Accounting for the New Gains from Trade Liberalization*

Chang-Tai Hsieh
University of Chicago and NBER

Nicholas Li
University of Toronto

Ralph Ossa
University of Zurich and CEPR

Mu-Jeung Yang
University of Utah

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Abstract

We challenge the conventional wisdom on the variety and productivity gains from trade liberalization which are commonly referred to as "new" gains from trade. In particular, we show that the import variety gains measured in studies such as Broda and Weinstein (2006) are counteracted by exactly analogous domestic variety losses. Similarly, we show that the domestic productivity gains measured in studies such as Trefler (2004) are counteracted by exactly analogous import productivity losses. We then account for all these gains and losses in an application to the Canada-US Free Trade Agreement and show that Canada actually experienced net "new" losses from trade.

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*Emails: chsieh@chicagobooth.edu, nick.li@utoronto.ca, ralph.ossa@econ.uzh.ch, mjyang@eccles@utah.edu.
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1 Introduction

One of the most celebrated contributions of the so-called "new" trade theory is that it identifies "new" gains from trade. In particular, the Krugman (1980) model predicts that trade liberalization gives consumers access to a wider range of imported products thereby bringing about import variety gains. Moreover, the Melitz (2003) model adds that trade liberalization forces the least productive firms to exit out of production thereby bringing about domestic productivity gains. These "new" gains from trade have in common that they are driven by changes in the set of firms serving a market so that they could also be referred to as extensive margin gains.

These theoretical contributions have spurred an influential empirical literature measuring such extensive margin gains. Broda and Weinstein (2006), for example, document that US consumers benefitted substantially from the increase in the range of imported products available to them between 1972 and 2001. Trefler (2004), for instance, shows that Canadian manufacturing productivity rose significantly following the Canada-US Free Trade Agreement as a result of the exit of low productivity firms. As a result, the consensus view is that trade liberalization brings about extensive margin adjustments which result in import variety and domestic productivity gains.

In this paper, we argue that this consensus view is incomplete. Our main point is remarkably simple but has been overlooked in the empirical literature so far. In particular, we show that the import variety gains measured in studies such as Broda and Weinstein (2006) are counteracted by exactly analogous domestic variety losses. Similarly, we show that the domestic productivity gains measured in studies such as Trefler (2004) are counteracted by exactly analogous import productivity losses. We then account for all these gains and losses in an application to the Canada-US Free Trade Agreement and show that Canada actually experienced net "new" losses from trade.

Our main point can be illustrated in the context of the canonical Melitz (2003) model. In this model, trade liberalization induces additional foreign firms to enter into exporting which brings about import variety gains. However, it also forces some domestic firms to exit out of production which brings about domestic variety losses. Moreover, the exiting domestic firms are less productive than the continuing domestic firms since the domestic productivity cutoff rises which leads to domestic productivity gains. At the same time, the new foreign exporters are less productive than the incumbent foreign exporters since the foreign export productivity cutoff falls which leads to import productivity losses.

Our empirical analysis is guided by an exact decomposition of the gains from trade into "traditional" gains and "new" gains. This decomposition is based on a generalized Melitz (2003) model and can be expressed in terms of simple sufficient statistics building on the seminal work of Feenstra (1994). The "new" gains describe the gains that only arise if there are changes in the set of firms serving a country, namely the abovementioned variety and productivity effects. The "traditional" gains describe the gains that also arise if there are no changes in the set of firms serving a country, such as reductions in import prices resulting from reductions in trade costs.

We apply our decomposition to measure the "new" gains from trade reaped by Canada as a result of the Canada-US Free Trade Agreement (CUSFTA). We start with a simple before-and-after analysis at the aggregate level and then turn to a differences-in-differences analysis at the industry-level to control for potential contemporaneous shocks. Our main finding is that Canada suffered from "new" welfare losses which accumulate to -1.52% of Canada's real income between 1988 and 1996. Note that this does not mean that Canada actually lost from CUSFTA but instead says that the "new" margins contributed negatively to Canada's overall ("new" and "traditional") gains from CUSFTA.[1]

Unlike earlier studies, our analysis combines micro data on domestic and foreign plants. In particular, we use micro data on Canadian producers to calculate the domestic variety losses and domestic productivity gains, and micro data on US exporters to calculate the import variety gains and import productivity losses. It turns out that the overall "new" gains from trade can be calculated from changes in the market shares of continuing domestic and foreign plants. The intuition is that a fall in the market share of continuing plants implies that exit is more important than entry, either because more plants exit or because the exiting plants are more productive on average.

[1] See Head and Ries (1999), Trefler (2004), Breinlich (2008), Lileeva (2008), Lileeva and Trefler (2010), Melitz and Trefler (2012), and Breinlich and Cunat (forthcoming) for earlier empirical analyses of CUSFTA.

Besides the abovementioned literature on the extensive margin effects of trade liberalization, our paper is most closely related to the recent Arkolakis et al (2012) gains from trade literature.[2] One key difference is that we do not compare the gains from trade across models but instead decompose the gains from trade taking as given one model, namely a generalized version of the Melitz (2003) model. Another key difference is that we do not make a theoretical point but provide an empirical decomposition using micro data which allows us to relax some of Arkolakis et al's (2012) strongest assumptions on the process of entry and the distribution of firm productivities.[3]

The remainder of this paper is organized as follows. In the next section, we present our methodology by developing our general heterogeneous firm model, describing our decomposition of welfare changes into "traditional" gains from trade and "new" gains from trade, and linking our decomposition to sufficient statistics. In the third section, we then turn to our application to the Canada-US Free Trade Agreement (henceforth abbreviated as CUSFTA) by discussing our data, describing our aggregate findings, and presenting our industry-level results which also include the results obtained from our differences-in-differences analysis. A final section then draws conclusions and summarizes our main results.

2 Methodology

2.1 Basic framework

We introduce our methodology using a generic heterogeneous firm model of trade. Consumers have constant elasticity of substitution preferences over differentiated varieties sourced from many countries. These varieties are produced by monopolistic firms with heterogeneous productivities at constant marginal costs using labor only and trade is subject to iceberg costs. We remain agnostic about the determinants of entry into production and exporting and simply say that M_{ij} firms from country i serve country j. Hence, there may or may not be fixed

[2] Other contributions to this literature include Arkolakis et al (2008), Atkeson and Burstein (2010), Melitz and Redding (2015), and Ossa (2015).

[3] Having said this, we also show that the "new" gains from trade are exactly zero in our model if we impose the assumptions of Arkolakis et al's (2012) and focus on the effects of a reduction in variable trade costs. The reason is that the import variety gains are then exactly offset by domestic variety losses and the domestic productivity gains are then exactly offset by import productivity losses. In that sense, our decomposition can also provide some intuition for the original Arkolakis et al (2012) result.

market access costs and firms may or may not sort into production and exporting according to productivity cutoffs.

In this environment, a country i firm with productivity φ faces a demand $q_{ij}(\varphi) = \frac{p_{ij}(\varphi)^{-\sigma}}{P_j^{1-\sigma}} Y_j$ in country j, where p_{ij} is the delivered price in country j, P_j is the price index in country j, Y_j is the income in country j, and $\sigma > 1$ is the elasticity of substitution. As a result, it adopts a constant markup pricing rule $p_{ij}(\varphi) = \frac{\sigma}{\sigma-1} \frac{w_i \tau_{ij}}{\varphi}$, where w_i is the wage rate in country i and $\tau_{ij} > 1$ are the iceberg trade costs. This implies that the value of bilateral trade flows can be written as $X_{ij} = \int_{\varphi \in \Phi_{ij}} M_{ij} \left(\frac{\sigma}{\sigma-1} \frac{w_i \tau_{ij}}{\varphi P_j} \right)^{1-\sigma} Y_j dG_i(\varphi | \varphi \in \Phi_{ij})$, where Φ_{ij} is the set of productivities corresponding to all country i firms serving country j and $G_i(\varphi | \varphi \in \Phi_{ij})$ is their cumulative distribution.

These bilateral trade flows can be rewritten as $X_{ij} = M_{ij} \left(\frac{\sigma}{\sigma-1} \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij} P_j} \right)^{1-\sigma} Y_j$, where $\tilde{\varphi}_{ij} = \left(\int_{\varphi \in \Phi_{ij}} \varphi^{\sigma-1} dG_i(\varphi | \varphi \in \Phi_{ij}) \right)^{\frac{1}{\sigma-1}}$ is the Melitz (2003) measure of average productivity. Hence, they can be thought of as depending on average prices, $X_{ij} = M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j} \right)^{1-\sigma} Y_j$, where average prices depend on average productivity, $\tilde{p}_{ij} = \frac{\sigma}{\sigma-1} \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$. As will become clear shortly, the relationships $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j} \right)^{1-\sigma} Y_j$ and $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$ are all we need to derive our decomposition of price index changes. Our decomposition of welfare changes then follows from this decomposition of price index changes and the additional assumption that total income is proportional to labor income $Y_j \propto w_j L_j$.

Overall, our methodology therefore applies to all models satisfying $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j} \right)^{1-\sigma} Y_j$, $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$, and $Y_j \propto w_j L_j$. An important special case is the standard Melitz (2003) model in which free entry ensures that $Y_j \propto w_j L_j$ trivially. While we maintain the CES assumption $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j} \right)^{1-\sigma} Y_j$ throughout our analysis, we explore how our approach has to be modified if either of the other two relationships break. In particular, we consider a version with endogenous markups in which average prices are not proportional to average marginal costs. Moreover, we consider a version with tariff revenues in which total income is not proportional to labor income.

2.2 Welfare decomposition

In this environment, welfare is given by real per-capita income so that log changes in welfare can be written as $\ln \frac{W_j'}{W_j} = \ln \frac{Y_j'/L_j'}{Y_j/L_j} - \ln \frac{P_j'}{P_j}$. Our first assumption, $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j}\right)^{1-\sigma} Y_j$, immediately implies $\ln \frac{P_j'}{P_j} = \ln \frac{\tilde{p}_{ij}'}{\tilde{p}_{ij}} - \frac{1}{\sigma-1} \ln \frac{M_{ij}'}{M_{ij}} + \frac{1}{\sigma-1} \ln \frac{\lambda_{ij}'}{\lambda_{ij}}$, where $\lambda_{ij} = \frac{X_{ij}}{Y_j}$ are expenditure shares. Summing up over all source countries using the Sato (1976)-Vartia (1976) weights $\bar{\lambda}_{ij} = \left(\frac{\lambda_{ij}^{'}-\lambda_{ij}}{\ln \lambda_{ij}^{'}-\ln \lambda_{ij}}\right) / \left(\sum_{m=1}^{N} \frac{\lambda_{mj}^{'}-\lambda_{mj}}{\ln \lambda_{mj}^{'}-\ln \lambda_{mj}}\right)$, the last term cancels so that $\ln \frac{P_j'}{P_j} = \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\ln \frac{\tilde{p}_{ij}'}{\tilde{p}_{ij}} - \frac{1}{\sigma-1} \ln \frac{M_{ij}'}{M_{ij}}\right)$.[4] This simply captures that changes in the price index are expenditure share weighted averages of changes in average prices and elasticity of substitution adjusted changes in available variety.

Our second assumption, $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$, allows us to write changes in average prices in terms of changes in wages, changes in trade costs, and changes in average productivity, $\ln \frac{\tilde{p}_{ij}'}{\tilde{p}_{ij}} = \ln \frac{w_i'}{w_i} + \ln \frac{\tau_{ij}'}{\tau_{ij}} - \ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}}$. To make explicit that $\tilde{\varphi}_{ij}$ can change because of changes in the average productivity of continuing firms or because of changes in the composition of firms, we separately define the average productivity of continuing firms $\tilde{\varphi}_{ij}^c$ and expand $\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} = \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c} + \left(\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right)$ so that $\ln \frac{\tilde{p}_{ij}'}{\tilde{p}_{ij}} = \ln \frac{w_i'}{w_i} + \ln \frac{\tau_{ij}'}{\tau_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c} - \left(\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right)$. To be clear, $\tilde{\varphi}_{ij}^c$ is defined analogously to $\tilde{\varphi}_{ij}$ as $\tilde{\varphi}_{ij}^c = \left(\int_{\varphi \in \Phi_{ij}^c} \varphi^{\sigma-1} dG_i \left(\varphi | \varphi \in \Phi_{ij}^c\right)\right)^{\frac{1}{\sigma-1}}$ so that $\tilde{\varphi}_{ij}^c$ changes only if the productivities of continuing firms change.[5]

Together, our first two assumptions therefore allow us to decompose price index changes as $\ln \frac{P_j'}{P_j} = -\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\frac{1}{\sigma-1} \ln \frac{M_{ij}'}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right)\right) + \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\ln \frac{\tau_{ij}'}{\tau_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c} + \ln \frac{w_i'}{w_i}\right)$. While we could make many of our points using this price index decomposition, we further invoke our third assumption $Y_j \propto w_j L_j$ to be able to also provide a full welfare decomposition. This assumption implies that log changes in nominal per-capita income are given by log changes in nominal wages, $\ln \frac{Y_j'/L_j'}{Y_j/L_j} = \ln \frac{w_j'}{w_j}$, so that log changes in welfare can be written as log changes in real wages, $\ln \frac{W_j'}{W_j} = \ln \frac{w_j'}{w_j} - \ln \frac{P_j'}{P_j}$. Substituting our price index decomposition then

[4] Notice that these weights are simply logarithmic averages of the expenditure shares λ_{ij} and λ_{ij}' normalized such that they sum to 1.

[5] In our application, continuing firms correspond to firms which have neither exited nor entered as a result of trade liberalization. It can be shown that $\ln \frac{\tilde{\varphi}_{ij}^{c'}}{\tilde{\varphi}_{ij}^c}$ is just a weighted average of the productivity changes of continuing firms with the weights being Sato-Vartia weights defined over the market shares of individual continuing firms among all continuing firms from country i serving country j.

immediately yields our welfare decomposition:

$$\ln \frac{W_j'}{W_j} = \underbrace{\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\frac{1}{\sigma - 1} \ln \frac{M_{ij}'}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}} \right) \right)}_{\text{"new" gains}} + \underbrace{\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(-\ln \frac{\tau_{ij}'}{\tau_{ij}} + \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}} + \left(\ln \frac{w_j'}{w_j} - \ln \frac{w_i'}{w_i} \right) \right)}_{\text{"traditional" gains}} \quad (1)$$

Applied to the gains from trade liberalization, this formula has a straightforward interpretation.[6] The first line describes the gains that only arise if there are changes in the set of firms serving country j, which we label "new" gains from trade. The second line describes the gains that also arise if there are no changes in the set of firms serving country j, which we label "traditional" gains from trade. We choose these labels since the first line includes the import variety and domestic productivity gains that are typically associated with "new" trade models. However, we urge the reader not to overinterpret these labels but instead keep our simple definition in mind.[7]

Concretely, the "new" gains capture changes in the price index driven by changes in the set of firms serving country j. In particular, the price index is decreasing in the number of domestic and foreign varieties available in the domestic market, which is captured by the terms $\frac{1}{\sigma-1} \ln \frac{M_{ij}'}{M_{ij}}$. Moreover, the price index is decreasing in the average productivity of domestic and foreign firms serving the domestic market, which is captured by the terms $\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}}$. Recall that we separately account for the productivity changes of continuing firms so that the terms $\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}}$ isolate only changes in average productivity brought about by changes in the composition of firms.

According to a standard Melitz (2003) model, these effects should have an offsetting char-

[6] Notice that these gains might come from reductions in variable or fixed trade costs even though fixed trade costs do not feature explicitly in the formula. Notice also that trade liberalization is only one of many possible applications of this formula. Essentially, it provides an exact decomposition of the welfare effects of arbitrary shocks in any environment satisfying $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j} \right)^{1-\sigma} Y_j$, $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$, and $Y_j \propto w_j L_j$.

[7] For example, we understand that (i) our basic model does not feature gains arising from comparative advantage which one might also want to call "traditional" gains, (ii) we work with a Melitz (2003) model so that one might want to call all our gains "new" gains, (iii) the Krugman (1980) "new" trade model does not feature import variety gains unless one compares autarky to free trade, (iv) neither the canonical "traditional" nor the canonical "new" trade models feature within-firm productivity effects.

acter. In particular, trade liberalization induces additional foreign firms to enter into exporting which brings about an import variety gain. However, it also forces some domestic firms to exit out of production which brings about a domestic variety loss. Moreover, the exiting domestic firms are less productive than the continuing domestic firms since the domestic productivity cutoff rises which leads to a domestic productivity gain. At the same time, the new foreign exporters are less productive than the incumbent foreign exporters since the foreign export productivity cutoff falls which leads to an import productivity loss.

Interestingly, they even cancel exactly in the Pareto version of Melitz (2003) considered by Arkolakis et al (2008). As we show in the appendix, the import variety gains are then exactly offset by domestic variety losses so that $\sum_{i=1}^{N} \frac{\bar{\lambda}_{ij}}{\sigma-1} \ln \frac{M'_{ij}}{M_{ij}} = 0$. Similarly, the domestic productivity gains are then exactly offset by import productivity losses so that $\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} \right) = 0$. As a result, the "new" gains from trade are then also exactly zero which explains why Arkolakis et al (2008) find that firm heterogeneity does not affect the gains from trade. We do not impose any of this in our application but instead simply measure which of these offsetting effects dominate.[8,9,10]

Against this background, it becomes clear that standard approaches to estimating the "new" gains from trade capture only partial effects. In particular, existing studies estimating the variety gains from trade typically focus on the increase in the number of imported varieties but downplay the fall in the number of domestically produced varieties (see, for example, Broda and Weinstein, 2006). Similarly, available studies estimating the productivity gains from trade usually emphasize the increase in the average productivity of domestic firms but

[8] As explained earlier, our decomposition (1) is valid for any shock hitting the economy and not just for changes in variable trade costs. However, our above discussion of the Melitz-Pareto model implicitly restricts attention to changes in variable trade costs. As will be clear from the appendix, a reduction in fixed trade costs or an increase in the trading partner's labor force can still bring about "new" gains even in this special case.

[9] Feenstra (2010) has shown that in this special case it is also true that $\ln \frac{W'_j}{W_j} = \ln \frac{\tilde{\varphi}'_{jj}}{\tilde{\varphi}_{jj}}$. While it is tempting to conclude from this that domestic productivity gains are the only source of welfare gains, it is easy to verify that $\ln \frac{\tilde{\varphi}'_{jj}}{\tilde{\varphi}_{jj}} = \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(-\ln \frac{\tau'_{ij}}{\tau_{ij}} + \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} + \left(\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i} \right) \right)$. Hence, $\ln \frac{\tilde{\varphi}'_{jj}}{\tilde{\varphi}_{jj}}$ is simply a sufficient statistic for what we call the "traditional" gains which would also appear in a version of our model without firm heterogeneity. For example, the term $-\sum_{i=1}^{N} \bar{\lambda}_{ij} \ln \frac{\tau'_{ij}}{\tau_{ij}}$ simply captures the direct effect trade cost reductions have on the domestic price index which then brings about a number of endogenous adjustments including domestic selection effects among heterogeneous firms.

[10] Atkeson and Burstein (2010) show that the "indirect effect" of small trade cost reductions is zero in a symmetric two-country Melitz (2003) model even without imposing Pareto because of a combination of free entry and optimal selection. What they refer to as "indirect effect" in their welfare decomposition corresponds to what we call "new gains from trade".

do not account for the decrease in the average productivity of foreign firms (see, for example, Trefler, 2004).

The "traditional" gains in formula (1) capture changes in the price index which also arise if there is no entry and exit as well as changes in the terms-of-trade. In particular, import prices are of course affected by trade costs which is captured by the term $\ln \frac{\tau'_{ij}}{\tau_{ij}}$. Moreover, prices also change if the average productivity of continuing domestic or foreign firms changes which is captured by the term $\ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}$. Recall that $\tilde{\varphi}^{c}_{ij}$ changes only if the productivities of continuing firms change so that this term isolates only within-firm productivity effects. Finally, relative wage changes $\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i}$ amount to terms-of-trade changes since prices are proportional to wages in this constant markup environment.[11]

Notice that terms-of-trade changes are not a fundamental source of gains from trade but rather affect the international division of the gains from trade. This is because the relative wage term has a zero sum character globally which is particularly easy to see in the special case of small shocks. Specifically, the Sato-Vartia weights can then be replaced with simple expenditure shares which makes it easy to show that $\sum_{j=1}^{N} \frac{Y_j}{Y^W} \left(\sum_{i=1}^{N} \lambda_{ij} \left(\frac{dw_j}{w_j} - \frac{dw_i}{w_i} \right) \right) = 0$, where $Y^W = \sum_{j=1}^{N} Y_j$ is world income. To see this, notice that income has to equal expenditure, $Y_j = \sum_m X_{mj}$, and income has to equal revenues, $Y_j = \sum_n X_{jn}$, which immediately implies the above result.

We take no stance on how the "new" gains interact with the "traditional" gains in the sense that we do not restrict how $\ln \frac{M'_{ij}}{M_{ij}}$ and $\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}$ co-move with $\ln \frac{\tau'_{ij}}{\tau_{ij}}$, $\ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}$, and $\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i}$. Of course, they are ultimately all co-determined in general equilibrium so that any distinction between "traditional" and "new" gains involves a judgement call. However, our definition of the "new" gains should be uncontroversial since selection gains are rarely argued to materialize through changes in $\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i}$ or $\ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}$. As a case in point, these terms do not even respond to trade liberalization in the original Melitz (2003) model since countries are symmetric and firm productivities are exogenous.

[11] It is sometimes argued that trade liberalization not only increases domestic productivity by forcing the least productive firms to exit but also by reallocating resources from less to more productive continuing firms. While one might suspect that such reallocations are also part of the "new" gains, they actually show up as terms-of-trade effects in the "traditional" gains. To see this, notice that they do not change the purchasing power of domestic wages in terms of domestic goods since firms charge constant markups over marginal costs. Hence, they can only change the purchasing power of domestic wages in terms of foreign goods which happens only if they affect domestic wages relative to foreign wages.

A more serious concern is that the Sato-Vartia weights multiplying the "traditional" and "new" gains are defined over all firms. This implies, for example, that the gains from having access to additional foreign varieties are larger if trade costs have been reduced by more and vice versa since lower trade costs and additional import varieties increase the Sato-Vartia weights. As we explain in more detail later, we address this concern by verifying that our main result that the "new" gains from CUSFTA reaped by Canada are negative is robust to an alternative decomposition which multiplies the "traditional" gains using Sato-Vartia weights defined only over the subset of continuing firms.[12]

2.3 Sufficient statistics

We estimate the "new" gains from trade by expressing them in terms of simple sufficient statistics which also follow from our assumptions $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j}\right)^{1-\sigma} Y_j$ and $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$. In particular, we consider the total sales from country i to country j associated with only continuing firms, $X_{ij}^c \propto M_{ij}^c \left(\frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}^c} \frac{1}{P_j}\right)^{1-\sigma} Y_j$, and express them as a fraction of the total sales from country i to country j associated with all firms, $X_{ij} \propto M_{ij} \left(\frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}} \frac{1}{P_j}\right)^{1-\sigma} Y_j$, which yields $\frac{X_{ij}^c}{X_{ij}} = \frac{M_{ij}^c}{M_{ij}} \left(\frac{\tilde{\varphi}_{ij}^c}{\tilde{\varphi}_{ij}}\right)^{\sigma-1}$. Upon taking changes and using the fact that the number of continuing firms does not change by definition, we obtain our basic measurement equation for the "new" gains from trade,

$$\frac{1}{\sigma-1} \ln\left(\frac{X_{ij}^c / X_{ij}}{X_{ij}^{c\prime} / X_{ij}^{\prime}}\right) = \frac{1}{\sigma-1} \ln \frac{M_{ij}^{\prime}}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}_{ij}^{\prime}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right) \tag{2}$$

Hence, all we need to quantify the "new" gains from trade reaped by country j is information on the change in the market shares of continuing firms in country j. For example, if the market share of continuing exporters from country i among all exporters from country i falls following trade liberalization, this indicates that selection effects among country i's exporters must have contributed positively to country j's "new" gains from trade. This is because entry into exporting must have been more important than exit out of exporting under

[12] This issue can also be explained with reference to the recent gains from trade literature. In particular, our formula suggests that the "new" gains from trade should be zero in Krugman (1980) and Melitz (2003) with Pareto. At the same time, Redding and Melitz (2015) show that the gains from trade are smaller in Krugman (1980) than in Melitz (2003) with Pareto if one conditions on initial trade shares and structural parameters. The explanation is that the Sato-Vartia import expenditure shares respond more to trade liberalization in Melitz (2003) with Pareto under these assumptions since it features additional extensive margin effects.

these circumstances, either because more firms entered than exited or because the entering firms were more productive than the exiting firms.[13]

While formula (2) only measures the overall "new" gains from trade, it can be easily expanded to also measure the underlying variety and productivity effects. To see this, notice that trade flows can be separated into their extensive and intensive margins by defining average revenues $\tilde{r}_{ij} \propto \left(\frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}} \frac{1}{P_j}\right)^{1-\sigma} Y_j$ and writing $X_{ij} \propto M_{ij}\tilde{r}_{ij}$. Of course, this can be done for all subsets of firms and time periods so that also $X^c_{ij} \propto M^c_{ij}\tilde{r}^c_{ij}$, $X'_{ij} \propto M'_{ij}\tilde{r}'_{ij}$, and $X^{c'}_{ij} \propto M^c_{ij}\tilde{r}^{c'}_{ij}$. As a result, we can write $\frac{1}{\sigma-1}\ln\left(\frac{X^c_{ij}/X_{ij}}{X^{c'}_{ij}/X'_{ij}}\right)$ in terms of the variety and productivity effects induced by entry and exit, keeping in mind that M'_{ij} is given by M_{ij} minus exit plus entry which can of course occur at the same time,

$$\underbrace{\frac{1}{\sigma-1}\ln\left(\frac{X^c_{ij}/X_{ij}}{X^{c'}_{ij}/X'_{ij}}\right)}_{\text{overall "new" gains}} = \underbrace{\underbrace{\frac{1}{\sigma-1}\ln\frac{M^c_{ij}}{M_{ij}}}_{\text{variety loss}} + \underbrace{\frac{1}{\sigma-1}\ln\frac{\tilde{r}^c_{ij}}{\tilde{r}_{ij}}}_{\text{prod. gain}}}_{\text{loss from exit}} + \underbrace{\underbrace{\frac{1}{\sigma-1}\ln\frac{M'_{ij}}{M^c_{ij}}}_{\text{variety gain}} + \underbrace{\frac{1}{\sigma-1}\ln\frac{\tilde{r}'_{ij}}{\tilde{r}^{c'}_{ij}}}_{\text{prod. loss}}}_{\text{gain from entry}} \tag{3}$$

The term $\frac{1}{\sigma-1}\ln\frac{M^c_{ij}}{M_{ij}}$ represents the variety loss from exit since exit implies that the number of continuing firms is smaller than the total number of firms in the pre-period. Similarly, the term $\frac{1}{\sigma-1}\ln\frac{M'_{ij}}{M^c_{ij}}$ summarizes the variety gain from entry since entry implies that the total number of firms in the post-period is larger than the number of continuing firms. The revenue ratios simply capture the associated effects on average productivity. In particular, the term $\frac{1}{\sigma-1}\ln\frac{\tilde{r}^c_{ij}}{\tilde{r}_{ij}} = \ln\frac{\tilde{\varphi}^c_{ij}}{\tilde{\varphi}_{ij}}$ measures the productivity change due to exit which one would expect to be positive. Similarly, the term $\frac{1}{\sigma-1}\ln\frac{\tilde{r}'_{ij}}{\tilde{r}^{c'}_{ij}} = \ln\frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}^{c'}_{ij}}$ describes the productivity change due to entry which one would expect to be negative.

Notice that our measurement of the effects of selection on average productivity is quite different from what is usually done in the literature. In particular, the standard approach is based on obtaining measures of productivity levels either by simply computing real output per worker such as Trefler (2004) or by leveraging more complex techniques from the industrial organization literature such as Pavcnik (2002). In contrast, we do not compute productivity

[13] While trade liberalization would induce only entry into exporting in the Melitz (2003) model, our formula allows for some firms to enter into exporting and others to exit out of exporting at the same time. Similarly, while trade liberalization would induce only exit out of domestic production in the Melitz (2003) model, our formula allows for some firms to exit out of domestic production and others to enter into domestic production at the same time. This is important because there is substantial churning in the data.

levels at all but instead infer the effects selection has on average productivity by comparing the average revenues of continuing firms to the average revenues of all firms within a given time period as suggested by our theory.[14]

Since $X_{ij} > X_{ij}^c$ if there is exit and $\frac{1}{\sigma-1}\ln\left(\frac{X_{ij}^c}{X_{ij}}\right) = \frac{1}{\sigma-1}\ln\frac{M_{ij}^c}{M_{ij}} + \frac{1}{\sigma-1}\ln\frac{\tilde{r}_{ij}^c}{\tilde{r}_{ij}}$, the productivity gain from exit can never exceed the variety loss from exit so that exit is always associated with a welfare loss. Similarly, since $X_{ij}' > X_{ij}^{c\prime}$ if there is entry and $\ln\left(\frac{X_{ij}'}{X_{ij}^{c\prime}}\right) = \frac{1}{\sigma-1}\ln\frac{M_{ij}'}{M_{ij}^c} + \frac{1}{\sigma-1}\ln\frac{\tilde{r}_{ij}'}{\tilde{r}_{ij}^{c\prime}}$, the productivity loss from entry can never exceed the variety gain from entry so that entry is always associated with a welfare gain. Intuitively, consumers care about all varieties no matter how unproductive the associated firms. The productivity terms merely account for the fact that consumers care less about low-productivity varieties since they are sold at higher prices.

Importantly, our statements that exit is always associated with a welfare loss and entry is always associated with a welfare gain are conditional on our three assumptions $X_{ij} \propto M_{ij}\left(\frac{\tilde{p}_{ij}}{P_j}\right)^{1-\sigma} Y_j$, $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$, and $Y_j \propto w_j L_j$. As a result, they apply to equilibrium adjustments in the number of firms in models such as the canonical Melitz (2003) model but cannot be used to assess whether policy should be used to remove or add firms. For example, if governments subsidized entry in order to increase the number of firms in the Melitz (2003) model, the assumption $Y_j \propto w_j L_j$ would no longer hold since households would then also have to cover the subsidy costs.

Our formulas for the "new" gains from trade can be roughly thought of as decompositions of the "Feenstra-Ratio" which is widely used to adjust changes in the price index for new product varieties. In particular, one can show that Feenstra's (1994) original method yields $\ln\frac{W_j'}{W_j} = \sum_{i=1}^N \bar{\lambda}_{ij}^c\left(-\ln\frac{\tau_{ij}'}{\tau_{ij}} + \left(\ln\frac{w_j'}{w_j} - \ln\frac{w_i'}{w_i}\right) + \ln\frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right) + \frac{1}{\sigma-1}\ln\left(\frac{Y_j^c/Y_j}{Y_j^{c\prime}/Y_j'}\right)$ in our environment, where the last term represents the "Feenstra-Ratio". As can be seen, this is closely related to our decompositions $\ln\frac{W_j'}{W_j} = \sum_{i=1}^N \bar{\lambda}_{ij}\left(-\ln\frac{\tau_{ij}'}{\tau_{ij}} + \left(\ln\frac{w_j'}{w_j} - \ln\frac{w_i'}{w_i}\right) + \ln\frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right) + \frac{1}{\sigma-1}\sum_{i=1}^N \bar{\lambda}_{ij}\ln\left(\frac{X_{ij}^c/X_{ij}}{X_{ij}^{c\prime}/X_{ij}'}\right)$ as well as $\ln\frac{W_j'}{W_j} = \sum_{i=1}^N \bar{\lambda}_{ij}\left(-\ln\frac{\tau_{ij}'}{\tau_{ij}} + \left(\ln\frac{w_j'}{w_j} - \ln\frac{w_i'}{w_i}\right) + \ln\frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right) + \frac{1}{\sigma-1}\sum_{i=1}^N \bar{\lambda}_{ij}\left(\ln\frac{M_{ij}^c}{M_{ij}} + \ln\frac{\tilde{r}_{ij}^c}{\tilde{r}_{ij}} - \ln\frac{M_{ij}^c}{M_{ij}'} - \ln\frac{\tilde{r}_{ij}^{c\prime}}{\tilde{r}_{ij}'}\right)$ implied by equations (1) - (3).

[14] Notice that we implicitly use the productivity growth of continuing firms as a benchmark when calculating the effects of entry and exit on average productivity. For example, by inferring the productivity consequences of exit from relative revenues before exit occurs, we assume that the productivity of exiting firms would have grown as fast as the productivity of continuing firms had they not exited.

We say "roughly" because our welfare decompositions and their Feenstra (1994) analog are not exactly the same. In particular, we work with Sato-Vartia weights calculated using shipments of all firms, $\bar{\lambda}_{ij}$, so that our "traditional" gains capture what would be the only gains if all firms were continuing firms and import shares were the same as they are in the data *for all firms*. In contrast, the Feenstra (1994) analog applies Sato-Vartia weights using the shipments of all continuing firms, $\bar{\lambda}^c_{ij}$, so that its "traditional" gains capture what would be the only gains if all firms were continuing firms and import shares were the same as they are in the data *for all continuing firms*.

Conceptually, this implies that part of the gains captured by the Feenstra-Ratio show up in our "traditional" gains. For example, we attribute the price-reducing effects of tariff cuts to our "traditional" gains even if they apply to newly available varieties which makes sense given that our "new" gains are meant to isolate variety and productivity effects.[15] However, we will see that this difference is not crucial for our main result that the "new" gains from CUSFTA reaped by Canada are negative. In particular, this result is robust to using the Feenstra-Ratio as an alternative measure of the "new" gains as long as it is accurately computed using Canadian expenditure on Canadian and US varieties.

Our finding that the "new" gains remain negative using this alternative decomposition should also address concerns that our preferred Sato-Vartia weights $\bar{\lambda}_{ij}$ confound intensive and extensive margin effects. For example, one might argue that we should not use $\bar{\lambda}_{ij}$ when calculating the "traditional" gains since it also includes foreign entry into exporting which should be part of the "new" gains. However, we have seen earlier that the alternative decomposition in which the Feenstra-Ratio captures the "new" gains also uses $\bar{\lambda}^c_{ij}$ to calculate the "traditional" gains so that our negative "new" gains result is robust to limiting these trade shares to continuing firms.

[15] This can be seen more formally by separating the Feenstra-Ratio into our "new" gains from trade term and an adjustment term, $\frac{1}{\sigma-1}\ln\frac{Y^c_j/Y_j}{Y^{c\prime}_j/Y^{\prime}_j} = \sum_{i=1}^N \bar{\lambda}_{ij}\frac{1}{\sigma-1}\ln\frac{X^c_{ij}/X_{ij}}{X^{c\prime}_{ij}/X^{\prime}_{ij}} + \sum_{i=1}^N \left(\bar{\lambda}_{ij}-\bar{\lambda}^c_{ij}\right)\left(-\ln\frac{\tau^{\prime}_{ij}}{\tau_{ij}} + \left(\ln\frac{w^{\prime}_j}{w_j} - \ln\frac{w^{\prime}_i}{w_i}\right) + \ln\frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^c_{ij}}\right)$, which follows straightforwardly from the above decompositions. The adjustment term gives the portion of the Feenstra-Ratio which we attribute to the "traditional" gains and essentially captures "traditional" forces acting on new firms.

2.4 Extensions

Before taking our methodology to the data, we consider a number of extensions to explore the robustness of our approach to departures from the assumptions we have so far imposed. In particular, we consider versions with nontraded and intermediate goods, endogenous markups, tariff revenues, multiproduct firms, and heterogeneous quality. However, we continue to limit ourselves to one-sector models for now and postpone a discussion of multi-sector versions to when we introduce our difference-in-differences approach later on. In the interest of brevity, we relegate detailed derivations to the appendix and only provide an intuitive discussion of the central insights in the main text.

2.4.1 Nontraded and intermediate goods

We introduce nontraded and intermediate goods as in Alvarez and Lucas (2007) by assuming that consumers spend a share $1 - \mu_j$ of their income on nontraded goods, firms spend a fraction $1 - \eta_j$ of their costs on intermediate goods, firms aggregate varieties into goods just like consumers, and nontraded goods are produced under perfect competition and constant returns. In the appendix, we show that we can then still apply equations (1) - (3) with the only difference that decomposition (1) has to be scaled by the factor $\frac{\mu_j}{\eta_j}$. Intuitively, nontraded goods dampen the gains from trade because they make trade less important while intermediate goods magnify the gains from trade because they allow firms to benefit from lower input costs.

In the presence of intermediate goods, the interpretation of decomposition (1) also has to be broadened in the sense that it then combines direct and indirect effects. For example, a "traditional" fall in trade costs or a "new" increase in import variety then not only benefits consumers directly but also indirectly because firms charge lower prices as a result of reduced input costs. Mechanically, these indirect gains then also show up as labor productivity gains even if the fundamental firm productivities φ remain unchanged. This is simply because firms can produce more output per worker if they have access to cheaper or more intermediate goods.

2.4.2 Endogenous markups

We allow for endogenous markups in our CES environment by assuming that there is a discrete number of firms instead of a continuum of firms so that firms take the price index effects of their pricing decisions into account. The implication of this is that more productive firms also charge higher markups since they face lower demand elasticities due to their larger market shares. In the appendix, we show that equations (1) - (3) then still remain valid as long as we reinterpret the average productivity terms in decomposition (1). In particular, they then no longer only capture average productivity effects in isolation but a combination of average productivity and average markup effects.

This reinterpretation applies to the selection effects as well as the within-firm productivity effects. In the extended model, the term $\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} \right)$ captures that entry and exit change average prices not only because the entering and exiting firms have different productivities but also because they charge different markups. Similarly, the term $\sum_{i=1}^{N} \bar{\lambda}_{ij} \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}$ captures that productivity growth among continuing firms not only changes average prices by affecting marginal costs but also by affecting markups. Consumers are indifferent about whether average prices change because of changes in average productivity or the average markup as long as $Y_j \propto w_j L_j$.

2.4.3 Tariff revenue

In the appendix, we show that we can still apply equations (1) - (3) if we allow for tariff revenue R_j as long as we add the term $\ln \frac{1+\left(\frac{R_j}{w_j L_j}\right)'}{1+\left(\frac{R_j}{w_j L_j}\right)}$ to decomposition (1). We allocate this term to the "traditional" gains from trade since it would also appear if there was no entry and exit. Caliendo et al (2015) have recently argued that there is more entry in response to trade liberalization in a Melitz (2003) model with tariff revenue. While this may be, we do not have to take a stance on this issue since we decompose the observed response to CUSFTA through the lens of a model which remains agnostic about the determinants of entry into production and exporting.[16]

[16] Along the same lines, we can still apply equations (1) - (3) if we allow for arbitrary profits Π_j as long as we add the term $\ln \frac{1+\left(\frac{\Pi_j}{w_j L_j}\right)'}{1+\left(\frac{\Pi_j}{w_j L_j}\right)}$ to decomposition (1). However, changes in profits are much harder to reliably

2.4.4 Multi-product firms

We introduce multi-product firms following a simplified version of Bernard et al (2011). In particular, we maintain our earlier assumption that utility is a CES aggregate over a continuum of varieties and add that each variety is now also a CES aggregate over a continuum of products. We impose the same elasticity of substitution between and within varieties so that multi-product firms act as if they were a collection of independent single-product firms. Just as we remain agnostic about the selection of firms into markets, we also remain agnostic about the selection of products into firms and simply assume that country i firm making variety ω sells $K_{ij\omega}$ products to country j.

In the appendix, we show that there are then two versions of equations (1) - (3), the original one which can be implemented using firm-level data and an additional one which can be implemented using product-level data. The additional one further decomposes changes in the average productivity of continuing firms into changes in the average productivity of continuing products and the variety and average productivity effects associated with the entry and exit of products. Essentially, there are then not only firm-level "new" gains from trade but also product-level "new" gains from trade which can both be identified with our methodology given sufficient data.

Unfortunately, we cannot apply this extended decomposition in our CUSFTA analysis since we do not currently have access to product-level Canadian data. As a result, we are not able to identify any product-level "new" gains from trade and implicitly subsume them under the term $\ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}}$ in the "traditional" gains from trade. Notice, however, that the resulting bias has an ambiguous sign since the product-level "new" gains are driven by the same opposing forces as the firm-level "new" gains. In particular, CUSFTA is likely to give Canadian consumers access to more and on average less productive US products but less and on average more productive Canadian products from continuing firms.

measure so that we maintain our implicit assumption $\Pi_j \propto w_j L_j$ throughout (recall that this is trivially satisfied in the standard case of free entry).

2.4.5 Heterogeneous quality

We introduce heterogeneous quality by allowing for preference shifters in the utility function. In the appendix, we show that equations (1) - (3) then still remain valid as long as we adopt a broader definition of $\tilde{\varphi}_{ij}$ which averages over the product of preference shifters and productivities. For example, we have shown earlier that exit brings about large welfare losses if the exiting firms have a high market share. Here, we merely add that this could be because the exiting firms are particularly productive or because their products are of particularly high quality. This result echoes a well-known isomorphism between productivity and quality in Melitz (2003) type environments.

3 Application

3.1 Data

We now use our methodology to measure the "new" gains from trade reaped by Canada as a result of CUSFTA. CUSFTA was a free trade agreement between Canada and the US which was signed on January 2, 1988. It mandated annual reductions in tariffs and other trade barriers over a ten-year implementation period starting on January 1, 1989 which were accompanied by a significant increase in bilateral trade. In particular, the average tariff imposed against manufacturing imports among the CUSFTA partners fell from over 8% to below 2% in Canada and from 4% to below 1% in the US and bilateral manufacturing trade roughly doubled in nominal terms.[17]

CUSFTA can be viewed as a natural experiment which makes it ideal for isolating the effects of trade liberalization. In particular, it was not accompanied by other macroeconomic reforms or implemented in response to a macroeconomic crisis unlike many trade liberalizations in developing countries. Also, it was hard to anticipate since it faced strong political opposition in Canada which was only overcome in a general election on November 21, 1988. As a result, we feel comfortable interpreting our measured welfare effects as gains from trade

[17] There were four categories of goods for which different phase-ins applied: Category A, goods for which all tariffs were eliminated on January 1, 1989; Category B: goods for which tariffs were eliminated in five annual steps until January 1, 1993; Category C, goods for which tariffs were eliminated in ten annual steps until January 1, 1998; Category D, goods for which tariffs were already eliminated before CUSFTA. See Figure 1 in Trefler (2004) for an illustration of the time series of tariff cuts.

resulting from CUSFTA but would also like to reiterate that our welfare decomposition is valid regardless of what shock hits the economy.

To implement our methodology, we need information on domestic sales in Canada and exports to Canada before and after CUSFTA came into force broken down into sales by continuing firms, exiting firms, and entering firms. In order to separately identify variety gains and productivity gains, we also need these sales broken down into their extensive and intensive margins which essentially means that we need to know the respective number of firms. As we now explain in more detail, we use micro data from Canada and the US. The US is by far the most important trading partner of Canada accounting for on average 70% of its manufacturing imports during our sample period.

Our Canadian data come from an annual survey of manufacturing establishments which was initially called Census of Manufactures and is now known as Annual Survey of Manufactures. It covers all but the very smallest Canadian manufacturing establishments currently requiring an annual value of shipments of only $30,000 or more. Notice that an accurate representation of small firms is very important for our purposes since we are particularly interested in entering and exiting firms.[18] We do not have direct access to this confidential data and rely on special tabulations provided to us by Statistics Canada when calculating our Canadian estimates.

We have information on the counts and domestic shipments of all, all entering, and all exiting establishments in 1978, 1988, and 1996 at the 2-digit Canadian SIC level. We define an entering establishment as an establishment which was not in the database in the previous year for which we have data, that is in 1978 or 1988. Similarly, we define an exiting establishment as an establishment which was not in the database in the subsequent year for which we have data, that is in 1988 or 1996. Hence, in any time period, establishments can always be separated into entering and continuing ones with respect to the previous time period and exiting and continuing ones with respect to the subsequent time period.

We choose the years 1978, 1988, and 1996 to construct our Canadian summary statistics

[18] Baldwin et al (2002) discuss how the entry and exit rates obtained from the Annual Survey of Manufactures compare to the ones obtained from the Business Register or the Longitudinal Employment Analysis Program. They document that they correlate much more highly if long differences are considered which is comforting because we will focus on time spans of 8-10 years.

because those are the years for which Statistics Canada officials were most confident in the sampling frame, resulting in the most reliable decomposition of the establishment population into entering, continuing, and exiting establishments.[19] Despite this precaution, there are still some discrepancies in the reported counts of continuing establishments in adjacent time periods. We correct this, by first adjusting the shares of establishments that are reported to exit until the next period and then recalculating their average revenues so that the total revenues remain unchanged.[20]

Our US data come from the Census of Manufactures which is available every five years. Unfortunately, this census only contains information on exports starting in 1987 so that we restrict attention to the 1987 and 1997 census years leaving us without direct information on US pre-trends. Moreover, exports are not reported by destination so that we have to calculate the sufficient statistics we need using more aggregated data.[21] We use data on the counts of new, continuing, and exiting exporters as well as their average revenues from export shipments which we match to the 2-digit Canadian SIC level using a concordance available from the website of the University of Toronto library.[22]

In our baseline calculations, we use the total number of new, continuing, and exiting US exporters as a proxy for the number of new, continuing, and exiting US exporters to Canada and proceed analogously with the corresponding total and average export revenues. As should be clear from our decompositions (2) and (3), this yields unbiased estimates of the associated welfare effects in simple differences as long as the establishment count, total revenue, and average revenue shares of continuing exporters to all destinations are representative of the establishment count, total revenue, and average revenue shares of continuing exporters to

[19] For example, it is well-known that small firms were undercounted in the Annual Survey of Manufactures in the early 1990s due to budget cuts (Baldwin et al, 2002). As we mentioned in the previous footnote, taking long differences also reduces the likelihood of measurement error.

[20] In particular, it should be true that $M_{jj}^{c} = M_{jj}^{c'}$ by definition but we usually observe small deviations from this such that $M_{jj}^{c} > M_{jj}^{c'}$. We correct this by setting M_{jj}^{c} equal to $M_{jj}^{c'}$ and $\tilde{r}_{jj}$ equal to $\frac{M_{jj}^{c}}{M_{jj}^{c'}}\tilde{r}_{jj}$ so that total revenues remain unchanged. We adopt this procedure since random sample attrition is the most likely explanation for the discrepancy.

[21] While Canadian customs collects transaction-level data on imports from the US, it is only available from 1992 onwards and also cannot be reliably matched to US firms. In an effort to save resources, US customs does not separately collect transaction-level data on exports to Canada.

[22] Notice that we could also compute the effects of selection on the average productivity of US exporters by comparing the average *domestic* revenues of continuing US exporters to the average *domestic* revenues of all US exporters. We have experimented with this alternative approach and obtained very similar results just as predicted by our theory.

Canada.

Since it is hard to reliably verify the accuracy of this restriction, we interpret our simple-differences results with caution and refer also to our differences-in-differences approach. In this approach, we compare the most and least liberalized Canadian industries so that the treatment effect is accurately measured as long as the error in the restriction differences out. For example, if there was a trend towards entering into exporting to another market which was uncorrelated with Canadian tariff cuts, then this trend would drop out when we take cross-industry differences so that the differential effect of US exports in the most liberalized industries would still be correctly accounted for.

In addition, we also corroborate our US results using trade data instead of micro data by defining a US variety as a Schedule B industry code as is commonly done in the literature (see, for example, Broda and Weinstein 2006). It turns out that the sufficient statistic based on equation (2) is remarkably similar whether it is calculated from micro data or trade data which gives us some confidence in using the trade data to see if US exports to Canada had any major pre-trends. However, the trade data become an unreliable guide when calculating the more detailed decomposition (3) so that we use the micro data as our benchmark throughout the analysis.[23]

We also need estimates of the elasticities of substitution for our calculations and we use the ones from Oberfield and Raval (2014). They are estimated using the 1987 US Census of Manufactures exploiting the condition that markups should equal $\sigma/(\sigma-1)$. They are available from Table VII of their online appendix and we again used the concordance from Peter Schott's website to match them to 2-digit Canadian SIC codes. The matched elasticities range from 3.3 to 4.4 and average to 3.7 which is within the range of alternative estimates in the literature. Whenever we report results using aggregate data, we simply work with this average elasticity of 3.7.

[23] This is likely the result of having many more firms in the micro data than products in the trade data. The micro data likely capture substantial firm entry within schedule B product categories that were already exported to Canada before CUSFTA, while the trade data capture a smaller number of "new export" products that have higher export revenues in part because previously exporting firms as well as newly exporting firms entered in those categories.

3.2 Aggregate results

3.2.1 Sufficient statistics

We now present the sufficient statistics needed to calculate the "new" gains from CUSFTA on the Canadian economy. Recall that CUSFTA came into force on January 2, 1989 and mandated annual tariff reductions over a 10-year implementation period. Given the years for which we have micro data, we therefore take 1988-1996 to be our "CUSFTA" period for Canada and 1987-1997 to be our "CUSFTA" period for the US which we use to track the effects of CUSFTA on the Canadian economy. In addition, we also construct a "pre-trend" period for Canada ranging from 1978-1988 in order to see if our Canadian micro data is subject to any significant pre-trends.

Table 1 starts by presenting the sufficient statistics needed to calculate the "new" gains from CUSFTA using equation (2). Panel A focuses on exiting, continuing, and entering Canadian firms and summarizes what share of the domestic market they captured among all Canadian firms at the beginning and end of our pre-trend and CUSFTA periods. By definition, the market shares of exiting and continuing firms always sum to 100% at the beginning of a period (firms will exit or not by the end of the period) and the market shares of entering and continuing firms always sum of to 100% at the end of a period (firms have entered or not since the beginning of the period).

As can be seen, these market shares moved just like one would expect given that CUSFTA exposed Canadian firms to tougher competition in the Canadian market by reducing the trade barriers faced by US firms. In particular, the market share of exiting Canadian firms far exceeded the market share of entering Canadian firms in the CUSFTA period resulting in a sharp rise in the market share of continuing Canadian firms. In contrast, such a sharp rise was not observed in the pre-trend period in which the market share of exiting Canadian firms was much more similar to the market share of entering Canadian firms even though there was still a slight pre-trend in the same direction.

Panel B turns to entering, continuing, and exiting US firms following the same logic as Panel A. Entry is now defined as entry into exporting and the market shares are the export market shares of entering US exporters among all US exporters and so on. Just like the domestic market shares of Canadian firms, the export market shares of US exporters also adjusted exactly as one would expect following CUSFTA given that it made exporting more attractive for US firms. In particular, the market share of exiting US exporters was smaller than the market share of entering US exporters in the CUSFTA period resulting in a fall in the market share of continuing US exporters.

While we do not have micro data on US exporters before 1987, we can still get a sense of the pre-trends from the trade data following an approach which is widely used in the literature (see, for example, Broda and Weinstein 2006). In particular, we can simply think of a variety as a disaggregated product category in the trade data and then treat each product category like we would treat an exporting plant in the micro data. We do this at the Schedule B level focusing on exports from the US to Canada. For the CUSFTA period, this requires a crosswalk between HS codes and Schedule B codes that we construct using publicly available concordances.[24]

We first verify that the numbers in Panel B of Table 1 for the CUSFTA period would have been similar had we used trade data instead of micro data and then use the trade data to look at the pre-trend period. In particular, the market share of continuing US exporters was 61.8% in 1987 and 61.4% in 1997 according to the trade data which is very close to the 64.5% in 1987 and 61.3% in 1997 obtained using the micro data. Moreover, the market share of continuing US exporters was 88.2% in 1978 and 87.0% in 1987 which suggests that US entry into exporting to Canada and US exit out of exporting to Canada was not subject to any major trends before 1987.[25]

Tables 2 and 3 explore Table 1 further providing the statistics needed to decompose the "new" welfare effects following formula (3). In particular, they separate the sales ratios from Table 1 into the corresponding ratios of firm counts (Table 2) and the corresponding ratios

[24] All trade data is from the Center for International Data at UC Davis. The Schedule B codes were replaced by HS codes in 1989 which were subsequently revised in 1996. We first link the HS codes before and after 1996 using the concordance of Pierce and Schott (2012) and then map this all into Schedule B codes using a concordance available from the Center for International Data at UC Davis. The Schedule B codes are substantially more aggregated than the HS codes so we treat all HS codes which cannot be matched to Schedule B codes as new varieties.

[25] The results look similar if we look at US exports to all destinations mimicking what we do in the micro data. Then, the market shares of continuing US exporters are 80.8% in 1978 and 82.0% in 1987 for the pre-trend period, and 66.1% in 1987 and 65.0% in 1997 for the CUSFTA period. We have also experimented with state-level trade data which allows us to define US varieties as state-product pairs instead of country-product pairs and obtained very similar results.

of average sales (Table 3) so that the entries in Table 1 are simply the product of the entries in Table 2 and Table 3. For example, the domestic market share of continuing Canadian firms was 75.6% in 1978 because 48.3% of Canadian firms were continuing firms, the average revenues of continuing firms were equal to 156.5% of the average revenues of all Canadian firms, and $75.6\% = 48.3\% * 156.5\%$.

Table 2 reveals the extensive margin patterns which are underlying the market shares presented in Table 1. Most obviously, it shows that there was a lot of entry and exit among Canadian firms and US exporters with entering and exiting firms accounting for an average 56.2% of all firms. Moreover, it indicates that the number of Canadian firms dropped in the CUSFTA period despite a sharp upward trend in the pre-trend period while the number of US exporters grew dramatically in the CUSFTA period. This can also be seen directly from the total counts of Canadian firms and US exporters which are shown in parentheses in Table 2.[26]

Table 3 complements this by turning to the intensive margin patterns which are underlying the market shares presented in Table 1. As can be seen, continuing firms were much larger than exiting or entering firms which implies that they were also much more productive according to the model we use. While this mechanically implies that exit increases average productivity due to selection and entry decreases average productivity due to selection, we can say more about the net effects of selection by interpreting the revenue shares in Table 3 through the lens of our earlier mapping from average revenues to average productivities, $\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} = \frac{1}{\sigma-1}\left(\ln \frac{\tilde{r}^{c}_{ij}}{\tilde{r}_{ij}} - \ln \frac{\tilde{r}^{c\prime}_{ij}}{\tilde{r}'_{ij}}\right)$.[27]

Specifically, the negative effect of entry on average productivity always dominated the positive effect of exit on average productivity among Canadian and US firms. While the net

[26] The sharp rise in the number of Canadian firms in the pre-trend period is also documented in alternative datasets. For example, Gu et al (2003) find a similar trend using data from the Longitudinal Employment Analysis Program which is available starting in 1983. While we are not aware of any systematic study analyzing the causes of this trend, it correlates with declining unemployment, declining interest rates, and immigration reforms that allowed for "business class" immigration for the first time.

[27] As one would expect, we cannot plausibly use the trade data to infer what Tables 2 and 3 might have looked liked if we had micro data for US exporters in the pre-trend period since it fails to capture the massive churning we see in the micro data during the CUSFTA period. For example, the trade data suggests that only 33.8% of all US firms in 1987 exit out of exporting until 1997 whereas the micro data shows that it is actually 54.7%. However, we know from the micro data that the total number of US manufacturing establishments only grew slightly during our sample period (from 317,000 in 1977 to 346,000 in 1987 and then to 361,000 in 1997) which also suggests that there was probably no major pre-CUSFTA trend.

selection effect was minimal for Canadian firms in the CUSFTA period, it was strikingly large for Canadian firms in the pre-trend period and US exporters in the CUSFTA period. Using the average Oberfield and Raval (2014) elasticity of $\sigma = 3.7$ for our calculations, the net effect of selection on average productivity was -0.4% among Canadian firms in the CUSFTA period, -12.8% among Canadian firms in the pre-trend period, and -17.1% among US exporters in the CUSFTA period.

While the adjustments in the number of Canadian firms, the number of US firms, and the average productivity of US exporters following CUSFTA were therefore exactly as one would expect, the finding that selection implied a slight decrease in the average productivity of Canadian firms is quite surprising at first. However, it is important to note that there is a strong pre-trend in the data and that selection still increased the average productivity of Canadian firms relative to this pre-trend. In any case, we will also find positive effects of selection on Canadian productivity in our later differences-in-differences specifications so that this surprising result will not hold up.

3.2.2 Gains from trade

Table 4 puts all the pieces together and finally calculates the "new" gains from CUSFTA on the Canadian economy. Panels A and B first show the welfare effects of entry and exit by Canadian firms and US exporters respectively, following formula (3). Panel C then turns to the combined effect by aggregating across countries to generate net "new" variety gains and "new" productivity gains, following formula (1). Panel D finally accounts for nontraded and intermediate goods by applying Canada's manufacturing expenditure share μ_j and its share of value added in gross production η_j as explained above. All values are annualized for better comparability and we again set $\sigma = 3.7$ throughout.[28]

Looking only at the CUSFTA period, we find that the overall "new" gains from CUSFTA were negative for Canada. Not adjusting for nontraded and intermediate goods, Canada's real

[28] As one would expect, Canadian consumers spend more on Canadian goods than on US goods so that the Canadian effects matter more for the overall "new" gains from trade. In particular, the Sato-Vartia weights are 79.3% and 20.7% in the pre-trend period and 70.7% and 29.3% in the CUSFTA period, with the larger value always representing the weight on domestic goods. We use $\mu_j = 0.32$ and $\eta_j = 0.50$ which are averages of Canada's manufacturing expenditure share and share of value added in gross production yielding an overall adjustment coefficient of $\frac{\mu_j}{\eta_j} = 0.64$.

income increased by 0.20% per year due to "new" variety gains but decreased by a -0.54% per year due to "new" productivity losses resulting in negative "new" gains from trade of -0.34% per year. Underlying this are positive net variety effects of 1.90% per year combined with negative net productivity effects of -1.71% per year resulting from the net entry of US exporters as well as negative net variety effects of -0.50% and negative net productivity effects of -0.05% resulting from the net exit of Canadian firms.

Canada's overall "new" gains from CUSFTA increase to -0.23% when we take simple differences thereby controlling for the pre-trend in Canada. We set all US pre-CUSFTA effects to 0.00% in these calculations since we do not have any US pre-CUSFTA data and the available evidence suggests that there were no major US pre-trends.[29] While the overall welfare effect is similar with or without taking differences, the net variety gains and net productivity gains switch signs. In particular, the variety gains become negative while the productivity gains become positive since Canada experienced substantial net entry of underperforming firms in the pre-CUSFTA period.

Table 4 confirms our earlier conjecture that partial calculations can yield grossly mismeasured estimates of the "new" gains from trade. In particular, Canada's 1.90% per year net variety gain from the larger number of US exporters is almost entirely offset by its -0.50% per year net variety loss from the lower number of domestic firms once both are appropriately weighted leaving Canada with only a 0.20% per year net variety gain. Also, the -0.05% per year productivity loss from domestic selection is made much worse by the -1.71% per year productivity loss from foreign selection implying an overall -0.54% per year net productivity loss again after taking the appropriate weights into account.

While imports from the US account for the vast majority of Canadian imports, one might still be concerned that our results are affected by third-country effects. To address this issue, we turn again to highly disaggregated trade data which allows us to look at imports from all countries and not just from the US. We find that the "new" gains from trade are -0.31% per year when we include all countries and -0.37% per year when we include only the US which suggests that there were only small third-country effects. These numbers do not adjust for

[29] Recall that our analysis of disaggregated trade data suggested that US exports to Canada were not subject to any major trend in the pre-CUSFTA period. Recall also that the total number of US firms (i.e. exporters and non-exporters) stays fairly constant over time.

nontraded goods, intermediate goods, or pre-trends and are quite close to the corresponding -0.34% we obtained using US micro data and reported in Panel C of Table 4.[30]

As we explained above, our "new" gains are not exactly the same as the gains captured by the Feenstra-Ratio which is commonly used to adjust for new varieties when calculating changes in CES price indices. However, the "new" gains from trade reaped by Canada as a result of CUSFTA would still be negative if this alternative measure was used. In particular, the "new" losses would then amount to -0.22% instead of -0.34% per year, again not adjusting for nontraded goods, intermediate goods, or pre-trends. Recall that the difference captures traditional forces acting on new varieties which we assign to the "traditional" gains such as the direct price-reducing effects of tariff cuts.[31]

3.2.3 Micro versus macro approach

Table 5 contrasts the net welfare effects presented in Table 4 with the net welfare effects one would obtain if one did not rely on our general framework but instead applied the special case of Melitz (2003) with Pareto distributed productivities considered by Arkolakis et al (2008). In the appendix, we show that changes in the number of firms and their average productivity then depend on changes in trade shares through the relationships $\ln \frac{M'_{ij}}{M_{ij}} = \ln \frac{\lambda'_{ij}}{\lambda_{ij}}$ and $\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} = -\frac{1}{\theta} \ln \frac{\lambda'_{ij}}{\lambda_{ij}}$, where θ is the Pareto shape parameter, all under the assumption that the size of the labor force, the fixed cost of entry, and the fixed cost of accessing domestic and foreign markets remain unchanged.

In order to mimic the results we would obtain if we did not have any micro data, we calculate the net variety and net productivity effects indirectly from the observed changes in trade shares. However, we leverage our micro data to obtain an estimate of the Pareto shape parameter θ which we need for these calculations. In particular, we show in the appendix

[30] Since these calculations do not include pre-trends, we work with trade data at the HS-10 level instead of the Schedule B level. We have again experimented with state-level US trade data and obtained very similar results.

[31] Some readers might also wonder how changes in tariff revenue affect the overall gains from trade. The share of tariff revenue in Canada's total spending dropped from 0.69% in 1988 to 0.18% in 1996 so that the adjustment term $\ln \frac{1+\left(\frac{R_j}{w_j L_j}\right)'}{1+\left(\frac{R_j}{w_j L_j}\right)}$ derived in the appendix amounts only to -0.06% in annualized terms. Recall from our earlier discussion that we allocate this term to the "traditional" gains from trade.

that $\theta = -\frac{\ln \frac{M'_{ij}}{M_{ij}} - \ln \frac{M'_{ii}}{M_{ii}}}{\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}'_{ii}}{\tilde{\varphi}_{ii}}}$ which we can implement using our earlier formula $\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} = \frac{1}{\sigma - 1}\left(\ln \frac{\tilde{r}^{c}_{ij}}{\tilde{r}_{ij}} - \ln \frac{\tilde{r}^{c\prime}_{ij}}{\tilde{r}'_{ij}}\right)$ if we assume that $\ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} = \ln \frac{\tilde{\varphi}^{c\prime}_{ii}}{\tilde{\varphi}^{c}_{ii}}$. Comparing US exporters to all US firms at the beginning and end of the CUSFTA period, we find $\theta = 2.91$ which is within the range of existing estimates in the literature.

Table 5 does not present a full decomposition following equation (3) but simply reports the "new" variety gains and "new" productivity gains along the lines of formula (1). One difference from Table 4 is that the domestic and foreign components are now already weighted by the appropriate $\bar{\lambda}_{ij}$ so that they immediately sum up to the combined effects. The values under "Baseline" essentially present the same information as Table 4 while the values under "Melitz-Pareto" report the results obtained from the model of Arkolakis et al (2008). As we explained earlier, the "new" variety and "new" productivity gains then exactly cancel so that there are no "new" gains from trade.

As can be seen, the restricted model does a good job of capturing the negative selection effects on US exporters but is much less successful with respect to all other margins determining the "new" gains from trade. Of course, this is not a coincidence since we have calibrated the Pareto shape parameter using data on US entry into exporting. As a general rule, the restricted model fares better in the specification taking pre-CUSFTA trends into account but even then it fails to approximate the "new" variety gains and "new" productivity gains from trade. Overall, we find that the restricted model substantially overestimates the "new" gains from trade.

3.3 Industry-level results

3.3.1 Multi-industry extension

We now turn to an analysis of the effects of CUSFTA on the Canadian economy at the industry-level with two main goals in mind. First, we would like to check how sensitive our baseline results are to the level of aggregation thereby addressing concerns about aggregation bias which have been raised in the recent literature on the measurement of the gains from trade.[32] Second, we would like to explore the effects of CUSFTA in a differences-in-differences setting comparing the most strongly and the least strongly liberalized industries in order to deal with the possibility that our baseline results also reflect macroeconomic shocks other than the trade liberalization brought about by CUSFTA.[33]

Our analysis is guided by a multi-industry extension of our baseline methodology. In particular, we now assume that our earlier setup applies industry-by-industry allowing for industries to differ in terms of all model variables and parameters other than wages reflecting free labor mobility within countries between industries. As a result, changes in the ideal industry price indices can be decomposed just like our ideal aggregate price indices earlier, yielding $\ln \frac{P'_{js}}{P_{js}} = \sum_{i=1}^{N} \bar{\lambda}_{ijs} \left(\ln \frac{\tau'_{ijs}}{\tau_{ijs}} + \ln \frac{w'_i}{w_i} - \ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}} \right) - \sum_{i=1}^{N} \bar{\lambda}_{ijs} \left(\frac{1}{\sigma_s - 1} \ln \frac{M'_{ijs}}{M_{ijs}} + \left(\ln \frac{\tilde{\varphi}'_{ijs}}{\tilde{\varphi}_{ijs}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}} \right) \right)$, where s now indexes industries. To be clear, $\bar{\lambda}_{ijs}$ are now defined over industry expenditure shares $\lambda_{ijs} = \frac{X_{ijs}}{Y_{js}}$ exactly analogous to the aggregate weights we considered before.

Assuming a nested-CES structure, we now aggregate over these ideal industry price indices in a similar way. In particular, we define the ideal aggregate price index to be a CES aggregate over the ideal industry price indices with an upper-level elasticity ε so that $P_j = \left(\sum_{s=1}^{S} P_{js}^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}$. This implies that the overall expenditure on industry s varieties is given by $Y_{js} = \left(\frac{P_{js}}{P_j} \right)^{1-\varepsilon} Y_j$ so that we can write $P_j = P_{js} (\nu_{js})^{\frac{1}{\varepsilon-1}}$ with $\nu_{js} = \frac{Y_{js}}{Y_j}$ being the industry expenditure shares. Taking changes we obtain $\frac{P'_j}{P_j} = \frac{P'_{js}}{P_{js}} \left(\frac{\nu'_{js}}{\nu_{js}} \right)^{\frac{1}{\varepsilon-1}}$ which we can manipulate just as before to yield $\ln \frac{P'_j}{P_j} = \sum_{s=1}^{S} \bar{\nu}_{js} \ln \frac{P'_{js}}{P_{js}}$ after defining $\bar{\nu}_{js} = \frac{\frac{\nu'_{js} - \nu_{js}}{\ln \nu'_{js} - \ln \nu_{js}}}{\sum_{k=1}^{S} \frac{\nu'_{jk} - \nu_{jk}}{\ln \nu'_{jk} - \ln \nu_{jk}}}$. Combining this yields our multi-industry version of equation (1),

$$\ln \frac{W'_j}{W_j} = \underbrace{\sum_{s=1}^{S} \bar{\nu}_{js} \left(\sum_{i=1}^{N} \bar{\lambda}_{ijs} \left(\frac{1}{\sigma_s - 1} \ln \frac{M'_{ijs}}{M_{ijs}} + \left(\ln \frac{\tilde{\varphi}'_{ijs}}{\tilde{\varphi}_{ijs}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}} \right) \right) \right)}_{\text{"new" gains from trade}} \quad (4)$$

$$+ \underbrace{\sum_{s=1}^{S} \bar{\nu}_{js} \left(\sum_{i=1}^{N} \bar{\lambda}_{ijs} \left(-\ln \frac{\tau'_{ijs}}{\tau_{ijs}} + \left(\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i} \right) + \ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}} \right) \right)}_{\text{"traditional" gains from trade}}$$

[32] Ossa (2015), for example, shows that the gains from trade are typically much larger in multi-industry specifications since imports in the "average" industry matter much less than imports in "critical" industries which are essential for the functioning of the economy.

[33] Recall that this is purely an issue of interpretation since our decomposition is valid regardless of what shocks hit the economy.

Essentially, all this extended formula says is that we can first apply our baseline formula at the industry level and then aggregate across industries using the weights $\bar{\nu}_{js}$. This implies that the welfare effects we discussed earlier now apply at the industry level and it is easy to show that they can also be measured in the same way. In particular, equations (2) and (3) now become $\frac{1}{\sigma_s-1}\ln\left(\frac{X^c_{ijs}/X_{ijs}}{X^{c'}_{ijs}/X'_{ijs}}\right)=\frac{1}{\sigma_s-1}\ln\left(\frac{M'_{ijs}}{M_{ijs}}\right)+\left(\ln\frac{\tilde{\varphi}'_{ijs}}{\tilde{\varphi}_{ijs}}-\ln\frac{\tilde{\varphi}^{c'}_{ijs}}{\tilde{\varphi}^{c}_{ijs}}\right)$ and $\frac{1}{\sigma_s-1}\ln\left(\frac{X^c_{ijs}/X_{ijs}}{X^{c'}_{ijs}/X'_{ijs}}\right)=\frac{1}{\sigma_s-1}\ln\frac{M^c_{ijs}}{M_{ijs}}+\frac{1}{\sigma_s-1}\ln\frac{\tilde{r}^c_{ijs}}{\tilde{r}_{ijs}}-\frac{1}{\sigma_s-1}\ln\frac{M^c_{ijs}}{M'_{ijs}}-\frac{1}{\sigma_s-1}\ln\frac{\tilde{r}^{c'}_{ijs}}{\tilde{r}'_{ijs}}$. Again, $\frac{1}{\sigma_s-1}\ln\frac{M^c_{ijs}}{M_{ijs}}-\frac{1}{\sigma_s-1}\ln\frac{M^c_{ijs}}{M'_{ijs}}$ are the variety gains from exit and entry and $\frac{1}{\sigma_s-1}\ln\frac{\tilde{r}^c_{ijs}}{\tilde{r}_{ijs}}-\frac{1}{\sigma_s-1}\ln\frac{\tilde{r}^{c'}_{ijs}}{\tilde{r}'_{ijs}}$ are the productivity gains from exit and entry which we now summarize as

$$\underbrace{\frac{1}{\sigma_s-1}\ln\left(\frac{X^c_{ijs}/X_{ijs}}{X^{c'}_{ijs}/X'_{ijs}}\right)}_{\text{overall "new" gains}}=\underbrace{\frac{1}{\sigma_s-1}\ln\frac{M'_{ijs}}{M_{ijs}}}_{\text{net variety gains}}+\underbrace{\frac{1}{\sigma_s-1}\left(\ln\frac{\tilde{r}^c_{ijs}}{\tilde{r}_{ijs}}-\ln\frac{\tilde{r}^{c'}_{ijs}}{\tilde{r}'_{ijs}}\right)}_{\text{net productivity gains}} \tag{5}$$

In the above discussion, we implicitly assumed that trade liberalization does not change the number of industries and all countries always supply goods from all industries. This makes sense for our particular application since CUSFTA did not have any extensive margin effects at the industry-level defined by 2-digit Canadian SIC codes. However, we show in the appendix that our methodology can easily be extended to also incorporate industry-level extensive margin effects. In particular, one can use changes in the market shares of continuing sectors and continuing suppliers to quantify the welfare effects of industry-level selection using variations of equations (4) and (5).[34]

As should be easy to verify, our earlier extensions also generalize naturally to the multi-industry case. In particular, non-traded and intermediate goods can be introduced by scaling all welfare effects by the factor $\frac{\mu_j}{\eta_j}$, endogenous markups and heterogeneous quality can be accommodated by appropriately reinterpreting the term $\sum_{i=1}^{N}\bar{\lambda}_{ijs}\left(\ln\frac{\tilde{\varphi}'_{ijs}}{\tilde{\varphi}_{ijs}}-\ln\frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}}\right)$, tariff revenue can be accounted for by adding the term $\ln\frac{1+\left(\frac{R_j}{w_jL_j}\right)'}{1+\left(\frac{R_j}{w_jL_j}\right)}$, and multi-product firms can be featured by separating varieties into an additional CES nest. This also applies to the extended

[34] This extended methodology then also comprehensively captures any Ricardian gains from inter-industry trade. As should be clear, all resource reallocations from less to more productive continuing industries show up as terms-of-trade effects in the "traditional" gains (which is also captured in decomposition 4). Moreover, any additional resource reallocations arising as a result of countries selecting into or out of particular industries appear as an additional term in the "traditional" gains (which is not captured in decomposition 4 but in appendix equation 9). Notice that our multi-industry model features Ricardian comparative advantage because it allows for cross-country and cross-industry variation in productivity.

multi-industry model from the appendix so that it would even be feasible to simultaneously incorporate industry-level, firm-level, and product-level selection effects.

3.3.2 Multi-industry results

We begin by exploring whether our baseline results are subject to aggregation bias by comparing the gains from trade computed by applying formula (1) and (3) using aggregate data to the gains from trade computed by applying formula (4) and (5) using industry-level data. The results are summarized in Table 6 which follows exactly the same format as Table 5. In particular, we again show our aggregate results and then compare them to their industry-level equivalents, each time applying the appropriate Sato-Vartia weights. As can be seen, our findings are similar when using industry-level data with the combined overall "new" gains being almost unchanged.[35]

There are two main reasons why we do not find any aggregation bias in contrast to Ossa (2015). First, we work at the 2-digit level and our elasticity estimates do not vary much at that level of disaggregation ranging only between 3.3 and 4.4. Ossa's (2015) point is that only a few critical (i.e. low-elasticity) industries are needed to generate large gains from trade and that such critical industries can typically only be identified at high levels of disaggregation. Second, we only consider relatively small tariff changes instead of the full gains of moving from autarky to current levels of trade so that the access countries have to particular industries does not change that much anyway.

We then exploit cross-industry variation in tariff cuts to assess if our baseline results are indeed driven by CUSFTA. In our calculations, we mainly rely on the tariff cut measures constructed by Trefler (2004) which give the changes in the bilateral tariffs between Canada and the US following CUSFTA net of the changes in the respective most-favored nation (MFN) tariffs. The motivation for considering such changes in bilateral tariff preferences instead of simple bilateral tariff cuts is that Canadian and US MFN tariffs also changed somewhat as

[35] To be clear, the results under "Aggregate, w/o pre-trend" report $\bar{\lambda}_{ij}\Delta y_{ij}$, where $\bar{\lambda}_{ij}$ are the Sato-Vartia weights from formula (1) and Δy_{ij} are the variety, productivity, or overall gains computed for the CUSFTA period using formula (3). Analogously, the results under "Industry, w/o pre-trend" report $\sum_s \bar{\nu}_{js}\bar{\lambda}_{ijs}\Delta y_{ijs}$, where $\bar{\nu}_{js}$ and $\bar{\lambda}_{ijs}$ are the Sato-Vartia weights from formula (4) and Δy_{ijs} are the variety, productivity, or overall gains computed for the CUSFTA period using formula (4). The results with pre-trends report the difference between the statistics calculated for the CUSFTA and pre-trend periods.

a result of the Uruguay Round Agreement which came into force in 1994 towards the end of our CUSFTA period.[36]

Before we discuss our formal results, it is instructive to first look at some simple correlations calculated over our CUSFTA period. Figure 1 plots the industry-level sufficient statistic for Canada's overall "new" gains from domestic entry and exit, $\ln\left(\frac{X_{jjs}^{c}/X_{jjs}}{X_{jjs}^{c\prime}/X_{jjs}^{\prime}}\right)$, against changes in Canada's tariff preferences granted to the US, $\ln\frac{\tau_s^{CAN\prime}}{\tau_s^{CAN}}$, abstracting for now from the elasticity of substitution adjustment $\frac{1}{\sigma_s-1}$ in order to plot only data. As can be seen, the figure exhibits a strong positive correlation which suggests that the Canadian welfare losses from domestic exit dominate the Canadian welfare gains from domestic entry more in more strongly liberalized industries.

Figures 2 and 3 then break up these overall "new" gains from domestic entry and exit into net variety gains and net productivity gains by considering changes in domestic variety, $\ln\frac{M_{jjs}^{\prime}}{M_{jjs}}$, and changes in domestic average productivity, $\ln\frac{\tilde{r}_{jj}^{c}}{\tilde{r}_{jj}}-\ln\frac{\tilde{r}_{jj}^{c\prime}}{\tilde{r}_{jj}^{\prime}}$, following decomposition (5). While there is a clear positive correlation in Figure 2 implying that the number of domestic varieties falls more in more strongly liberalized industries, the correlation between tariff cuts and average productivity changes is only weakly negative. This already indicates that selection effects only induced small changes in Canadian average productivity which we will confirm more formally below.

Figures 4-6 contain the analogous plots for US exporters, showing how the corresponding overall "new" gains, net variety gains, and net productivity gains correlate with changes in Canada's tariff preferences granted to the US. Figure 4 exhibits a negative correlation which suggests that the overall welfare gains from US entry into exporting dominate the overall welfare losses from US exit out of exporting more in more strongly liberalized industries. Figures 5 and 6 reveal that this negative correlation is again mainly driven by variety instead of productivity effects but overall Canadian tariff cuts clearly have a weaker impact on US exporters than on domestic Canadian firms.

Figures 7-10 explore the domestic welfare effects further by looking at exit and entry

[36] We thank Trefler for sharing his tariff measures with us. They are originally at the 4-digit level and we aggregate them to the 2-digit level using Canadian imports from the US as weights. We drop the transport equipment industry in all our industry-level calculations because it was already exempted from MFN prior to CUSFTA as a result of the Canada-US Auto Pact (see Trefler, 2004).

separately. In particular, Figures 7 and 8 show the exit and entry effects underlying the net entry results plotted in Figure 1 using an industry-level version of our earlier decomposition (3). Interestingly, the net effects are driven much more by exit than entry which is further explored in Figures 9 and 10. Figure 9 shows that the gross variety losses are even more strongly related to Canadian tariff cuts than the net variety losses depicted in Figure 2. Also, Figure 10 now shows a clear relationship between Canadian tariff cuts and productivity gains when only the exiting firms are taken into account.

Against this background, we now turn to our differences-in-differences analysis adopting a flexible regression approach following Trefler (2004). The basic idea is to estimate the "new" welfare effects of CUSFTA by first regressing our industry-level sufficient statistics from formula (5) on industry-level tariff cuts and then evaluating the estimated equations at observed tariff cuts disregarding the constant which soaks up any common trends. While this is not a classic differences-in-differences specification in the sense of comparing treatment industries to control industries, it still identifies the effects of CUSFTA only from cross-industry variation in tariff cuts.[37]

We report our results in Table 7 where we again also include our baseline numbers as a reference. In specification 2, we run industry-level regressions of the form $\Delta y_{ijs} = \beta_0 + \beta_1 \Delta\tau_s^{CAN} + \epsilon_{ijs}$ for our CUSFTA period and then calculate treatment effects from $\sum_s \bar{\nu}_{js}\bar{\lambda}_{ijs}\hat{\beta}_1\Delta\tau_s^{CAN}$, where Δy_{ijs} are the net variety gains, net productivity gains, and overall gains from formula (5), $\Delta\tau_s^{CAN}$ are the log-changes in Canadian tariff preferences granted to the US, $\bar{\nu}_{js}$ and $\bar{\lambda}_{ijs}$ are the Sato-Vartia weights from equation (4), and $\hat{\beta}_1$ is the estimated slope coefficient of the regression line. Essentially, we first calculate the predicted Δy_{ijs} for all industries and then average over them using Sato-Vartia weights.

In specification 3, we then estimate $\Delta y_{ijs} = \beta_0 + \beta_1\Delta\tau_s^{CAN} + \beta_2\Delta\tau_s^{US} + \beta_3\Delta\tau_s^{CAN,MEX} + \epsilon_{ijs}$ for domestic effects and $\Delta y_{ijs} = \beta_0 + \beta_1\Delta\tau_s^{CAN} + \beta_2\Delta\tau_s^{US} + \beta_3\Delta\tau_s^{MEX,US} + \epsilon_{ijs}$ for foreign effects and report $\sum_s \bar{\nu}_{js}\bar{\lambda}_{ijs}\left(\hat{\beta}_1\Delta\tau_s^{CAN} + \hat{\beta}_2\Delta\tau_s^{US}\right)$, where the new variables are log-changes in US tariff preferences granted to Canada ($\Delta\tau_s^{US}$), Canadian tariff preferences granted to

[37] As can be seen from the abovementioned figures, the rubber industry experienced virtually no tariff cuts so that our regression results essentially show the effects of CUSFTA relative to this industry. Just like Trefler (2004), we cannot completely rule out that it was also affected by CUSFTA through general equilibrium forces or other (omitted) variables which would then show up in the constant term.

Mexico ($\Delta\tau_s^{CAN,MEX}$), and Mexican tariff preferences granted to the US ($\Delta\tau_s^{MEX,US}$). We also include $\Delta\tau_s^{CAN,MEX}$ and $\Delta\tau_s^{MEX,US}$ as controls in our regressions since NAFTA also came into force in 1994. Specification 4 simply extends specification 3 by further differencing the Canadian dependent variables with respect to their pre-CUSFTA trends.[38]

As can be seen from Panel C of Table 7, all three differences-in-differences specifications corroborate our earlier result that the combined "new" gains from CUSFTA on the Canadian economy are negative because Canada loses more from the exit of domestic firms out of production than it gains from the entry of US firms into exporting taking variety effects and productivity effects into account. Moreover, these "new" welfare losses remain economically significant in all three specifications bearing in mind that they are reported in annualized terms. For example, specification 2 implies a total (unadjusted) real income loss of $8 * (-0.19\%) = -1.52\%$ over our 8-year CUSFTA period.

While the differences-in-differences results therefore broadly confirm our earlier conclusions, they also allow us to make some additional points. In particular, Panel A of Table 7 shows that the foreign variety gains fall sharply in our differences-in-differences specifications. Moreover, Panel B of Table 7 highlights that the productivity effects due to domestic selection become positive in our differences-in-differences specifications. This suggests that the large US entry into exporting and the small decrease in domestic Canadian productivity measured in our baseline specification are largely driven by aggregate shocks which cannot be attributed to CUSFTA.

Having said this, our domestic productivity results are quite close to zero which seems at odds with what Trefler (2004) finds.[39] However, Trefler (2004) also reports that the average employment of all firms grows about as fast as the average employment of continuing firms,

[38] Our measures of Canadian tariff preferences granted to Mexico are aggregated from information on average duties at the HS-10 level which we obtain from the University of Toronto library. We construct the Mexican tariff preferences granted to the US from Kowalczyk and Davis (1998). We do not include $\hat{\beta}_3\Delta\tau_s^{CAN,MEX}$ or $\hat{\beta}_3\Delta\tau_s^{MEX,CAN}$ when calculating the average treatment effects because we are interested in the average treatment effect of CUSFTA in which Mexico is not involved. Recall that we only have data on the pre-CUSFTA period for Canada so that we cannot control for pre-CUSFTA trends when we estimate the US effects.

[39] We emphasize here the differences between our results and Trefler's (2004) because it is the most prominent study on CUSFTA to date. However, we should add that other papers on the productivity effects of CUSFTA already challenge Trefler's estimates. For example, Lileeva (2008) reports that selection among Canadian plants negatively affected Canadian productivity which she attributes to substantial exit among large Canadian plants that were only serving the Canadian market.

$\frac{\tilde{l}'_{jjs}}{\tilde{l}_{jjs}} \approx \frac{\tilde{l}^{c\prime}_{jjs}}{\tilde{l}^{c}_{jjs}}$, when analyzing the employment effects of CUSFTA. When interpreted through the lens of our model, this immediately implies that $\ln \frac{\tilde{\varphi}'_{jjs}}{\tilde{\varphi}_{jjs}} - \ln \frac{\tilde{\varphi}^{c\prime}_{jjs}}{\tilde{\varphi}^{c}_{jjs}} \approx 0$ from formula (5) since $\ln \frac{\tilde{r}^{c}_{jjs}}{\tilde{r}_{jjs}} - \ln \frac{\tilde{r}^{c\prime}_{jjs}}{\tilde{r}'_{jjs}} = \ln \frac{\tilde{l}^{c}_{jjs}}{\tilde{l}_{jjs}} - \ln \frac{\tilde{l}^{c\prime}_{jjs}}{\tilde{l}'_{jjs}}$ given that average revenues are proportional to the average wage bill. Hence, our conclusion differs from Trefler's (2004) not because we have different findings but because our model tells us to interpret them differently.

Essentially, our measurement of firm productivity differs from Trefler's (2004) in fundamental ways. In particular, we adopt firm revenue as a size-based measure of firm productivity and calculate the effects of selection on average productivity by comparing the average revenues of continuing firms and all firms. This works because relative firm revenues are log-proportional to relative firm productivities in our model since all other determinants of firm revenues drop out. Trefler (2004) instead calculates firm productivity by deflating nominal value added per worker with producer price indices which is inconsistent with the Melitz (2003) model our decomposition is based on.

To see this, take the standard Melitz (2003) model and consider as an example a non-exporting Canadian firm. Using the average price $\tilde{p}_{jjs}$ as a producer price deflator, it should be easy to verify that the statistic calculated by Trefler (2004) is $\frac{p_{jjs}(\varphi)q_{jjs}(\varphi)}{\tilde{p}_{jjs}l_{jjs}(\varphi)} = \tilde{\varphi}_{jjs}\frac{l^{v}_{jjs}(\varphi)}{l^{v}_{jjs}(\varphi)+f_{js}}$, where employment is split into a fixed and a variable part, $l_{jjs}(\varphi) = f_{js} + l^{v}_{jjs}(\varphi)$. As can be seen, this statistic only measures a function of firm productivity but not firm productivity itself so that additional steps would have to be taken to accurately recover firm productivity. Moreover, it relies critically on taking the model's fixed cost assumption literally because otherwise value added per worker would be the same across firms.[40]

It is worth contemplating what economic forces might explain our domestic productivity result. One possibility is that fixed costs are heterogeneous so that the most profitable firms which survive trade liberalization are not necessarily the most productive ones. A more elab-

[40] For our purposes, an important additional drawback of using real value added per worker is that it also takes into account resource reallocations from less to more productive *continuing* firms such as from non-exporters to exporters when it is computed at the industry-level. As we explained earlier, such resource reallocations are only welfare relevant to the extent that they change the terms-of-trade of the country and should therefore not be included in our measure of the "new" gains. Notice that this issue also somewhat confounds the abovementioned link between our productivity results and Trefler's (2004) employment results because our theory would strictly speaking suggest to look only at the variable employment devoted to producing goods for the domestic market not taking export activities into account. Indeed, this is precisely why we focus on the domestic revenues instead of the total revenues of Canadian firms in our application so that we perform our calculations in a fully theory-consistent way.

orate story is that the theoretical link between trade liberalization and average productivity does not extend to multi-industry settings in which more complex general equilibrium forces are at play. Along these lines, Segerstrom and Sugita (2015) have recently shown that domestic productivity should actually fall in more deeply liberalized industries in a multi-industry Melitz (2003) model contrary to what is commonly thought.

Tables 8-10 report all regression results underlying the differences-in-differences calculations shown in Table 7. Table 8 effectively just puts numbers on the correlations shown in Figures 1-6 now also taking into account heterogeneity in $\frac{1}{\sigma_s - 1}$. As the figures suggest, Canada's tariff cuts against the US are significantly related to Canada's variety gains and overall "new" gains but not to Canada's productivity gains. The main message from Tables 9 and 10 is that US tariff cuts against Canada and Mexican tariff cuts against the US are not significantly related to any of our sufficient statistics which is not too surprising since we are measuring the effects of CUSFTA on the Canadian economy.

4 Conclusion

In this paper, we measured the "new" gains from trade reaped by Canada as a result of CUSFTA. We thought of the "new" gains from trade of a country as all welfare effects pertaining to changes in the set of firms serving that country as emphasized in the "new" trade literature. To this end, we first developed an exact decomposition of the gains from trade based on a general heterogeneous firm model which allowed us to account for "traditional" and "new" gains using simple sufficient statistics. We then applied this decomposition using Canadian and US micro data and found that the "new" welfare effects of CUSFTA on Canada were negative.

Given the usual narrative that trade liberalization expands import variety and improves domestic productivity, how is it possible that we find negative "new" gains from trade? The answer is simply that import variety gains are counteracted by domestic variety losses, and domestic productivity gains are counteracted by import productivity losses, which all have to be taken into consideration for an accurate measurement of the "new" gains from trade. Essentially, trade liberalization brings about mirroring selection effects among domestic producers and foreign exporters and focusing only on import variety and domestic productivity gains amounts to cherry-picking only the positive parts.

Let us close with a reminder that our finding of negative "new" gains from CUSFTA does not imply that CUSFTA actually left Canada worse off. Instead, it simply says that the extensive margin adjustments commonly linked to "new" gains from trade have contributed negatively to Canada's overall gains from CUSFTA. Moreover, our measure of the "new" gains from trade accounts only for selection effects and did not include any within-firm productivity effects which we instead ascribed to the "traditional" gains from trade. Earlier work such as Trefler (2004) has found that within-firm productivity also increased as a result of CUSFTA and we have nothing to add to this debate.

5 Appendix

5.1 Special case of Arkolakis et al (2008)

This appendix presents a version of Melitz (2003) considered by Arkolakis et al (2008) and derives the associated expressions mentioned in the main text. This is a special case of our model because it imposes a specific entry process and assumes Pareto distributed productivities. In particular, entrants into country i have to hire f_i^e units of labor in country i before drawing their productivities, where f_i^e is a fixed cost of entry. Moreover, entrants into country i wishing to serve market j have to hire f_{ij} unit of labor in country j, where f_{ij} is a fixed market access costs. Firms draw their productivities from $G_i(\varphi) = 1 - \left(\frac{A_i}{\varphi}\right)^{\theta}$, where A_i is the Pareto location parameter, and θ is the Pareto shape parameter.

A country i firm then only exports to country j if its productivity exceeds φ_{ij}^* which is implicitly defined by $r_{ij}\left(\varphi_{ij}^*\right) = \sigma w_j f_{ij}$ so that $\tilde{r}_{ij} = \left(\frac{\tilde{\varphi}_{ij}}{\varphi_{ij}^*}\right)^{\sigma-1} \sigma w_j f_{ij}$ and $\lambda_{ij} = M_{ij}\left(\frac{\tilde{\varphi}_{ij}}{\varphi_{ij}^*}\right)^{\sigma-1} \frac{\sigma f_{ij}}{L_j}$. Upon noticing that $\tilde{\varphi}_{ij} = \left(\frac{\theta}{\theta-\sigma+1}\right)^{\frac{1}{\sigma-1}} \varphi_{ij}^*$ under Pareto and holding constant f_{ij} and L_i, this implies $\ln\lambda_{ij}' - \ln\lambda_{ij} = \ln\frac{M_{ij}'}{M_{ij}}$ so that $\sum_{i=1}^N \bar{\lambda}_{ij}\ln\frac{M_{ij}'}{M_{ij}} = 0$, as claimed in the main text. Imposing free entry, it is easy to show that $M_{ij} = \left(\frac{A_i}{\varphi_{ij}^*}\right)^{\theta} \frac{L_i}{\frac{\theta\sigma}{\sigma-1} f_i^e}$ so that also $\sum_{i=1}^N \bar{\lambda}_{ij}\left(\ln\frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln\frac{A_i'}{A_i}\right) = 0$ if f_i^e does not change, which is what was claimed in the main text since now $\frac{A_i'}{A_i} = \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}}$. The same equations and restrictions also immediately yield the other relationships mentioned in the main text, i.e. $\theta = -\frac{\ln\frac{M_{ij}'}{M_{ij}} - \ln\frac{M_{ii}'}{M_{ii}}}{\ln\frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln\frac{\tilde{\varphi}_{ii}'}{\tilde{\varphi}_{ii}}}$, $\ln\frac{M_{ij}'}{M_{ij}} = \ln\frac{\lambda_{ij}'}{\lambda_{ij}}$, and $\ln\frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln\frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}} = -\frac{1}{\theta}\ln\frac{\lambda_{ij}'}{\lambda_{ij}}$.

5.2 Nontraded and intermediate goods

This appendix elaborates on the nontraded and intermediate goods extension described in the main text. In particular, we assume that consumers spend a share $1-\mu_j$ of their income on nontraded goods so that the aggregate price index becomes $P_j = \left(P_j^T\right)^{\mu_j}\left(P_j^N\right)^{1-\mu_j}$, where P_j^T and P_j^N are the price indices of traded and nontraded goods. Moreover, we suppose that firms spend a fraction $1-\eta_j$ of their costs on intermediates using the same variety aggregator as consumers so that input costs are given by $c_j = (w_j)^{\eta_j}(P_j)^{1-\eta_j}$. Finally, we impose that nontraded goods are produced under constant returns and perfect competition with productivity φ_j^N so that $P_j^N = \frac{c_j}{\varphi_j^N}$.

Per-capita welfare is then still proportional to real wages given our earlier assumption that final expenditure is proportional to labor income, $W_j \propto \frac{w_j}{P_j}$. Solving $c_j = (w_j)^{\eta_j} (P_j)^{1-\eta_j}$ for w_j and substituting yields $W_j \propto \left(\frac{c_j}{P_j}\right)^{\frac{1}{\eta_j}}$ which can be further manipulated to $W_j \propto \left(\frac{c_j}{P_j^T}\right)^{\frac{\mu_j}{\eta_j}} \left(\varphi_j^N\right)^{\frac{1-\mu_j}{\eta_j}}$ upon substituting $P_j = \left(P_j^T\right)^{\mu_j} \left(P_j^N\right)^{1-\mu_j}$ and $P_j^N = \frac{c_j}{\varphi_j^N}$. Abstracting from productivity changes in the nontraded sector for simplicity, this implies $\ln \frac{W_j'}{W_j} = -\frac{\mu_j}{\eta_j} \ln \frac{P_j^{T\prime}}{P_j^T}$ if c_j is chosen as the numeraire. Given that P_j^T now corresponds to P_j from the earlier model, $\ln \frac{P_j^{T\prime}}{P_j^T}$ can now be decomposed in a perfectly analogous fashion yielding an extended version of formula (1):

$$\ln \frac{W_j'}{W_j} = \underbrace{\frac{\mu_j}{\eta_j} \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(-\ln \frac{\tau_{ij}'}{\tau_{ij}} + \left(\ln \frac{c_j'}{c_j} - \ln \frac{c_i'}{c_i}\right) + \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right)}_{\text{"traditional" gains from trade}} \underbrace{+\frac{\mu_j}{\eta_j} \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\frac{1}{\sigma-1} \ln \frac{M_{ij}'}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}_{ij}'}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^c}\right)\right)}_{\text{"new" gains from trade}} \quad (6)$$

To understand the robustness of this simple roundabout specification, it is helpful to explore how it generalizes to arbitrary firm-level input-output structures. In particular, suppose that the intermediate goods price index of firm φ in country j is given by $P_j^I(\varphi) = \left(\sum_{i=1}^N \int_{\varphi' \in \Phi_{ij}^I(\varphi)} p_{ij}(\varphi')^{1-\sigma} dG\left(\varphi' | \varphi' \in \Phi_{ij}^I(\varphi)\right)\right)^{\frac{1}{1-\sigma}}$, where $\Phi_{ij}^I(\varphi)$ is the subset of firms from country i supplying intermediate goods to firm φ in country j. Maintaining our earlier assumption that firms spend a fraction $1-\eta_i$ of their costs on intermediates, this implies that the input costs of firm φ in country i can be written as $c_i(\varphi) = (w_i)^{\eta_i} \left(P_i^I(\varphi)\right)^{1-\eta_i}$ which yields the pricing formula $p_{ij}(\varphi) = \frac{\sigma}{\sigma-1} \frac{c_i(\varphi)\tau_{ij}}{\varphi}$.

Using the roundabout input costs $c_i = (w_i)^{\eta_i} (P_i)^{1-\eta_i}$ as a benchmark, we can expand the pricing formula to $p_{ij}(\varphi) = \frac{\sigma}{\sigma-1} \frac{c_i \tau_{ij}}{\frac{c_i}{c_i(\varphi)}\varphi}$ and again express aggregate trade flows as $X_{ij} = M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j}\right)^{1-\sigma} Y_j$ and average prices as $\tilde{p}_{ij} = \frac{\sigma}{\sigma-1} \frac{c_i}{\tilde{\varphi}_{ij}}$. However, we now have to use a generalized notion of average productivity $\tilde{\varphi}_{ij} = \left(\int_{\varphi \in \Phi_{ij}} \left(\frac{c_i}{c_i(\varphi)}\varphi\right)^{\sigma-1} dG_i(\varphi | \varphi \in \Phi_{ij})\right)^{\frac{1}{\sigma-1}}$ which is defined over adjusted productivity levels $\frac{c_i}{c_i(\varphi)}\varphi$ thereby taking deviations in the access to intermediate goods from the roundabout benchmark into account. Conditional on this generalization, our sufficient statistic (2) and decomposition (6) remain completely unchanged, as should be easy to verify.

The interpretation of this is that our original sufficient statistic (2) still accurately measures the direct effects of selection on consumer welfare by calculating the average productivity changes associated with entry and exit using the adjusted firm productivities $\frac{c_i}{c_i(\varphi)}\varphi$. However, our original decomposition (6) now provides an oversimplified accounting of the indirect propagation of these effects through the input-output structure by merely scaling all direct effects by $\frac{1}{\eta_j}$. This results in an error which becomes part of the change in the average productivity of continuing firms $\ln \frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}}$ which we anyway do not attempt to measure and subsume under the "traditional" gains.

This can be seen most clearly by writing the expression for $\tilde{\varphi}_{ij}^{c}$ in changes which yields $\frac{\tilde{\varphi}_{ij}^{c\prime}}{\tilde{\varphi}_{ij}^{c}} = \left(\int_{\varphi' \in \Phi_{ij}^{c\prime}} \frac{r_{ij}(\varphi)}{\tilde{r}_{ij}^{c}} \left(\frac{P_i'/P_i}{P_i^{I\prime}(\varphi')/P_i^{I}(\varphi)} \right)^{(1-\eta_i)(\sigma-1)} \left(\frac{\varphi'}{\varphi} \right)^{\sigma-1} dG_i' \left(\varphi' | \varphi' \in \Phi_{ij}^{c\prime} \right) \right)^{\frac{1}{\sigma-1}}$ and shows that the growth rate of $\tilde{\varphi}_{ij}^{c}$ now also depends on the growth rate of $P_i^I(\varphi)$ relative to P_i. For example, if continuing firms were more likely to self-select into importing, trade liberalization would make their price index fall by more than the roundabout specification suggests, which would then show up as an increase in their average productivity. Without firm-level input-output data which would permit a direct estimation of $\frac{P_i^{I\prime}(\varphi')}{P_i^{I}(\varphi)}$ following our methodology, this could be explored further by making functional form assumptions on the relationship $\Phi_{ij}^{I}(\varphi)$.

5.3 Endogenous markups

This appendix elaborates on the endogenous markup extension described in the main text. In particular, we assume that there is a discrete number of firms instead of a continuum of firms so that each firm takes the price index effects of its pricing decisions into account. As should be easy to verify, the pricing formula then becomes $p_{ij}(\varphi) = \frac{\varepsilon_{ij}(\varphi)}{\varepsilon_{ij}(\varphi)-1}\frac{w_i\tau_{ij}}{\varphi}$, where $\varepsilon_{ij}(\varphi) = \sigma - \frac{p_{ij}(\varphi)q_{ij}(\varphi)}{Y_j}(\sigma-1)$ is the demand elasticity faced by a firm with productivity φ from country i in country j. Intuitively, more productive firms then charge higher markups because consumers respond less to their price increases because these price increases also imply larger price index increases due to these firms' larger market shares.

Our methodology is robust to this modification in the sense that it only requires a reinterpretation of the average productivity term. To see this, notice that we can simply rewrite the pricing formula as $p_{ij}(\varphi) = \frac{\sigma}{\sigma-1}\frac{w_i\tau_{ij}}{\frac{\sigma/\varepsilon_{ij}(\varphi)}{(\sigma-1)/\left(\varepsilon_{ij}(\varphi)-1\right)}\varphi}$ so that the model with endogenous markups looks like a model with constant markups and scaled productivities. In particular, it should be clear that we can still write $X_{ij} \propto M_{ij}\left(\frac{\tilde{p}_{ij}}{P_j}\right)^{1-\sigma} Y_j$, $\tilde{p}_{ij} \propto \frac{w_i\tau_{ij}}{\tilde{\varphi}_{ij}}$, and $Y_j \propto w_j L_j$ just using the modified definition of average productivity $\tilde{\varphi}_{ij} = \left(\sum_{\varphi\in\Phi_{ij}}\left(\frac{\sigma/\varepsilon_{ij}(\varphi)}{(\sigma-1)/(\varepsilon_{ij}(\varphi)-1)}\varphi\right)^{\sigma-1} g_i\left(\varphi|\varphi\in\Phi_{ij}\right)\right)^{\frac{1}{\sigma-1}}$, where $g_i\left(\varphi|\varphi\in\Phi_{ij}\right)$ is now the fraction of country i firms with productivity φ serving country j.

5.4 Tariff revenue

This appendix explores the effects of allowing for tariff revenue. We relabel the iceberg trade costs as θ_{ij} and introduce ad valorem tariffs t_{ij} such that $\tau_{ij} = 1 + t_{ij}$. Thinking of X_{ij} and $\tilde{p}_{ij}$ as values gross of the tariff, tariff revenues can be written as $R_j = \sum_{i=1}^N \frac{t_{ij}}{\tau_{ij}} X_{ij}$ and our three key equations become $X_{ij} \propto M_{ij}\left(\frac{\tilde{p}_{ij}}{P_j}\right)^{1-\sigma} Y_j$, $\tilde{p}_{ij} \propto \frac{\sigma}{\sigma-1}\frac{w_i\theta_{ij}\tau_{ij}}{\tilde{\varphi}_{ij}}$, and $Y_j \propto w_j L_j + R_j$. Just as before, we can now define the import shares $\lambda_{ij} = \frac{X_{ij}}{Y_j}$ and write $\ln\frac{P'_j}{P_j} = \sum_{i=1}^N \bar{\lambda}_{ij}\left(\ln\frac{\tau'_{ij}}{\tau_{ij}} + \ln\frac{w'_i}{w_i} - \ln\frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^c_{ij}}\right) - \sum_{i=1}^N \bar{\lambda}_{ij}\left(\frac{1}{\sigma-1}\ln\frac{M'_{ij}}{M_{ij}} + \left(\ln\frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln\frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^c_{ij}}\right)\right)$. However, we now have to impose $\ln\frac{(Y_j/L_j)'}{(Y_j/L_j)} = \ln\frac{w'_j}{w_j} + \ln\frac{1+\left(\frac{R_j}{w_jL_j}\right)'}{1+\left(\frac{R_j}{w_jL_j}\right)}$ so that our welfare decomposition becomes,

$$\ln\frac{W'_j}{W_j} = \underbrace{\sum_{i=1}^N \bar{\lambda}_{ij}\left(-\ln\frac{\tau'_{ij}}{\tau_{ij}} + \left(\ln\frac{w'_j}{w_j} - \ln\frac{w'_i}{w_i}\right) + \ln\frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^c_{ij}}\right) + \ln\frac{1+\left(\frac{R_j}{w_jL_j}\right)'}{1+\left(\frac{R_j}{w_jL_j}\right)}}_{\text{"traditional" gains from trade (incl. tariff revenue)}}$$
$$+\underbrace{\sum_{i=1}^N \bar{\lambda}_{ij}\left(\frac{1}{\sigma-1}\ln\frac{M'_{ij}}{M_{ij}} + \left(\ln\frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln\frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^c_{ij}}\right)\right)}_{\text{"new: gains from trade}} \quad (7)$$

5.5 Multi-product firms

This appendix elaborates on the multi-product firm extension described in the main text. We maintain our earlier assumption that utility is a CES aggregate over a continuum of varieties indexed by ω with an elasticity of substitution σ so that the aggregate price indices are given by $P_j = \left(\sum_{i=1}^N \int_{\omega\in\Omega_{ij}} p_{ij\omega}^{1-\sigma} d\omega\right)^{\frac{1}{1-\sigma}}$. We add that each variety is a CES aggregate over a continuum of products indexed by υ with the same elasticity of substitution σ so that the prices $p_{ij\omega}$ are also price indices given by $p_{ij\omega} = \left(\int_{\upsilon\in\Upsilon_{ij\omega}} p_{ij\omega\upsilon}^{1-\sigma} d\upsilon\right)^{\frac{1}{1-\sigma}}$. To be clear, each firm makes one variety, Ω_{ij} is the set of varieties from country i available in country j, and $\Upsilon_{ij\omega}$ is the set of products contained in variety $\omega \in \Omega_{ij}$.

It should be clear that changes in the aggregate price indices can then still be decomposed into $\ln \frac{P'_j}{P_j} = \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\ln \frac{\tau'_{ij}}{\tau_{ij}} + \ln \frac{w'_i}{w_i} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}\right) - \sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\frac{1}{\sigma-1} \ln \frac{M'_{ij}}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}\right)\right)$ and measured using $\frac{1}{\sigma-1} \ln \left(\frac{X^c_{ij}/X_{ij}}{X^{c\prime}_{ij}/X'_{ij}}\right) = \frac{1}{\sigma-1} \ln \frac{M'_{ij}}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}\right)$. Moreover, one can show that changes in the average productivity of continuing firms can then be further decomposed into $\ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}} = \int_{\omega\in\Omega^c_{ij}} \bar{\lambda}^c_{ij\omega} \ln \frac{\tilde{\varphi}^{c\prime}_{ij\omega}}{\tilde{\varphi}^{c}_{ij\omega}} d\omega + \int_{\omega\in\Omega^c_{ij}} \bar{\lambda}^c_{ij\omega} \left(\frac{1}{\sigma-1} \ln \frac{K'_{ij\omega}}{K_{ij\omega}} + \left(\ln \frac{\tilde{\varphi}'_{ij\omega}}{\tilde{\varphi}_{ij\omega}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij\omega}}{\tilde{\varphi}^{c}_{ij\omega}}\right)\right) d\omega$ and measured using $\frac{1}{\sigma-1} \ln \left(\frac{X^c_{ij\omega}/X_{ij\omega}}{X^{c\prime}_{ij\omega}/X'_{ij\omega}}\right) = \frac{1}{\sigma-1} \ln \left(\frac{K'_{ij\omega}}{K_{ij\omega}}\right) + \left(\ln \frac{\tilde{\varphi}'_{ij\omega}}{\tilde{\varphi}_{ij\omega}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij\omega}}{\tilde{\varphi}^{c}_{ij\omega}}\right)$, where $\bar{\lambda}^c_{ij\omega} = \frac{\frac{\lambda^{c\prime}_{ij\omega} - \lambda^c_{ij\omega}}{\ln \lambda^{c\prime}_{ij\omega} - \ln \lambda^c_{ij\omega}}}{\int_{\omega\in\Omega^c_{ij}} \frac{\lambda^{c\prime}_{ij\omega} - \lambda^c_{ij\omega}}{\ln \lambda^{c\prime}_{ij\omega} - \ln \lambda^c_{ij\omega}} d\omega}$ and $\lambda^c_{ij\omega} = \frac{x_{ij\omega}}{\int_{\omega\in\Omega^c_{ij}} x_{ij\omega} d\omega}$. This then implies the following extended welfare decomposition:

$$\ln \frac{W'_j}{W_j} = \underbrace{\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(-\ln \frac{\tau'_{ij}}{\tau_{ij}} + \left(\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i}\right) + \int_{\omega\in\Omega^c_{ij}} \bar{\lambda}^c_{ij\omega} \ln \frac{\tilde{\varphi}^{c\prime}_{ij\omega}}{\tilde{\varphi}^{c}_{ij\omega}} d\omega\right)}_{\text{"traditional" gains}}$$
$$+ \underbrace{\sum_{i=1}^{N} \bar{\lambda}_{ij} \left(\frac{1}{\sigma-1} \ln \frac{M'_{ij}}{M_{ij}} + \left(\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij}}{\tilde{\varphi}^{c}_{ij}}\right)\right)}_{\text{firm-level "new" gains}}$$
$$+ \underbrace{\sum_{i=1}^{N} \int_{\omega\in\Omega^c_{ij}} \bar{\lambda}_{ij} \bar{\lambda}^c_{ij\omega} \left(\frac{1}{\sigma-1} \ln \frac{K'_{ij\omega}}{K_{ij\omega}} + \left(\ln \frac{\tilde{\varphi}'_{ij\omega}}{\tilde{\varphi}_{ij\omega}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ij\omega}}{\tilde{\varphi}^{c}_{ij\omega}}\right)\right) d\omega}_{\text{product-level "new" gains}} \quad (8)$$

To be clear, $\frac{M'_{ij}}{M_{ij}}$ still captures changes in the number of firms while $\frac{K'_{ij\omega}}{K_{ij\omega}}$ now captures changes in the number of products . Similarly, $\ln \frac{\tilde{\varphi}'_{ij}}{\tilde{\varphi}_{ij}}$ still captures changes in average productivity across firms while $\ln \frac{\tilde{\varphi}'_{ij\omega}}{\tilde{\varphi}_{ij\omega}}$ now captures changes in the average productivity across products. In particular, $\tilde{\varphi}_{ij\omega} = \left(\frac{1}{K_{ij\omega}} \int_{\upsilon\in\Upsilon_{ij\omega}} \varphi_{i\omega\upsilon}^{\sigma-1} d\upsilon\right)^{\frac{1}{\sigma-1}}$ and $\tilde{\varphi}^c_{ij\omega} = \left(\frac{1}{K^c_{ij\omega}} \int_{\upsilon\in\Upsilon^c_{ij\omega}} \varphi_{i\omega\upsilon}^{\sigma-1} d\upsilon\right)^{\frac{1}{\sigma-1}}$ which are just cross-product analogs to the cross-firm expressions from before. Also, $\tilde{\varphi}_{ij} = \left(\frac{1}{M_{ij}} \int_{\omega\in\Omega_{ij}} \left(K_{ij\omega}^{\frac{1}{\sigma-1}} \tilde{\varphi}_{ij\omega}\right)^{\sigma-1} d\omega\right)^{\frac{1}{\sigma-1}}$ and $\tilde{\varphi}^c_{ij} = \left(\frac{1}{M^c_{ij}} \int_{\omega\in\Omega^c_{ij}} \left(K_{ij\omega}^{\frac{1}{\sigma-1}} \tilde{\varphi}_{ij\omega}\right)^{\sigma-1} d\omega\right)^{\frac{1}{\sigma-1}}$ which are now aggregates over the firm-level productivities $K_{ij\omega}^{\frac{1}{\sigma-1}} \tilde{\varphi}_{ij\omega}$. Detailed derivations of these and all other expressions from this appendix are available upon request.

5.6 Industry-level extensive margin effects

This appendix elaborates on how we allow for industry-level extensive margin adjustments in our multi-industry extension as mentioned in the main text. At the aggregate level, we now assume that consumers in country j have access to varieties from S_j industries so that the aggregate price indices become $P_j = \left(\sum_{s \in S_j} P_{js}^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}$. At the industry-level, we now assume that N_{js} countries supply industry s varieties to country j so that we can write $P_{js} = \left(\sum_{i \in N_{js}} P_{ijs}^{1-\sigma_s}\right)^{\frac{1}{1-\sigma_s}}$ and $P_{ijs} = \left(\int_{\omega \in \Omega_{ijs}} p_{ijs\omega}^{1-\sigma_s} d\omega\right)^{\frac{1}{1-\sigma_s}}$, where Ω_{ijs} is the set of industry s varieties from country i available in country j. Notice that we have separated the original P_{js} from the main text into a new P_{js} and a new P_{ijs} which will be useful below.

Changes in the aggregate price index can then be decomposed into $\ln \frac{P_j'}{P_j} = \left(\ln \frac{w_j'}{w_j} - \ln \frac{\tilde{\varphi}_j^{c\prime}}{\tilde{\varphi}_j^c}\right) - \left(\frac{1}{\varepsilon-1} \ln \frac{S_j'}{S_j} + \left(\ln \frac{\tilde{\varphi}_j'}{\tilde{\varphi}_j} - \ln \frac{\tilde{\varphi}_j^{c\prime}}{\tilde{\varphi}_j^c}\right)\right)$ using $\frac{1}{\varepsilon-1} \ln \left(\frac{X_j^c/X_j}{X_j^{c\prime}/X_j'}\right) = \frac{1}{\varepsilon-1} \ln \left(\frac{S_j'}{S_j}\right) + \left(\ln \frac{\tilde{\varphi}_j'}{\tilde{\varphi}_j} - \ln \frac{\tilde{\varphi}_j^{c\prime}}{\tilde{\varphi}_j^c}\right)$. Moreover, changes in the average productivity of continuing industries can then be decomposed into $\ln \frac{\tilde{\varphi}_j^{c\prime}}{\tilde{\varphi}_j^c} = \sum_{s \in S_j^c} \bar{\nu}_{js}^c \ln \frac{\tilde{\varphi}_{js}^{c\prime}}{\tilde{\varphi}_{js}^c} + \sum_{s \in S_j^c} \bar{\nu}_{js}^c \left(\frac{1}{\sigma_s-1} \ln \frac{N_{js}'}{N_{js}} + \left(\ln \frac{\tilde{\varphi}_{js}'}{\tilde{\varphi}_{js}} - \ln \frac{\tilde{\varphi}_{js}^{c\prime}}{\tilde{\varphi}_{js}^c}\right)\right)$ using $\frac{1}{\sigma_s-1} \ln \left(\frac{X_{js}^c/X_{js}}{X_{js}^{c\prime}/X_{js}'}\right) = \frac{1}{\sigma_s-1} \ln \frac{N_{js}'}{N_{js}} + \left(\ln \frac{\tilde{\varphi}_{js}'}{\tilde{\varphi}_{js}} - \ln \frac{\tilde{\varphi}_{js}^{c\prime}}{\tilde{\varphi}_{js}^c}\right)$. Finally, changes in the average productivity of continuing suppliers can then be decomposed into $\ln \frac{\tilde{\varphi}_{js}^{c\prime}}{\tilde{\varphi}_{js}^c} = \sum_{i \in N_{js}^c} \bar{\lambda}_{ijs}^c \left(-\ln \frac{\tau_{ijs}'}{\tau_{ijs}} + \left(\ln \frac{w_j'}{w_j} - \ln \frac{w_i'}{w_i}\right) + \ln \frac{\tilde{\varphi}_{ijs}^{c\prime}}{\tilde{\varphi}_{ijs}^c}\right) + \sum_{i \in N_{js}^c} \bar{\lambda}_{ijs}^c \left(\frac{1}{\sigma_s-1} \ln \frac{M_{ijs}'}{M_{ijs}} + \left(\ln \frac{\tilde{\varphi}_{ijs}'}{\tilde{\varphi}_{ijs}} - \ln \frac{\tilde{\varphi}_{ijs}^{c\prime}}{\tilde{\varphi}_{ijs}^c}\right)\right)$ using $\frac{1}{\sigma_s-1} \ln \left(\frac{X_{ijs}^c/X_{ijs}}{X_{ijs}^{c\prime}/X_{ijs}'}\right) = \frac{1}{\sigma_s-1} \ln \frac{M_{ijs}}{M_{ijs}'} + \ln \frac{\tilde{\varphi}_{ijs}'}{\tilde{\varphi}_{ijs}} -$

$\ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}}$. Together, this then implies the extended welfare decomposition:

$$\ln \frac{W'_j}{W_j} = \underbrace{\sum_{s\in S^c_j} \bar{\nu}^c_{js} \left(\sum_{i\in N^c_{js}} \bar{\lambda}^c_{ijs} \left(-\ln \frac{\tau'_{ijs}}{\tau_{ijs}} + \left(\ln \frac{w'_j}{w_j} - \ln \frac{w'_i}{w_i} \right) + \ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}} \right) \right)}_{\text{"traditional" gains w/o industry- or supplier-level selection}}$$
$$+ \underbrace{\left(\frac{1}{\varepsilon - 1} \ln \frac{S'_j}{S_j} + \left(\ln \frac{\tilde{\varphi}'_j}{\tilde{\varphi}_j} - \ln \frac{\tilde{\varphi}^{c\prime}_j}{\tilde{\varphi}^{c}_j} \right) \right)}_{\text{"traditional" industry-level selection}}$$
$$+ \underbrace{\sum_{s\in S^c_j} \bar{\nu}^c_{js} \left(\frac{1}{\sigma_s - 1} \ln \frac{N'_{js}}{N_{js}} + \left(\ln \frac{\tilde{\varphi}'_{js}}{\tilde{\varphi}_{js}} - \ln \frac{\tilde{\varphi}^{c\prime}_{js}}{\tilde{\varphi}^{c}_{js}} \right) \right)}_{\text{"traditional" supplier-level selection}}$$
$$+ \underbrace{\sum_{s\in S^c_j} \bar{\nu}^c_{js} \left(\sum_{i\in N^c_{js}} \bar{\lambda}^c_{ijs} \left(\frac{1}{\sigma_s - 1} \ln \frac{M'_{ijs}}{M_{ijs}} + \left(\ln \frac{\tilde{\varphi}'_{ijs}}{\tilde{\varphi}_{ijs}} - \ln \frac{\tilde{\varphi}^{c\prime}_{ijs}}{\tilde{\varphi}^{c}_{ijs}} \right) \right) \right)}_{\text{"new" gains from trade}} \quad (9)$$

This formula collapses to equation (4) in the main text if all industries are continuing industries, $S_j = S^c_j$, and all suppliers are continuing suppliers, $N^c_{js} = N_{js}$. The first additional term labelled "traditional industry-level selection" captures the welfare effects of changes in the set of industries consumers in country j have access to. The second additional term labelled "traditional supplier-level selection" captures the welfare effects of changes in the set of countries supplying industry s varieties to country j. While both these terms could appear in a general Ricardian model, the most common versions assume $S_j = S^c_j$ and emphasize supplier-level selection effects.

To be clear, the averages are now defined as $\tilde{\varphi}_{ijs} = \left(\frac{1}{M_{ijs}} \int_{\omega\in\Omega_{ijs}} \varphi^{\sigma_s - 1}_{is\omega} d\omega \right)^{\frac{1}{\sigma_s - 1}}$, $\tilde{\varphi}_{js} = \left(\frac{1}{N_{js}} \sum_{i\in N_{js}} \left(M^{\frac{1}{\sigma_s-1}}_{ijs} \frac{\tilde{\varphi}_{ijs} w_j}{w_i \tau_{ijs}} \right)^{\sigma_s - 1} \right)^{\frac{1}{\sigma_s - 1}}$, and $\tilde{\varphi}_j = \left(\frac{1}{S_j} \sum_{s\in S_j} \left(N^{\frac{1}{\sigma_s-1}}_{js} \tilde{\varphi}_{js} \right)^{\varepsilon - 1} \right)^{\frac{1}{\varepsilon - 1}}$ across all firms, suppliers, and industries, with equivalents of $\tilde{\varphi}^c_{ijs} = \left(\frac{1}{M^c_{ijs}} \int_{\omega\in\Omega^c_{ijs}} \varphi^{\sigma_s - 1}_{is\omega} d\omega \right)^{\frac{1}{\sigma_s - 1}}$, $\tilde{\varphi}^c_{js} = \left(\frac{1}{N^c_{js}} \sum_{i\in N^c_{js}} \left(M^{\frac{1}{\sigma_s-1}}_{ijs} \frac{\tilde{\varphi}_{ijs} w_j}{w_i \tau_{ijs}} \right)^{\sigma_s - 1} \right)^{\frac{1}{\sigma_s - 1}}$, and $\tilde{\varphi}_j = \left(\frac{1}{S_j} \sum_{s\in S_j} \left(N^{\frac{1}{\sigma_s-1}}_{js} \tilde{\varphi}_{js} \right)^{\varepsilon - 1} \right)^{\frac{1}{\varepsilon - 1}}$ across continuing firms, suppliers, and industries. Moreover, $\bar{\nu}^c_{js}$ and $\bar{\lambda}^c_{ijs}$ are Sato-Vartia weights defined over market shares of continuing industries, $\nu^c_{js} = \frac{Y_{js}}{\sum_{s\in S^c_j} Y_{js}}$, and continuing suppliers, $\lambda^c_{ijs} = \frac{X_{ijs}}{\sum_{i\in N^c_j} X_{ijs}}$. Detailed derivations of these and all other expressions from this appendix are available upon request.

5.7 Heterogeneous quality

This appendix elaborates on how we allow for heterogeneous quality. We introduce preference shifters $\upsilon_{ij\omega}$ into the utility functions such that the demand functions become $q_{ij\omega} = \upsilon_{ij\omega}^{\sigma-1} \frac{p_{ij\omega}^{-\sigma}}{P_j^{1-\sigma}} Y_j$. Firms producing higher quality varieties then sell more but still charge constant markups over marginal costs since the demand elasticity remains unchanged. Bilateral trade flows can then still be written as $X_{ij} = M_{ij} \left(\frac{\sigma}{\sigma-1} \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}} \frac{1}{P_j} \right)^{1-\sigma} Y_j$ using the broadened definition $\tilde{\varphi}_{ij} = \left(\frac{1}{M_{ij}} \int_{\omega \in \Omega_{ij}} (\upsilon_{ij\omega} \varphi_\omega)^{\sigma-1} d\omega \right)^{\frac{1}{\sigma-1}}$ which now averages over preference shifters and productivities. As a result, we then still have (i) $X_{ij} \propto M_{ij} \left(\frac{\tilde{p}_{ij}}{P_j} \right)$, (ii) $\tilde{p}_{ij} \propto \frac{w_i \tau_{ij}}{\tilde{\varphi}_{ij}}$, and (iii) $Y_j \propto w_j L_j$ so that all results from the main text generalize accordingly.

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TABLE 1: OVERALL MARKET SHARES

A: Market shares of Canadian plants

Pre-trend				**CUSFTA**			
1978		**1988**		**1988**		**1996**	
Exit	Cont.	Cont.	Enter	Exit	Cont.	Cont.	Enter
24.4%	75.6%	78.4%	21.6%	28.0%	72.0%	81.2%	18.8%

B: Market shares of US exporters

				CUSFTA			
				1987		**1997**	
				Exit	Cont.	Cont.	Entry
				35.5%	64.5%	61.3%	38.7%

Notes: Panel A shows the domestic market shares of entering, continuing, and exiting Canadian plants among all Canadian plants. Panel B shows the export market shares of entering, continuing, and exiting US exporters among all US exporters.

TABLE 2: EXTENSIVE MARGINS OF MARKET SHARES

A: Shares of Canadian plants

Pre-trend				CUSFTA			
1978		1988		1988		1996	
Exit	Cont.	Cont.	Enter	Exit	Cont.	Cont.	Enter
51.7%	48.3%	35.5%	64.5%	49.6%	50.4%	56.2%	43.8%
(28,000 plants)		(38,000 plants)		(38,000 plants)		(34,000 plants)	

B: Shares of US exporters

CUSFTA			
1987		1997	
Exit	Cont.	Cont.	Entry
54.7%	45.3%	27.1%	72.9%
(29,000 plants)		(48,000 plants)	

Notes: Panel A shows the fraction of entering, continuing, and exiting Canadian plants among all Canadian plants. Panel B shows the fraction of entering, continuing, and exiting US exporters among all US exporters. The numbers in parentheses give the total number of active plants or exporters rounded to the nearest 1,000.

TABLE 3: INTENSIVE MARGINS OF MARKET SHARES

A: Relative sizes of Canadian plants

Pre-trend				CUSFTA			
1978		**1988**		**1988**		**1996**	
Exit	Cont.	Cont.	Enter	Exit	Cont.	Cont.	Enter
47.2%	156.5%	220.7%	33.4%	56.5%	142.7%	144.4%	43.0%
(-12.8% productivity loss)				(-0.4% productivity loss)			

B: Relative sizes of US exporters

				CUSFTA			
				1987		**1997**	
				Exit	Cont.	Cont.	Enter
				64.9%	142.4%	225.9%	53.1%
				(-17.1% productivity loss)			

Notes: Panel A shows the average domestic sales of entering, continuing, and exiting Canadian plants as a share of the average domestic sales of all Canadian plants. Panel B shows the average foreign sales of entering, continuing, and exiting US exporters as a share of the average foreign sales of all US exporters. The numbers in parentheses give the implied average productivity growth rates due to selection assuming $\sigma=3.7$.

TABLE 4: "NEW" GAINS FROM CUSFTA OF CANADA

A: Annualized welfare effects of domestic entry and exit (Canadian plants)

	Pre-trend	**CUSFTA**	**Difference**
Net welfare effect	-0.14%	-0.56%	-0.42%
Net variety effect	1.14%	-0.50%	-1.64%
Net productivity effect	-1.28%	-0.05%	1.22%
Welfare loss from exit	-1.04%	-1.52%	-0.49%
Variety loss	-2.69%	-3.17%	-0.47%
Productivity gain	1.66%	1.65%	-0.01%
Welfare gain from entry	0.90%	0.96%	0.07%
Variety gain	3.83%	2.66%	-1.17%
Productivity loss	-2.93%	-1.70%	1.23%

B: Annualized welfare effects of foreign entry and exit (US exporters)

	CUSFTA	**Difference**
Net welfare effect	0.19%	0.19%
Net variety effect	1.90%	1.90%
Net productivity effect	-1.71%	-1.71%
Welfare loss from exit	-1.62%	-1.62%
Variety loss	-2.93%	-2.93%
Productivity gain	1.31%	1.31%
Welfare gain from entry	1.81%	1.81%
Variety gain	4.83%	4.83%
Productivity loss	-3.02%	-3.02%

C: Annualized overall welfare effects of entry and exit

	Pre-trend	**CUSFTA**	**Difference**
"New" gains from trade	-0.11%	-0.34%	-0.23%
"New" variety gains	0.90%	0.20%	-0.70%
"New" productivity gains	-1.01%	-0.54%	0.47%

D: Adjusted annualized overall welfare effects of entry and exit (μ,η≠1)

	Pre-trend	**CUSFTA**	**Difference**
"New" gains from trade	-0.07%	-0.22%	-0.15%
"New" variety gains	0.58%	0.13%	-0.45%
"New" productivity gains	-0.65%	-0.34%	0.30%

Notes: This table decomposes the "new" gains from CUSFTA on the Canadian economy. Panel A shows the unweighted welfare effects arising from the entry and exit of Canadian plants calculated using formula (3). Panel B shows the unweighted welfare effects arising from the entry and exit of US exporters calculated using formula (3). Panel C applies formula (1) and averages between the values from Panels A and B using the Sato-Vartia weights to obtain the overall welfare effects of CUSFTA on the Canadian economy. Panel D further accounts for nontraded and intermediate goods following formula (4). All values are reported in annualized terms by taking simple averages and assume σ=3.7.

TABLE 5: BASELINE MODEL VERSUS MELITZ-PARETO SPECIAL CASE

A: Annualized "new" variety gains

	Baseline		Melitz-Pareto	
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.36%	-1.26%	-0.78%	-0.73%
Foreign (weighted)	0.56%	0.56%	0.78%	0.73%
Combined	0.20%	-0.70%	0.00%	0.00%

B: Annualized "new" productivity gains

	Baseline		Melitz-Pareto	
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.04%	0.97%	0.73%	0.68%
Foreign (weighted)	-0.50%	-0.50%	-0.73%	-0.68%
Combined	-0.54%	0.47%	0.00%	0.00%

C: Annualized overall "new" gains

	Baseline		Melitz-Pareto	
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.39%	-0.28%	-0.05%	-0.05%
Foreign (weighted)	0.06%	0.06%	0.05%	0.05%
Combined	-0.34%	-0.23%	0.00%	0.00%

D: Adjusted annualized overall "new" gains ($\mu,\eta\neq1$)

	Baseline		Melitz-Pareto	
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.25%	-0.18%	-0.04%	-0.03%
Foreign (weighted)	0.04%	0.04%	0.04%	0.03%
Combined	-0.22%	-0.15%	0.00%	0.00%

Notes: This table compares the "new" gains from CUSFTA from Table 4 which are calculated using formula (1) (under "Baseline") to the "new" gains from CUSFTA obtained from the Melitz (2003) model used by Arkolakis et al (2008) which is a special case of ours (under "Melitz-Pareto"). All welfare effects are given in annualized terms, are weighted by their corresponding Sato-Vartia weights, and assume σ=3.7. The entries under "w/o pre-trend" look at the post-CUSFTA period and the entries under w/ pre-trend look at the difference between the post-CUSFTA and the pre-CUSFTA period. Panel D adjusts for nontraded and intermediate goods following formula (4).

TABLE 6: BASELINE MODEL VERSUS INDUSTRY DIFFERENCES

	Baseline		Industry	
A: Annualized "new" variety gains				
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.36%	-1.26%	-0.25%	-0.85%
Foreign (weighted)	0.56%	0.56%	0.44%	0.44%
Combined	0.20%	-0.70%	0.20%	-0.41%
B: Annualized "new" productivity gains				
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.04%	0.97%	-0.12%	0.57%
Foreign (weighted)	-0.50%	-0.50%	-0.40%	-0.40%
Combined	-0.54%	0.47%	-0.52%	0.17%
C: Annualized overall "new" gains				
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.39%	-0.28%	-0.36%	-0.28%
Foreign (weighted)	0.06%	0.06%	0.04%	0.04%
Combined	-0.34%	-0.23%	-0.33%	-0.24%
D: Adjusted annualized overall "new" gains (μ,η≠1)				
	w/o pre-trend	**w/ pre trend**	**w/o pre-trend**	**w/ pre trend**
Domestic (weighted)	-0.25%	-0.18%	-0.23%	-0.18%
Foreign (weighted)	0.04%	0.04%	0.02%	0.02%
Combined	-0.22%	-0.15%	-0.21%	-0.16%

Notes: This table compares the "new" gains from CUSFTA from Table 4 which are calculated from formula (1) using aggregate data (under "Baseline") to the "new" gains from CUSFTA calculated from formula (5) using industry-level data (under "Industry"). All welfare effects are given in annualized terms and are weighted by their corresponding Sato-Vartia weights. The aggregate results assume σ=3.7 while the industry-level result impose the Oberfield and Raval (2014) elasticities. The entries under "w/o pre-trend" look at the post-CUSFTA period and the entries under "w/ pre-trend" look at the difference between the post-CUSFTA and the pre-CUSFTA period. Panel D adjusts for nontraded and intermediate goods following formulas (4) and (7).

TABLE 7: BASELINE MODEL VS. INDUSTRY DIFFERENCES-IN-DIFFERENCES

A: Annualized "new" variety gains	**(1) Baseline**	**(2) Diff-in-diff, CAN tariffs only**	**(3) Diff-in-diff, full CUSFTA**	**(4) Diff-in-diff, full CUSFTA w/ pre-trends**
Domestic (weighted)	-0.36%	-0.26%	-0.32%	-0.27%
Foreign (weighted)	0.56%	0.05%	0.02%	0.02%
Combined	0.20%	-0.21%	-0.30%	-0.26%

B: Annualized "new" productivity gains	**(1) Baseline**	**(2) Regression, CAN tariffs only**	**(3) Regression, full CUSFTA**	**(4) Regression, full CUSFTA w/ pre-trends**
Domestic (weighted)	-0.04%	0.04%	0.09%	0.07%
Foreign (weighted)	-0.50%	-0.02%	0.00%	0.00%
Combined	-0.54%	0.02%	0.10%	0.07%

C: Annualized overall "new" gains	**(1) Baseline**	**(2) Regression, CAN tariffs only**	**(3) Regression, full CUSFTA**	**(4) Regression, full CUSFTA w/ pre-trends**
Domestic (weighted)	-0.39%	-0.22%	-0.22%	-0.20%
Foreign (weighted)	0.06%	0.03%	0.02%	0.02%
Combined	-0.34%	-0.19%	-0.20%	-0.18%

D: Adjusted annualized overall "new" gains (μ,η≠1)	**(1) Baseline**	**(2) Regression, CAN tariffs only**	**(3) Regression, full CUSFTA**	**(4) Regression, full CUSFTA w/ pre-trends**
Domestic (weighted)	-0.25%	-0.14%	-0.14%	-0.13%
Foreign (weighted)	0.04%	0.02%	0.01%	0.01%
Combined	-0.22%	-0.12%	-0.13%	-0.12%

Notes: This table compares the "new" gains from CUSFTA from Table 4 which are calculated from formula (1) by taking differences using aggregate data (specification 1) to the "new" gains from CUSFTA calculated from formula (5) by running differences-in-differences regressions using industry-level data exploiting cross-industry variation in tariff cuts (specifications 2-4). All welfare effects are given in annualized terms, are weighted by their corresponding Sato-Vartia weights, and use the Oberfield and Raval (2014) elasticities. Panel D adjusts for nontraded and intermediate goods following formulas (4) and (7). The regressions results underlying the effects calculated for specifications 2-4 can be found in Tables 8-10.

TABLE 8: REGRESSION RESULTS UNDERLYING TABLE 7, SPECIFICATION 2

	"new" variety gains		**"new" productivity gains**		**overall "new" gains**	
	domestic	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
	$\frac{1}{\sigma_s - 1} ln \frac{M'_{jjs}}{M_{jjs}}$	$\frac{1}{\sigma_s - 1} ln \frac{M'_{ijs}}{M_{ijs}}$	$\frac{1}{\sigma_s - 1}\left(ln \frac{\bar{r}^c{}_{jjs}}{\bar{r}_{jjs}} - ln \frac{\bar{r}^{c\prime}{}_{jjs}}{\bar{r}'_{jjs}}\right)$	$\frac{1}{\sigma_s - 1}\left(ln \frac{\bar{r}^c{}_{ijs}}{\bar{r}_{ijs}} - ln \frac{\bar{r}^{c\prime}{}_{ijs}}{\bar{r}'_{ijs}}\right)$	$\frac{1}{\sigma_s - 1} ln \left(\frac{X^c{}_{jjs}/X_{jjs}}{X^{c\prime}{}_{jjs}/X'_{jjs}}\right)$	$\frac{1}{\sigma_s - 1} ln \left(\frac{X^c{}_{ijs}/X_{ijs}}{X^{c\prime}{}_{ijs}/X'_{ijs}}\right)$
$ln \frac{\tau'_s{}^{CAN}}{\tau_s{}^{CAN}}$	1.090***	-1.056**	-0.161	0.376	0.929***	-0.680**
	(0.260)	(0.381)	(0.213)	(0.318)	(0.222)	(0.316)
constant	-0.110	1.507***	-0.454***	-1.004***	-0.563***	0.503**
	(0.172)	(0.252)	(0.141)	(0.210)	(0.147)	(0.209)
observations	21	21	21	21	21	21
R^2	0.481	0.288	0.029	0.069	0.481	0.196

Notes: This table shows the regression results underlying the welfare effects reported in Table 7, specification 2. Standard errors are given in parentheses and ***, **, * indicate significance at the 1%, 5%, 10% level.

TABLE 9: REGRESSION RESULTS UNDERLYING TABLE 7, SPECIFICATION 3

	"new" variety gains		**"new" productivity gains**		**overall "new" gains**	
	domestic	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
	$\frac{1}{\sigma_s-1} ln \frac{M'_{jjs}}{M_{jjs}}$	$\frac{1}{\sigma_s-1} ln \frac{M'_{ijs}}{M_{ijs}}$	$\frac{1}{\sigma_s-1}\left(ln \frac{\bar{r}^c{}_{jjs}}{\bar{r}_{jjs}} - ln \frac{\bar{r}^{c\prime}{}_{jjs}}{\bar{r}'_{jjs}}\right)$	$\frac{1}{\sigma_s-1}\left(ln \frac{\bar{r}^c{}_{ijs}}{\bar{r}_{ijs}} - ln \frac{\bar{r}^{c\prime}{}_{ijs}}{\bar{r}'_{ijs}}\right)$	$\frac{1}{\sigma_s-1} ln\left(\frac{X^c{}_{jjs}/X_{jjs}}{X^{c\prime}{}_{jjs}/X'_{jjs}}\right)$	$\frac{1}{\sigma_s-1} ln\left(\frac{X^c{}_{ijs}/X_{ijs}}{X^{c\prime}{}_{ijs}/X'_{ijs}}\right)$
$ln \frac{\tau'_s{}^{CAN}}{\tau_s{}^{CAN}}$	1.171***	-1.285**	-0.221	0.501	0.950**	-0.784*
	(0.392)	(0.505)	(0.285)	(0.434)	(0.358)	(0.447)
$ln \frac{\tau'_s{}^{US}}{\tau_s{}^{US}}$	0.317	1.204	-0.348	-0.736	-0.031	0.468
	(0.699)	(0.978)	(0.509)	(0.840)	(0.639)	(0.866)
$ln \frac{\tau'_s{}^{CAN,MEX}}{\tau_s{}^{CAN,MEX}}$	-0.079		0.027		-0.052	
	(0.178)		(0.129)		(0.162)	
$ln \frac{\tau'_s{}^{MEX,US}}{\tau_s{}^{MEX,US}}$		-0.056		0.041		-0.016
		(0.056)		(0.048)		(0.050)
constant	0.027	1.076	-0.616***	-0.680	-0.589***	0.397
	(0.198)	(0.630)	(0.144)	(0.541)	(0.181)	(0.558)
observations	20	21	20	21	20	21
R^2	0.556	0.390	0.155	0.152	0.452	0.216

Notes: This table shows the regression results underlying the welfare effects reported in Table 7, specification 3. Standard errors are given in parentheses and ***, **, * indicate significance at the 1%, 5%, 10% level.

TABLE 10: REGRESSION RESULTS UNDERLYING TABLE 7, SPECIFICATION 4

	"new" variety gains		**"new" productivity gains**		**overall "new" gains**	
	domestic	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
	$\Delta \frac{1}{\sigma_s - 1} ln \frac{M'_{jjs}}{M_{jjs}}$	$\frac{1}{\sigma_s - 1} ln \frac{M'_{ijs}}{M_{ijs}}$	$\Delta \frac{1}{\sigma_s - 1} \left(ln \frac{\bar{r}^c{}_{jjs}}{\bar{r}_{jjs}} - ln \frac{\bar{r}^{c\prime}{}_{jjs}}{\bar{r}'_{jjs}} \right)$	$\frac{1}{\sigma_s - 1} \left(ln \frac{\bar{r}^c{}_{ijs}}{\bar{r}_{ijs}} - ln \frac{\bar{r}^{c\prime}{}_{ijs}}{\bar{r}'_{ijs}} \right)$	$\Delta \frac{1}{\sigma_s - 1} ln \left(\frac{X^c{}_{jjs}/X_{jjs}}{X^{c\prime}{}_{jjs}/X'_{jjs}} \right)$	$\frac{1}{\sigma_s - 1} ln \left(\frac{X^c{}_{ijs}/X_{ijs}}{X^{c\prime}{}_{ijs}/X'_{ijs}} \right)$
$ln \frac{\tau'_s{}^{CAN}}{\tau_s{}^{CAN}}$	1.329**	-1.285**	-0.120	0.501	1.209***	-0.784*
	(0.594)	(0.505)	(0.393)	(0.434)	(0.368)	(0.447)
$ln \frac{\tau'_s{}^{US}}{\tau_s{}^{US}}$	-0.371	1.204	-0.335	-0.736	-0.706	0.468
	(1.059)	(0.978)	(0.700)	(0.840)	(0.655)	(0.866)
$ln \frac{\tau'_s{}^{CAN.MEX}}{\tau_s{}^{CAN,MEX}}$	-0.694**		0.472**		-0.222	
	(0.269)		(0.178)		(0.167)	
$ln \frac{\tau'_s{}^{MEX,US}}{\tau_s{}^{MEX,US}}$		-0.056		0.041		-0.016
		(0.056)		(0.048)		(0.050)
constant	-1.172***	1.076	0.538**	-0.680	-0.633***	0.397
	(0.301)	(0.630)	(0.199)	(0.541)	(0.186)	(0.558)
observations	20	21	20	21	20	21
R^2	0.360	0.390	0.353	0.152	0.440	0.216

Notes: This table shows the regression results underlying the welfare effects reported in Table 7, specification 4. Standard errors are given in parentheses and ***, **, * indicate significance at the 1%, 5%, 10% level.

Figure 1: Overall domestic "new" gains from CUSFTA

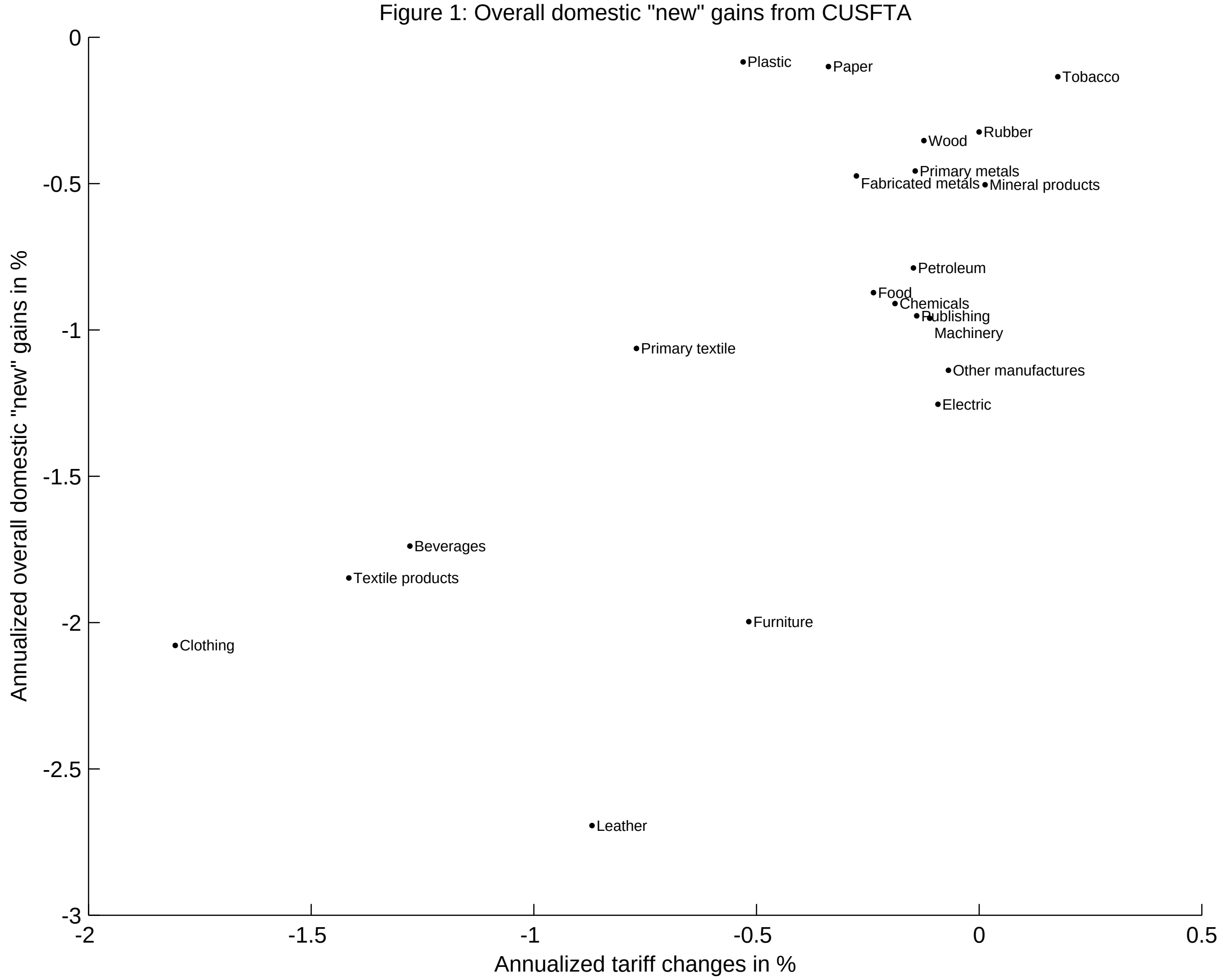

Figure 2: Domestic net variety gains from CUSFTA

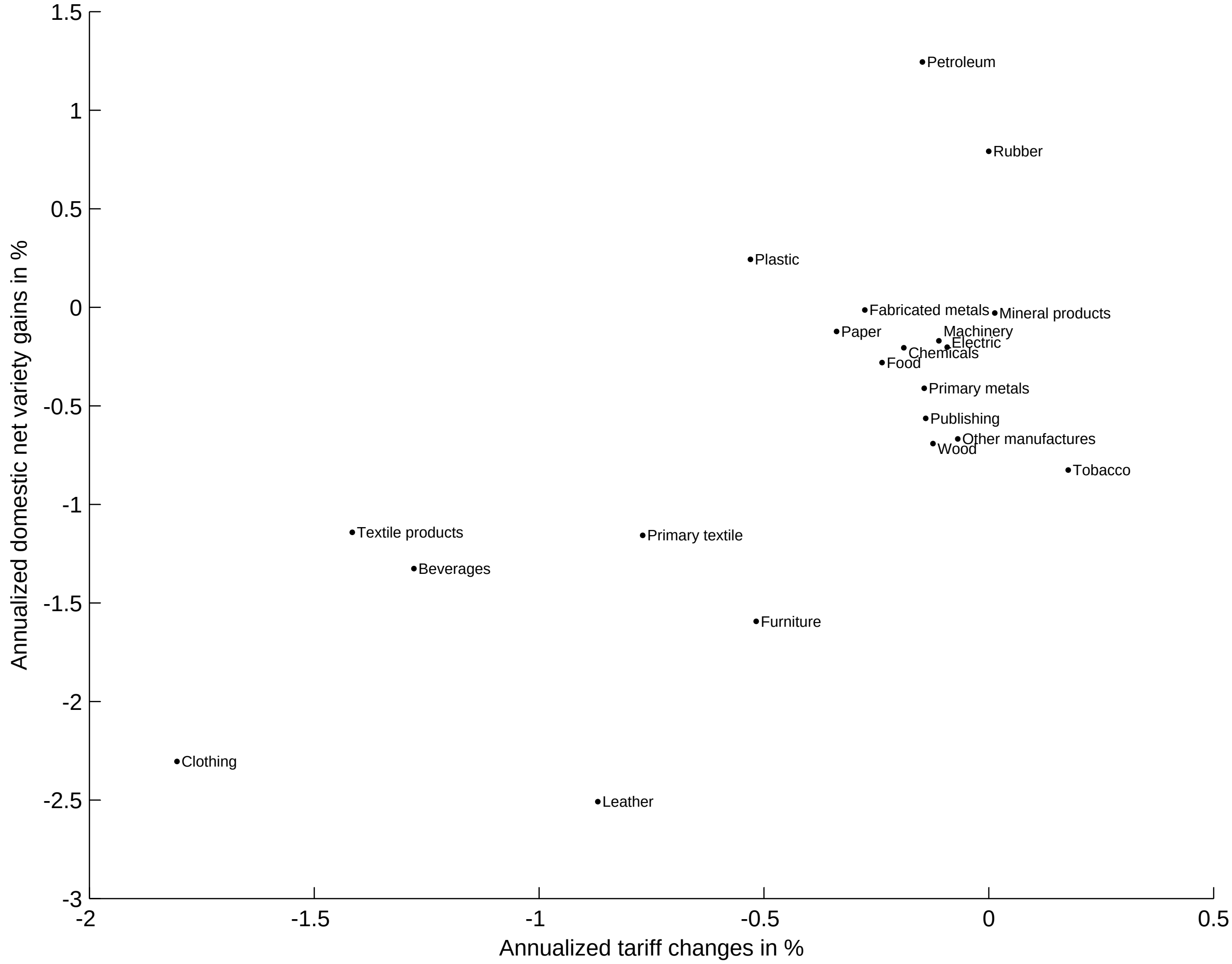

Figure 3: Domestic net productivity gains from CUSFTA

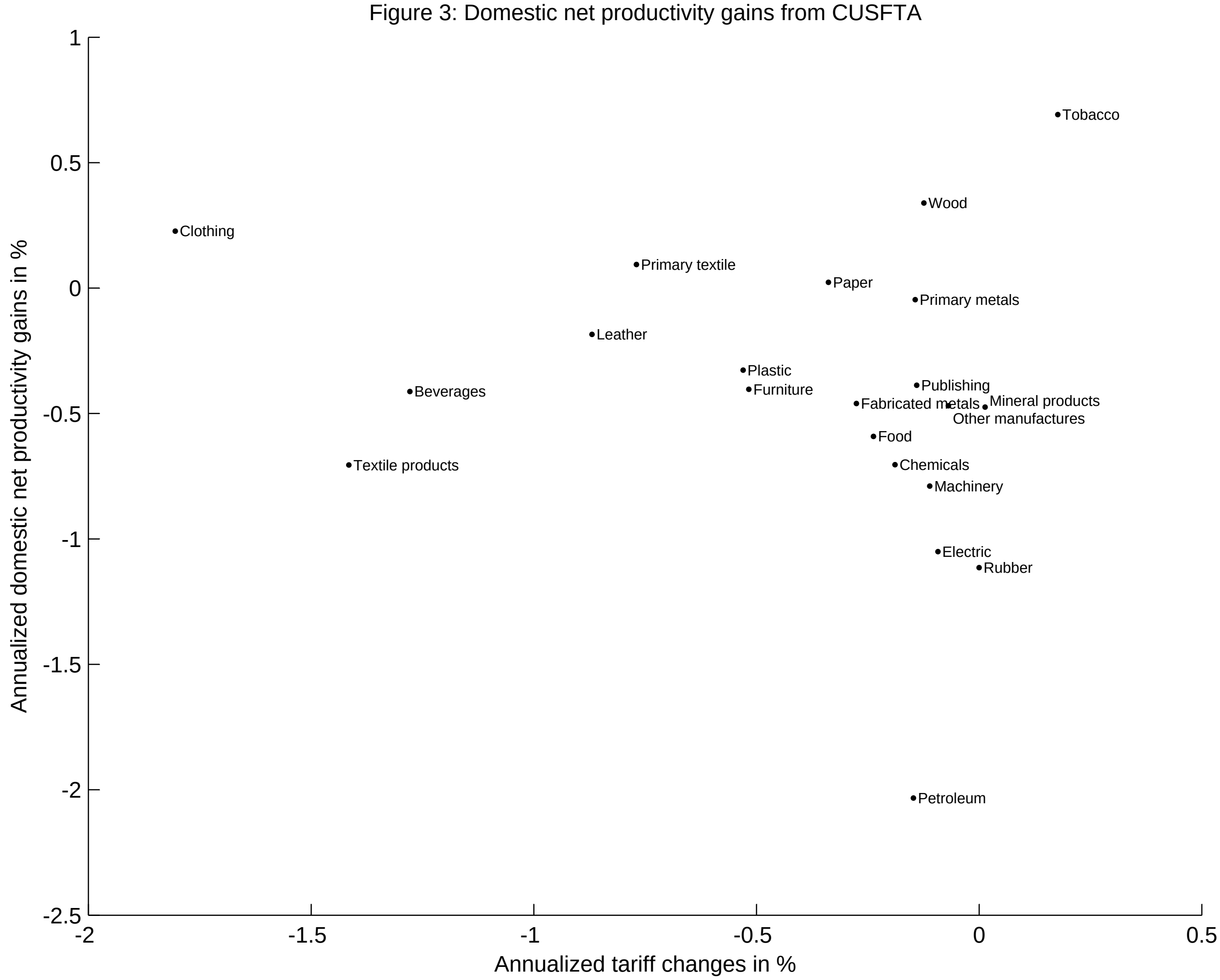

Figure 4: Overall foreign "new" gains from CUSFTA

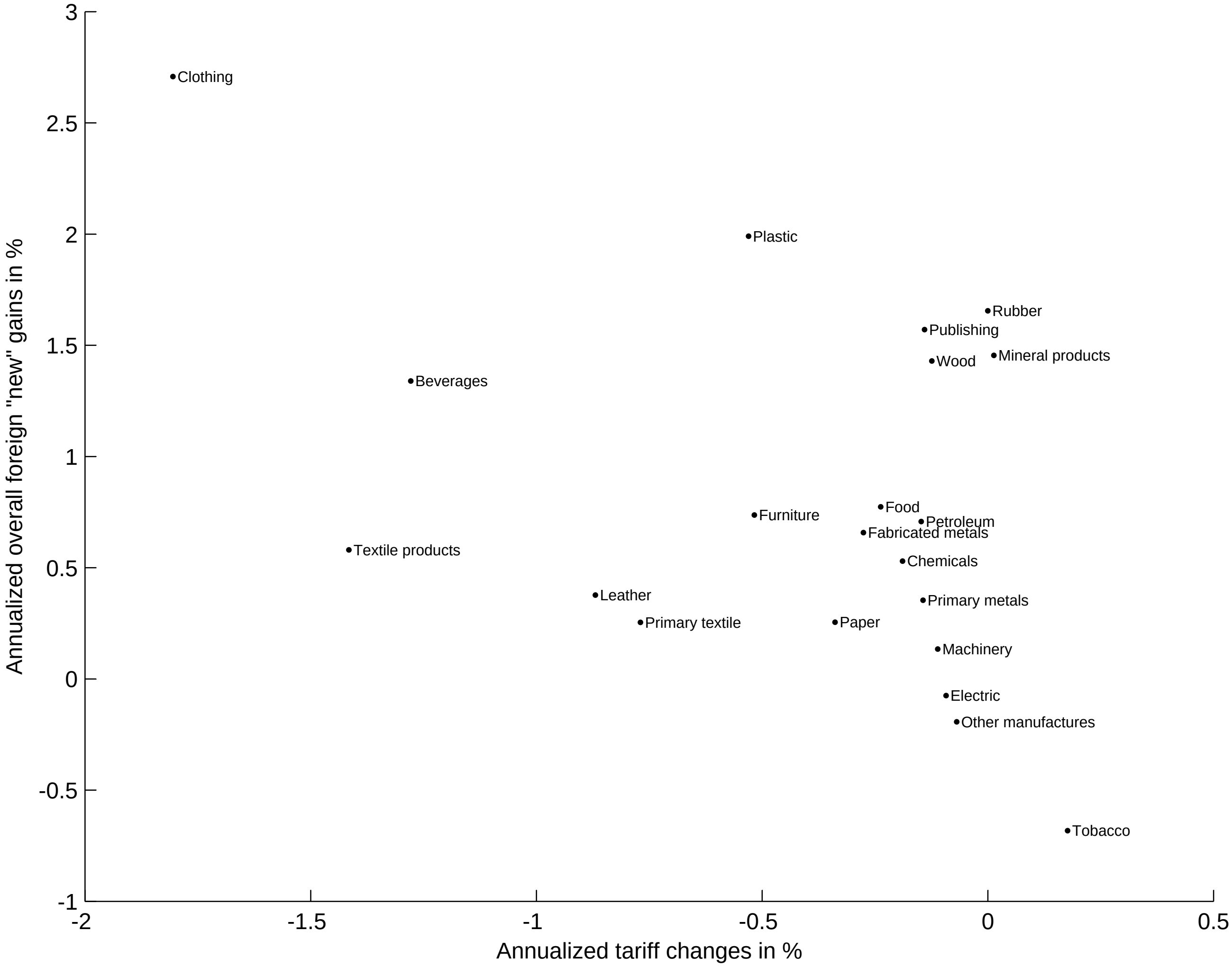

Figure 5: Foreign net variety gains from CUSFTA

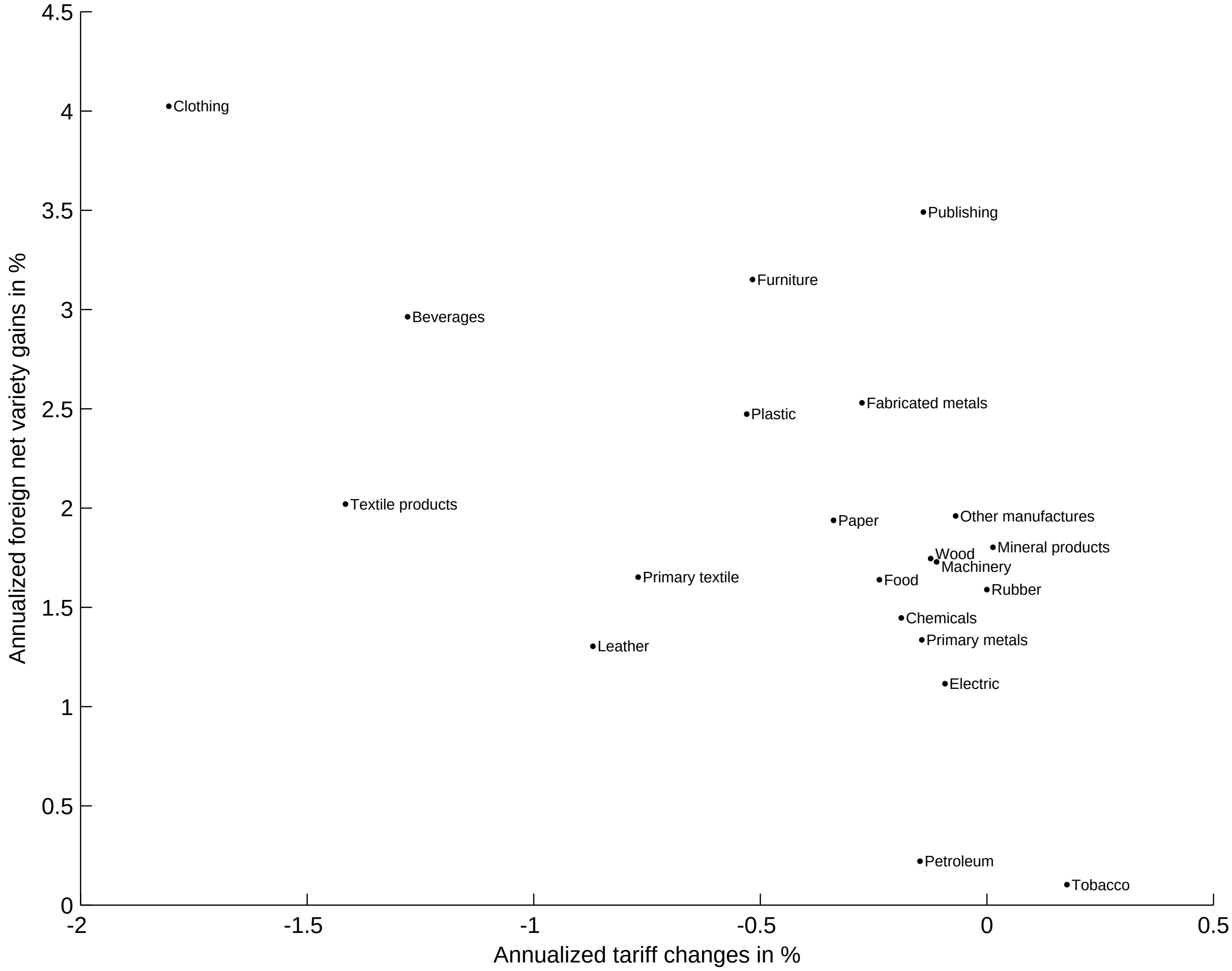

Figure 6: Foreign net productivity gains from CUSFTA

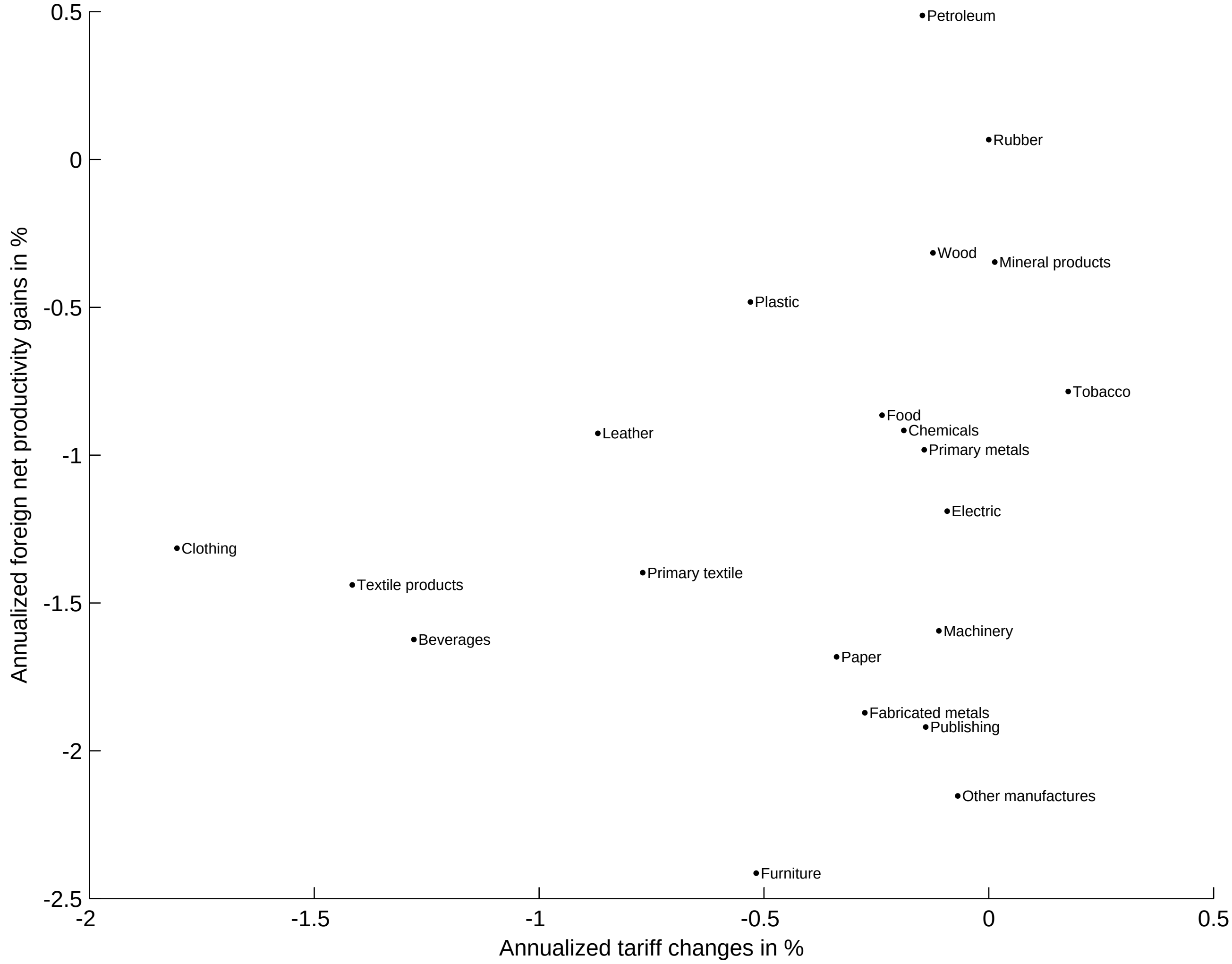

Figure 7: Overall domestic "new" gains from CUSFTA - exit only

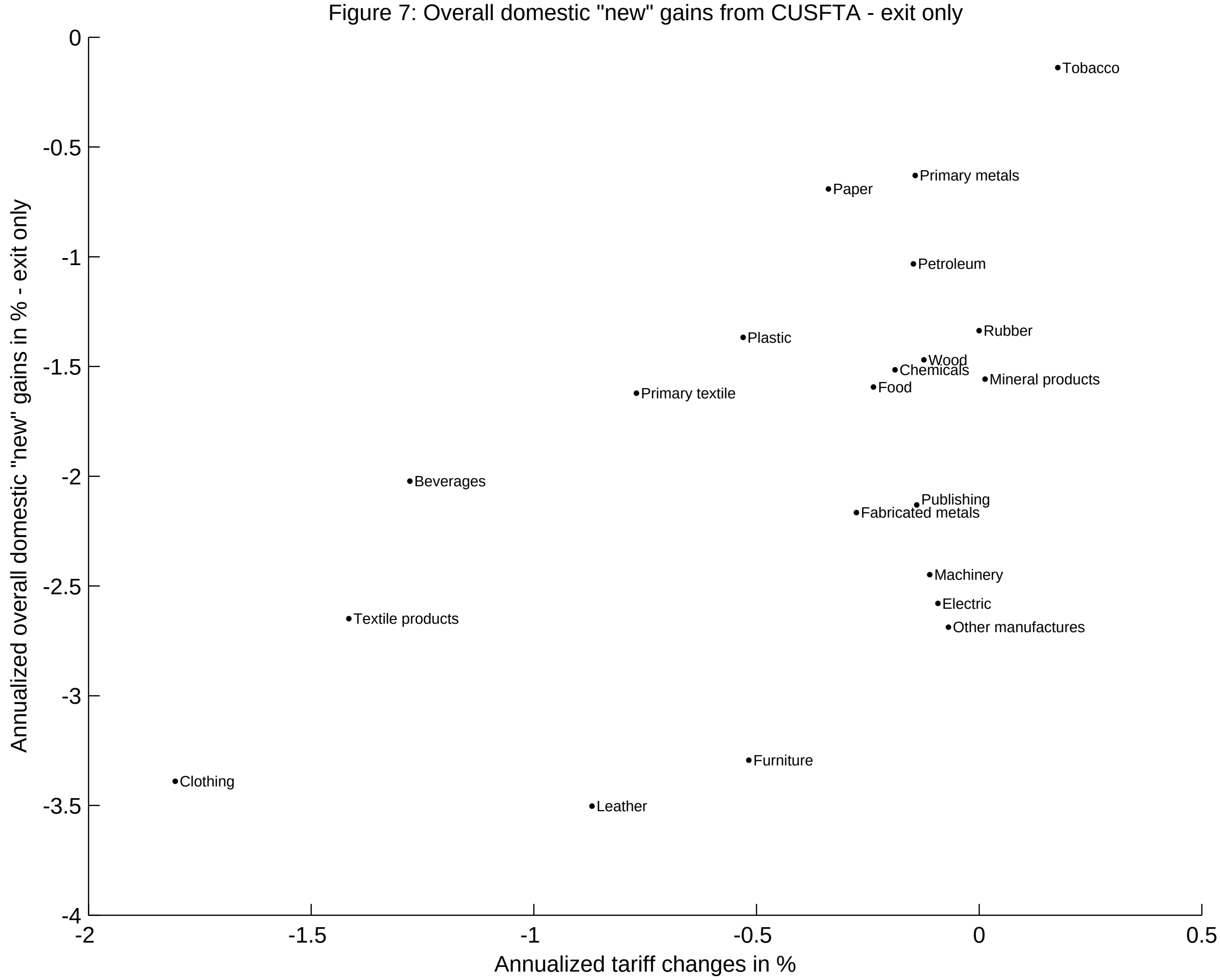

Figure 8: Overall domestic "new" gains from CUSFTA - entry only

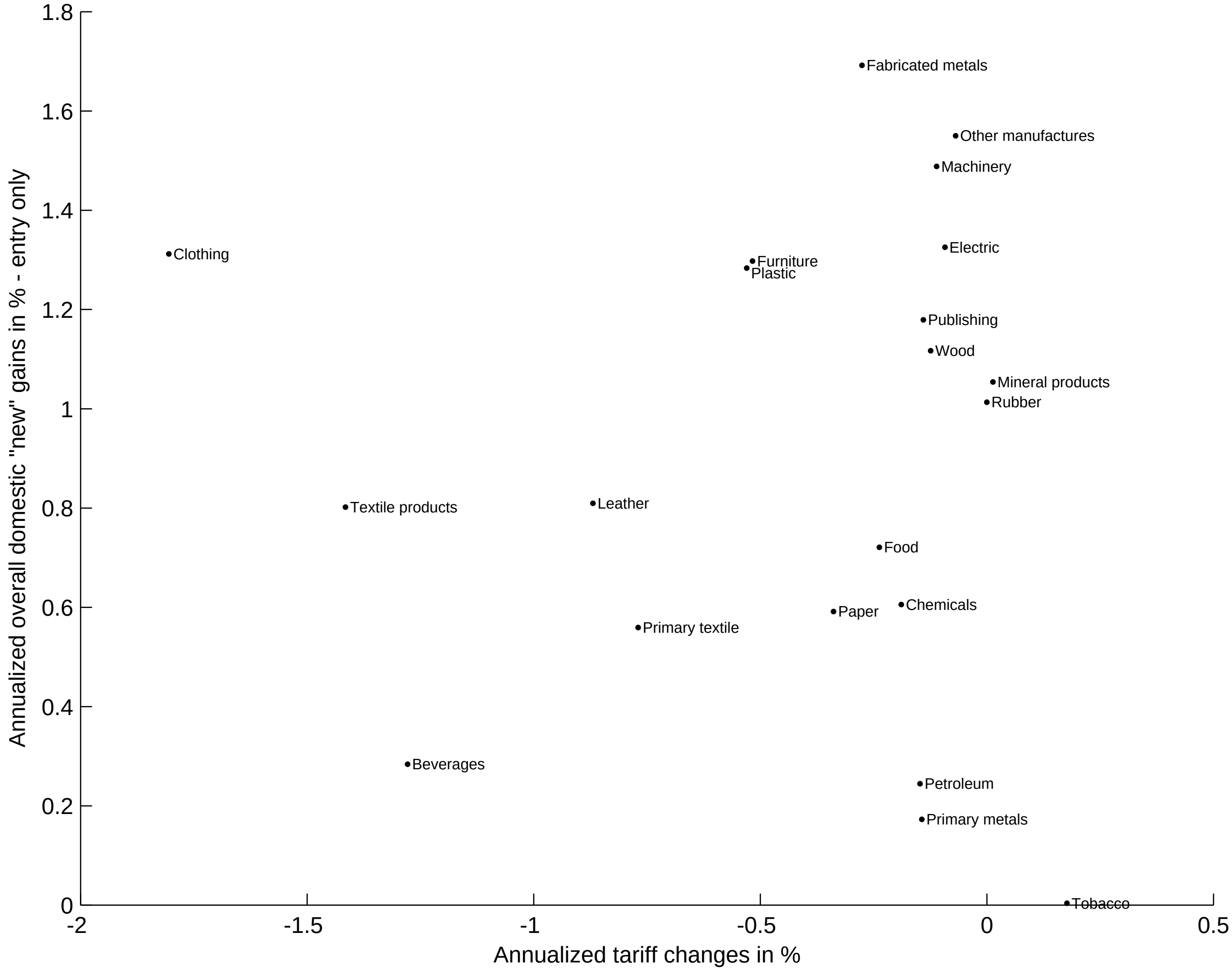

Figure 9: Domestic net variety gains from CUSFTA - exit only

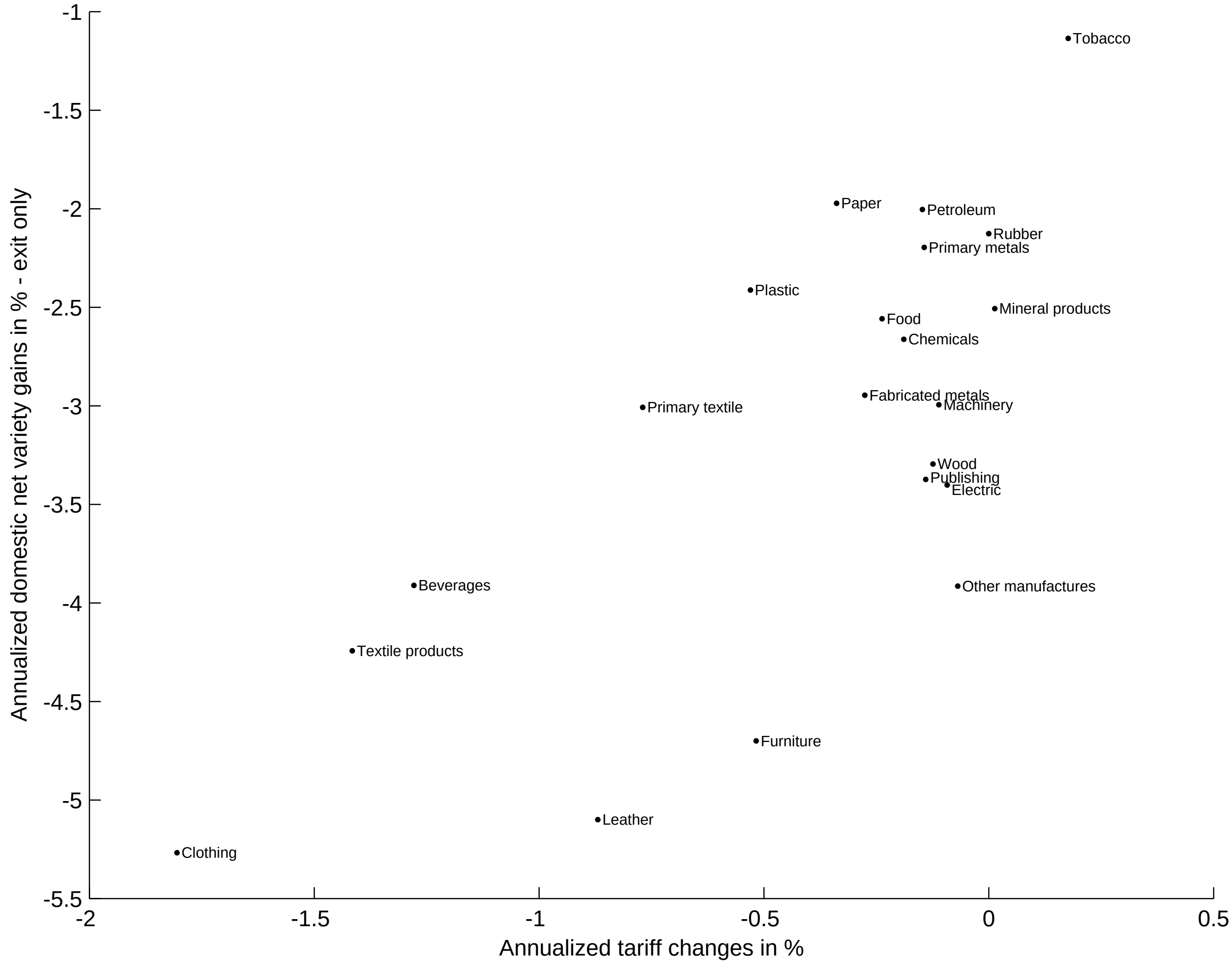

Figure 10: Domestic net productivity gains from CUSFTA - exit only