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Welfare effect of mergers and trade liberalization

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Abstract

In a two-country model where firms behave *à la* Cournot, we show that marginal and non-marginal trade liberalization have different effects on the social desirability of horizontal mergers. Marginal tariff reductions increase (decrease) the desirability of merger at sufficiently low (high) tariff levels. In the neighborhood of free trade, for sufficiently low cost savings from merger, trade liberalization increases the desirability of merger whilst decreasing the profitability, implying that mergers should be actively encouraged by competition authorities. Furthermore, we identify ranges of tariff levels for which, if trade liberalization increases (decreases) the desirability of merger, it necessarily increases (decreases) its profitability.

1 Introduction

During the past two decades, the world has been gradually moving closer to free trade. In North America, the Canada-US Free Trade Agreement (1989) has been closely followed by NAFTA (1994). In Europe, the move towards free trade has been a necessary step towards closer economic integration. Tariff levels across many countries and sectors have been on the decline. For example, average Canadian tariffs on manufactured goods fell from 10% to 2.3% between 1988 and 1997 (Baggs (2005)). At the same time, mergers between firms have been on the rise. During the period 1980-99, worldwide mergers grew at a rate of 42% (World Investment Report 2000, UNCTAD). The merger wave of the late 1980's was followed by another five times larger in volume during the late 1990's. In 2006, merger volumes grew to an unprecented level with the total value of merger activity surpassing

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$1.3 trillion (The Economist, January 2007). About 70% of all mergers are domestic, that is, mergers between different firms within the same country (Brakman, Garresten and Marrewijk (2005)).

Several explanations have been offered for the growth in the volume of merger activity in recent years. Qiu and Zhou (2006) attribute the rising number of mergers world-wide to the information asymmetry about domestic demand that exists between domestic and foreign firms. Bjorvatn (2004) attributes this to closer economic integration of markets. Although not the only contender, trade liberalization remains one of the most-studied factors affecting firms' incentives to merge. There exist a few studies which investigate whether trade liberalization actively encourages mergers (Benchekroun and Ray Chaudhuri (2006), Falvey (2005), Faria and Yildiz (2005), Gaudet and Kanouni (2004), Horn and Persson (2001), Long and Vousden (1995), Ross (1988), Yildiz (2003)).

International organizations, including the WTO, the IMF and the OECD, have also been concerned with the interaction of competition policy and trade policy in recent years. One of the rising concerns is that, as trade liberalization undermines the use of trade policy as a strategic tool, countries use competition policy strategically to improve their own welfare at the expense of others. There exist a few studies which allow countries to use competition policy strategically and examine how the optimal number of firms responds to trade liberalization (Horn and Levinsohn (2001), De Stefano and Rysman (2004) and Richardson (1999)). On the other hand, Collie (2003) and Saggi and Yildiz (2006) present the effect of mergers on a country's optimal trade policy.

We focus on the impact of horizontal domestic mergers on social welfare. We say that a tariff reduction increases (decreases) the desirability of a merger when it increases (decreases) the merger-induced change in social welfare. We address two important questions: (i) Does trade liberalization render a domestic horizontal merger more desirable to society? (ii) Does trade liberalization move desirability and profitability in the same direction? In addressing these issues we simultaneously address some other interesting questions that arise: Who are the winners and the losers from such

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mergers in the face of trade liberalization? What are the implications of trade liberalization for domestic competition policy?

We consider two countries, Home and Foreign, with segmented markets and identical demand conditions. We focus on the case where both countries have the same number of firms. All firms are assumed to produce a homogeneous good and compete *à la* Cournot. A "Home firm" is a firm that undertakes production in Home, and a "Foreign firm" is one that undertakes production in Foreign. All firms are allowed to sell their output locally and to export.

We focus on the merger of two Home firms with different production technologies. Subsequent to the merger, the merged entity is assumed to have access to the more efficient of the two technologies. This scenario reflects two of the most commonly cited reasons for firms to participate in merger activity. First, the merger participants can gain market power subsequent to the merger. Second, there are cost savings from the merger, since by participating in the merger, one of the merger participants gains access to cheaper technology. We vary the level of merger-induced cost savings in order to distinguish between two main types of mergers: those with high cost savings that lead to greater productive efficiency and those with low cost savings that lead mainly to increased market power of the merger participants. We then investigate the impact of trade liberalization on each type of merger.

Trade liberalization, in this model, takes the form of equal bilateral tariff reductions. This reflects the situation subsequent to rounds of international negotiations. For example, when the NAFTA was signed in 1994, it was mandated that tariffs in North America be gradually phased out over a period of 14 years. Trade liberalization following free trade agreements often occurs as piecemeal tariff reductions, as in the above example. We, therefore, present a global analysis for all positive tariff levels, rather than restricting the analysis to either the neighborhood of free trade or of the optimal tariff level, which has been the case in the previously mentioned studies on strategic

competition policy.[1]

Now let us turn to a discussion of our main results. In addressing our first question of interest, we find that the effect of trade liberalization on the desirability of merger is crucially dependent on the tariff level prior to liberalization. The desirability of a merger is defined to be the merger-induced change in social welfare. This is shown to be convex and non-monotonic in the tariff level, which explains why our results vary with the pre-liberalization tariff level. In the neighborhood of free trade, marginal trade liberalization is shown to increase the desirability of merger, whereas at sufficiently high tariff levels, desirability of merger falls in response to marginal trade liberalization. Thus, the conclusions around a strictly positive tariff level and in the neighborhood of free trade may give conflicting recommendations on how to adjust competition policy following a marginal tariff reduction. Moreover, the impact of marginal trade liberalization, at any given tariff level, can fail to accurately predict the change in the desirability of merger in response to tariff reductions which are non-marginal. Thus, we show that relying on marginal analyses to ascertain the response of merger policy to trade liberalization can lead to detrimental policy changes. It is essential to take into consideration the exact pre- and post-liberalization tariff levels in order to obtain accurate policy prescriptions.

In order to determine the conditions under which competition policy should actively encourage or disallow a merger in the face of trade liberalization, it is not sufficient to focus solely on the desirability of merger. We must silmultaneously determine the effect of trade liberalization on the profitability of the merger. This brings us to the second important question addressed by this paper. Does trade liberalization move the social and private responses to a potential merger in the same direction?

In the neighborhoods of free trade and the prohibitive tariff, for sufficiently low cost savings from

[1]Exceptions include Gaudet and Kanouni (2004) who focus on the effect of moving from a prohibitive to a non-prohibitive tariff on the profitability of merger.

merger, desirability and profitability of merger are shown to move in opposite directions in response to trade liberalization, whereas for intermediate levels of tariff they move in the same direction. Interestingly, we show that in the neighborhood of free trade, for sufficiently low cost savings from merger, trade liberalization increases the desirability of merger whilst decreasing the profitability. Thus, under these conditions, competition policy is needed to actively encourage the realization of potential mergers.

We are also able to obtain the following results independent of the level of cost savings from merger. This analysis is useful because in reality tariff changes are transparent but cost savings from merger are not. Competition bureaus can, at best, estimate the latter. We show that at tariff levels below a certain threshold, if desirability of merger falls in response to trade liberalization so must profitability, whereas at tariff levels above a certain threshold, if desirability rises so must the merger's profitability. Thus, regardless of the level of cost savings from merger, when the pre-liberalization tariff level lies within either of these ranges, the need to actively use merger policy in response to trade liberalization to encourage or prevent mergers is reduced. If the merger becomes more (less) desirable, it is naturally more (less) likely to be realized.

We proceed as follows. Section 2 sets up the basic model. Section 3 derives the change in welfare due to the merger for any given tariff level. Section 4 discusses the impact of trade liberalization on the desirability of merger. Section 5 derives the conditions under which trade liberalization increases both profitability and desirability of merger and those under which one is increased at the expense of the other. Section 6 presents the concluding remarks.

2   The Model and Preliminaries

We consider a scenario with two countries, Home and Foreign, with segmented markets. All firms produce a homogenous product. To explain the realization of mergers amongst firms within an

industry, the industrial organization literature has identified two main factors, both of which have been shown to be empirically relevant and both of which are incorporated in our model: (i) firms merge in order to gain market power (ii) firms merge in order to benefit from a resulting reduction in their cost of production. The latter can arise due to the existence of economies of scale in the firms' production function or if the merger results in the shutting down of one of the plants leading to fixed cost savings. Thereby, the merged entity would enjoy a lower average cost of production than either of the merger participants prior to the merger. Alternatively, it is possible that the merger participants vary in their productive efficiency and that the merger is motivated by the fact that the high cost firm wishes to gain access to the low cost firm's technology. Our model incorporates this latter feature by allowing the merger participants to have heterogenous cost structures. Home has $n + 2$ firms where n firms are identical with marginal cost c. Firm 1 and firm 2 in Home, the merger participants, have different marginal costs, c_1 and c_2 respectively (at least one different from c). Without loss of generality let us assume that $c_1 > c_2$. Let the difference between the marginal costs of firms 1 and 2 be denoted by z, that is, $z \equiv c_1 - c_2$. Subsequent to the merger of firm 1 and firm 2, the cost of production of the new entity is assumed to correspond to the lower of the two marginal costs, that is c_2. There, thus, exist cost savings from merger, denoted by z. Foreign also has $(n + 2)$ firms each with a constant marginal cost given by c_F. Each of the $n + 2$ foreign firms sells y in Home and y^* in Foreign. Firm 1 sells x_1 in Home and x_1^* in Foreign. Firm 2 sells x_2 in Home and x_2^* in Foreign. Each of the n identical Home firms sells x in Home and x^* in Foreign.

Firms compete in quantities, that is, *à la* Cournot. The inverse demand in each country is given by:

$$P(Y) = a - bY$$

where $a, b > 0$ and Y is the total quantity sold in the country.

Each country imposes an import tariff. It is assumed that the tariffs imposed by Foreign and

Home are identical, denoted by t. We focus on the case where both countries simultaneously reduce t by the same amount, that is, equal bilateral tariff reduction. This reflects the scenario where countries sign a free trade agreement, such as NAFTA, subsequent to which the signatories must phase out their tariffs over a period of several years.

The market equilibrium

Let the total quantity sold in Home be $Q \equiv x_1 + x_2 + nx + (n+2)y$ and that in Foreign be $Q^* \equiv x_1^* + x_2^* + nx^* + (n+2)y^*$. The profits of Home firm i from its sales in Home are given by:

$$\pi_i \equiv \begin{cases} x_i(a - bQ) - c_i x_i & \text{if } i = 1, 2 \\ \\ x(a - bQ) - cx, & \text{if } i = 3, 4, ..., n+2 \end{cases} \quad (1)$$

The profits of Home firm i from its sales in Foreign are given by:

$$\pi_i^* \equiv \begin{cases} x_i^*(a - bQ^*) - (c_i + t)x_i^* & \text{if } i = 1, 2 \\ \\ x^*(a - bQ^*) - (c + t)x^*, & \text{if } i = 3, 4, ..., n+2 \end{cases} \quad (2)$$

The profits of Foreign firm f from its sales in Home are given by:

$$\pi_f \equiv y(a - bQ) - (c_F + t)y, \text{ for } f = 1, 2, ..., n+2 \quad (3)$$

The profits of Foreign firm f from its sales in Foreign are given by:

$$\pi_f^* \equiv y^*(a - bQ^*) - c_F y^*, \text{ for } f = 1, 2, ..., n+2 \quad (4)$$

Each Home firm, i, takes the quantity chosen by the other $(2n+3)$ firms as given and chooses the quantities that maximize its profits as given by (1) and (2). Similarly, each Foreign firm, f, takes the quantity chosen by the other $(2n+3)$ firms as given and chooses the quantities that maximize its profits given by (3) and (4). Before proceeding with the analysis, the following simplifying assumptions are made: $c = c_2 = c_F = 0$ and $a = b = 1$. This is done to avoid lengthening the essay with the study of numerous possible cases that do not significantly add to the nature of the

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conclusions. For an interior equilibrium, the quantities sold in Home by the different firms are given by:

$$
\begin{aligned}
\hat{x}_1 &= \frac{1 + (n+2)\,t - (2n+4)\,z}{(2n+5)} \\
\hat{x}_2 &= \frac{1 + z + (n+2)\,t}{(2n+5)} \\
\hat{x} &= \frac{1 + z + (n+2)\,t}{(2n+5)} \\
\hat{y} &= \frac{1 + z - (n+3)\,t}{(2n+5)}
\end{aligned}
$$

The equilibrium quantities sold in Foreign are given by:

$$
\begin{aligned}
\hat{x}_1^* &= \frac{1 + t + nt - (t+z)(2n+4)}{(2n+5)} \\
\hat{x}_2^* &= \frac{1 + t + z + nt - (2n+4)\,t}{(2n+5)} \\
\hat{x}^* &= \frac{1 + 2t + z - (n+5)\,t}{(2n+5)} \\
\hat{y}^* &= \frac{1 + 2t + z + nt}{(2n+5)}
\end{aligned}
$$

It is straightforward to obtain the profits for each firm at the equilibrium by substituting the quantities above into equations (1), (2), (3) and (4). The profits of firms 1 and 2 at the equilibrium can be written as

$$
\pi_i + \pi_i^* = \left((\hat{x}_i)^2 + (\hat{x}_i^*)^2 \right), \quad i = 1, 2
$$

A merger

A domestic merger of two firms, firms 1 and 2, in Home is examined. When these two firms merge, the new entity and the $2n+2$ other firms compete *à la* Cournot. Recall that the cost of production of the new entity is assumed to correspond to the lower of the two marginal costs resulting in cost savings from merger, denoted by z. The subscript, M, denotes post-merger values throughout the rest of the essay.

Let X_M and X_M^* denote the quantities sold by the merged entity in Home and Foreign respectively. For interior solutions, the post-merger equilibrium quantities sold in Home are given by:

$$\hat{X}_M = \frac{1 + (n+2)\,t}{(2n+4)}$$

$$\hat{x}_M = \frac{1 + (n+2)\,t}{(2n+4)}$$

$$\hat{y}_M = \frac{1 - (n+2)\,t}{(2n+4)}$$

The total post-merger sales in Home is given by $\hat{Q}_M \equiv \hat{X}_M + n\hat{x}_M + (n+2)\,\hat{y}_M$. The post-merger equilibrium quantities sold in Foreign are given by:

$$\hat{X}_M^* = \frac{1 - (n+3)\,t}{(2n+4)}$$

$$\hat{x}_M^* = \frac{1 - (n+3)\,t}{(2n+4)}$$

$$\hat{y}_M^* = \frac{1 + (n+1)\,t}{(2n+4)}$$

The profits[2] of the merged firm from sales in Home and Foreign respectively are given by:

$$\Pi_M = \left(\hat{X}_M\right)^2 \text{ and } \Pi_M^* = \left(\hat{X}_M^*\right)^2.$$

Moreover, for notational convenience we define the following:

$$B \equiv 138n + 153n^2 + 60n^3 + 8n^4 + 14 > 0 \tag{5}$$

Although, for clarity, we focus on the case where both countries have an equal number of firms, the main results of this paper hold more generally for all combinations of the number of Home and Foreign firms such that $B > 0$.

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[2] In a closed economy, under Cournot oligopoly, mergers are not always profitable. In fact, as shown by Salant, Switzer and Reynolds (1983), a non-cost-reducing merger is only profitable if at least 80% of the industry participates in the merger. The case studied in Salant, Switzer and Reynolds (1983) can be retrieved from the model at hand by for example setting $c_1 = c_2 = c_F = c$ and either $t = 0$ or t at a prohibitive level such that no trade takes place.

It is noted that, under these specifications, the following conditions hold at equilibrium. It holds that pre- and post-merger quantities in Home, $\hat{x}_1$, $\hat{x}_2$, $\hat{x}$, $\hat{y}$, $\hat{X}_M$, $\hat{x}_M$, and $\hat{y}_M$ are strictly positive iff $t \in \left(t_{\min}(z), t_{\max}(z) + \frac{(2n+5)z}{(n+3)} \right)$, where

$$t_{\min}(z) \equiv 2z - \frac{a}{n+2}$$

and

$$t_{\max}(z) \equiv \frac{a - 2z(n+2)}{n+3}$$

It holds that pre- and post-merger quantities in Foreign, $\hat{x}_1^*$, $\hat{x}_2^*$, $\hat{x}^*$, $\hat{y}^*$, $\hat{X}_M^*$, $\hat{x}_M^*$, and $\hat{y}_M^*$ are strictly positive iff $t \in [0, t_{\max}(z))$. We further note that $t_{\max}(z) > t_{\min}(z)$ iff $z < \frac{a}{2(n+2)}$.

3   Welfare Effects of a Merger

One of the main objectives of this paper is to use the framework set up in the previous section to determine whether trade liberalization makes mergers more or less desirable to society. In this section, we take the first step towards this objective by defining the concept of social desirability of a merger. In our context, this is equivalent to determining the welfare implication in Home of the merger between firms 1 and 2. Social welfare, taken to be the sum of consumers' surplus, producers' surplus and government revenue, denoted by CS, PS and TR respectively, is given by:

$$W = CS + TR + PS$$

Post-merger social welfare is denoted by:

$$W_M = CS_M + TR_M + PS_M$$

The change in welfare due to a merger is given by $F \equiv W_M - W$, that is:

$$F = (CS_M - CS) + (TR_M - TR) + (PS_M - PS) \tag{6}$$

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The merger, thus, increases welfare if and only if $F > 0$.

Marginal trade liberalization is said to increase (decrease) the desirability of the merger (from the social viewpoint) at $t = t_0$ iff $\frac{\partial F}{\partial t}\big|_{t=t_0} < 0$ ($\frac{\partial F}{\partial t}\big|_{t=t_0} > 0$).

A non-marginal tariff reduction from t_1 to t_0 is said to increase (decrease) the desirability of the merger iff $F|_{t=t_0} > F|_{t=t_1}$ ($F|_{t=t_0} < F|_{t=t_1}$).

Before proceeding to determine the impact of marginal and non-marginal trade liberalization on the social desirability of mergers, it is useful to examine the components of F, as presented by (6), using Lemmas 1 - 4 below. This enables us to explain the impact of trade liberalization on different groups within the society, such as consumers, firms and the government, and thereby, to identify the main (often counter-acting) forces driving the results presented in the following section.

Let us begin with the effect of the merger on consumers' surplus. Pre-merger consumers' surplus is given by:

$$CS = \int_0^Q P(Y)dY - P(Q)Q = \frac{1}{2}Q^2 \tag{7}$$

Post-merger consumers' surplus is given by:

$$CS_M = \int_0^{Q_M} P(Y)dY - P(Q_M)Q_M = \frac{1}{2}(Q_M)^2 \tag{8}$$

where Q_M represents the total post-merger sales in Home.

LEMMA 1:

(i) For all $t > t_{\min}(z)$, it holds that the merger-induced change in consumers' surplus, $(CS_M - CS)$, is negative.

(ii) $(CS_M - CS)$ is convex and monotonically decreasing in t for all $t \in [0, t_{\max}(z))$.

PROOF:

(i) It can be shown that $Q > Q_M$ iff $t > t_{\min}(z)$. Thus, it follows from (7) and (8) that $(CS_M - CS) < 0$ for all $t > t_{\min}(z)$.

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(ii) We have:

$$
\begin{aligned}
\frac{\partial^2}{\partial t^2}(CS_M - CS) &= \left(\left(\frac{\partial Q_M}{\partial t}\right)^2 - \left(\frac{\partial Q}{\partial t}\right)^2\right) \\
&= (n+2)^2\left(\left(\frac{1}{2\,(n+2)}\right)^2 - \left(\frac{1}{2n+5}\right)^2\right) \\
&> 0
\end{aligned}
$$

This shows that $(CS_M - CS)$ is strictly convex in t. It is also noted that $\frac{\partial}{\partial t}(CS_M - CS) < 0$ for all $t \in [0, t_{\max}(z))$. This proves that $(CS_M - CS)$ is monotonically decreasing in t for all non-prohibitive tariff levels. $\blacksquare$

Lemma 1 states that consumers' surplus falls after the merger due to the fall in total sales in Home. This implies that for non-prohibitive tariff levels, a reduction in the tariff level results in the merger being less harmful to consumers. The lower the tariff level, the greater the volume of imports. This implies a lower equilibrium price of the product in the Home market, which in turn reduces the merger-induced loss in consumers' surplus.

We now turn to the change in tariff revenue as a result of the merger. Pre-merger and post-merger tariff revenues at any given t are given by $TR \equiv t\,(n+2)\,y$ and $TR_M \equiv t\,(n+2)\,y_M$ respectively.

LEMMA 2: *The merger-induced change in tariff revenue, $(TR_M - TR)$, is positive, and is convex and monotonically increasing in t for all $t \in [0, t_{\max}(z))$.*

PROOF: We have

$$
\frac{\partial^2}{\partial t^2}(TR_M - TR) = \frac{(n+2)}{(2n+5)} > 0
$$

This shows that $(TR_M - TR)$ is strictly convex in t. It also holds that

$$
\frac{\partial\,(TR_M - TR)}{\partial t}\Big|_{t=t^*} = 0
$$

where $t^* \equiv \frac{4z - a + 2nz}{2(n+2)}$. It is noted that $t^* < 0$ for all z such that $t_{\max}(z) > 0$. This, together with $(TR_M - TR)|_{t=0} = 0$, ensures that for all non-prohibitive tariff levels $(TR_M - TR) > 0$ and $\frac{\partial}{\partial t}(TR_M - TR) > 0$. ∎

Lemma 2 can be explained as follows. At any given tariff level, the joint Home sales of the merging firms is shown to fall as a result of the merger. In a Cournot setting, this implies that all other firms serving the Home market, Home and Foreign firms alike, increase their outputs. In other words, imports rise. The increase in imports as a result of the merger is linear and increasing in t, $I_M - I$, as shown below:

$$I_M - I = \frac{a + (n+2)t - (2n+4)z}{2(2n+5)} \tag{9}$$

From (9), we have the unexpected result that in response to trade liberalization, the magnitude of the merger-induced rise in imports decreases. This can be explained as follows. The higher the tariff level, the greater the market power enjoyed by the merging firms in the Home market and the greater the fall in their joint output after the merger. This in turn implies a greater reaction by Foreign firms in terms of a rise in the volume of their sales in the Home market. This explains why the change in tariff revenue due to merger increases in the tariff level.

From Lemmas 1 and 2, it is possible to identify groups to whom the merger becomes more desirable as trade is liberalized and others to whom the merger becomes less desirable.

PROPOSITION 1: *For all non-prohibitive tariff levels, a tariff reduction makes the merger less harmful to consumers and less desirable to the customs agency.*

PROOF: The proof follows directly from Lemmas 1 and 2. ∎

In Proposition 1, "customs agency" refers to that division of the government which is responsible for collecting tariff revenue. Subsequent to the merger, the tariff revenue collected by the customs

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agency rises, as explained above. However, from Lemma 2 it follows that this gain in tariff revenue diminishes as the tariff is reduced. This is explained by (9) which shows that as the tariff is reduced, the merger-induced change in imports diminishes in magnitude. This, in turn, causes the merger-induced change in tariff revenue that the customs agency collects to fall in the face of trade liberalization. Thus, from the custom agency's perspective, the merger becomes less desirable in response to trade liberalization. On the other hand, consumers are less adversely affected by the merger as a result of trade liberalization, as shown by Lemma 1.

Next we examine the effect of the merger on producers' surplus, at any given tariff level. Pre-merger producers' surplus is given by:

$$PS = (\pi_1 + \pi_1^*) + (\pi_2 + \pi_2^*) + n(\pi + \pi^*)$$

Post-merger producers' surplus is given by:

$$PS_M = (\Pi_M + \Pi_M^*) + n(\pi_M + \pi_M^*)$$

The merger participants can gain or lose from the merger, depending on the values of t and z. This is because, in a Cournot oligopoly, the merger participants have to sacrifice some market share in order to bring about the gain in market power subsequent to the merger.[3] The non-participating firms will gain from the merger, but it is unclear as to whether the merger will become more or less desirable to them as trade is liberalized. The reason for this ambiguity is that unlike $(CS_M - CS)$ and $(TR_M - TR)$, the expression for $(PS_M - PS)$ can be non-monotonic even for non-prohibitive tariff levels. For all non-participating Home firms, the merger-induced change in profits from Home sales is increasing in the tariff level (the "Home effect"), whereas the merger-induced change in profits from Foreign sales is decreasing in the tariff level for non-prohibitive tariff levels (the "Foreign effect"). The reverse holds for the merger participants. At high tariff levels, the volume of exports is low,

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[3]This is illustrated by Salant, Switzer and Reynolds (1983).

so that the "Home effect" dominates. As the tariff level is lowered, the volume of exports rises and the "Foreign effect" becomes stronger and eventually outweighs the "Home effect". This causes the non-monotonicity of $(PS_M - PS)$ in t even for non-prohibitive tariff levels.

Whether $(PS_M - PS)$ is concave or convex in t depends on the number of Home firms to Foreign firms. The change in producers' surplus due to merger can be decomposed into the change in the profits of the merging firms and that of the non-participating firms. The former has been shown to be quadratic and concave in t in Benchekroun and Ray Chaudhuri (2006). The latter is shown to be convex in t, as follows. The merger-induced change in joint profits of the n non-partcipating Home firms, denoted $\Delta\pi_{-M}$ is given by:

$$\Delta\pi_{-M} \equiv n\left(\pi_M + \pi_M^*\right) - n\left(\pi + \pi^*\right)$$

with

$$\frac{\partial^2}{\partial t^2}\left(\Delta\pi_{-M}\right) = 2n\left(\left(\frac{\partial x_M}{\partial t}\right)^2 + \left(\frac{\partial x_M^*}{\partial t}\right)^2 - \left(\frac{\partial x}{\partial t}\right)^2 - \left(\frac{\partial x^*}{\partial t}\right)^2\right)$$

which after simplifications yields

$$\frac{\partial^2}{\partial t^2}\left(\Delta\pi_{-M}\right) = \frac{\left(10n + 2n^2 + 13\right)\left(4n + 9\right)n}{2\left(2n + 5\right)^2} > 0$$

Essentially the merging firms perform a "service" to the non-participating firms by reducing total quantity supplied in the market and raising price. The non-participating firms free-ride on this. When the number of Home firms is less than the number of Foreign firms, most of the free-riders are foreign firms.[4] The greater is the number of Foreign firms relative to the number of Home firms, the smaller the magnitude of the *domestic* non-participating firms relative to all other firms (including the domestic merging firms). Thus, the greater is the merger-induced change in profits of the merging firms as a proportion of $(PS_M - PS)$. This causes $(PS_M - PS)$ to become concave

[4]For the linear demand case and for any given tariff level, Dixit (1984) shows that for a domestic merger within an open economy to be welfare-improving, imports as a proportion of total domestic sales must be less than 50%.

in t if the number of Foreign firms is sufficiently larger than the number of Home firms. Lemma 3, below, gives the case where Home and Foreign have an equal number of firms.

LEMMA 3: *The merger-induced change in producers' surplus, $(PS_M - PS)$, is strictly concave in t for $t \in [0, t_{\max}(z))$.*

PROOF: We have that $(PS_M - PS)$ is quadratic in t. When Home and Foreign each have $(n + 2)$ firms, it holds that

$$\frac{\partial^2}{\partial t^2}(PS_M - PS) = -\frac{(3n + 7)\left(10n + 2n^2 + 13\right)}{2\left(2n + 5\right)^2\left(n + 2\right)^2} < 0. \blacksquare$$

In this section, by examining the separate components of F, we have identified groups within the society which find the merger less desirable (the customs agency) and less undesirable (consumers) in the face of trade liberalization. We have also discussed the merger-induced changes in the profits of the merger participants and of the non-participants and distinguished between how each depends on the tariff level. Our next step is to evaluate the combined effect on these different groups within society. This leads us to the main question of interest of this paper: How does the social desirability of merger vary as the tariff level is reduced? In other words, we proceed to examine how F varies in t. It is noted that F is a quadratic function of t. Whether F is concave or convex in t depends on the rates of change of $(PS_M - PS)$ (which is concave in t) relative to $(TR_M - TR)$ and $(CS_M - CS)$ (which are both convex in t) with respect to t.

LEMMA 4: *The merger-induced change in welfare, F, is strictly convex in t for $t \in [0, t_{\max}(z))$.*

PROOF: When Home and Foreign have $(n + 2)$ firms, computing the second derivative of F with respect to t gives:

$$\frac{\partial^2 F}{\partial t^2} = \frac{B}{4\left(2n + 5\right)^2\left(n + 2\right)^2} > 0$$

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where B is given by (5). This implies that the merger-induced change in welfare, F, is quadratic and strictly convex in t.∎

4 Trade liberalization and desirability of merger

Our ultimate objective in this paper is to determine whether the change in the desirability of merger from the perspective of society and of the merger partricipants in response to trade liberalization are aligned and thereby to infer the implications for merger policy within this context. Having identified, in the previous section, the factors which affect the merger-induced change in welfare as the tariff is reduced, we are now in a position to address the first of these issues: Under what conditions does a reduction in the tariff level increase the desirability of the merger in question? We shall return to the response of the profitability of merger in the following section.

Marginal trade liberalization

We first determine how the merger-induced change in welfare, F, responds to marginal reductions in t.

PROPOSITION 2: *Let*

$$t_w(z) \equiv \frac{1}{B}\left(8z(n+3)^2(n+2)^2 - \left(23n + 4n^2 + 32\right)\right) \tag{10}$$

and

$$z_w(t) \equiv t_w^{-1}(z) = \frac{Bt + \left(23n + 4n^2 + 32\right)}{8(n+3)^2(n+2)^2} \tag{11}$$

For any tariff $t > 0$ and $z > z_w(0)$, marginal trade liberalization increases (decreases) the desirability of a merger iff $t \in [0, t_w(z))$ (iff $t > t_w(z)$).

PROOF: It holds that $\frac{\partial F}{\partial t}\big|_{t=t_w(z)} = 0$. It holds that $t_w(z) > 0$ iff $z > z_w(0)$. This, together with Lemma 4 completes the proof. ∎

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Proposition 2 shows that, given any $z > z_w(0)$, the effect of a marginal tariff reduction on F is dependent on the pre-liberalization tariff level, t. By Lemma 4, it holds that F is convex in t. Proposition 2 shows further that F is non-monotonic in t for $z > z_w(0)$. A marginal tariff reduction makes the merger more desirable only if the pre-liberalization tariff level is sufficiently low. At tariff levels higher than the threshold $t_w(z)$, on the other hand, a marginal tariff reduction has the reverse effect on the desirability of merger. The direct policy implication of Proposition 2 is as follows. The role of the competition bureau, is shown to depend on the pre-liberalization tariff level. In the neighbourhood of free trade, a marginal tariff reduction increases the social desirability of the merger, so that the competition bureau need not be concerned about the impact of marginal trade liberalization. If the merger would have been allowed pre-liberalization, then it will necessarily be allowed post-liberalization. However, at sufficiently higher tariff levels, this does not hold. A proposed merger that would have been welfare improving and therefore allowed pre-liberalization, may become socially undesirable as a result of trade liberalization. Thus, at high tariff levels the competition bureau needs to be more vigilant with regard to its merger policy in response to trade liberalization. It is interesting to note that $t_w(z)$ is increasing in z. Thus, for any $z > 0$, we have $t_w(z) > t_w(0)$. That is, as long as $t_w(0) > 0$, we have that the non-monotonicity of F in t holds for all positive levels of cost savings from merger and the ensuing policy implications, as discussed above, become relevant.

The analysis in Proposition 2 can be used to give important new insights to the role of cost savings from merger in determining the effect of trade liberalization on the desirability of mergers. In particular, for a given tariff level, the impact of marginal trade liberalization crucially depends on the level of cost savings, as illustrated by Corollary 1.

COROLLARY 1: *For any tariff $t > 0$ and $z > 0$, a marginal trade liberalization increases (decreases) the desirability of a merger iff $z > z_w(t) > 0$ (iff $z \in (0, z_w(t))$).*

PROOF: Straightforward from the definition of $z_w(t)$. ∎

Corollary 1 shows that, at any given tariff level, the effect of a marginal tariff reduction on F is dependent on the magnitude of the merger-induced cost savings, z. A marginal tariff reduction makes the merger more desirable only if the cost savings are sufficiently high. If the merger entails low cost savings, then a marginal tariff reduction has the reverse effect. It is interesting to note that the critical level of cost savings, beyond which marginal trade liberalization increases the desirability of merger, $z_w(t)$, is increasing in t. Thus, for any $t > 0$, it holds that $z_w(t) > z_w(0)$. At any given tariff level, Corollary 1 implies that the role of the competition bureau depends on the level of cost savings from merger. At sufficiently low cost saving levels, a proposed merger that would have been welfare improving and therefore allowed pre-liberalization, may become socially undesirable as a result of trade liberalization. Therefore, the competition bureau needs to become more cautious with regard to its merger policy in response to trade liberalization when the cost savings from merger are low. However, at sufficiently high levels of cost savings, the competition bureau need not be concerned about the impact of marginal trade liberalization. If the merger would have been allowed pre-liberalization, then it will necessarily be allowed post-liberalization.

We proceed to identify a range of cost savings for which the effect of marginal trade liberalization is independent of the tariff level. For $z \in [0, z_w(0))$, it holds that $t_w(z) < 0$ and therefore, a marginal trade liberalization decreases the desirability of a merger for all $t > 0$.

Trade liberalization: a global analysis

We now turn our attention to another interesting implication of Proposition 2. Since a marginal analysis can lead to different results at different levels of tariff, a marginal analysis may not be a reliable predictor of the effects of non-marginal tariff reductions. For a merger with a given level of cost savings, we seek to determine the conditions under which the impact of marginal and non-

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marginal trade liberalization will differ.

Given cost savings from merger, z, if trade liberalization increases the desirability of merger in the neighborhood of free trade, then, by Proposition 2, it will increase the desirability of the merger for any pre-liberalization tariff level, t_0 such that $t_0 < t_w(z)$. It can also be concluded that a non-marginal change in tariff from $t = t_0 < t_w(z)$ to $t = 0$ will increase the desirability of a merger: that is, for a given level of cost savings z, if $t_0 < t_w(z)$ then $F(t_0, z) < F(0, z)$.

An interesting case arises when the pre-liberalization tariff level is sufficiently large: $t = t_0 > t_w(z_0)$. Given cost savings from merger z, it holds that $\frac{\partial F}{\partial t}\big|_{t=t_0} > 0$ and $\frac{\partial F}{\partial t}\big|_{t=0} < 0$. The analysis of a marginal tariff reduction will cease to be a reliable predictor of the desirability of merger when moving from protection to free trade. The conclusions around $t = t_0$ and $t = 0$ give conflicting recommendations on how to adjust competition policy following a move toward free trade.

PROPOSITION 3: *Let*

$$\tilde{t}(z) = 2t_w(z)$$

For $t \in \left(t_w(z), \tilde{t}(z)\right)$ and $z > z_w(0)$, it holds that $\frac{\partial F}{\partial t}\big|_t > 0$ and yet $F(0, z) > F(t, z)$.

PROOF: The function $F(t, z) - F(0, z)$ is a convex quadratic function of t with roots at $t = 0$ and $t = \tilde{t}(z)$. Therefore, for $t \in (0, \tilde{t}(z))$ it holds that $F(t, z) - F(0, z) < 0$ and for $t > \tilde{t}(z)$ it holds that $F(t, z) - F(0, z) > 0$. This, together with Proposition 2, concludes the proof. ■

Proposition 3 identifies a range of moderate values of pre-liberalization tariff levels, $t \in \left(t_w(z), \tilde{t}(z)\right)$, at which marginal trade liberalization decreases the desirability of merger whereas a complete removal of a tariff increases the desirability of merger. This brings us to one of the main conclusions of this paper regarding merger policy under trade liberalization. Proposition 3 implies that in order to derive accurate policy decisions, the competition bureau must take into consideration the exact pre- and post-liberalization tariff levels rather than relying on marginal analyses. Starting from a tariff

level, $t \in \left(t_w \left(z \right), \tilde{t} \left(z \right) \right)$, at which the merger is desirable, a jump to free trade necessitates that the competition bureau allow the merger. If, however, the move to free trade is gradual, as is typically the case subsequent to the signing of international trade treaties, it becomes relevant to investigate the effect of reducing the tariff level marginally. As illustrated by Proposition 3, this could lead to the merger becoming undesirable in the period immediately following the free trade agreement. The competition bureau would then need to compare the costs of allowing the merger in the short run and the benefits of allowing the merger in the longer run when the tariff level eventually approaches zero.

5 Profitability and desirability of merger

We now combine the analysis of the desirability of a horizontal merger with the analysis of the profitability of such a merger to address the second important question of the essay: does trade liberalization move the social and private responses to a potential merger in the same direction? In order to determine the implications for competition policy, one must study the effect of trade liberalization on the profitability of the merger as well as the desirability of the merger. For example, can trade liberalization increase the desirability of the merger but decrease its profitability? In such a case, instead of preventing a potential merger, competition policy might have to be designed to actively encourage the merger. In this section, ranges of cost savings and tariff levels are identified for which trade liberalization increases (or decreases) both the profitability and desirability of merger, and those for which it increases one but not the other.

PROPOSITION 4: *Let*

$$t^* \left(z \right) \equiv \frac{a \left(12n + 4n^2 + 7 \right) - 4z \left(2n + 3 \right) \left(n + 2 \right)^2}{\left(12n + 4n^2 + 7 \right) \left(10n + 2n^2 + 13 \right)}$$

and

$$z_w^* \equiv \frac{\left(12n + 4n^2 + 7\right)\left(37n + 8n^2 + 43\right)a}{4\left(n+2\right)^2\left(409n + 296n^2 + 84n^3 + 8n^4 + 168\right)} > 0$$

(i) For $z \in [0, z_w^*)$ and $t \in (\max\{0, t_w(z)\}, t^*(z))$, a marginal tariff reduction decreases both the profitability and the desirability of the merger.

(ii) For $z > z_w^*$ and $t \in (\max\{0, t^*(z)\}, t_w(z))$, a marginal tariff reduction increases both the profitability and the desirability of the merger.

PROOF: Marginal trade liberalization increases (decreases) the profitability of a merger iff $t > t^*(z)$ $(t < t^*(z))$ (See Corollary 1 of Benchekroun and Ray Chaudhuri (2006)). It can be shown that $t_w(z_w^*) - t^*(z_w^*) = 0$, with $t_w(z) - t^*(z)$ linear and increasing in z. Thus, for $z \in [0, z_w^*)$, it holds that $t_w(z) < t^*(z)$ and for $z > z_w^*$, it holds that $t_w(z) > t^*(z)$. It holds that $t^*(z) > 0$ iff $z < z^*(0)$, where $z^*(t) = t^{*-1}(z)$, and $t_w(z) > 0$ iff $z < z_w(0)$. Since $z_w(0) < z_w^* < z^*(0)$, it holds that $t^*(z) > 0$ for $z \in [0, z_w^*)$ and $t_w(z) > 0$ for $z > z_w^*$. This, together with Proposition 2, concludes the proof. ■

Proposition 4 shows that given values of pre-liberalization tariff levels lying between $t_w(z)$ and $t^*(z)$, the need for competition policy to actively disallow or encourage the merger in response to trade liberalization is reduced. If trade liberalization renders the merger more desirable, the merger is naturally more likely to be realized since it simultaneously becomes more profitable. If trade liberalization renders the merger less desirable, the merger is naturally less likely to be realized since it simultaneously becomes less profitable.

There do arise cases, for extreme values of pre-liberalization tariff levels, for which the desirability and profitability of the merger move in opposite directions as trade is liberalized.

PROPOSITION 5:

(i) For $z < z^*(0)$ and $t \in [0, \min\{t^*(z), t_w(z)\})$, trade liberalization increases the desirability and decreases the profitability of the merger.

(ii) For $t > \max\{t_w(z), t^*(z)\}$, trade liberalization decreases the desirability and increases the profitability of the merger.

PROOF: We have $t^*(z) > 0$ iff $z < z^*(0)$. The proof follows directly from the definitions of $t^*(z)$ and $t_w(z)$, and Proposition 2. ∎

Proposition 5 shows that, given sufficiently low levels of cost savings from merger, there does exist a range of pre-liberalization tariffs, $t \in [0, \min\{t^*(z), t_w(z)\})$, for which trade liberalization increases the desirability of merger but reduces its profitability, so that competition policy might be needed to actively encourage the merger. For tariff levels higher than $\max\{t_w(z), t^*(z)\}$, on the other hand, the need for competition policy to actively prevent the potential merger in the face of trade liberalization increases. Although the merger becomes more profitable to the merger participants, and therefore, is more likely to be realized, it becomes less desirable to society.

The analysis in Propositions 4-5 illustrates the conditions under which increased desirability necessarily implies increased profitability and vice versa, for a merger with a given level of cost-savings. The level of cost savings, in reality, is difficult to ascertain. Moreover, the potential cost savings from a proposed merger are even harder for the competition bureau to measure. Therefore, in Proposition 6, we derive policy prescriptions independent of the level of cost savings from merger.

PROPOSITION 6: *Let*

$$t_w^* \equiv \frac{(14n + 4n^2 + 3)a}{(409n + 296n^2 + 84n^3 + 8n^4 + 168)} > 0$$

$$t_2 \equiv \frac{a}{10n + 2n^2 + 13} > 0$$

(i) *For $t \in (t_w^*, t_2)$, the following holds: If trade liberalization increases the desirability of merger then it necessarily increases its profitability. If trade liberalization decreases the profitability of merger then it necessarily decreases its desirability.*

(ii) *For $t \in [0, t_w^*)$, the following holds: If trade liberalization increases the profitability of merger then it necessarily increases its desirability. If trade liberalization decreases the desirability of merger then it necessarily decreases its profitability.*

PROOF:

(i) If trade liberalization increases the desirability of merger then, from Corollary 1, it follows that $z > z_w(t)$. It can be shown that $z_w(t_w^*) - z^*(t_w^*) = 0$ for $m = n + 2$, with $z_w(t) - z^*(t)$ linear and increasing in t. Thus, for $t \in [0, t_w^*)$, it holds that $z_w(t) < z^*(t)$ and for $t > t_w^*$, it holds that $z_w(t) > z^*(t)$. By definition of $z^*(t)$, for $z > z_w(t) > z^*(t)$ it follows that marginal trade liberalization increases the profitability of merger. On the other hand, if trade liberalization decreases the profitability of merger then, from Proposition 1 it follows that $z < z^*(t)$. Since $z_w(t) > z^*(t)$, and by definition of $z_w(t)$, it follows that, for $z < z^*(t) < z_w(t)$, marginal trade liberalization decreases the desirability of the merger. Moreover, for $t \in (0, t_2)$ $(t > t_2)$ it holds that $z^*(t) > 0$ $(z^*(t) < 0)$.[5] It is straightforward to show that $t_2 > t_w^*$ for $m, n > 0$.

(ii) Similar to proof of (i). ∎

Proposition 6(i) shows that, regardless of the cost savings from merger, when the tariff level lies within the range $t \in (t_w^*, t_2)$, the need for competition policy to actively encourage the merger in the face of trade of liberalization is reduced even when trade liberalization makes the merger more desirable. If the merger becomes more desirable, it is naturally more likely to be realized. Proposition 6(ii) shows that, regardless of the cost savings from the merger, when the tariff level lies within the range $t \in (0, t_w^*)$, the need for competition policy to actively disallow the merger in

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[5] See Proposition 2, Benchekroun and Ray Chaudhuri (2006).

the face of trade of liberalization is reduced even when trade liberalization makes the merger less desirable. This is because the merger is naturally less likely to be realized.

6   Conclusion

In this paper the effects of bilateral tariff reductions on cost-reducing horizontal domestic mergers were analyzed. A two-country framework was used, where firms engaged in Cournot competition. It was shown that, in the neighborhood of free trade, marginal trade liberalization increases the desirability of merger, whereas the reverse holds at sufficiently high tariff levels. In the neighborhoods of free trade and the prohibitive tariff, for sufficiently low cost savings from merger, desirability and profitability of merger were shown to move in opposite directions in response to trade liberalization, whereas for intermediate levels of tariff it was shown that they move in the same direction. We further showed that in the neighborhood of free trade, for sufficiently low cost savings from merger, trade liberalization increases the desirability of merger whilst decreasing the profitability. Thus, a scenario was illustrated where competition policy might be called upon to actively encourage domestic mergers rather than preventing them, in response to trade liberalization.

Previous studies have restricted their analyses to either the neighborhood of free trade or of the optimal tariff level. Since trade liberalization following free trade agreements often occurs as piecemeal tariff reductions, starting form a strictly positive initial tariff, we presented a global analysis for all positive tariff levels. Moreover, it was shown that for a given level of cost savings, the impact of marginal trade liberalization on the desirability of merger can fail to be a reliable indicator of the same when tariff changes are non-marginal.

Regardless of the level of cost savings, it was shown that at sufficiently high tariff levels, if trade liberalization increases the desirability of a given merger then it necessarily increases its profitability, whilst at tariff levels below a certain threshold, if desirability falls so must profitability. Thus, at

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sufficiently high tariff levels, if the merger becomes more desirable, it is naturally more likely to be realized, whilst in the neighborhood of free trade, if the merger becomes less desirable, it is naturally less likely to be realized.

Our results were obtained for the case where two domestic firms merge, and given that all bilateral tariff reductions are equal for the two countries. It would be interesting to consider the cases of cross-border mergers and unilateral tariff reductions.

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