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Cross-Border Price Effects of Mergers and Acquisitions – A Quantitative Framework for Competition Policy*

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Abstract

Decisions of national competition authorities have important effects on other jurisdictions. We provide a framework to quantify the domestic and cross-border effects of mergers, and to draw conclusions for the coordination of national merger policies. We develop a two-country model with many sectors. In each sector, producers vary in terms of their marginal costs, and are engaged in Cournot competition. We allow for profitable mergers to take place subject to the non-violation of a given national competition policy. Because of trade costs and perceived differences in qualities between domestic and foreign products, mergers may have different consumer surplus effects in the home and the foreign country. We calibrate the model using data for the year 2002 for 167 manufacturing sectors in the U.S. and Canada. We choose parameters to match relevant moments in the data, including industry sales, concentration ratios and trade flows. We find that in the majority of industries a merger approval policy based on domestic consumer surplus is too restrictive from the viewpoint of the neighboring country. We also show that adopting a supra-national policy that approves a merger if and only if it increases the sum of consumer surplus in the two countries would lead to significant gains for U.S. consumers but hurt consumers in Canada. These results highlight the difficulties in coordinating national competition policies in a way acceptable to all participating countries.

KEY WORDS: International Aspects of Competition Policy, Mergers and Acquisitions, Cournot Competition, International Trade

JEL CLASSIFICATION: F12, F13, L13, L44

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1 Introduction

Because of cross-border demand and supply linkages, decisions of national competition authorities have important effects on other jurisdictions. This implies that for a given objective function (such as the maximization of domestic consumer surplus, which is by and large current practice in the USA and the EU), conflicts between national competition authorities can arise. For example, consider a proposed merger between two companies based in country A, which also export to country B. Depending on the initial market structures in the two countries, the merger might have very different consumer surplus effects in each jurisdiction. For example, it might be the case that there are a number of competing companies in country A but the two merging companies are the only providers of a certain good in country B. In this case, the efficiency gains arising from the merger might be sufficient to outweigh its anti-competitive effect in country A but not in country B, leading to conflicting decisions of the two competition authorities.

In this paper, we provide a framework to quantify the domestic and cross-border effects of mergers, and to draw conclusions for the coordination of national merger policies. We develop a two-country model with many sectors. In each sector, producers vary in terms of their marginal costs, and are engaged in Cournot competition. We allow for profitable mergers to take place subject to the non-violation of a given national competition policy. Because of trade costs and perceived differences in qualities, the set of firms active in both markets is not identical. Mergers might therefore have different consumer surplus effects in the home and the foreign country, depending on differences in the initial market structures. We calibrate the model using data for the year 2002 for 167 manufacturing sectors in the U.S. and Canada. We find that in the majority of industries a merger approval policy based on domestic consumer surplus is too restrictive from the viewpoint of the neighboring country. We also show that adopting a supra-national policy that approves a merger if and only if it increases the sum of consumer surplus in the two countries would lead to significant gains for U.S. consumers but hurt consumers in Canada. These results highlight the difficulties in coordinating national competition policies in a way acceptable to all participating countries.

Our paper relates to several strands in the literature. First, we contribute to the literature regarding the optimal design of merger policy (e.g., Williamson (1968), Farrell and Shapiro (1990), Nocke and Whinston (2010; forthcoming)). This literature focuses almost exclusively on closed economy settings, which, as we argue, abstracts from some important cross jurisdictional aspects of merger policy on which we concentrate here.[1]

[1]Examining competition policy in open economy settings also allows for possible interactions between competition and trade policy, which will be another aspect of our analysis in future work.

Another key difference is that the above-mentioned literature characterizes the optimal merger approval policy whereas our paper *quantifies* the performance and welfare effects of changes in merger policy (as well as of changes in structural parameters for a given merger policy).

More closely related to our paper is a relatively small literature which also looks at aspects of competition policy in open economy settings, and possible interactions of competition and trade policy (e.g., Head and Ries (1997), Horn and Levinsohn (2001)). Our main contribution compared to this literature is that we provide a quantitative framework for the analysis of such issues. Having such a framework is important because it allows to quantify the importance of possible externalities, and to conduct counterfactual simulations to analyze the effects of different competition or trade policy regimes. Calibrating our model to match important cross-sectional moments in the data also imposes some discipline on parameter values and functional forms. We think that this is important given the lack of general results in the literature (see, for example, Horn and Levinsohn (2001)). Finally, we also provide a more realistic modeling approach to merger formation by allowing for endogenous merger formation, rather than simply setting the number of firms in each country as most existing studies do.

We also contribute to the literature in international trade concerned with the causes and consequences of domestic and cross-border mergers (e.g., Neary (2007), Nocke and Yeaple (2007, 2008); di Giovanni (2005), Breinlich (2008)) and with strategic aspects of firm behaviour and trade policy in open economy settings (e.g., Brander and Spencer (1983, 1985); Brander (1995)). While competition policy is not usually the focus of this literature, we share an interest in the consequences of introducing mergers and strategic interactions into models of international trade, and use comparable modeling frameworks. The techniques we introduce to calibrate our model should also be applicable to a quantification of some of the insights from this earlier literature.

Finally, our paper draws on the parts of the industrial organization literature related to merger incentives and endogenous merger formation (e.g., Salant, Switzer and Reynold (1983), Perry and Porter (1985), Deneckere and Davidson (1985); Kamien and Zang (1990), Pesendorfer (2005)) and to closed-economy merger simulations (e.g., Nevo (2000)). We show how to adapt the insights from this literature to open economy settings and, regarding our model's calibration, how to make do with the more limited amount of information available for the parameterization of our framework.

The rest of this paper is organized as follows. In Section 2, we introduce a simple two-country model of imperfect competition. In Section 3, we introduce mergers and study the domestic and cross-border price effects of mergers. We provide conditions under which merger approval based on domestic consumer surplus only is a *too-lenient-for-thy-neighbor*

policy and under which it is a *too-tough-for-thy-neighbor policy*, thus shedding light on the potential conflict between national competition authorities. In Section 4, we impose additional structure on our model so as to operationalize it for quantitative analysis. In Section 5, we calibrate this model on data for the year 2002 for 167 manufacturing sectors in the U.S. and Canada. We assume that national competition authorities approve mergers between domestic firms if and only if they reduce domestic prices, which is in line with the actual legal standard. We choose parameters to match industry sales, Herfindahl indices and trade flows. In Section 6, we present the results of our calibration exercise. As discussed above, we find that although approved mergers between U.S. firms reduce prices in the U.S., a considerable fraction of them induce significant price increases in Canada, at the expense of Canadian consumers. In the majority of industries, however, merger approval based on domestic consumer surplus only is a *too-tough-for-thy neighbor policy*. That is, a more lenient merger approval policy would benefit consumers in the neigboring country. We also use the calibrated model for counterfactual analysis. Importantly, we find that adopting a supra-national policy that approves a merger if and only if it increases the sum of consumer surplus in the two countries would lead to significant gains for U.S. consumers but hurt consumers in Canada. Finally, Section 7 concludes.

2 The Basic Model

Consider a setting with two possibly asymmetric countries ($i, j = 1, 2$), S manufacturing sectors and an outside sector. Country i is endowed with L^i units of labor. Labor markets are perfectly competitive, and we assume perfect labor mobility across sectors and no labor mobility across countries. In country i, the representative consumer's utility function is given by:

$$U(Q_0, \boldsymbol{Q}) = Q_0 + \sum_{s=1}^{S} \left(u_s^i(Q_s^{i,i} + Q_s^{i,j}) - \phi_s^i Q_s^{i,j} \right),$$

and the consumer's budget constraint is:

$$P_0^i Q_0^i + \sum_{s=1}^{S} \left(P_s^{i,i} Q_s^{i,i} + P_s^{i,j} Q_s^{i,j} \right) \leq I^i,$$

where Q_0^i (resp. P_0^i) is the consumption (resp. price) of the outside good, $Q_s^{k,l}$ (resp. $P_s^{k,l}$) is the consumption (resp. price) in country k of goods produced in country l in sector s, $k, l \in \{1, 2\}$, u_s^i is a well-behaved sub-utility function and I^i is total income in country i. ϕ_s^i is a home bias parameter, which captures differences in perceived quality between

domestic and foreign products, as well as trade costs between countries.[2] The model also includes the case where consumers are foreign-biased, which arises when $\phi_s^i < 0$. Assume that consumer income I^i is sufficiently large so that a positive quantity of the outside good is consumed, and that $P_s^{i,i} = P_s^{i,j} + \phi_s^i$ so that the representative consumer is willing to buy domestic and foreign products. Then, these preferences generate an inverse demand function for sector s's product in country i:

$$\begin{aligned} P_s^{i,i}\left(Q_s^i\right) &= \max\left\{u_s^{i\prime}\left(Q_s^i\right), 0\right\}, \\ P_s^{i,j}\left(Q_s^i\right) &= \max\left\{u_s^{i\prime}\left(Q_s^i\right) - \phi_s^i, 0\right\}, \end{aligned}$$

where $Q_s^i \equiv Q_s^{i,i} + Q_s^{i,j}$ is aggregate consumption of sector s's product in country i.

The outside good is produced under perfect competition using a constant-returns-to-scale technology with labor as the only factor of production. One unit of labor generates α^i units of output. We also assume that the outside good is freely traded, and that parameters are such that the outside sector produces positive amounts in both countries. We further use the price of the outside good as the *numéraire* ($P_0^1 = P_0^2 = 1$) which pins down wage rates at $w^i = \alpha^i$.

We assume that manufacturing trade is not subject to trade costs apart from the ones captured by our home bias parameters. We also assume that firms compete *à la* Cournot in each country and are able to segment markets perfectly. Manufacturing firms combine labor and intermediate inputs under constant returns to scale, and we assume that the outside good is the only intermediate input used in the production process. The production function technology is specified further in Section 4 below. Let $\mathcal{N}_s^i$ denote the set, and N_s^i the number, of (potentially active) manufacturing firms in country i and sector s. Further, let $c_{k,s}$ denote the marginal (and unit) cost of production of firm k in sector s, and $q_{k,s}^i$ that firm's output in country i. We say that firm k is *active* in country i and sector s if $q_{k,s}^i > 0$ in equilibrium.

We impose the following standard assumption on demand and thus, implicitly, on the sub-utility function u_s^i (see Vives, 2001):

Assumption 1 *For any country i and sector s, $P^{i,i}(Q) > \min_{k\in\mathcal{N}_s^i} c_{k,s}$ for $Q > 0$ sufficiently small. Moreover, for any aggregate output $Q > 0$ such that $P_s^{i,i}(Q) > 0$ and any $q \in [0, Q]$:*

[2]Note that Canadian and US firms have enjoyed duty-free access to each other's markets since at least 1999, which marked the end of the implementation period of the Canada-US Free Trade Agreement of 1989. In our view, this makes the modeling of trade frictions on the demand side a more compelling choice than the use of standard iceberg trade costs (although of course physical and non-tariff barriers to trade remain to some extent).

(i) $P_s^{i,i\prime}(Q) + qP_s^{i,i\prime\prime}(Q) < 0$;

(ii) $\lim_{Q\to\infty} P_s^{i,i}(Q) = 0$ *and* $\lim_{Q\to\infty} P_s^{i,j}(Q) = 0$.

It is well known that this assumption implies that there exists a unique and stable Nash equilibrium in each sector and country (Vives, 2001). To see that the standard result from closed economy models is applicable here, note that the inverse demand function faced by foreign firms differs from that faced by domestic firms in the same sector only by a constant (the home bias parameter). Hence, it is *as if* all firms selling in sector s and country i face inverse demand $P_s^{i,i}$ but the marginal cost of foreign firm $k \in \mathcal{N}_s^j$, $j \neq i$, is $c_{k,s} + \phi_s^i$ instead of $c_{k,s}$. Stability of equilibrium implies that comparative statics are "well behaved." In particular, the reduction of an active firm's marginal cost induces an increase in aggregate equilibrium output.

3 The Domestic and Foreign Price Effects of Mergers

In this section, we study the effects of a merger between two domestic firms on domestic and foreign prices and, thus, on domestic and foreign consumer surplus. As antitrust laws in the U.S., the EU and many other jurisdictions have adopted a consumer surplus (CS) standard, our analysis sheds light on the potential conflict between the antitrust authorities of different countries. In adopting a merger approval policy that is designed to maximize its own domestic consumer surplus, an antitrust authority generically follows either a *too-lenient-for-thy-neighbor policy* or a *too-tough-for-thy-neighbor policy*. In the following, we characterize the conditions under which one type of conflict is more likely than the other.

Consider merger $M_s = \{1, 2\}$ between firms $1 \in \mathcal{N}_s^1$ and $2 \in \mathcal{N}_s^1$ in sector s that are located in country 1 and are active in country i. Dropping the subscript s from now on for notational ease, let $\overline{c}_M$ denote the merged entity's post-merger marginal cost. Denote aggregate output in country i before the merger by Q^{i*}, and after the merger by $\overline{Q}^{i*}$. The induced change in consumer surplus in country i is

$$\Delta CS^i(M) = -\int_{Q^{i*}}^{\overline{Q}^{i*}} QP^{i,i\prime}(Q)dQ,$$

which is positive if and only if $\overline{Q}^{i*} > Q^{i*}$. We say that merger M is *CS-neutral* in country i if $\Delta CS^i(M) = 0$, *CS-decreasing* if $\Delta CS^i(M) < 0$, and *CS-increasing* if $\Delta CS^i(M) > 0$.

The following lemma characterizes the CS-effects of merger M:

Lemma 1 *Consider merger $M = \{1, 2\}$ between firms $1 \in \mathcal{N}^1$ and $2 \in \mathcal{N}^1$ that are active in country i. The merger is CS-neutral in country i if the post-merger marginal cost $\overline{c}_M$*

satisfies

$$\overline{c}_M = \widehat{c}_M^i \equiv (c_1 + c_2) - P^{i,1}(Q^{i*}),$$

CS-decreasing if $\overline{c}_M > \widehat{c}_M^i$ *and CS-increasing if* $\overline{c}_M < \widehat{c}_M^i$.

Proof. See Nocke and Whinston (2010). ■

The lemma shows that merger M is CS-neutral in country i if and only if the post-merger marginal cost $\overline{c}_M$ is equal to some threshold value $\widehat{c}_M^i$ that is increasing in the merger partners' pre-marginal costs and decreasing in the pre-merger equilibrium price in country i. Generically, we have $\widehat{c}_M^1 \neq \widehat{c}_M^2$, implying that the interests of the antitrust authorities of the two countries are not perfectly aligned. To the extent that only the authority in the merger partners' home country (country 1) has the power to approve or block merger M, the domestic CS-standard of country 1's is a *too-lenient-for-thy-neighbor policy* if $\widehat{c}_M^1 > \widehat{c}_M^2$ (in which case country 1 may approve the merger even if it is CS-decreasing in country 2) and a *too-tough-for-thy-neighbor policy* if $\widehat{c}_M^1 < \widehat{c}_M^2$ (in which case country 1 may block the merger even if it is CS-increasing in country 2).

The following proposition characterizes the type of misalignment of interests between the two authorities:

Proposition 1 *The domestic CS-standard for merger approval in country 1 is a* too-lenient-for-thy-neighbor policy *if* $P^{1,1}(Q^{1*}) < P^{2,2}(Q^{2*}) - \phi^2$*, and a* too-tough-for-thy-neighbor policy *if* $P^{1,1}(Q^{1*}) > P^{2,2}(Q^{2*}) - \phi^2$.

Proof. This follows from Lemma 1. ■

The following two results are immediate implication of the proposition:

Corollary 1 *Suppose the two countries are identical, so that* $P^{1,1}(Q^{1*}) = P^{2,2}(Q^{2*})$ *and* $\phi^1 = \phi^2 \equiv \phi$*. Then the domestic CS-standard for merger approval in each country is a* too-lenient-for-thy-neighbor policy *if the home bias parameter is negative,* $\phi < 0$*, and a* too-tough-for-thy-neighbor policy *if the home bias parameter is positive,* $\phi > 0$.

Corollary 2 *The domestic CS-standard for merger approval in country 1 is a* too-lenient-for-thy-neighbor policy *for country 2 and* vice versa *if*

$$\phi^1 < P^{1,1}(Q^{1*}) - P^{2,2}(Q^{2*}) < -\phi^2.$$

Similarly, the domestic CS-standard for merger approval in country 1 is a too-tough-for-thy-neighbor policy *for country 2 and* vice versa *if*

$$-\phi^2 < P^{1,1}(Q^{1*}) - P^{2,2}(Q^{2*}) < \phi^1.$$

The conditions for the two types of misalignment of interests, as stated in Proposition 1, involve endogenous prices. This raises the question: Under what conditions on primitives is one type more likely to arise than the other? Summing the first-order conditions of profit maximization in country i, yields

$$\sum_{k\in\mathcal{N}^i} \max\left\{P^{i,i}(Q^{i*}) - c_k, 0\right\} + \sum_{k\in\mathcal{N}^j} \max\left\{P^{i,i}(Q^{i*}) - \phi^i - c_k, 0\right\} + Q^{i*}P^{i,i\prime}(Q^{i*}) = 0. \quad (1)$$

Note that the LHS of (1) is decreasing in Q^{i*} by Assumption 1.

We obtain:

Proposition 2 *There exists a (possibly negative) threshold value $\widehat{\phi}^2$ of the home bias parameter in country 2 such that the domestic CS-standard for merger approval in country 1 is a* too-lenient-for-thy-neighbor policy *if $\phi^2 < \widehat{\phi}^2$, and a* too-tough-for-thy-neighbor policy *if $\phi^2 > \widehat{\phi}^2$. Moreover, $\widehat{\phi}^2$ is weakly decreasing in ϕ^1.*

Proof. First, note that a change in ϕ^j does not affect $P^{i,i}(Q^{i*})$, as can be seen from (1). Second, applying the implicit function theorem to (1) gives

$$\frac{dP^{i,i}(Q^{i*})}{dQ^{i*}}\frac{dQ^{i*}}{d\phi^i} = \frac{N^{i,j}P^{i,i\prime}(Q^{i*})}{N^{i,j}P^{i,i\prime}(Q^{i*}) + [(N^{i,i}+1)P^{i,i\prime}(Q^{i*}) + Q^{i*}P^{i,i\prime\prime}(Q^{i*})]},$$

where $N^{i,i}$ (resp. $N^{i,j}$) is the number of firms from country i (resp. j) that are active in country i. Note that the term in brackets is negative by Assumption 1, implying that $dP^{i,i}(Q^{i*})/d\phi^i < 1$. Assumption 1 also implies that $dP^{i,i}(Q^{i*})/d\phi^i \geq 0$, where the inequality is strict if $N^{i,j} \geq 1$ (i.e., if $P^{i,i}(Q^{i*}) - \phi^i > \min_{k\in\mathcal{N}^j} c_k$). Hence, $\Psi(\phi^2) \equiv P^{1,1}(Q^{1*}) - \left[P^{2,2}(Q^{2*}) - \phi^2\right]$ is strictly increasing and continuous in ϕ^2, $\Psi(\phi^2) < 0$ for ϕ^2 sufficiently small, and $\Psi(\phi^2) > 0$ for ϕ^2 sufficiently large. It follows that there exists a unique $\widehat{\phi}^2$ such that $\Psi\left(\widehat{\phi}^2\right) = 0$. Moreover, $\Psi(\phi^2)$ is weakly increasing in ϕ^1, implying that $\widehat{\phi}^2$ is weakly decreasing in ϕ^1. The assertions of the proposition then follow from the conditions in Proposition 1. ■

To obtain further results on the misalignment of interests between the two countries, we impose additional structure:

Proposition 3 *Suppose that inverse demand in country $i \in \{1,2\}$ is linear and given by $P^{i,i}(Q^i) = a^i - b^iQ^i$. Suppose also that all $N^1 + N^2$ firms are active in both countries. Then, the threshold value $\widehat{\phi}^2$ of the home bias parameter in country 2 is given by*

$$\widehat{\phi}^2 = \frac{a^2 - a^1 - N^2\phi^1}{N^2 + 1}.$$

Hence, $d\widehat{\phi}^2/da^1 < 0$, $d\widehat{\phi}^2/da^2 > 0$, $d\widehat{\phi}^2/dN^1 = 0$, *and* $d\widehat{\phi}^2/dN^2 < 0$ *if and only if* $a^1 - a^2 < \phi^1$.

Proof. Under the assumption of the proposition, (1) becomes

$$\left(N^1 + N^2\right)\left[a^i - b^i Q^{i*}\right] - \sum_{k \in \mathcal{N}^1 \cup \mathcal{N}^2} c_k - N^j \phi^i - b^i Q^{i*} = 0,$$

or

$$b^i Q^{i*} = \frac{\left(N^1 + N^2\right) a^i - \sum_{k \in \mathcal{N}^1 \cup \mathcal{N}^2} c_k - N^j \phi^i}{N^1 + N^2 + 1}.$$

Hence,

$$\begin{aligned} \widehat{\phi}^2 &= \left[a^2 - b^2 Q^{2*}\right] - \left[a^1 - b^1 Q^{1*}\right] \\ &= \frac{a^2 - a^1 - N^2 \phi^1}{N^2 + 1}. \end{aligned}$$

■

The proposition shows that the "likelihood" that the domestic CS-standard for merger approval in country 1 is a *too-lenient-for-thy-neighbor policy* is decreasing in the demand level a^1 in country 1, increasing in the demand level a^2 in country 2, independent of the number N^1 of firms in country 1, and decreasing in the number N^2 of firms in country 2 if and only if $a^1 - a^2 < \phi^1$.

4 Operationalization of Our Theoretical Model for Quantitative Analysis

In this section, we put more structure on preferences and technologies and define a merger formation process. This will allow us to take our model to the data in the next section.

4.1 Preferences, Technologies and Markets

In sector s and country i, sub-utility $u_s^i(.)$ introduced in Section 2 is given by $u_s^i(Q_s^i) = a_s^i Q_s^i - \frac{1}{2} b_s^i \left(Q_s^i\right)^2$, where we recall that $Q_s^i = Q_s^{i,i} + Q_s^{i,j}$. This quadratic functional form generates a linear inverse demand function for sector s's product in country i:

$$\begin{aligned} P_s^{i,i}\left(Q_s^i\right) &= \max\left\{a_s^i - b_s^i Q_s^i, 0\right\}, \\ P_s^{i,j}\left(Q_s^i\right) &= \max\left\{a_s^i - \phi_s^i - b_s^i Q_s^i, 0\right\}. \end{aligned}$$

We solve the Cournot competition game with linear demands in Appendix A.

The production function of firm k in sector s and country i is given by

$$q_k = \frac{1}{(\eta_s^i)^{\eta_s^i}(1-\eta_s^i)^{1-\eta_s^i}} z_k l_k^{\eta_s^i} q_{0,k}^{1-\eta_s^i},$$

where l_k and $q_{0,k}$ denote firm k's consumption of labor and intermediate goods (i.e., the outside good), η_s^i is the labor input share in sector s and industry i, and z_k is the productivity of firm k. The marginal and unit costs of firm k are then given by

$$c_k = \frac{1}{z_k}(w^i)^{\eta_s^i}(P_0^i)^{(1-\eta_s^i)} = \frac{1}{z_k}(\alpha^i)^{\eta_s^i}.$$

Firms' productivities are determined as follows. There are initially a number N_s^i of potentially active manufacturing firms in each country and sector. Firm k in sector s and country i is endowed with κ_k units of intangible capital. We can think of κ_k as being the set of patents or blueprints of firm k. It is drawn from the cumulative distribution function $F(.|\theta_s^i)$, where θ_s^i is a vector of parameters.

When a set K of firms merge in country i and sector s, they combine their intangible capital, and the merged firm's intangible capital becomes $\kappa_m = \sum_{k\in K} \kappa_k$.[3] Firm k's productivity z_k is a function of its stock of intangible capital: $z_k = f_s^i(\kappa_k)$. We parameterize the mapping from intangible capital to productivity as follows: $f_s^i(\kappa_k) = \kappa_k^{\beta_s^i}$, where β_s^i is the elasticity of productivity with respect to intangible capital. Notice that β_s^i can also be thought of as a synergy parameter in the following sense: if a firm of productivity z_1 merges with a firm of productivity z_2, then the productivity of the merged entity becomes

$$z_m = (\kappa_1 + \kappa_2)^{\beta_s^i} = \left(z_1^{\frac{1}{\beta_s^i}} + z_2^{\frac{1}{\beta_s^i}} \right)^{\beta_s^i}. \tag{2}$$

Note that z_m is decreasing in β_s^i and that, when $\beta = \infty$, $z_m = \max(z_1, z_2)$, which corresponds to the case of no synergies in the sense of Farrell and Shapiro (1990).

4.2 Merger Formation Process

We allow firms to merge horizontally, subject to two conditions. First, mergers must be profitable for the merger partners. That is, the profits of the joint entity must be strictly larger than the sum of the initial profits of the merger partners. Second, mergers must not decrease consumer surplus (i.e., not increase price). This is, by and large, current

[3] We abstract from cross-border mergers in this preliminary version of the paper. We also abstract from conglomerate mergers, in the sense that a firm in sector s cannot merge with a firm in sector s'. The assumption here is that intangible capital is sector-specific, so a conglomerate merger involves neither efficiency gains nor market power effects and is therefore profit-neutral.

practice of most competition authorities (including the United States and the European Union). In our counterfactual simulations below, we will examine various modifications to this baseline competition policy standard and evaluate the resulting consequences for industrial structure and welfare.

We model the merger formation process as a bargaining process. This raises a number of challenges. First, there are several firms in each industry and multiple mergers may obtain. Second, the bargaining process involves externalities as firms compete in the same market. Unfortunately, the literature on bargaining does not provide any convincing off-the-shelf solution to such bargaining processes.[4]

Our solution concept is pairwise stability: in equilibrium, each sector should be in a state in which no more mergers are feasible (i.e., profitable and approved by the competition authority). To obtain a probability distribution over the set of pairwise-stable industry structures, we model merger formation as a dynamic random matching process. That is, merger opportunities in both countries arise randomly each period until no more mergers are feasible. As will become clear, this approach is particularly well-suited for the quantification of our model.

We now describe the merger formation process for a given sector s. Note that a similar process takes place in all sectors in a country. We drop sector subscripts for ease of notation. Merger opportunities arise sequentially in both countries. The probability in a given round for a merger opportunity to arise in country i is given by $\omega^i = N^i / \left(N^i + N^{i'}\right)$, where N^i denotes the number of firms in country i in the current round.

If a merger opportunity arises in country i, we randomly draw twice from all potentially active firms in sector s. Note that neither target nor acquirer needs to be active for a merger to take place. We can think of the acquisition of an inactive firm as the acquisition of a patent or blueprint which is of use for the acquirer but has not been previously used. Likewise, the merger of two inactive firms can be thought of as the combination of patents or blueprints which in turn might result in the combined firm becoming active in the market.

To verify whether a merger is feasible we evaluate our profitability and approvability criteria for the current market structure. Note that firms behave myopically in the sense that they do not take into account the effects the currently proposed merger might have on the likelihood of future mergers. Likewise, the merger authority approves a proposed merger if and only if it raises its (static) welfare criterion (here: domestic consumer surplus), not taking into account the possibility of future mergers. If the merger is feasible, we let the two firms merge and compute the new equilibrium, where the number of potentially

[4]The small literature on bargaining with externalities (e.g., Jehiel and Moldovanu (1995a; 1995b), Gomes (2005), Gomes and Jehiel (2005)) provides only partial characterization results.

active firms has been reduced by one and the efficiency of the merged entity is given by equation (2). We repeat this process until there are no more feasible mergers in any of the two markets.

5 Model Calibration

We calibrate the model using data for the year 2002 for 149 manufacturing sectors in the U.S. and Canada. The United States and Canada are particularly well suited for our quantification exercise. First, they represent a significant share of global industrial activity in 2002, accounting for 28% of world-wide manufacturing value added and close to 20% of international trade in manufactured products.[5] They are also two well-integrated markets where cross-border effects of M&As are likely to be relevant. Finally, both countries have been using the same industry classification since 1997, which makes the comparison of industry concentration measures across countries feasible.

5.1 Outline of Calibration Procedure

In each sector, we need parameter values for a^{US} and a^{CAN} (intercepts of the inverse demand functions), b^{US} and b^{CAN}(slope of the inverse demand functions), N^{US} and N^{CAN} (number of potentially active plants/firms), β^{US} and β^{CAN} (strength of synergies), ϕ^{US} and ϕ^{CAN} (home biases), and η^{US} and η^{CAN} (labor shares). We assume that firm productivity parameters are drawn from a lognormal distribution with mean θ_0 and variance θ_1.[6] We also need parameter values for α^{US} and α^{CAN} (the productivity of the outside sectors).

We choose units of the numeraire so that $\alpha^{US} = 1$, and set α^{CAN} equal to the ratio of Canadian to US wages in the data. Consistent with our Cobb-Douglas specification of firms' production functions and our assumption of perfectly competitive labor markets, η^{US} and η^{CAN} are set equal to the ratio of the wage bill to total costs in each sector. In this preliminary version of our paper, we restrict $a^{US} = a^{CAN} = 50$, $\theta_0 = 0$, and $\theta_1 = 1$. We also fix the strength of synergies by imposing $\beta^{US} = \beta^{CAN} = 3$. This amounts to assuming that, on average, a merger lowers the marginal cost of the most efficient merging partner by about 5%.

We choose values for the remaining parameters $\Gamma = (b^{US}, b^{CAN}, N^{US}, N^{CAN}, \phi^{US}, \phi^{CAN})$ to match relevant moments in the data. For the moment, we match industry sales, bilateral trade flows and Herfindahl-Hirschman indices (HHIs) as our preferred measures of industry concentration.

[5] Figures from the World Trade Organization and the World Bank Development Indicators.

[6] Since there is a one-to-one mapping from intangible capital to productivity, it makes no difference whether we randomly draw intangible capital or productivity.

We now give a brief overview of how the features of our model and the data allow for the identification of the parameters to be estimated. First, fix N^{US} and N^{CAN} and let $i \neq j$ in $\{US, CAN\}$. Then, as shown in Appendix A, country i's expected imports (denoted Export^{ji}) and the expected total sales of firms located in country i in their domestic market (denoted Sales^{i}) are functions of b_i and ϕ_i only. Besides, Export^{ji} and Sales^{i} are both proportional to $1/b^i$, Export^{ji} is strictly decreasing in ϕ^i and Sales^{i} is strictly increasing in ϕ^i. Therefore, there exists a unique value of ϕ^i which matches the ratio of domestic sales to imports, and this value of ϕ^i is independent of b^i. By proportionality, for this value of ϕ^i, there also exists a unique value of b^i which allows us to match Sales^{i}. By proportionality and by definition of ϕ^i, Export^{ji} is also exactly matched when parameters are set equal to (b^i, ϕ^i). It follows that, for a given pair (N^{US}, N^{CAN}), there exists a unique quadruplet (b^{US}, b^{CAN}, ϕ^{US}, ϕ^{CAN}) such that exports and domestic sales moments are exactly matched.

Next, we notice that, keeping exports and domestic sales moments matched, an increase in N^i has a strongly negative impact on the expected domestic Herfindahl index (HHI^{i}), and a much weaker impact on HHI^{j}. Besides, HHI^{i} converges to 10000 as N^i goes to 1, and to 0 as N^i goes to the infinity. From this, we conclude that there exists a unique Γ such that exports and domestic sales moments are exactly matched, and such that deviations from empirical HHIs are minimized.[7]

This identification argument motivates the following iterative calibration procedure. We first calibrate the model under the assumption that mergers and acquisitions are not feasible. We first pick an initial guess Γ_0^0 for our parameters, and draw productivities according to $\log z \sim N(0,1)$. We compute expected values of our theoretical moments using standard Monte Carlo methods with 2000 iterations. We adjust N^{US} and N^{CAN} to match Herfindahl indices, and update our initial guess to Γ_1^0. Next, we update (b^{US}, b^{CAN}, ϕ^{US}, ϕ^{CAN}) to perfectly match exports and domestic sales moments, which gives us a new value of the parameters vector, Γ_2^0. We repeat these steps until we converge to parameter values Γ_0^∞ such that all moments are perfectly matched, up to integer constraints on the numbers of potential entrants. Next, we allow for mergers and acquisitions. Denote by T the number of periods of the merger game. We first set T at some initial value, say $T = 200$, simulate merger opportunities as described in Section 4.2, and repeat the steps above until we converge to some parameter vector Γ_T^∞. For these parameter values, we check whether no merger has taken place within the last 100 periods of the merger game. If so, we assume that all merger opportunities have been exhausted, stop the calibration

[7] We cannot match HHIs exactly due to integer constraints on the numbers of potential entrants. However, the absolute deviation between theoretical and empirical moments is less than 3% on average across sectors.

algorithm, and obtain our final parameter estimate: $\hat{\Gamma} = \Gamma_T^{\infty}$. Else, we update T to $T' = 2 \times T$, and repeat the steps above until convergence obtains.

5.2 Data

For the above calibration procedure, we require data on cost shares, industry sales, bilateral trade flows between the United States and Canada, and Herfindahl indices for both countries. We work at the five-digit level of the North American Industry Classification System (NAICS) which is the most disaggregated level at which Canadian and U.S. industry definitions are identical. This yields a total of 167 manufacturing industries for the year 2002. In this version of the paper, we drop sectors which have an American or a Canadian HHI below 100. This reduces the number of sectors to 149.

Data on U.S. and Canadian industry-level sales, cost shares and Herfindahl indices are from the U.S. Census Bureau and Statistics Canada, respectively. Labor's share in total cost is measured as an industry's wage bill divided by the sum of the wage bill and the industry's intermediate input expenditures. Data on U.S. exports to, and imports from, Canada are from the NBER website (see Feenstra, Romalis and Schott, 2002). We convert all value entries into U.S. dollars using the 2002 U.S.-Canadian dollar exchange rate. In accordance with our choice of units and numéraire, we further normalize value entries with the average U.S. wage rate for the year 2002. We calculate U.S. and Canadian wage rates by dividing the economy-wide wage bill by the number of persons in employment. This yields an average wage for the U.S. of 36,510 USD and an average wage rate for Canada of 23,879 USD in 2002.[8]

5.3 Calibration Results

In Table 1, we present summary statistics for our empirical moments and parameter estimates. Note that the model is exactly identified so that we match all empirical moments by construction.

Regarding the empirical moments, we observe that U.S. production is approximately 10 times bigger than Canadian production, which also holds approximately for the size of the two markets. Secondly, the Canadian market is substantially more concentrated than the U.S. market as can be seen from the higher values for the Herfindahl indices. Finally, the U.S. was running a substantial trade deficit with Canada in the year 2002.

[8]Data are again from the U.S. Census Bureau and Statistics Canada. We count both employees and self-employed persons. For the latter, we use total receipts (i.e., sales) as a proxy for the wage bill. This will overestimate wages of the self-employed, although dropping the self-employed does not change average wages by much.

Turning to our parameter estimates, we note that the slope of the inverse demand curve, which is essentially a market size parameter, is much flatter in the U.S. than in Canada. This is mainly driven by the differences in total shipments which are two of the moment we are matching. The higher concentration observed for the Canadian market in turn is responsible for the fact that the number of potential entrants is only about half as large on average in Canada. Finally, the U.S. market seems to be much more difficult to penetrate for Canadian firms than the Canadian market is for U.S. firms. In the average sector in the U.S., the price paid by consumers to Canadian firms ($P^{US} - \phi^{US}$) is about 65% lower than the price paid to U.S. firms (P^{US}). By contrast, in the average sector in Canada, U.S. firms only face a 5% price disadvantage compared to Canadian firms. We also notice that, in some sectors in the U.S. and in Canada, domestic consumers are actually foreign biased.

6 Results and Counterfactual Experiments

6.1 Cross-Border Price Transmission of Mergers

Table 2 shows summary statistics on the within-sector average percentage price increase resulting from a merger between active firms in each of the two countries.[9] We show the average effect on both domestic prices and prices in the other country. We note two main results. First, mergers never increase domestic prices by construction, because our baseline merger policy only allows mergers to go through which do not decrease consumer surplus in the merger partners' home country.

Second, U.S. mergers can have substantial effects on prices in Canada: in the average sector, a U.S. merger reduces Canadian prices by 0.11% on average, an order of magnitude similar to the average effect of a U.S. merger in the U.S. The distribution of these average effects ranges from -1.07% to 2.09%, meaning that, in some sectors, mergers which are consumer surplus increasing in the U.S. can be strongly anticompetitive in Canada.

In the average and in the median sector, a Canadian merger also tends to lower U.S. prices, but with an order of magnitude about ten times smaller than for U.S. mergers in Canada. The distribution of these price effects is also less dispersed, although there exist sectors in which the average Canadian merger lowers or increases U.S. prices by about 0.4%.

[9] A merger involving an inactive firm necessarily (weakly) lowers prices in both countries, since it involves an efficiency effect, but no market power effect.

6.2 Too Lenient or Too Tough for Thy Neighbor?

Results in Section 6.1 suggest that domestic competition policies are likely to be of the too-tough-for-thy-neighbor type, since in the average and in the median sector, a merger in country i lowers prices in country j. To confirm this conjecture, we examine the outcome of two counterfactual experiments. In Counterfactual 1, the U.S. competition authority becomes slightly less proactive, and starts clearing any merger which raises domestic prices by less than $\delta_1\%$, whereas the Canadian competition authority sticks to domestic consumer surplus maximization. In Counterfactual 2, the U.S. competition authority maximizes domestic consumer surplus, and the Canadian one clears mergers which do not raise domestic prices by more than $\delta_2\%$. We set $\delta_1 = \delta_2 = 0.1$. These thought experiments allow us to approximate the derivative of expected consumer surplus in country i with respect to δ_j around $\delta_j = 0$, which gives us a good measure of whether national competition policies are too lenient or too tough from the neighbors' point of view.

In Table 3, we can see that increasing δ_1 from 0% to 0.1% has a small but positive impact on the Canadian consumer surplus in the median and in the average sector, meaning that merger policy in the U.S. tends to be of the too-tough-for-thy-neighbor type. While the average and median effects are small, the between-sector standard deviation is quite high: in some sectors, U.S. merger control is strongly too-tough-for-thy-neighbor, while in some others, it is strongly too-lenient-for-thy-neighbor. Similar remarks apply to Table 4, in which we provide summary statistics on the impact of δ_2 on consumer surplus in the United States. In the average and in the median sector, U.S. consumers would slightly benefit if merger control in Canada became softer, but there also exist sectors in which softening the Canadian competition policy would strongly increase or decrease consumer surplus in the United States.

6.3 International Coordination of Competition Policies

An easy way to coordinate competition policies would be to force merging firms to get approval from both competition authorities, or, equivalently, to give a veto right to each country for mergers taking place in the neighboring country. In Table 5, we examine the outcome of a counterfactual experiment in which only those mergers are allowed that increase consumer surplus in both countries.

On average, gains are small but positive. In the average industry, U.S. consumers gain 1.6 million dollars, and Canadian consumers gain 196 thousand dollars. Notice that in sectors in which competition policies are of the too-lenient-for-thy-neighbor type, changes in consumer surplus can be much higher. These changes can reach 150 million dollars in the U.S. and close to 25 million dollars in Canada. Intuitively, in such sectors, the country

whose policies are too lenient for its neighbor tends to lose from coordination, since some of the mergers which previously made its consumers better off are now blocked under the new policy regime. The other country obviously benefits from its neighbor's becoming tougher.

We believe the reason why the gains are small on average is that, by construction, veto rights do not allow country i to make country j's competition authority more lenient. Veto rights are only beneficial for country i in situations in which it would like country j to be stricter. But we know from the previous subsection that such situations tend to be rare. This explains why, on average, we obtain only a small decrease (-0.6%) in the number of mergers in both countries, and a small impact on market performance.

Another solution would be to merge the US and Canadian competition authorities into one supra-national institution, and to have this institution maximize total consumer surplus. We report summary statistics on the outcome of this counterfactual in Table 6.

This new policy has a much stronger impact on market performance than the previous counterfactual experiment. In the average industry, consumer surplus in the US would go up by over 17 million dollars (so, if we sum across all 149 industries in our data, the total gain would be over 2.5 billion dollars in the U.S.), whereas Canadian consumer surplus would go down by 7.6 million dollars on average. While this policy change is unlikely to be adopted given the losses it entails for Canadian consumers, it is interesting to understand where these effects come from. Given the size difference between the two markets, such a supra-national competition authority would effectively be maximizing consumer surplus in the US, except in a small number of sectors in which mergers have a much stronger impact in Canada than in the United States. Since we know from the previous subsection that Canada tends to be too tough for its neighbor, our supra-national competition authority now clears many more mergers in Canada: we can see that the number of Canadian mergers increases by 10% on average. This benefits U.S. consumers, but hurts Canadian consumers.

These counterfactual experiments highlight the fact that there is no obvious way to make countries internalize the externalities they exert on each other. Veto rights do not allow competition authorities to address the main source of conflict, which is that national merger policies tend to be too tough. A supra-national competition authority maximizing global consumer surplus would essentially ignore Canadian consumers, which Canada would be unlikely to accept.

6.4 Competition Policy and Social Welfare

As we mentioned earlier, most competition authorities aim to maximize consumer surplus. Such a policy can be incompatible with welfare-maximization. Intuitively, a consumer-surplus-neutral merger is likely to be profitable (see Nocke and Whinston 2010) and hence, to increase industry profit and social welfare. By continuity, a merger which is slightly consumer-surplus-decreasing also improves social welfare. It follows that a competition authority which only aims at keeping prices low tends to block too many mergers from a social welfare perspective. We confirm this intuition by running two counterfactual experiments: first, we relax both national competition policies, by allowing mergers which raise domestic prices by less than 5% to go through; second we assume that national competition authorities maximize (domestic) social welfare instead of consumer surplus. Results are reported in Tables 7 and 8, respectively.

These two counterfactuals lead to similar results. For the reasons outlined above, many more mergers are allowed to go through, industry concentration increases in both countries, prices rise, but social welfare improves significantly.

On top of the main effect mentioned above (from a social welfare perspective, country i's competition policy is too tough for itself), there can be additional effects:

(i) Mergers in country i which were previously blocked (call these mergers "marginal mergers") raise prices in country i. This raises the profits that foreign firms make in country i, and hence social welfare in country j.

(ii) In some sectors, marginal mergers in country i raise (resp. lower) prices in country j. The effect this has on social welfare in country j is ambiguous: on the one hand, distortions worsen (resp. improve); on the other hand, some profit is shifted from country i to country j (resp. from country j to country i).

At least for our estimated parameter values, however, effect (ii) does not seem to be important – we do not observe any industries in Canada or the US where welfare actually falls (although increases can be close to zero).

7 Conclusions and Outline Future Work

Tbw.

References

[1] Breinlich, Holger (2008). "Trade Liberalization and Industrial Restructuring through Mergers and Acquisitions." *Journal of International Economics*, vol. 76(2), 254-266.

[2] Brander, James A. (1995). "Strategic Trade Policy." In: *Handbook of International Economics*, vol. 3, eds. Gene Grossman and Kenneth Rogoff, North Holland: Amsterdam.

[3] Brander, James A., and Barbara J. Spencer (1983). ?????

[4] Brander, James A., and Barbara J. Spencer (1985). "Export Subsidies and International Market Share Rivalries." *Journal of International Economics*, vol. 18(1), 81-100.

[5] Deneckere, Raymond and Carl Davidson (1985). "Incentives to Form Coalitions with Bertrand Competition." *Rand Journal of Economics*, vol. 16(4), 473-486.

[6] diGiovanni, Julian (2005). "What Drives Capital Flows? The Case of Cross-Border M&A Activity and Financial Deepening." *Journal of International Economics*, vol. 65(1), 127-149.

[7] Farrell, Joseph, and Carl Shapiro (1990). "Horizontal Mergers: An Equilibrium Analysis." *American Economic Review,* vol. 80(1), 107-26.

[8] Gomes, Armando (2005). "Multilateral Contracting with Externalities." *Econometrica*, vol. 73(4), 1329-1350.

[9] Gomes, Armando, and Philippe Jehiel (2005). "Dynamic Processes of Social and Economic Interactions: On the Persistence of Inefficiencies." *Journal of Political Economy*, vol. 113(3), 626-667.

[10] Head, Keith, and John Ries (1997). "International Mergers and Welfare under Decentralized Competition Policy." *Canadian Journal of Economics*, vol. 30(4b), 1104-1123.

[11] Horn, Henrik, and James Levinsohn (2001). "Merger Policies and Trade Liberalisation." *Economic Journal*, vol. 111(470), 244-276.

[12] Jehiel, Philippe, and Benny Moldovanu (1995a). "Negative Externalities May Cause Delay in Negotiations." *Econometrica*, vol. 63(6), 1321-1335.

[13] Jehiel, Philippe, and Benny Moldovanu (1995b). "Cyclical Delay in Bargaining with Externalities." *Review of Economic Studies*, vol. 62(4), 619-637.

[14] Kamien, Morton I., and Israel Zang (1990). "The Limits of Monopolization through Acquisition." *Quarterly Journal of Economic*s, vol. 105(2), 465-499.

[15] McAfee, R. Preston, and Michael A. Williams (1992). "Horizontal Mergers and Antitrust Policy." *Journal of Industrial Economics,* vol. 40(2), 181-87.

[16] Neary, J. Peter (2007). "Cross-Border Mergers as Instruments of Comparative Advantage." *Review of Economic Studies*, vol. 74(4), 1229-1257.

[17] Nevo, Aviv (2000). "Mergers with Differentiated Products: The Case of the Read-to-Eat Breakfast Cereal Industry." *Rand Journal of Economics,* vol. 31(3), 395-421.

[18] Nocke, Volker, and Stephen Yeaple (2007). "Cross-Border Mergers and Acquisitions vs. Greenfield Foreign Direct Investment: The Role of Firm Heterogeneity." *Journal of International Economics*, vol. 72(2), 336-365.

[19] Nocke, Volker, and Stephen Yeaple (2008). "An Assignment Theory of Foreign Direct Investment." *Review of Economic Studies*, vol. 57(2), 529-557.

[20] Nocke, Volker, and Michael D. Whinston (2010). "Dynamic Merger Review." *Journal of Political Economy,* vol. 118(6), 1200-51.

[21] Nocke, Volker, and Michael D. Whinston (forthcoming). "Merger Policy with Merger Choice." *American Economic Review*, forthcoming.

[22] Perry, Martin K., and Robert H. Porter (1985). "Oligopoly and the Incentive for Horizontal Merger." *American Economic Review*, vol. 75(1), 219-227.

[23] Pesendorfer, Martin (2005). "Mergers under Entry." *Rand Journal of Economics*, vol. 36(3), 661-679.

[24] Salant, Stephen W., Sheldon Switzer, and Robert J. Reynolds (1983). "Losses from Horizontal Merger: The Effects of an Exogenous Change on Industry Structure on Cournot-Nash Equilibrium." *Quarterly Journal of Economics*, vol. 98(2), 185-199.

[25] Williamson, Oliver E. 1968. "Economies as an Antitrust Defense: The Welfare Tradeoffs." *American Economic Review,* vol. 58(1), 18-36.

A Solution of the Cournot Game with Linear Demands

As each firm can sell its good at home and abroad, the number of potentially active firms in sector s is $N_s = N_s^1 + N_s^2$ in both countries. However, because a firm can profitably sell in a market only if its unit cost is less than the market price it faces (net of the home bias), the number of *active* firms can vary across countries. We drop sector subscripts from now on to ease notation.

Consider the manufacturing market in country i. For every firm k, we let $\gamma_k^i = c_k$ if firm k is based in country i, and $\gamma_k^i = c_k + \phi^i$ if it is located in country $j \neq i$. We relabel firms such that $\gamma_1^i \leq \gamma_2^i \leq \ldots \leq \gamma_N^i$, i.e., adjusting for the home bias, firms are ranked from the most productive to the least productive.

Consider an equilibrium candidate in which the first M firms are active. For $1 \leq k \leq M$, the profit of firm k in country i is given by $\pi_k^i = \left(a^i - b^i(q_k^i + Q_{-k}^i) - \gamma_k^i\right) q_k^i$, where q_k^i is the output of firm k in country i, and $Q_{-k}^i = \sum_{l \neq k} q_l^i$ is the total output of its rivals. This yields the usual first-order condition: $a^i - b^i Q_{-k}^i - \gamma_k^i - 2b^i q_k^i = 0$. Denoting by $\Gamma_M^i = \sum_{k=1}^M \gamma_k^i$ the sum of the home bias-adjusted marginal costs of the first M firms, and summing over the active firms' first-order conditions, we obtain the market prices in this equilibrium candidate:

$$P^{i,i} = \frac{a + \Gamma_M^i}{M+1} \text{ and } P^{i,j} = P^{i,i} - \phi^i.$$

Notice that the price-cost margin of firm k is $P^{i,i} - \gamma_k^i$. It follows from usual stability arguments (e.g., Vives, 2001) that there exists a unique $\overline{M} \in \{0, 1, \ldots, N\}$ such that

$$\begin{array}{rl} \frac{a^i + \Gamma_M^i}{M+1} > \gamma_M^i & \text{for all } 1 \leq M \leq \overline{M}, \\ \text{and } \frac{a^i + \Gamma_M^i}{M+1} \leq \gamma_M^i & \text{for all } \overline{M} + 1 \leq M \leq N. \end{array}$$

Therefore, at the unique Nash equilibrium, only the first $\overline{M}$ firms are active, and

$$\begin{aligned} P^{i,i} &= \frac{a^i + \Gamma_{\overline{M}}^i}{\overline{M}+1}, \\ P^{i,j} &= P^{i,i} - \phi^i, \\ q_k^i &= \frac{\max(P^{ii} - \gamma_k^i, 0)}{b^i}, \quad 1 \leq k \leq N, \\ \pi_k^i &= \frac{\max(P^{ii} - \gamma_k^i, 0)^2}{b^i}, \quad 1 \leq k \leq N. \end{aligned}$$

Figures and Tables

Table 1: Empirical Moments and Parameter Values – Summary Statistics

Empirical Moment	Mean	Median	Standard Deviation	Minimum	Maximum
Shipments US	21441392	10989510	31806293	989421	230013000
Shipments CAN	1953900	905448	4201223	47098	44177100
HHI US	658	511	552	102	2760
HHI CAN	1385	969	1176	112	6200
Exports US	780247	274190	1414319	1972	10003740
Exports CAN	891939	296826	2715881	727	30996990
Labcostshare_US	28.0%	27.1%	9.4%	3.4%	53.0%
Labcostshare_CAN	25.2%	25.1%	9.4%	1.7%	44.5%
Estimated Parameters	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**
N_{US}	55.08	26.00	62.14	4.00	296.00
N_{CAN}	47.89	16.00	88.20	2.00	607.00
$1/b_{US}$	5185.24	2932.55	6501.25	107.07	40816.33
$1/b_{CAN}$	498.40	237.53	669.56	13.46	4672.90
phi_{US}	2.31	1.80	1.77	-0.61	8.47
phi_{CAN}	1.14	0.54	2.59	-5.21	12.40
phi_{US}/P_{US}	0.65	0.68	0.19	-0.31	0.91
phi_{CAN}/P_{CAN}	0.05	0.32	0.90	-5.75	0.91
Other Parameters	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**
a_{US}	50	50	50	50	50
a_{CAN}	50	50	50	50	50
α_{US}	1	1	1	1	1
α_{CAN}	0.654	0.654	0.654	0.654	0.654
β_{US}	3	3	3	3	3
β_{CAN}	3	3	3	3	3
Θ_0	0	0	0	0	0
Θ_1	1	1	1	1	1
Observations	149	149	149	149	149

Notes: All data are at the 5-digit NAICS level for the year 2002. All value entries (shipments, exports) are in 000s current USD.

Table 2: Simulated Domestic and Cross-Border Price Effects of Mergers between Active Firms

Price Effect	Mean	Median	Standard Deviation	Minimum	Maximum
US merger, US price	-0.158%	-0.123%	0.150%	-1.371%	-0.025%
US merger, Canadian price	-0.112%	-0.035%	0.324%	-1.073%	2.091%
Canadian merger, Canadian price	-0.130%	-0.098%	0.094%	-0.547%	-0.019%
Canadian merger, US price	-0.009%	0.000%	0.064%	-0.367%	0.464%

Table 3: Simulated Effects of a Merger Policy Change (Counterfactual 1: the US excepts mergers which increase prices by less than 0.1%; Canada excepts mergers which do not raise prices).

Change in Outcome (000s USD or %)	Mean	Median	Standard Deviation	Minimum	Maximum
Total Consumer Surplus US+Canada	-38901.64	-5380.661	73972.77	-496243.9	-3.422812
Consumer Surplus US	-38995.82	-5426.299	74154.7	-504860.3	-2.852344
Consumer Surplus Canada	94.44514	43.35563	5793.476	-65955.31	9401.325
Number of US Mergers	5.580%	5.707%	2.152%	0.637%	12.302%
Number of Canadian Mergers	0.056%	0.013%	0.129%	-0.395%	0.529%
US HHI	1.079%	0.246%	1.688%	0.000%	8.694%
Canadian HHI	0.077%	0.007%	0.622%	-4.666%	2.125%

Table 4: Simulated Effects of a Merger Policy Change (Counterfactual 2: Canada excepts mergers which increase prices by less than 0.1%; the US excepts mergers which do not raise prices).

Change in Outcome (000s USD or %)	Mean	Median	Standard Deviation	Minimum	Maximum
Total Consumer Surplus US+Canada	-1555.293	-73.02	12704.4	-122162.5	54838.02
Consumer Surplus US	1689.897	73.02	15232.79	-109091.9	118803.5
Consumer Surplus Canada	-3245.615	-237.315	9004.874	-64002.03	0
Number of US Mergers	0.038%	0.012%	0.067%	-0.097%	0.403%
Number of Canadian Mergers	6.143%	5.968%	3.190%	-0.004%	18.218%
US HHI	0.007%	0.000%	0.034%	-0.141%	0.295%
Canadian HHI	0.610%	0.129%	1.282%	-3.281%	6.218%

Table 5: Simulated Effects of a Merger Policy Change (Counterfactual 3: Only Accept Mergers which Increase CS in both countries).

Change in Outcome (000s USD or %)	Mean	Median	Standard Deviation	Minimum	Maximum
Total Consumer Surplus US+Canada	1818.3	-2.3	14953.1	-1460.4	172108.1
Consumer Surplus US	1622.6	-4.6	13095.6	-1460.4	148522.7
Consumer Surplus Canada	195.5	0.0	1942.6	-45.6	23585.5
Number of US Mergers	-0.622%	0.000%	3.258%	-25.522%	0.130%
Number of Canadian Mergers	-0.571%	0.000%	3.168%	-30.255%	0.087%
US HHI	-0.008%	0.000%	0.059%	-0.692%	0.011%
Canadian HHI	-0.140%	0.000%	0.951%	-8.775%	0.042%

Table 6: Simulated Effects of a Merger Policy Change (Counterfactual 4: Accept Mergers which Increase Total CS).

Change in Outcome (000s USD or %)	Mean	Median	Standard Deviation	Minimum	Maximum
Total Consumer Surplus US+Canada	9549.4	0.0	31153.6	-6206.7	207084.7
Consumer Surplus US	17188.5	73.0	52690.2	-5294.0	364369.8
Consumer Surplus Canada	-7637.6	-129.8	23616.7	-157294.2	13764.3
Number of US Mergers	0.198%	0.237%	1.693%	-17.672%	2.481%
Number of Canadian Mergers	9.602%	1.268%	17.215%	-27.782%	82.784%
US HHI	0.054%	0.008%	0.110%	-0.153%	0.724%
Canadian HHI	0.383%	0.052%	1.428%	-8.702%	4.986%

Table 7: Simulated Effects of a Merger Policy Change (Counterfactual 5: Accept Mergers which increase domestic prices by less than 5%).

Change in Outcome (000s USD or %)	Mean	Median	Standard Deviation	Minimum	Maximum
Total Welfare US+Canada	186803.7	109612.1	233128.7	1965.835	1239734
Total Consumer Surplus US+Canada	-178063.2	-105942.9	219087.3	-1103332	-2100.466
Welfare US	157254.3	94141.03	205572.8	1571.071	1104062
Welfare Canada	29549.96	12595.95	37959.21	92.41594	193220
Consumer Surplus US	-159252.9	-96532.44	197883.8	-1093402	4463.348
Consumer Surplus Canada	-18811.18	-3388.584	39920.49	-232294.9	3556.302
Number of US Mergers	41.50%	35.80%	31.97%	11.01%	223.26%
Number of Canadian Mergers	48.28%	39.23%	40.79%	-0.30%	338.46%
US HHI	3.90%	2.60%	2.99%	0.52%	11.42%
Canadian HHI	3.79%	2.84%	3.56%	-0.38%	18.05%

Table 8: Simulated Effects of a Merger Policy Change (Counterfactual 6: Accept Mergers which Increase Domestic Welfare).

Change in Outcome (000s USD or %)	Mean	Median	Standard Deviation	Minimum	Maximum
Total Surplus US+Canada	190152.6	110296.7	241296.9	1973.3	1380516.0
Total Consumer Surplus US+Canada	-188601.3	-107996.6	237891.2	-1312462.0	-2117.0
Surplus US	156710.0	88162.5	206345.9	1349.2	1153132.0
Surplus Canada	33443.6	14825.9	44642.0	402.4	227740.3
Consumer Surplus US	-176924.6	-102885.2	225897.0	-1253023.0	5106.8
Consumer Surplus Canada	-11675.3	-2175.3	26266.6	-210827.0	7251.8
Number of US Mergers	41.368%	35.263%	31.903%	11.226%	216.279%
Number of Canadian Mergers	27.872%	24.153%	17.898%	0.000%	110.870%
US HHI	3.981%	2.634%	3.079%	0.227%	11.802%
Canadian HHI	2.840%	2.077%	3.014%	-0.401%	16.674%