathematica 3.0*.

[17] The specific functional forms of these tax variables are presented in Appendix A.2.

Proposition 1. In the case that the countries do not coordinate either their trade or merger policies, there exists a negative relationship between each country's export tax policy and merger policy at all allowed values of merger, i.e. $\Delta e^i/\Delta K_i < 0$. *The same is true for its domestic sales tax policy and merger policy, i.e.* $\Delta s^i/\Delta K_i < 0$.

Proof. See Appendix B.

The intuition behind the above proposition is as follows. To extract as much profit as possible from its export market, country A's government could either have firms merge or impose high export taxes. In other words, these two policies are substitutes for the purpose of extracting profits from its trading partner, country B. Since mergers cause prices in the domestic market to increase as well, to maximize the domestic consumers' surpluses, the preferred method of profit extraction would be to charge high export taxes. However, if country A needs to use its merger policy for some reason, then it compensates the domestic consumers by subsidizing domestic consumption more heavily.

The substitution of the equilibrium tax functions into each country's welfare equation yields the maximization problem in that country's merger policy variable. For example, in country A, the national welfare maximization now takes the following form:

$$\underset{K_A}{max}\ w_x^A(s^A(K_A;\Psi), e^A(K_A;\Psi), K_A;\Psi) + lcs_{ym}^A(e^B(K_B;\Omega), K_B;\Omega). \tag{13}$$

Interestingly, after substituting the optimal domestic sales tax into the welfare function, the terms representing the industry profit in the domestic market and the total sales tax revenue cancel each other out. Therefore, w_x^A in equation 13 is really the sum of the consumers' surpluses in the domestic market, the export market industry profit and the export tax revenue.

The function w_x^A is a u-shaped curve in K_A. It has an almost flat area for $0 < K_A \leq 1$ and is very skewed to the left. In addition, it peaks twice at $K_A = 1$ and $K_A = N_A$. The latter value of K_A represents a monopoly, and, with the integer constraint, the former represents no merger.

The intuition for the aforementioned twin-peak feature of w_x^A function is as follows. In country A's market, there are two kinds of distortions related with good x brands. The first

one is deadweight loss caused by price mark-ups resulting from the oligopolistic industry structure. The second one is production inefficiency resulting from mergers that make the price ratio between any pair of brands unequal to their marginal rate of transformation. [18] In the present model, country A's government cannot tailor tax rates to firms but must apply a uniform rate to all firms. Therefore, unless all firms charge the same price in a Bertrand equilibrium, country A cannot correct both kinds of distortions using a uniform domestic sales tax.

If firms charge a single common price, the second kind of distortion disappears, and country A's government can eliminate the first kind with its domestic sales tax. With the assumed merger process and firm symmetry, firms charge the same price only if they are merged into a monopoly, or if there is no merger at all. As a result, consumers' surpluses from good x brands at $K_A = 1$ and $K_A = N_A$ are made larger than those at other partial merger equilibria. In addition, adjusting the values of domestic sales tax variable, country A achieves the same level of consumers' surpluses at these two levels of merger.

Similarly, in country A's export market, there exist two kinds of distortions resulting from partial mergers. First, unless $K_A = N_A$, firms do not set their prices to a common monopolist's price, and country A consequently cannot extract maximum monopoly profit from country B. In addition, there exists production inefficiency since the price ratio between two brands is not equal to their marginal rate of transformation. Because firms charge the same price in an equilibrium at $K_A = 1$ and $K_A = N_A$, in these cases, country A can use its uniform export tax to correct both kinds of distortions and induce the common monopolist's price from firms at the same time. Consequently, at these two levels of merger, country A obtains the same level of export industry profit net of the tax revenue.

Brining the results in the two markets together, we see that the function w_x^A must yield larger values at $K_A = 1$ and $K_A = N_A$ than at any other values of K_A.

If we abstract away from the integer constraint for a moment, we see that the first order condition of the welfare function is satisfied only at $K_A = 1$ over its domain $0 < K_A \leq N_A$. Therefore, this section takes $K_A = 1$ as the solution of the maximization problem 13. [19] With

[18] I would like to thank Professor Alan Deardorff for bringing these points to my attention.

[19] *The Mathematica* showed that the first order condition of the welfare function was a polynomial of

the integer constraint in place, this outcome means that country A's government wishes to have no merger in the good x industry. Because the two countries are symmetric, the same result holds for country B regarding its good y industry, i.e. $K_B = 1$.

Let s_*^A and e_*^A denote the optimal domestic sales tax and export tax respectively for country A evaluated at $K_A = 1$. Similarly, let w_*^A stand for its national welfare evaluated at $K_A = 1$ and $K_B = 1$. Then, these values can be summarized as follows.

$$s_*^A = -\frac{(\alpha - c^A)N_A}{N_A + \gamma(N_A - 1)}, \tag{14}$$

$$e_*^A = \frac{\gamma(\alpha - c^A)(N_A - 1)}{2[N_A + \gamma(N_A - 1)]} \; and \tag{15}$$

$$w_*^A = \frac{3}{4} l N_A (\alpha - c^A)^2 + \frac{1}{8} l N_B (\beta - c^B)^2. \tag{16}$$

5.2 Trade Liberalization

In this part of the paper, we examine the role of merger policy when the countries are bound by an international agreement that calls for trade liberalization. The trade liberalization is modeled as an exogenous constraint that limits the countries' export tax values below the level levied in the independently determined policy case.

The new constraint does not affect the process of domestic sales tax formulation since the sales tax is imposed on domestic brands' home sales only, and the two countries' markets are segmented. Hence, the optimal domestic sales tax in country A still takes the functional form in equation 11, and the part of proposition 1 about the domestic sales tax continues to hold. Furthermore, at this optimal level, the industry profit in the domestic market cancels out the government's sales tax revenue as in subsection 5.1.

Let $\bar{e}^A$ and $\bar{e}^B$ be the values of export taxes that trade liberalization dictates for country A and B respectively. Then, country A's welfare maximization problem now can be represented as follows.

$$\underset{K_A}{max} \; w_x^A(s^A(K_A;\Psi), \bar{e}^A, K_A;\Psi) + l c s_{ym}^A(\bar{e}^B, K_B;\Omega) \tag{17}$$

degree six in K_A. It yielded six roots to the first order condition; however, of the six, three were imaginary, and one was negative. $K_A = 1$ was one of the remaining two. The other solution implied that $K_A = N_A$ only if $\gamma \to \infty$ in the limit, contradicting the assumptions made in section 4.

The first order condition of equation 17 is a polynomial of degree twelve in K_A. Unfortunately, it is extremely difficult to interpret this expression because the coefficient of each monomial itself is also a polynomial in the exogenous parameters N_A and γ. Given this difficulty, the remainder of this subsection will focus on a special case of complete trade liberalization, i.e. $\bar{e}^A = 0$ and $\bar{e}^B = 0$, to simplify the analysis. [20] Subsection 5.4 will present some selected results from numerical simulations for the general case.

If we take the integer constraint into consideration, we can derive the following proposition immediately in this special case.

Proposition 2. If trade is completely liberalized, it is never in each country's interest to have no merger in its domestic industry.

Proof. See Appendix B.

The intuition behind the above proposition is the same as that in subsection 5.1. Since each country no longer has control over its export tax under trade liberalization, it has an incentive to use its merger policy to extract profits from its trading partner. Therefore, the merger policy's role as a strategic trade policy evidenced in other papers is also at work in the present analysis.

In order to find exact solutions, the derivative of the welfare function was evaluated numerically for industry sizes (N_A) of 10, 20, 50 and 100. For each industry size, a grid search was performed over all allowed values of K_A and γ to see whether the expression ever reached zero. The grids for K_A and γ were 1 and 0.1 respectively. The grid search showed that the derivative changed its sign between $K_A = 0$ and $K_A = 1$ from negative to positive. At other values of K_A, the derivative of the welfare function never reached zero and was always significantly positive.

The integer constraint allows us to ignore the sign change between $K_A = 0$ and $K_A = 1$ and concentrate on the range of K_A that makes the first order condition of the welfare function positive. The positiveness of the first order condition for all possible values of $K_A \geq 1$ implies that country A has an incentive to merge its firms into a monopoly. Because country B is a mirror image of country A, it also has the same incentive regarding its good

[20] The assumption of complete trade liberalization does not eliminate the high degree polynomial problem mentioned above. Nevertheless, it cuts down the length of the equation by a great deal.

y industry, i.e. country B wishes to set $K_B = N_B$. With these new industry structures, the optimal domestic sales tax and total welfare in country A are

$$s^A_{**} = -(\alpha - c^A), \tag{18}$$

$$w^A_{**} = \frac{3}{4} l N_A (\alpha - c^A)^2 + \frac{1}{8} l N_B (\beta - c^B)^2. \tag{19}$$

Note that the welfare under complete trade liberalization is the same as the one achieved in the case where the countries set their policies autonomously. As explained in the previous subsection, each country can eliminate all distortions in both its domestic and export markets using its respective tax policies when K_i is equal to either one or N_i. Nevertheless, this does not guarantee that total welfare in the two different scenarios will be the same because the value of export tax desired for a monopoly may not be zero as complete trade liberalization dictates.

However, it turns out that the export tax value desired for a monopoly is indeed zero. The intuition for this result is as follows. The export tax is useful for country i only if it can use the policy to induce domestic firms to charge a monopoly price in their export market for maximum rent extraction. However, with $K_i = N_i$, firms voluntarily charge the desired monopoly price, and, hence, the optimal level of export tax for country i in this case is zero.

Since the export prices in a monopoly and in an unmerged industry are made the same for both good x and y brands as explained in subsection 5.1, in each country, the industry profits from exports and the consumers' surpluses from imports at these two levels of merger are the same. Since the domestic market distortions from home brands are also completely eliminated in these cases by the domestic sales subsidy, the welfare under complete trade liberalization is made the same as that resulting from independently determined policies.

5.3 Coordinating Merger Policies

The previous subsection has demonstrated that the countries have incentives to utilize their merger policies as strategic trade policies when trade is completely liberalized. Since each country's unilateral incentive is detrimental to its trading partner, there must be benefits from coordinating their merger policies. In the present section of the paper, we formally

investigate this possibility.

To be concrete, let us consider the effect of a merger policy coordination in which the countries reduce their numbers of merging firms by one each from the industry structures achieved in the case of complete trade liberalization, i.e. from monopolies. The effect of this small displacement on country A's welfare can be summarized as follows.

$$
\begin{aligned}
\Delta w^A &= \Delta w_x^A + l\Delta cs_{ym}^A \qquad (20)\\
&= (\, w_x^A\Big|_{K_A=N_A} - w_x^A\Big|_{K_A=N_A-1}\,) + l(\, cs_{ym}^A\Big|_{K_B=N_B} - cs_{ym}^A\Big|_{K_B=N_B-1}\,)\\
&= \frac{h_1[81\gamma^6h_0^3 + 16N_A^4h_2 + 16\gamma N_A^4h_3 + 9\gamma^5h_0^2h_4 + 16\gamma^3N_A^2h_5 + 8\gamma^2N_A^2h_6 + \gamma^4h_7]}{4(N_A+\gamma)(N_A+\gamma h_0)(3\gamma^2h_0 + 4N_A^2(1+\gamma))^2h_8}\\
&\quad -\frac{(\beta - c^B)^2lN_B(N_B+\delta)(N_B+\delta h_9)[9\delta^2h_9 + 4N_B^2 + 4\delta(N_B(N_B+2)-2)]}{2(3\delta^2h_9 + 4N_B^2 + 4\delta N_B^2)^2}
\end{aligned}
$$

$$
\begin{aligned}
where\ h_0 &= (N_A - 1),\\
h_1 &= [(\alpha - c^A)^2l\gamma^2h_1N_A],\\
h_2 &= (3N_A^2 - 8N_A + 8),\\
h_3 &= (9N_A^2 - 20N_A + 20),\\
h_4 &= (19N_A^2 + 8N_A - 8),\\
h_5 &= (3N_A^4 + 13N_A^3 - 20N_A^2 + 14N_A - 7),\\
h_6 &= (18N_A^4 - 15N_A^3 - N_A^2 + 32N_A - 16),\\
h_7 &= (136N_A^5 + 51N_A^4 - 382N_A^3 + 211N_A^2 - 24N_A + 8),\\
h_8 &= [9\gamma^2h_1 + 4N_A^2 + 4\gamma(N_A(N_A+2)-2)]\ and\\
h_9 &= (N_B - 1).
\end{aligned}
$$

It can be easily verified that the two terms separated by a minus sign in the above equation are positive. Unfortunately, the whole expression cannot be signed without knowing the specific values of the exogenous parameters. However, if the following supplementary assumptions are added, the benefits of the merger policy coordination can be clearly demonstrated.

Proposition 3. If the demand parameters for good x and y brands are the same, and if the firms are identical across countries in their costs and numbers, then both countries will gain by reducing their merger policy levels by one firm each from the monopoly structures desired under complete trade liberalization.

Proof. See Appendix B.

Given the analytical difficulty of determining the sign of equation 20, for the general case that does not assume identical demand parameters and firm characteristics, we resort to numerical simulations to assess the benefits of coordinated merger policies.

5.4 Numerical Simulation

Tables 1, 2 and 3 report the results of numerical simulations of the full model for different choices of exogenous parameters. The table numbers correspond to the numbers of the simulation exercises. The values of exogenous parameters used in each simulation are reported at the beginning of each table. In these tables, the first panel presents the outcomes of the benchmark case (autonomously determined policies), and the second panel reports the effects of trade liberalization. The results for merger policy coordination are summarized in the third panel.

The last two columns under the country heading in each panel, w_x^A and $l \cdot cs_{ym}^A$ for example, represent that country's total welfare related to its specialized good and its total consumers' surpluses from imports respectively. The former term is the sum of consumers' surpluses from domestically produced brands and total industry profits from both domestic and export markets net of tax revenues. To get the country's total national welfare, one simply needs to add the two terms.

After the first simulation run, some of the initial parameter values were changed purposefully and were used in the subsequent simulations. To elaborate, the second simulation used different values of α and β from the first simulation in order to capture the effect of variant intercepts in the demand functions for good x and y brands. The third simulation used different industry sizes, N_A and N_B, and degrees of substitution, γ and δ, than the first exercise. [21] Other than the aforementioned changes, no additional parameter alteration was made in these exercises.

In each simulation, the merger incentive was examined for different degrees of trade liberalization. To elaborate, the countries' export taxes were reduced from the bench-mark-

[21] In the present framework, γ and δ are bounded from above by the number of firms in their respective industries. Therefore, it is not appropriate to change the industry size alone without making a corresponding change in the substitutability parameter.

case-levels to zero in five equal discrete steps, and, for each step, the size of a merging coalition that maximizes the national welfare was calculated.

The coordination of merger policies was simulated in a similar vein. For a chosen degree of trade liberalization, the merger policy coordination was modeled as a simultaneous reduction in the values of the countries' merger policy variables from their unilaterally optimal levels. The coordination process was carried out until no further reduction was feasible given the industry size, or no extra gains could be made for both countries from an additional reduction. Instead of letting the size of coordination to be one firm as in subsection 5.3, in all cases, the size of each reduction was specified to be some equal percentage of the countries' industry sizes.

In all three simulations, the incentive to merge domestic firms is evidenced for every degree of the trade liberalization considered. All three tables show that, after two steps of export tax reductions, both countries wish to create monopolies in their respective industries.

To be concrete, in table 1 for example, if the export taxes are reduced by 20 percent from the levels desired under the case of autonomous policy determination, country A wishes to have five firms in its domestic industry merged, and country B three firms.[22] An additional 20 percent reduction in the export taxes causes country A and B to increase the coalition sizes to nine and six respectively. For any trade liberalization that calls for more than 60 percent reductions in the export taxes, both countries have incentives to merge their respective industries into monopolies.

A caveat is in order at this point regarding the interpretation of national welfare under trade liberalization. One may notice that, in all three exercises, both countries' welfare increase up to the 40 percent export tax reduction but decrease for further reductions. The welfare increases again when the countries move from the 80 percent reduction to the complete trade liberalization. One must note that this result does not necessarily imply that the trade liberalization of a large magnitude is welfare diminishing for the participants and, hence, is not likely to occur. The result arises because of the partial equilibrium nature of the present analysis. Recall that the analysis does not show the benefits of trade liberalization

[22]The numbers in parentheses are the optimal merger coalition sizes that would result if the integer constraint were not imposed.

accruing to other industries which are not modeled explicitly.

The third panel of each table reports the effects of merger policy coordination for the 40 percent and 100 percent export tax reduction cases. As explained before, the merger policy coordination is modeled as a series of mutual reductions in the countries' merger policy variables. In these particular simulations, the magnitude of each reduction is taken to be 20 percent of the countries' respective industry sizes. [23]

As hinted in subsection 5.3, not every merger policy coordination, at least in the current format, is beneficial for both countries, and the scope for coordination depends on the specifics of a situation. For example, in the 40 percent partial trade liberalization case, every step of merger policy coordination improves both countries' welfare for the parameter values given in tables 1 and 2. As a result, country A and B reduce their merger coalition sizes until no additional reduction by twenty percent of their respective industry sizes is feasible. However, for the values in table 3, only the first step creates mutual improvement in the countries' welfare and hence is attainable under the assumed coordination rule.[24]

A similar pattern emerges in the case of complete trade liberalization. Again, for the parameter values in tables 1 and 2, every step of coordination is welfare enhancing for country A and B. However, no coordination is possible for the parameters in the third simulation because country B's welfare diminishes monotonically along the steps of coordination.[25]

A word of caution is in order. The 20 percent reduction rule considered above is only a crude representation of the merger policy coordination and is only for analytical convenience. There may exist many alternatives that can make the coordination desirable for any set of parameter values and any degree of trade liberalization considered.[26]

[23] In terms of firm numbers, each step of coordination requires a reduction by three firms for country A and two firms for country B in the first and second simulations. In the third simulation exercise, the rule translates into a reduction by two firms for country A and four firms for country B.

[24] Recall that the assumed merger policy coordination rule is that countries stop coordinating their policies if no mutual gains can be made from an additional step of coordination, or no further reduction is feasible given the industry sizes.

[25] To conserve space, no additional results are reported after the first step of coordination in table 3 for the complete trade liberalization case. One may note that, in this first step of coordination, country A's gain is substantial (4517) while the loss to country B is small (1856). If the countries were allowed to make a lump sum payment to each other, there would be scope for mutual improvement even in this particular case.

[26] For example, if the model parameters take on values specified in table 1 and 2, an agreement that constrains both countries to have no merger, i.e. one firm only in the merger set, creates larger welfare improvement for both countries than any of the exogenous reductions considered in the 40 percent partial

6 Extension

It has been shown previously that there exists a systematic relationship between each country's merger policy and its domestic sales tax policy. Therefore, the removal of the domestic sales tax variable from the analysis may change the results significantly. This issue is analyzed rigorously in the following subsections.

6.1 Autonomous Policy Determination Revisited

The removal of the domestic sales tax from the analysis does not affect the process of formulating the optimal export tax because all markets are segmented. Therefore, the equilibrium export tax function in country A is still represented by equation 12. Substituting this expression into country A's national welfare function yields the following result:

$$\max_{K_A} \; w_x^A(e^A(K_A;\Psi),K_A;\Psi) + lcs_{ym}^A(e^B(K_B;\Omega),K_B;\Omega). \tag{21}$$

Unfortunately, it is very difficult to find an exact value of K_A that satisfies the relevant first order condition for welfare maximization because the expression suffers from the same kind of high degree polynomial problem mentioned in subsection 5.2. However, it is possible to show that the expression changes its sign between $K_A = 0$ and $K_A = 1$. At zero, the expression is strictly positive, but it is negative at all other allowed values of K_A for a given industry size N_A. [27]

Recall that the integer constraint makes the equilibrium value of K_A less than one infeasible. Then, given the negativeness of the first order condition at all $K_A \geq 1$, the best attainable solution for country A is to set $K_A = 1$, i.e. to have no merger. Since the countries are symmetric, country B attains the same no merger solution, that is $K_B = 1$. At these solutions, the values of the optimal export tax and national welfare in country A are

trade liberalization case.

[27] The derivative of the welfare function could be easily signed at $K_A = 0, 1$ and N_A; however, for other values of K_A, it was necessary to resort to numerical evaluations for signing. As before, for industry sizes of 10, 20, 50 and 100, a grid search was performed to determine the sign of the derivative. The grids used for K_A and γ were 1 and 0.1 respectively. For all industry sizes, the first order condition was always negative at all $K_A \geq 1$.

as follows.

$$\hat{e}_*^A = \frac{\gamma(\alpha - c^A)(N_A - 1)}{2[N_A + \gamma(N_A - 1)]} \tag{22}$$

$$\hat{w}_*^A = \frac{(\alpha - c^A)^2 l N_A [3\gamma^2(N_A - 1)^2 + 12\gamma N_A(N_A - 1) + 10N_A^2]}{4(2N_A + \gamma(N_A - 1))^2} + \frac{1}{8}(\beta - c^B)^2 l N_B \tag{23}$$

With a little algebraic manipulations, it can be shown that $\hat{w}_*^A$ is less than w_*^A in equation 16, the welfare achieved with the optimal domestic sales tax.[28]

6.2 Trade Liberalization Revisited

Since the countries lose their control over export taxes when trade is liberalized, with the domestic sales tax unavailable, the only choice variable for country A is its merger policy, K_A. Now, country A's welfare maximization problem takes the following simple form:

$$\max_{K_A} \; w_x^A(\bar{e}^A, K_A; \Psi) + lcs_{ym}^A(\bar{e}^B, K_B; \Omega). \tag{24}$$

However, despite the simple representation, the explicit solutions to the above maximization problem are very lengthy and complex even if one ignores the integer constraint.

To facilitate the analysis, this subsection again concentrates on the special case of complete trade liberalization and defers the discussion of the general case to the succeeding subsection on numerical simulations.

Even in our special case, the interpretation of the solutions is made difficult by their complexity. Although it is not possible to obtain an explicit integer solution to equation 24, one can show that a merger to a monopoly is never in country A's interest.

Proposition 4. When the countries cannot impose domestic sales taxes, a merger in the presence of complete trade liberalization does not improve each country's national welfare unless the domestic industry size is large enough, and the brands of each good are sufficiently

[28]The second terms in equation 22 and 16 are the same; hence, we only need to verify that the first term in $\hat{w}_*^A$ is smaller than that in w_*^A. Remember that γ can take any value between 0 and N_A. The first term of $\hat{w}_*^A$ is an increasing function in γ. When $\gamma = N_A$, it is equal to $(\alpha - c^A)^2 l N_A G(N_A)$ where $G(N_A) = (1 + 3N_A(N_A + 2))/4(N_A + 1)^2$. Since $G(N_A)$ is strictly smaller than $3/4$ for all $N_A < \infty$, the result follows.

differentiated. However, a merger into a monopoly is never welfare maximizing regardless of the industry size and the degree of substitution between the brands.

Proof. See Appendix B.

The intuition behind proposition 4 is simple. Suppose that the conditions on the industry size and the degree of product differentiation are satisfied. Since country A can no longer use export taxes to extract rents from its trading partner when trade is completely liberalized, it needs to use its merger policy for that purpose. However, without the domestic sales subsidy, country A's government cannot offset price increases caused by mergers for its domestic consumers. Therefore, its incentive for merger is mitigated, and the merger into a monopoly is no longer welfare maximizing.

Since an explicit solution to equation 24 cannot be found, it is not possible to have an analytical discussion on the coordination of merger policies. Hence, we now turn to numerical simulations directly.

6.3 Numerical Simulation

In tables 4, 5 and 6, the results of simulations for the model without the domestic sales tax are summarized. The format of presentation for each table is the same as that described in subsection 5.4. The results of the benchmark case are followed by the results of trade liberalization and merger policy coordination respectively.

The parameter values used in these exercises were the same as those in the first three simulations, and the order of the parameter perturbation was also preserved. Hence, the parameters in the ith simulation for $i = 4$, 5, and 6 were the same as those in the $(i-3)$th simulation.

As in subsection 5.4, the trade liberalization was modeled as a series of mutual reductions in the countries' export taxes. The size of each reduction was again stipulated to be 20 percent of the export tax levels desired under the independently formulated policy case, and, for each reduction, the countries' incentives for merger were analyzed.

As for the merger policy coordination, the coordination procedure was the same as that described in subsection 5.4; however, the size of coordination was varied depending on the case. To elaborate, for the fourth and fifth simulations, the size of each mutual reduction

in the countries' merger policy variables was again taken to be 20 percent of each country's industry size. However, for the sixth simulation, it was specified to be 10 percent.[29]

It can be seen in tables 4-6 that the removal of the domestic sales tax variable from the analysis greatly reduces the countries' merger incentives for a given level of trade liberalization. Both countries wish to merge their domestic firms when the required reductions in their export taxes are substantial; however, as proposition 4 predicts, they never merge their firms into monopolies.

For example, in table 6, note that a merged industry structure starts to appear in both countries only after the fourth 20 percent reduction in the export taxes. For trade liberalization that calls for less than 80 percent reductions in the export taxes, only country B merges its firms while country A maintains an unmerged industry structure. Even in the case of complete trade liberalization, country A merges only 6 out of 10 firms, and country B merges 17 out of 20 firms.

The third panel in each table summarizes the outcomes of merger policy coordination for the 80 percent and 100 percent export tax reduction cases. Again, it is evident in these panels that the scope for mutually beneficial coordination depends on the details of a situation.

For the parameter values given in table 4, both countries' welfare improves along every step of the coordination in both cases of trade liberalization. However, if the parameters take on the values given in table 6, mutual gain is never possible. As for the fifth simulation, the mutual gain from the coordination is assured for the 80 percent export tax reduction case; however, in the case of complete trade liberalization, mutual welfare improvement is possible only up to the first step of the coordination.

Recall again that the above results are driven by the assumed format of merger policy coordination in the present analysis. Under some alternative arrangements, there may be mutual gains even for the parameter values assumed in table 6.

[29] It was necessary to decrease the size of merger policy coordination for the sixth simulation because the size of unilaterally optimal merger for country A was too small to begin with in some scenarios of trade liberalization.

7 Conclusion

The present paper has developed a simple two-good-two-country model to investigate the linkage between trade and merger policies and to consider the welfare effects of an international coordination of national merger policies. The current study has added two innovative features to the existing models in this area of research. First, it has avoided the traditional Cournot competition framework and instead assumed differentiated product Bertrand competition as a market structure. Second, unlike the existing papers which consider the interaction between trade and merger policies only, it has introduced an additional policy variable, a domestic sales tax, into the analysis.

The contribution of this paper is threefold. First, the present analysis has established an exact negative relationship between each country's export tax policy and merger policy. It has evidenced each country's incentive to use its merger policy as a strategic trade policy in the presence of trade liberalization. In particular, it has been shown that, when trade is completely liberalized, the countries wish to create monopolies in order to extract rents from their trading partners.

Second, this paper has clearly demonstrated the need to consider other policies in modeling as well as in decision making. It has provided evidence in support of the folklore that all policies interact with each other in an open economy. The analysis has illustrated how the removal of the domestic sales tax from the setup greatly reduces the countries' incentives for mergers in relation with trade liberalization. This result points to a possibility that the outcomes of other works may be substantially affected if an additional policy variable is introduced.

Lastly, this analysis has documented that, to realize full benefits of trade liberalization, an international coordination of national merger policies is necessary. It has been shown that even a crude means of coordination can create mutual welfare gains by limiting the countries' unilateral incentives to use their merger policies for rent extraction in the case of trade liberalization. Hence, the results of the present study render support to the recent movements in international fora that call for the international coordination of competition policies.

Appendix

A Basic Setup

This appendix presents the specific functional forms of firms' profits, consumer's surplus, domestic sales tax and export tax. Given the symmetry between the countries, only the equations pertinent to country A are presented.

A.1 Firms' Profits and Consumer's Surplus

The Bertrand Nash-equilibrium prices of the firm in the coalition and the firm outside it are presented below.

$$p_M^A = \frac{a_1 + N_A[(4N_A - 2K_A - 1)a_2 + (2N_A - 1)\alpha]\gamma + a_3}{4N_A^2 + [6N_A^2 - (2K_A + 2)]\gamma + [2N_A^2 + 2K_A - K_A^2 - (K_A + 2)N_A]\gamma^2} \quad (25)$$

$$p_O^A = \frac{a_1 + N_A[(4N_A - K_A - 2)a_2 + (2N_A - K_A)\alpha]\gamma + a_3}{4N_A^2 + [6N_A^2 - (2K_A + 2)]\gamma + [2N_A^2 + 2K_A - K_A^2 - (K_A + 2)N_A]\gamma^2} \quad (26)$$

$$\begin{aligned} where\ a_1 &= 2N_A^2(\alpha + c^A + s^A), \\ a_2 &= (c^A + s^A)\ and \\ a_3 &= (N_A - K_A)(2N_A + K_A - 2)a_2\gamma^2. \end{aligned}$$

Substituting the above equilibrium prices into the demand function 2 and multiplying the result by the population parameter l^A yield the equilibrium outputs for these firms as follows.

$$x_M^A = \frac{l^A(\alpha - c^A - s^A)[N_A(1+\gamma) - \gamma K_A][2N_A(1+\gamma) - \gamma]}{4N_A^2 + [6N_A^2 - (2K_A + 2)]\gamma + [2N_A^2 + 2K_A - K_A^2 - (K_A + 2)N_A]\gamma^2} \quad (27)$$

$$x_O^A = \frac{l^A(\alpha - c^A - s^A)[N_A(1+\gamma) - \gamma][2N_A(1+\gamma) - \gamma K_A]}{4N_A^2 + [6N_A^2 - (2K_A + 2)]\gamma + [2N_A^2 + 2K_A - K_A^2 - (K_A + 2)N_A]\gamma^2} \quad (28)$$

Note that, for the above equilibrium outputs to be positive, the term $(\alpha - c^A - s^A)$ must be positive. With the assumption on c^A in section 4, this restriction defines the upper limit of the values that the domestic sales tax variable, s^A, can take.[30] To be more specific, it must

[30] In a similar fashion, the firms' equilibrium outputs in country B's market, x_M^B and x_O^B, define the upper limit for country A's export tax variable, e^A.

be that $s^A < (\alpha - c^A)$.

Their equilibrium profits can be derived using equation 5 and the equilibrium prices p_M^A and p_O^A.

$$\pi_M^A = \frac{l^A N_A(\alpha - c^A - s^A)^2[N_A(1+\gamma) - \gamma K_A][2N_A(1+\gamma) - \gamma]^2}{[4N_A^2 + (6N_A^2 - (2K_A+2))\gamma + (2N_A^2 + 2K_A - K_A^2 - (K_A+2)N_A)\gamma^2]^2} \quad (29)$$

$$\pi_O^A = \frac{l^A N_A(\alpha - c^A - s^A)^2[N_A(1+\gamma) - \gamma][2N_A(1+\gamma) - \gamma K_A]^2}{[4N_A^2 + (6N_A^2 - (2K_A+2))\gamma + (2N_A^2 + 2K_A - K_A^2 - (K_A+2)N_A)\gamma^2]^2} \quad (30)$$

To get the equilibrium prices, outputs and profits of these firms in their export market, i.e. country B, one simply needs to change s^A to e^A and l^A to l^B.

When evaluated at p_M^A and p_O^A, country A's total consumers' surplus from good x takes the following form.

$$cs_{xm}^A = \frac{l^A N_A(b_1 b_2)[4b_3^3 N_A^3 - 8\gamma b_3^2 N_A^2 - \gamma b_3 N_A b_4 - \gamma^2 K_A b_5]}{2[4N_A^2 + 2\gamma N_A(3N_A - K_A - 1) + \gamma^2(N_A - K_A)(2N_A + K_A - 2)]^2} \quad (31)$$

$$\begin{aligned} where\ b_1 &= (\alpha - c^A - s^A)^2, \\ b_2 &= (N_A + \gamma(N_A - K_A)), \\ b_3 &= (1+\gamma), \\ b_4 &= (4(K_A-1)K_A + \gamma(K_A-2)(3K_A+2))\ and \\ b_5 &= (b_3(K_A-4)K_A - 4K_A - 3). \end{aligned}$$

Its total consumers' surplus from good y can be derived from the above equation by simply replacing N_A, K_A, c^A, s^A, α and γ with N_B, K_B, c^B, e^A, β and δ respectively.

A.2 Domestic Sales and Export Taxes

The maximization of country A's national welfare function with respect to its domestic sales tax and export tax variables, s^A and e^A, yields the following solutions.

$$s^A = -\frac{(\alpha - c^A)[4N_A^4 + 4\gamma N_A^3(3N_A - K_A - 1) + \gamma^2 N_A d_5 + \gamma^3 d_6]}{4N_A^4 + 4\gamma N_A^2 d_1 + \gamma^2 N_A d_2 + \gamma^3 d_3 + \gamma^4 d_4} \quad (32)$$

$$e^A = \frac{(\alpha - c^A)\gamma d_7[4N_A^2(N_A + K_A - 1) + \gamma^3 d_7(2N_A + K_A - 2)^2 + \gamma^2 d_8 + 4\gamma N_A d_9]}{2[4N_A^4 + 4\gamma N_A^2 d_1 + \gamma^2 N_A d_2 + \gamma^3 d_3 + \gamma^4 d_4]} \quad (33)$$

$$\begin{aligned} where\ d_1 &= [2N_A(2N_A - 1) - K_A(N_A - 1) - K_A^2], \\ d_2 &= [4N_A(6N_A^2 - 6N_A + 1) + 11K_A^2 N_A - K_A(12N_A^2 - 20N_A + 3) - 3K_A^3], \end{aligned}$$

$$
\begin{aligned}
d_3 &= [8N_A^2(2N_A^2 - 3N_A + 1) + K_A^4 + K_A^3(5N_A - 4) - K_A^2(10N_A^2 - 3) \\
&\quad -K_A N_A(12N_A^2 - 28N_A + 11)], \\
d_4 &= [2N_A(N_A - 1) - K_A(N_A - 2) - K_A^2]^2, \\
d_5 &= [4N_A^2(3N_A - 2) + K_A^2 N_A - K_A^3 - K_A(8N_A^2 - 4N_A - 1)], \\
d_6 &= [K_A N_A(4N_A^2 - 4N_A - 1) - K_A^2(N_A^2 - N_A - 1) - (4N_A^3 - K_A^3) \\
&\quad (N_A - 1)], \\
d_7 &= (N_A - K_A), \\
d_8 &= [4N_A(3N_A^2 - 5N_A + 2) + 4K_A(N_A^2 + N_A - 1) - K_A^3 - K_A^2(7N_A - 5)], \\
d_9 &= [3N_A^2 + 2K_A N_A - 4N_A - K_A^2 + 1].
\end{aligned}
$$

Under the assumptions made in section 4, it is not difficult to verify that the numerators and denominators of the fractions in equation 33 and those in equation 32 without the minus sign are all positive. As a result, $s^A < 0$ and $e^A > 0$ for all $N_A \geq 2$. That is, country A in fact wants to subsidize the domestic sales of good x brands.

B Proofs of Propositions

Given the symmetry between country A and B, it suffices to prove the propositions for one of the two countries. Again, for convenience, the propositions are proved for country A.

Proposition 1. In the case that the countries do not coordinate either their trade or merger policies, there exists a negative relationship between each country's export tax policy and merger policy at all allowed values of merger, i.e. $\Delta e^i/\Delta K_i < 0$. *The same is true for its domestic sales tax policy and merger policy, i.e.* $\Delta s^i/\Delta K_i < 0$.

Proof. The proof involves a series of very lengthy derivations. Therefore, to conserve space, some parts of expressions are abbreviated, and only a sketch of the proof is provided here. The full version of the proof is available from the author upon request.

Let g_1 and g_2 denote the denominator of equation 32 evaluated at the merger size $K_A^* + 1$ and K_A^* respectively. Then, the differences in tax values, Δe^A and Δs^A, can be summarized as follows.

$$s^A\Big|_{K_A=K_A^*+1} - s^A\Big|_{K_A=K_A^*} = \tag{34}$$
$$-\frac{(\alpha - c^A)\gamma K_A[32N_A^6 + 32\gamma N_A^5 g_3 + 4\gamma^2 N_A^3 g_4 + 4\gamma^3 N_A^2 g_5 + \gamma^4 N_A g_6 + \gamma^5 g_7 + \gamma^6 g_8]}{g_1 g_2},$$

$$e^A\Big|_{K_A=K_A^*+1} - e^A\Big|_{K_A=K_A^*} = \tag{35}$$
$$-\frac{(\alpha - c^A)\gamma K_A[32N_A^6 + 32\gamma N_A^5 g_3 + 4\gamma^2 N_A^3 g_4 + 4\gamma^3 N_A^2 g_5 + \gamma^4 N_A g_6 + \gamma^5 g_7 + \gamma^6 g_8]}{2g_1 g_2},$$

$$\begin{aligned}
where\ g_3 &= (6N_A - 2K_A - 3),\\
g_4 &= [N_A(120N_A^2 - 121N_A + 27) + 4K_A^2 N_A + K_A^3 - K_A(77N_A^2 - 41N_A + 1)],\\
g_5 &= [2N_A(80N_A^3 - 122N_A^2 + 55N_A - 7) + K_A^3(6N_A - 1) + 2K_A^2 N_A(7N_A - 6)\\
&\quad -K_A(148N_A^3 - 160N_A^2 + 44N_A - 1)],\\
g_6 &= [N_A g_{6a} + K_A^5 g_{6b} - K_A^4 g_{6c} + K_A^3 N_A g_{6d} + K_A^2 g_{6e} - K_A g_{6f}],\\
g_7 &= [N_A g_{7a} + K_A^5 g_{7b} - K_A^4 g_{7c} + K_A^3 g_{7d} + K_A^2 g_{7e} - 2K_A N_A g_{7f}]\ and\\
g_8 &= [N_A g_{8a} + K_A^5 g_{8b} - K_A^4 g_{8c} + K_A^3 g_{8d} + K_A^2 g_{8e} - K_A g_{8f}].
\end{aligned}$$

Notice that, because we are now dealing with the differences in tax values, the domain of each g_i is $1 \leq K_A \leq N_A - 1$.

For the proposition to be true, both equation 34 and equation 35 must be negative. Since g_1 and g_2 are positive, the proof can be completed by showing that the numerators of these equations without the minus sign are positive.

One can easily verify that g_3, g_4 and g_5 are all positive given the assumptions of section 4. Now, if the g_i's for $i = 6$, 7 and 8 are non-negative, the numerators of equations 34 and 35 except the minus sign are certain to be positive.

With little effort, it can be verified that each g_i is indeed non-negative in two steps. Here is an outline of the proof. First, it is shown that each g_i takes non-negative values at the end points of its domain with the value at $K_A = 1$ greater than the value at $N_A - 1$. Second, each g_i is shown to be a monotonically decreasing function in K_A for $1 \leq K_A \leq N_A - 1$. Combining these two steps, it is trivial to see that each g_i must be non-negative. *Q.E.D.*

Proposition 2. If trade is completely liberalized, it is never in each country's interest to have no merger in its domestic industry.

Proof. The direct way of proving this proposition would require us to find an integer value of K_A that maximizes the welfare function 17. However, this is not an easy task given the previously mentioned high degree polynomial problem. Therefore, instead, we prove the proposition by first showing that the first order condition of the welfare function evaluated at $K_A = 1$ is positive, and then that there exists some integer value of K_A in the domain that provides larger welfare than $K_A = 1$ holding everything else constant.

With e^A and e^B set to zero, the derivative of the country A's welfare function with respect to its merger policy variable yields the following expression when evaluated at $K_A = 1$.

$$\begin{aligned} \left.\frac{\partial w^A}{\partial K_A}\right|_{K_A=1} &= \left.\frac{\partial w_x^A}{\partial K_A}\right|_{K_A=1} \\ &= \frac{(\alpha - c^A)^2 l \gamma^2 N_A (N_A - 1)}{(2N_A + \gamma(N_A - 1))^3}. \end{aligned} \tag{36}$$

The above expression is strictly positive for $N_A \geq 2$. Therefore, it is beneficial for country A to increase K_A from 1, i.e. to have firms merged.

Now, we can complete the proof by showing the existence of some integer K_A greater than one in the domain that produces larger welfare than $K_A = 1$ for a given level of country B's merger policy. For analytical convenience, we compare the welfare at $K_A = N_A$ with that at $K_A = 1$. Let Δw_{*1}^A denote the difference in welfare between these two values of K_A. Then, it takes the following functional form.

$$\begin{aligned} \Delta w_{*1}^A &= w^A\Big|_{K_A=N_A} - w^A\Big|_{K_A=1} \\ &= \frac{(\alpha - c^A)^2 l \gamma^2 N_A (N_A - 1)^2}{4(2N_A + \gamma(N_A - 1))^2}. \end{aligned} \tag{37}$$

One can easily verify that the above expression is positive for $N_A \geq 2$; hence, country A attains larger welfare by setting $K_A = N_A$ than by having no merger. *Q.E.D.*

Proposition 3. If the demand parameters for good x and y brands are the same, and if the firms are identical across countries in their costs and numbers, then both countries will gain by reducing their merger policy levels by one firm each from the monopoly structures desired under complete trade liberalization.

Proof. The assumption of identical demand parameters and firm characteristics necessitates that $\alpha = \beta$, $\gamma = \delta$, $N_A = N_B$ and $c^A = c^B$. For convenience, this proof uses the variables pertinent to good x and country A. With this notational convention in place, equation 20 can be rewritten as follows.

$$\Delta w^A = -\frac{f_1(128N_A^6 + 81\gamma^7 f_0^3 + f_2 + f_3 + 9\gamma^6 f_0^2 f_4 + f_5 + f_6 + f_7)}{8(N_A+\gamma)(N_A+\gamma f_0)(3\gamma^2 f_0 + 4N_A^2 + 4\gamma N_A^2)(9\gamma^2 f_0 + f_8)} \tag{38}$$

$$\begin{aligned}
where\ f_0 &= (N_A - 1),\\
f_1 &= (N_A(9N_A + 40) - 40),\\
f_2 &= 48\gamma^2 N_A^4(N_A(25N_A + 32) - 32),\\
f_3 &= 16\gamma N_A^4(25N_A^2 + 32N_A - 32),\\
f_4 &= (29N_A^2 + 40N_A - 40),\\
f_5 &= 8\gamma^4 N_A^2(2N_A^4 + 162N_A^3 + 73N_A^2 - 470N_A + 235),\\
f_6 &= 8\gamma^3 N_A^2(22N_A^4 + 313N_A^3 - 217N_A^2 - 192N_A + 96),\\
f_7 &= \gamma^5(200N_A^5 + 1173N_A^4 - 2474N_A^3 + 557N_A^2 + 816N_A - 272)\ and\\
f_8 &= 4N_A^2 + 4\gamma(N_A^2 + 2N_A - 2).
\end{aligned}$$

The assumptions in section 4 make every f_i shown above positive and hence equation 38 negative for all $N_A \geq 2$. The negativeness of the expression shows that country A's welfare evaluated at $K_A = N_A - 1$ and $K_B = N_B - 1$ is larger than its welfare evaluated at $K_A = N_A$ and $K_B = N_B$. *Q.E.D.*

Proposition 4. When the countries cannot impose domestic sales taxes, a merger in the presence of complete trade liberalization does not improve each country's national welfare unless the domestic industry size is large enough, and the brands of each good are sufficiently differentiated. However, a merger into a monopoly is never welfare maximizing regardless of the industry size and the degree of substitution between the brands.

Proof. Differentiating equation 24 with respect to K_A and evaluating the result at $K_A = 1$ yield

$$\begin{aligned}
\left.\frac{\partial w^A}{\partial K_A}\right|_{K_A=1} &= \left.\frac{\partial w_x^A}{\partial K_A}\right|_{K_A=1}\\
&= \frac{(\alpha - c^A)^2 \gamma l N_A(\gamma(N_A - 1) - N_A)}{(2N_A + \gamma(N_A - 1))^3}.
\end{aligned} \tag{39}$$

A merger is desirable for country A only if the above expression is positive.

For $N_A \geq 1$, every term in equation 39 is definitely positive except the part $(\gamma(N_A - 1) - N_A)$. This term is negative for any $N_A \geq 2$ if $\gamma \leq 1$. If $\gamma > 1$, it takes on positive real numbers on condition that N_A is sufficiently large. As γ increases from 1, the industry size N_A required to make the expression $(\gamma(N_A - 1) - N_A)$ positive gets smaller. For example, if $\gamma > 1.5$, it is positive for $N_A \geq 3$. Therefore, only if the industry size is sufficiently large, and the brands of good x are not very close substitutes, it improves country A's welfare to have a merged domestic industry.

To complete the proof of the first half of the proposition, we show that there exists some integer K_A greater than one in the domain that yields larger welfare than $K_A = 1$ given that the conditions on the industry size and product differentiation are met, and that everything else is held constant. For simplicity, let us consider the welfare at $K_A = 2$ when γ is equal to 2. If we let Δw^A_{*2} denote the difference in welfare between $K_A = 2$ and $K_A = 1$, it is equal to

$$\Delta w^A_{*2} = \frac{(\alpha - c^A)^2 \gamma l [36N_A^4 - 162N_A^3 + 176N_A^2 - 73N_A + 12]}{4N_A(6N_A - 7))^2(2N_A - 1)^2} \tag{40}$$

The above expression becomes positive for the first time when $N_A = 4$ and gets larger in its value as N_A increases, making the welfare at $K_A = 2$ to be larger than that at $K_A = 1$.

As for the second half of the proposition, it would suffice to show the existence of some integer value of K_A that attains larger welfare than a monopoly for a given value of country B's merger policy regardless of the values of γ and N_A. We consider $K_A = N_A - 1$ for simplicity. The difference in welfare between these two values of merger policy can be summarized as follows.

$$\begin{aligned} \Delta w^A_{*3} &= w^A\Big|_{K_A = N_A - 1} - w^A\Big|_{K_A = N_A} \\ &= \frac{(\alpha - c^A)^2 \gamma l N_A(N_A - 1)[32N_A^2 + 44\gamma N_A^2 + 12N_A^2\gamma^2 - 9\gamma^3(N_A - 1)]}{8(3\gamma^2(N_A - 1) + 4N_A^2 + 4\gamma N_A 2)^2} \end{aligned} \tag{41}$$

Since γ is bounded from above by N_A, equation 41 is positive for all values of N_A, and country A's welfare is larger at $K_A = N_A - 1$ than at $K_A = N_A$. *Q.E.D.*

Table 1: Results from the Simulation 1 with Domestic Sales Tax

Parameter values: $N_A = 15$, $N_B = 10$, $c^A = 0.3$, $c^B = 0.2$, $l = 1000$, $\alpha = 1$, $\gamma = 3$, $\beta = 1.5$, $\delta = 2$.

1. Autonomous Policy Determination

Country A					Country B				
s^A	e^A	K_A	w_x^A	$l \cdot cs_{ym}^A$	s^B	e^B	K_B	w_y^B	$l \cdot cs_{xm}^B$
-0.1842	0.2579	1	5513	2113	-0.4643	0.4179	1	12675	919

2. Trade Liberalization

Country A					Country B				
s^A	$\bar{e}^A$	K_A	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	K_B	w_y^B	$l \cdot cs_{xm}^B$
-0.1984	0.2063	5 (4.71)	5490	2471	-0.4854	0.3343	3 (3.02)	12641	1109
-0.2482	0.1547	9 (9.44)	5437	2582	-0.5930	0.2507	6 (5.69)	12559	1208
-0.7000	0.1032	15	5473	1604	-1.3000	0.1671	10	12605	668
-0.7000	0.0516	15	5502	1850	-1.3000	0.0836	10	12658	788
-0.7000	0.0000	15	5513	2113	-1.3000	0.0000	10	12675	919

3. Merger Policy Coordination

Case 1: Export Taxes reduced by 40 percent

Country A					Country B				
s^A	$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
-0.2482	0.1547	9 (9.44)	5437	2582	-0.5930	0.2507	6 (5.69)	12559	1208
-0.2064	0.1547	6	5428	2841	-0.5085	0.2507	4	12549	1328
-0.1882	0.1547	3	5417	2966	-0.4711	0.2507	2	12530	1385

Case 2: Complete Trade Liberalization

Country A					Country B				
s^A	$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
-0.7000	0.0000	15	5513	2113	-1.3000	0.0000	10	12675	919
-0.3458	0.0000	12	5222	3273	-0.7766	0.0000	8	12263	1622
-0.2482	0.0000	9	5063	3964	-0.5930	0.0000	6	12022	1990
-0.2064	0.0000	6	4960	4360	-0.5085	0.0000	4	11850	2188
-0.1882	0.0000	3	4902	4552	-0.4711	0.0000	2	11749	2282

Table 2: Results from the Simulation 2 with Domestic Sales Tax

Parameter values: $N_A = 15$, $N_B = 10$, $c^A = 0.3$, $c^B = 0.2$, $l = 1000$, $\alpha = 1.3$, $\gamma = 3$, $\beta = 1.0$, $\delta = 2$.

1. Autonomous Policy Determination

Country A					Country B				
s^A	e^A	K_A	w_x^A	$l \cdot cs_{ym}^A$	s^B	e^B	K_B	w_y^B	$l \cdot cs_{xm}^B$
-0.2632	0.3684	1	11250	800	-0.2857	0.2571	1	4800	1875

2. Trade Liberalization

Country A					Country B				
s^A	$\bar{e}^A$	K_A	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	K_B	w_y^B	$l \cdot cs_{xm}^B$
-0.2835	0.2947	5 (4.71)	11204	936	-0.2987	0.2057	3 (3.02)	4787	2263
-0.3545	0.2211	9 (9.44)	11095	978	-0.3649	0.1543	6 (5.69)	4756	2465
-1.0000	0.1474	15	11169	608	-0.8000	0.1029	10	4774	1363
-1.0000	0.0737	15	11230	700	-0.8000	0.0514	10	4793	1609
-1.0000	0.0000	15	11250	800	-0.8000	0.0000	10	4800	1875

3. Merger Policy Coordination

Case 1: Export Taxes reduced by 40 percent

Country A					Country B				
s^A	$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
-0.3545	0.2211	9 (9.44)	11096	978	-0.3649	0.1543	6 (5.69)	4756	2465
-0.2949	0.2211	6	11077	1076	-0.3129	0.1543	4	4752	2709
-0.2689	0.2211	3	11054	1123	-0.2899	0.1543	2	4745	2826

Case 2: Complete Trade Liberalization

Country A					Country B				
s^A	$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
-1.0000	0.0000	15	11250	800	-0.8000	0.0000	10	4800	1875
-0.4940	0.0000	12	10657	1240	-0.4779	0.0000	8	4644	3309
-0.3545	0.0000	9	10333	1501	-0.3649	0.0000	6	4553	4062
-0.2949	0.0000	6	10122	1651	-0.3129	0.0000	4	4488	4466
-0.2689	0.0000	3	10004	1724	-0.2899	0.0000	2	4449	4657

Table 3: Results from the Simulation 3 with Domestic Sales Tax

Parameter values: $N_A = 10$, $N_B = 20$, $c^A = 0.3$, $c^B = 0.2$, $l = 1000$, $\alpha = 1$, $\gamma = 2$, $\beta = 1.5$, $\delta = 5$.

1. Autonomous Policy Determination

Country A					Country B				
s^A	e^A	K_A	w_x^A	$l \cdot cs_{ym}^A$	s^B	e^B	K_B	w_y^B	$l \cdot cs_{xm}^B$
-0.2500	0.2250	1	3675	4225	-0.2261	0.5370	1	25350	613

2. Trade Liberalization

Country A					Country B				
s^A	$\bar{e}^A$	K_A	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	K_B	w_y^B	$l \cdot cs_{xm}^B$
-0.2613	0.1800	3 (3.02)	3665	5327	-0.2596	0.4296	7 (7.06)	25196	716
-0.3193	0.1350	6 (5.69)	3641	5667	-0.3796	0.3222	14 (14.41)	24855	749
-0.7000	0.0900	10	3655	2944	-1.3000	0.2148	20	25119	465
-0.7000	0.0450	10	3670	3556	-1.3000	0.1074	20	25292	536
-0.7000	0.0000	10	3675	4225	-1.3000	0.0000	20	25350	613

3. Merger Policy Coordination

Case 1: Export Taxes reduced by 40 percent

Country A					Country B				
s^A	$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
-0.3193	0.1350	6 (5.69)	3641	5667	-0.3796	0.3222	14 (14.41)	24855	749
-0.2738	0.1350	4	3639	6425	-0.2833	0.3222	10	24800	824
-0.2537	0.1350	2	3633	6789	-0.2423	0.3222	6	24729	860

Case 2: Complete Trade Liberalization

Country A					Country B				
s^A	$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	s^B	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
-0.7000	0.0000	10	3675	4225	-1.3000	0.0000	20	25350	613
-0.4181	0.0000	8	3556	8861	-0.4801	0.0000	16	23158	949

Table 4: Results from the Simulation 4 without Domestic Sales Tax

Parameter values: $N_A = 15$, $N_B = 10$, $c^A = 0.3$, $c^B = 0.2$, $l = 1000$, $\alpha = 1$, $\gamma = 3$, $\beta = 1.5$, $\delta = 2$.

1. Autonomous Policy Determination

Country A				Country B			
e^A	K_A	w_x^A	$l \cdot cs_{ym}^A$	e^B	K_B	w_y^B	$l \cdot cs_{xm}^B$
0.2579	1	5353	2113	0.4179	1	12090	919

2. Trade Liberalization

Country A				Country B			
$\bar{e}^A$	K_A	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	K_B	w_y^B	$l \cdot cs_{xm}^B$
0.2063	1 (0.52)	5328	2532	0.3343	1 (0.52)	12053	1146
0.1547	1 (0.59)	5253	2989	0.2507	1 (0.53)	11939	1398
0.1032	5 (4.59)	5130	2484	0.1671	1 (0.00)	11749	1620
0.0516	8 (8.51)	4981	3921	0.0836	3 (3.30)	11490	1777
0.0000	11 (11.16)	4831	3964	0.0000	6 (5.59)	11197	1771

3. Merger Policy Coordination

Case 1: Export Taxes reduced by 80 percent

Country A				Country B			
$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
0.0516	8 (8.51)	4981	3921	0.0836	3 (3.30)	11490	1777
0.0516	5	4968	4017	0.0836	1	11483	1913

Case 2: Complete Trade Liberalization

Country A				Country B			
$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
0.0000	11 (11.16)	4831	3964	0.0000	6 (5.59)	11197	1771
0.0000	8	4799	4360	0.0000	4	11183	2071
0.0000	5	4756	4552	0.0000	2	11151	2229

Table 5: Results from the Simulation 5 without Domestic Sales Tax

Parameter values: $N_A = 15$, $N_B = 10$, $c^A = 0.3$, $c^B = 0.2$,
$l = 1000$, $\alpha = 1.3$, $\gamma = 3$, $\beta = 1.0$, $\delta = 2$.

1. Autonomous Policy Determination

Country A				Country B			
e^A	K_A	w_x^A	$l \cdot cs_{ym}^A$	e^B	K_B	w_y^B	$l \cdot cs_{xm}^B$
0.3684	1	10925	800	0.2571	1	4578	1875

2. Trade Liberalization

Country A				Country B			
$\bar{e}^A$	K_A	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	K_B	w_y^B	$l \cdot cs_{xm}^B$
0.2947	1 (0.52)	10873	959	0.2057	1 (0.52)	4564	2338
0.2211	1 (-0.50)	10720	1132	0.1543	1 (0.53)	4521	2852
0.1474	5 (4.59)	10470	1319	0.1029	1 (0.48)	4449	3307
0.0737	8 (8.51)	10165	1485	0.0514	3 (3.30)	4351	3626
0.0000	11 (11.16)	9860	1501	0.0000	6 (5.59)	4240	3613

3. Merger Policy Coordination

Case 1: Export Taxes reduced by 80 percent

Country A				Country B			
$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
0.0737	8 (8.51)	10165	1485	0.0514	3 (3.30)	4351	3626
0.0737	5	10138	1521	0.0514	1	4349	3903

Case 2: Complete Trade Liberalization

Country A				Country B			
$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
0.0000	11 (11.16)	9860	1501	0.0000	6 (5.59)	4240	3613
0.0000	8	9793	1651	0.0000	4	4235	4226
0.0000	5	9707	1724	0.0000	2	4223	4549

Table 6: Results from the Simulation 6 without Domestic Sales Tax

Parameter values: $N_A = 10$, $N_B = 20$, $c^A = 0.3$, $c^B = 0.2$, $l = 1000$, $\alpha = 1$, $\gamma = 2$, $\beta = 1.5$, $\delta = 5$.

1. Autonomous Policy Determination

Country A				Country B			
e^A	K_A	w_x^A	$l \cdot cs_{ym}^A$	e^B	K_B	w_y^B	$l \cdot cs_{xm}^B$
0.225	1	3505	4225	0.5370	1	24979	613

2. Trade Liberalization

Country A				Country B			
$\bar{e}^A$	K_A	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	K_B	w_y^B	$l \cdot cs_{xm}^B$
0.1800	1 (0.52)	3494	5498	0.4296	1 (0.53)	24812	734
0.1350	1 (0.53)	3462	6841	0.3222	5 (4.68)	24314	867
0.0900	1 (0.13)	3406	7739	0.2148	11 (11.12)	23574	1010
0.0450	3 (3.30)	3331	7992	0.1074	15 (15.11)	22770	1137
0.0000	6 (5.59)	3246	8078	0.0000	17 (17.37)	22020	1149

3. Merger Policy Coordination

Case 1: Export Taxes reduced by 80 percent

Country A				Country B			
$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
0.0450	3 (3.30)	3331	7992	0.1074	15 (15.11)	22770	1137
0.0450	2	3330	8792	0.1074	13	22714	1156

Case 2: Complete Trade Liberalization

Country A				Country B			
$\bar{e}^A$	$\bar{K}_A$	w_x^A	$l \cdot cs_{ym}^A$	$\bar{e}^B$	$\bar{K}_B$	w_y^B	$l \cdot cs_{xm}^B$
0.0000	6 (5.59)	3246	8078	0.0000	17	22020	1149
0.0000	5	3246	9496	0.0000	15	21841	1215
0.0000	4	3242	10447	0.0000	13	21591	1264

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