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Using the New Products Margin to Predict the Industry-Level Impact of Trade Reform*

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ABSTRACT

This paper develops a methodology for predicting the impact of trade liberalization on exports by industry (3-digit ISIC) based on the pre-liberalization distribution of exports by product (5-digit SITC). Using the results of Kehoe and Ruhl (2013) that much of the growth in trade after trade liberalization is in products that are traded very little or not at all, we predict that industries with a higher share of exports generated by least traded products will experience more growth. Using our methodology, we develop predictions for industry-level changes in trade for the United States and Korea following the U.S.-Korea Free Trade Agreement (KORUS). As a test for our methodology, we show that it performs significantly better than the applied general equilibrium models originally used for the policy evaluation of the North American Free Trade Agreement (NAFTA).

Keywords: Trade liberalization; Industry; Product
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1. Introduction

Employing the insight from Kehoe and Ruhl (2013) that products (5-digit SITC codes) that are traded very little or not at all are disproportionately responsible for changes in aggregate trade following trade reform, we hypothesize that these least traded products are important for predicting changes in industry-level (3-digit ISIC codes) trade after trade reform. In this paper, we develop a methodology to classify products as least traded and compute the share of exports in an industry accounted for by these products. We predict that industries with the highest shares of exports accounted for by least traded products will experience the largest increases in trade. Using this methodology, we predict what industries will experience the largest increases in trade between the United States and Korea following the implementation of their free trade agreement. We aggregate our industries in order to compare our predictions with those from standard general equilibrium models that use alternative industry definitions.

To demonstrate the usefulness of our methodology, we compare the actual changes in bilateral industry-level trade between Canada, Mexico, and the United States following the implementation of the North American Free Trade Agreement (NAFTA) with the ex-ante predictions generated by our methodology. We then compare the accuracy of our projections with those of a standard model that was used to predict the effects of NAFTA. We show that, in the case of NAFTA, our methodology performs better in its predictions, not only for the relative growth of trade by industry, but also for the absolute level of trade growth for each industry.

2. Growth in trade on the extensive margin

In this section, we develop a methodology based on the insight from Kehoe and Ruhl (2013): Much of the growth in trade following a trade liberalization occurs within the set of products that were not traded or were traded very little. We refer to growth in trade from products that were not previously traded or were traded very little as growth on the *extensive margin* or the *new products margin*. We refer to growth in trade from products that were previously traded in large amounts as growth on the *intensive margin*. Our methodology, based on that of Kehoe and Ruhl (2013), allows the cutoff for what products we consider to be least traded to vary across country pairs in order to take into account the relative importance of each product for a country's trade.

We define a *product* to be a 5-digit SITC Rev. 2 code. We sort all of the products from lowest to highest by their average value of trade over the first three years in our sample. (We average over three years to minimize the measure's dependence on any particular year.) Starting with the products with the least trade in the first three years, we then sum the value of trade in the base year until we accumulate a set of products that accounts for 10 percent of total trade in the base year. If a product is in that set, we classify it as a *least traded product*. Kehoe and Ruhl (2013) discuss alternative cutoffs for defining the set of least traded products, and consistent with their findings, the results of this paper are robust to modifications of our definition (for example, using 5 percent or 20 percent of total trade as the cutoff instead of 10 percent). Within the set of least traded products are products from different industries, where an industry — here a 3-digit ISIC Rev. 2 code — is itself a collection of products. A list of our industries and their descriptions are given in table 1. Adapting a concordance developed by Muendler (2009), we map each of the 1,836 5-digit SITC products into one of 37 3-digit ISIC industries, and then compute the share of trade accounted for by least traded products with each industry. How prevalent are these least traded products across industries? In table 4 we report the fraction of trade in an industry accounted for by least traded products in 2005. There are substantial differences across industries. For example, least traded products made up 67 percent of total textile exports (ISIC 321) from the United States to Korea in 2005, but only 7 percent of exports in the pottery, china, and earthenware industry (ISIC 361).

3. Predictions for U.S.-Korea FTA

The United States and Korea signed a free trade agreement, KORUS, in 2007, which was enacted in 2012. To make our predictions for the effects of KORUS, we look at bilateral trade at the product level between the United States and Korea from Comtrade and identify products as least traded or not using the base year of 2005. Using our concordance, we aggregate products into 3-digit ISIC industries and compute the share of least traded products in each industry. How is the level of least traded products in an industry related to the growth in trade in that industry following liberalization? Kehoe and Ruhl (2013) show that growth in least traded products can be explosive after liberalization, so it follows that industries with more least traded products would be expected to grow faster after liberalization than industries with fewer least traded products. Our prediction is that industries with higher shares of least traded products will experience more growth than industries with lower shares of least traded products.

We formulate our prediction of trade growth by industry as a simple linear function of the share of exports accounted for by least traded products in that industry. Specifically, we predict that the growth between period T_0 and T_1 in industry j will be

$$z_{ij}^k = \alpha_i^k + \beta_i^k s_{ij}^k, \tag{1}$$

where z_{ij}^k is the growth in exports from country i to country k in industry j deflated by GDP growth of the exporting country,

$$z_{ij}^k = 100\left(\frac{x_{ijT_1}^k / y_{iT_1}}{x_{ijT_0}^k / y_{iT_0}} - 1\right), \tag{2}$$

s_{ij}^k is the share of exports accounted for by least traded products in that industry, and α_i^k and β_i^k are constants. Here α_i^k is the average growth rate of nonleast traded products, and β_i^k is the additional growth generated by least traded products. Notice that as long as $\beta_i^k > 0$, all values of α_i^k and β_i^k give the same predictions for the relative growth across industries. One way we evaluate predictions versus observed changes in the data is to calculate correlations. Any series of predictions by industry of the form (1) generates the same correlation with a series of observations by industry if β_i^k is positive.

3.1 Parameterization

We need to choose values for α_i^k and β_i^k in order to use (1) to predict industry-level trade growth. We require these two parameters to generate aggregate predictions that match: first, the predicted total trade growth as measured by the gravity equation and, second, the cross-country average aggregate importance of the least traded products in total trade growth. The first condition is

$$\alpha_i^k + 0.1\beta_i^k = \hat{z}_i^k, \tag{3}$$

where the left-hand side of (3) is our model's prediction of total trade growth, and the right-hand side is the predicted trade growth from the gravity equation, which we specify below. The second condition is

$$\frac{\beta_i^k}{\alpha_i^k + 0.1\beta_i^k} = \gamma . \quad (4)$$

In (4), γ is the cross-country average of the ratio of the growth in trade of least traded products to overall growth in trade. In (4), as in (3), the left-hand side is a prediction of our model, and the right-hand side is an independent data moment. Given values of γ and $\hat{z}_i^k$, we solve the system of equation defined by (3) and (4) for α_i^k and β_i^k.

The value for γ comes from table 2 in Kehoe and Ruhl (2013). They estimate that γ is 3.59 using data on 1,913 bilateral country pairs covering 1995–2005. We find $\hat{z}_i^k$ by estimating a gravity equation using 2005 data,

$$\begin{aligned} \log x_i^k = {} & \lambda_\tau \log\left(1+\tau_i^k\right) + \lambda_2 \log y_i + \lambda_3 \log y_k + \lambda_4 \log d_i^k + \lambda_5 \log\left(\frac{y_i}{pop_i}\right) + \\ & \lambda_6 \log\left(\frac{y_k}{pop_k}\right) + \lambda_7 \text{border}_i^k + \lambda_8 \text{common\_lang}_i^k + \lambda_9 \text{colony}_i^k + \lambda_{10} + \varepsilon_i^k \end{aligned}, \quad (5)$$

where x_i^k is exports from country i to country k, τ_i^k is the average tariff rate, y_i is GDP, pop_i is population, and d_i^k is the distance between countries. We also include variables indicating whether the countries share a border, common language, or colonial relationship. The results of our gravity regression are listed in table 2. We estimate the coefficient on tariffs to be $\lambda_\tau = -3.51$, which we can use to predict the increase in trade corresponding to a decrease in tariffs from τ_i^k to $\tau_i^{k\prime}$ using the equation

$$\hat{z}_i^k = \exp\left(-\lambda_\tau \left[\log(1+\tau_i^k) - \log(1+\tau_i^{k\prime})\right] - 1\right) \times 100 . \quad (6)$$

Our estimate of λ_τ is comparable to the estimates found in the literature. Hayakawa (2013) estimates a coefficient on tariffs ranging from –3.35 to –4.08 depending on the exact specification of the gravity equation used.

For simplicity, we assume that a free trade agreement such as KORUS reduces tariffs to zero. Table 3 reports our results from equation (6). We suppress the subscripts and superscripts for countries and industries in our tables. We predict that total growth in bilateral trade will be 43.57 percent for U.S. exports to Korea and 14.14 percent for Korean exports to the United States. The massive difference is the result of initial tariffs that are significantly higher on U.S.

exports to Korea than they are on Korean exports to the United States. For our predictions using (1), we set $\alpha_{kor}^{usa} = 9.06$ and $\beta_{kor}^{usa} = 50.78$ for Korean exports to the United States and $\alpha_{usa}^{kor} = 27.92$ and $\beta_{usa}^{kor} = 156.46$ for Korean imports from the United States. We anticipate that future research will develop better methods of calculating α_i^k and β_i^k. For now, our primary focus remains on predicting the relative levels of growth across industries, for which α_i^k and β_i^k are irrelevant as long as $\beta_i^k > 0$.

3.2 KORUS predictions

Table 4 reports our predictions for each 3-digit ISIC industry. Our predictions vary widely across industries: For Korean exports to the United States, our predictions range from an increase of 9.1 percent in exports of beverages (ISIC 314) to an increase of 59.8 percent in exports of industries whose products are entirely least traded, such as glass and glass products (ISIC 362). For U.S. exports to Korea, our predictions are substantially higher, ranging from an increase of 27.9 percent for coal mining (ISIC 210) to 184.4 percent for entirely least traded industries. Another noticeable difference between our predictions on U.S. exports compared with our predictions on Korean exports is that there are fewer industries whose products are entirely least traded.

4. Predictions from other models

We compare our predictions with those from Kiyota and Stern (2007), which are based on the methodology and assumptions of the Brown-Deardorff-Stern model (Brown 1992, 1994; Brown, Deardorff, and Stern, 1992, 1995; Brown and Stern, 1989), and those from Yaylaci and Shikher (2014), which are based on the Ricardian framework of Eaton and Kortum (2002). Kiyota and Stern (2007) predict the changes in total imports and exports for 14 industries, as well as two service industries that we ignore, for Korea and the United States following liberalization. To make our results comparable to theirs, we aggregate the ISIC industries into their industries and compute the share of least traded products in each of those industries. Kiyota and Stern do not provide an exact concordance between the ISIC industries and their industries, so we develop one.

Kiyota and Stern focus on trade flows between Korea and the world and the United States and the world, whereas our methodology predicts bilateral trade flows. To make our predictions comparable to theirs, we apply our methodology to bilateral trade between the United States and Korea and assume that their trade with the rest of the world stays constant as a fraction of GDP. Tables 5 and 6 compare our results with those of Kiyota and Stern. There are significant differences in the predictions between the two methods: Our predictions have correlations with theirs that range from −0.27 for U.S. imports to 0.82 for Korean exports. There are especially large differences in relative growth rates between our predictions and those of Kiyota and Stern for Korean exports. They expect the least growth in mining followed by agriculture, whereas we expect those industries to experience the third most and second most growth, respectively. Both our predictions and Kiyota and Stern's predictions agree, however, that wearing apparel should experience the most growth among 14 industries for Korean exports. Despite the lower weighted correlation coefficient, there are no extremely large differences with regard to which industries we expect to grow the most for Korean imports. There is considerably more disagreement between our predictions and those of Kiyota and Stern for exports and imports to the United States. In particular, for imports to the United States, we expect textiles to be the fastest-growing industry, whereas Kiyota and Stern predict it will exhibit the second least growth, in fact growing less than GDP. This highlights another important difference: Kiyota and Stern predict trade to grow by less than GDP in some industries, whereas we do not predict trade to grow by less than GDP in any industries.

Yaylaci and Shikher (2014) predict the changes in bilateral trade for 15 manufacturing industries between the United States and Korea following liberalization. Yaylaci and Shikher lack predictions for the agricultural industry, so we exclude it from our predictions after classifying products as least traded. We follow the same methodology for computing the share of least traded products in each of their industries after aggregating our ISIC industries into their industries. Table 7 compares our predictions using their industry definitions with the predictions of Yaylaci and Shikher. Again, there are significant differences between them, with a correlation of 0.43 between our predictions and those of Yaylaci and Shikher for Korean exports to the United States and a correlation of 0.19 for U.S. exports to Korea. The largest difference is for Korean exports to the United States: We predict the paper industry will experience the most growth, whereas Yaylaci and Shikher predict it will experience the least growth of all industries. There are similarities as well: Yaylaci and Shikher predict, for example, that for Korean exports to the United States, food will exhibit the most growth, whereas we predict it will exhibit the second most growth. Similarly, we predict textiles will exhibit the most growth in U.S. exports to Korea, and Yaylaci and Shiker predict it will exhibit the second most growth.

5. Evaluating our methodology in the context of NAFTA

In this section, we evaluate the predictive power of our methodology by using it to "predict" the impact of NAFTA. We select 1989 as our base year and we use 2009 as our endpoint, since that is the year for full implementation of NAFTA. Our results are robust to selecting 2007 as our endpoint in order to avoid entangling the effects of NAFTA with the effects of the 2008–2009 recession and the fall in trade that accompanied it.

To parameterize the NAFTA model, we follow the procedure laid out in section 3.1, but we use only data that would be available in 1989. We estimate the gravity equation in (5) using 1989 data (results reported in table 2) and repeat the Kehoe and Ruhl (2013) exercise to estimate γ using 1978–1987 data. From our gravity regression we estimate $\lambda_\tau = -2.76$, which is lower than our estimate from our 2005 gravity equation. Estimating a gravity equation over multiple years of data would likely provide more stable estimates. We are not able to do this, however, because the TRAINS database does not provide tariff data before 1988. Using the 1978–1987 data, we estimate $\gamma = 3.65$, which is nearly identical to the estimate in Kehoe and Ruhl (2013), which uses 1995–2005 data. Table 8 contains the initial tariffs, predicted aggregate changes in trade, and our predicted α_i^k and β_i^k we use with equation (1) to make our NAFTA predictions for the United States, Canada, and Mexico. Tariffs for Mexican imports are unavailable for 1989, so we use Mexican tariffs in 1991 as the initial tariff levels.

5.1 Evaluating the parameterization methodology

We have estimated $\left(\alpha_i^k, \beta_i^k\right)$ for the NAFTA countries following the procedure in section 3.1, which uses only data that was available in 1989. Using the growth in trade that occurred following NAFTA, we can find the best possible coefficients given our statistical model's form and compare them with our estimates. These optimal coefficients are the solution to

$$\tilde{\alpha}_i^k, \tilde{\beta}_i^k = \arg\min \sum_{j=1}^{38} \omega_{ij}^k \left(\alpha_i^k + \beta_i^k s_{ij}^k - z_{ij}^{k,data}\right)^2, \tag{7}$$

where ω_{ij}^{k} is industry j's share of total exports from country i to k in 1989 and s_{ij}^{k} is the share of least traded products in each industry. The observed industry-level growth rate is $z_{ij}^{k,data}$. The observed industry growth rates, the share of least traded products in each industry, and the optimal coefficients are reported in tables 9–12. Take, for example, trade between Canada and the United States: Setting $\alpha_{usa}^{can} = -28.41$ and $\beta_{usa}^{can} = 114.46$ would have been the best possible linear prediction based on the least traded products data for U.S. exports to Canada, indicating that between 1989 and 2009, exports in the least traded set grew by 86.05 ($= -28.41 + 114.46$) percent more than U.S. GDP, whereas other exports grew 28.41 percent less than U.S. GDP.

Table 12 compares the optimal coefficients with our estimated coefficients that we used to make our NAFTA predictions. Overall, we find a correlation of 0.66 for $\tilde{\alpha}_{i}^{k}$ and α_{i}^{k} and a correlation of 0.63 for $\tilde{\beta}_{i}^{k}$ and β_{i}^{k}. These differences indicate that, while our methodology for estimating α_{i}^{k} and β_{i}^{k} performs reasonably well, there remains room for improvement.

5.2 Robustness

A potential concern is that higher growth rates for least traded products are driven by larger declines in tariffs. As evident in table 13, the least traded products are indeed subject to higher initial tariffs, and larger declines in tariffs from 1989–2009, when compared with non–least traded products. We use 1991 tariff data for Mexican imports, because tariff data are not available in 1989. We exclude the code 02242 (Dry Milk) for Canadian exports to Mexico as an outlier, because it experiences a tariff rate increase from 1.05 to 1.37, which skews the average tariff rate for non–least traded products upward. Table 13 shows that our assumption that a free trade agreement means the complete elimination of tariffs appears to be a good approximation of reality for the case of NAFTA. To investigate whether accounting for tariffs eliminates the finding that least traded products grow faster following trade liberalization, we estimate a modified version of (7) that incorporates tariff data,

$$\min_{\alpha_i^k, \beta_i^k} \sum_j \omega_{ij}^k \left(\alpha_i^k + \beta_i^k s_{ij}^k + \zeta_i^k \tau_{ij}^k - z_{ij}^{k\,data} \right)^2, \qquad (8)$$

where τ_{ij}^{k} is the average tariff rate in 1989.

As a further robustness check, we compute (7) and (8) using product-level trade and tariff data, where each j corresponds to a single product. The resulting estimates for α_i^k and β_i^k are reported in table 14 and show that accounting for tariffs does not significantly impact the degree to which least traded products grow more than non–least traded products. The only possible exception is for U.S. exports to Mexico, where our estimate of β_i^k falls significantly when estimated using industry-level data. When we estimate β_i^k using product-level data, however, we find no significant decrease after controlling for initial tariffs. Differences in tariffs do not appear to be responsible for the higher growth rates of least traded products.

There is room for future research to investigate other ways in which the new products margin may interact with other traditional determinants of trade flows. For example, it may be that least traded products exhibit more growth when an exporter exhibits a revealed comparative advantage in those products.

6. Predictions of NAFTA models

The previous section compared our results with the best possible linear forecasting model. In this section, we compare our results with those from general equilibrium models that were used to forecast the effects of NAFTA. To develop a baseline for judging our predictions for NAFTA, we follow Fox (1999) and Kehoe (2005) and evaluate the performance of one of the most prominent of the models built to analyze NAFTA, the Brown-Deardorff-Stern (BDS) model (Brown 1992, 1994; Brown, Deardorff, and Stern, 1992, 1995; Brown and Stern, 1989). In this section, we compare the predictions made by the BDS model and our forecasting model with the observed growth in trade following NAFTA. In the appendix, we perform similar comparisons for two alternative models of NAFTA.

6.1 The BDS model and the data

The BDS model made predictions at the industry level, where each of their 23 industries is defined as an aggregate of ISIC 3-digit industries. After aggregating our ISIC industries into the BDS industries, we compute the percentage growth in exports for each industry deflated by GDP growth. We report the industry-level export growth rates from the data and the predictions of the BDS model in tables 15–17.

We use two criteria to compare the predictions of the BDS model with the data: the weighted correlation coefficient between the model predictions and the data, where the weights are the 1989 trade volumes, and the estimated coefficients a_i^k and b_i^k from the regression

$$\min_{a_i^k, b_i^k} \sum_{j=1}^{23} \omega_{ij}^k \left(a_i^k + b_i^k z_{ij}^{k,model} - z_{ij}^{k,data} \right)^2, \tag{9}$$

where, again, j indexes the industry. The deviation of the coefficient b_i^k from 1 indicates how poorly the model does in predicting the signs and the absolute magnitudes of the changes in the data. In particular, b_i^k tells us whether the differences across industries are underpredicted ($b_i^k > 1$), overpredicted ($0 < b_i^k < 1$), or predicted in the wrong direction ($b_i^k < 1$).

We report the estimated coefficients from (9) for the NAFTA pairs in tables 15–17. Take, for example, exports from Canada to the United States, which we report in table 15. The BDS model does a poor job of predicting Canadian exports to the United States: The weighted correlation between the model's predictions and the data is negative (−0.28), and the coefficients from (9) that come closest to the data involve multiplying all of the predicted growth rates by −3.33 and adding 21.82.

6.2 The BDS model and our predictions

To make the predictions from our methodology comparable to the BDS predictions, we adjust our industry definitions to match those in BDS. Using the methodology laid out in section 3.1, we form our predictions for the NAFTA countries and report our results in tables 15–17 alongside the results from the BDS model. We find that our predictions based on the initial fraction of least traded products considerably outperform the BDS model for each country pair. Returning to the example of Canadian exports to the United States (see table 15), we see that our predictions perform well, with a weighted correlation of 0.30 and the linear function of the prediction that comes closest to the data involving multiplying all of the predicted growth rates by 4.17 and subtracting 52.64. That our predictions significantly outperform the predictions in BDS for Canadian exports to the United States can be seen in figures 1 and 2, which plot the regression lines resulting from (9) in a bubble plot, where the size of each bubble corresponds to that industry's weight.

Table 18 contains the corresponding statistics for all six of the bilateral North American country pairs. Notice that the BDS model had almost no predictive power for the impact of NAFTA by industry. In a regression on the pooled data for all six pairs, the coefficient b put on the predictions of the BDS model is 0.17, and when we allow b to differ by country pair, the weighted average is −0.94 compared with 2.49 and 2.85 for our predictions.

Table 19 compares the overall accuracy of our predictions with the accuracy of the BDS predictions. In this table we compare the average absolute percentage difference between the predictions and the actual growth over 1989–2009. Our predictions outperform the BDS predictions significantly. We also compare the accuracy of "predictions" based on the optimal coefficients from (7). Although these are not true predictions since they make use of ex-post data, they establish an upper bound of how useful predictions of the form (1) can be. We see that the best fit estimates perform very well, especially for bilateral trade involving Mexico. This suggests that there are large potential gains in accuracy from an improved methodology for estimating α_i^k and β_i^k .

It is worth stressing that this failure of the BDS model is not specific to this particular model. We focus on the BDS model because it is a widely used and well-documented model built to analyze the impact of NAFTA, and it has predictions for all directions of bilateral trade between Mexico, Canada, and the United States. Kehoe (2005) argues that two other models that were very prominent in policy discussions of NAFTA, the Cox-Harris model of Canada (Cox, 1994, 1995; Cox and Harris 1985, 1992a, 1992b) and the Sobarzo model of Mexico (Sobarzo, 1992a, 1992b, 1994, 1995), also perform poorly in this sort of exercise. In the appendix, we show that we achieve similar results with the Sobarzo model and the Cox-Harris model as well. It is also important to note that the sorts of models used to analyze NAFTA are still being employed to analyze trade policies around the world, so we expect our predictions to fare similarly against those from more recent papers. See, for example, Brown, Kiyota, and Stern (2005), Ciuriak and Chen (2007), DeRosa and Gilbert (2004), Francois, Rivera, and Rojas-Romagosa (2008), Lips and Rieder (2005), U.S. International Trade Commission (2004), as well as Kiyota and Stern (2007).

Why do these models have difficulty explaining industry trade patterns after liberalization? As Kehoe (2005) explains, the models used to predict the impact of NAFTA could not pick up increases in exports on the extensive margin, or new products margin, because of the assumptions made in these models. In particular, the sorts of Armington aggregators and Dixit-Stiglitz utility functions used in these models, along with no fixed costs of exporting, allowed only increases on the intensive margin.

6.3 Analysis

To get some idea of what drives our results, we examine an industry where the simple least traded products exercise does better than the BDS model: Canadian exports of chemicals to the United States, which grew 99.6 percent while the BDS model predicted −3.1 percent. The disaggregated data for this industry show that the chemicals industry is made up of 318 5-digit SITC categories. Of the 318 categories, 296 are least traded Canadian exports. Compared with Canadian GDP, the least traded chemicals increased by 187 percent, whereas the other non-least traded chemicals increased by only 47 percent. The growth in least traded products is far from uniform: For example, exports of the code 51571 (Sulphonamides) increased by 3,424 percent more than Canadian GDP, 58241 (Polyamides in primary forms) increased by 4 percent, and 58241 (Chlorine) decreased by 28 percent compared with Canadian GDP.

Products that report zero trade in 1989 are classified as least traded products, and if they report positive trade in 2009, that trade is counted toward the growth rate for least traded products. Notice, however, that the number of zero traded products has no influence on our shares s_i of least traded products in each industry in 1989. This means that the essential products in terms of generating any predictive power from our exercise are not products reporting zero trade, but products that are positively traded, although with very small amounts of trade. Arkolakis (2010) shows that the importance of products with small, nonzero trade to overall trade growth can be explained by marketing costs and the number of consumers that purchase a product. This additional margin for growth is diminishing for products with large amounts of trade and causes products with small, yet positive trade to experience higher levels of growth.

6.4 Prices and quantities

Although our exercises look at changes in the value of trade, our results are primarily driven by changes in quantities rather than changes in prices. To show this, we examine all products for which we have quantity data and decompose the changes in real value into changes in price and changes in quantity, where real value is taken to be the reported level of trade converted to the exporting country's national currency and then deflated by the exporting country's producer price index. We then compute a weighted average of this decomposition, using the initial trade value as each product's weight. To reduce the effect of outliers, we do not include products in the top and bottom fifth percentile of products in terms of the percentage of growth accounted for by changes in quantity. These results are shown in table 20, where we see that on average, 86.9 percent of all changes in value are due to changes in quantities. When more than 100 percent of the change is due to changes in quantities, this indicates that prices decreased while the total value of trade increased or vice versa.

7. Conclusions

This paper provides a methodology for predicting changes in bilateral trade across industries following a trade liberalization. Using this methodology, we provide estimates for growth in trade across industries for the United States and Korea following KORUS. We also evaluate our methodology in the context of NAFTA and show that our methodology — which exclusively focuses on least traded products — would have yielded better predictions than the general equilibrium models employed at the time. Our results suggest that researchers should include the new products margin in any analysis of the impact of trade reform. We hope this finding will spur the development of models that are consistent with the expansion of trade on the new products margin so that we can improve our ability to predict the effects of trade reforms and so that we can perform counterfactual analyses of alternative reforms.

Appendix: Other models of NAFTA

As shown in Kehoe (2005), the poor predictions of the BDS model are not unique, and other applied general equilibrium models predicting the effects of NAFTA performed in a similarly poor fashion. To show that our results extend beyond just the BDS model of NAFTA, we examine the Sobarzo model of Mexico (Sobarzo, 1992a, 1992b, 1994, 1995) and the Cox-Harris model of Canada (Cox, 1994, 1995; Cox and Harris 1985, 1992a, 1992b).

The Cox-Harris model predicted the changes in exports and imports between Canada and the World for 14 different industries. Since a concordance from the ISIC classification to the Cox-Harris industries is not provided in the original paper, we adapt the one provided in Kehoe (2005). We use imports and exports from Canada to the World, both as reported by Canada, from Comtrade as our base data and follow the same methodology we used for evaluating the BDS model. Since the Cox-Harris predictions are for total imports and exports for Canada, we follow the same procedure as we did for the Kiyota and Stern (2007) predictions for Korea, using the World as a trading partner. In our results shown in table A1, we see that the results are similar to what we found when evaluating the BDS model. We report our predictions instead of the share of least traded products, since the two are no longer perfectly correlated. The Cox-Harris model had very little predictive power for both imports and exports, whereas using the share of least traded products in each industry performed significantly better at matching the relative changes in industry trade, achieving a weighted correlation of the data of 0.24 for exports and 0.42 for imports compared with the weighted correlations of 0.06 and 0.04, respectively, for the Cox-Harris model.

The Sobarzo model predicted the changes in imports and exports between Mexico and North America for 21 different industries, where North America is considered to be Canada and the United States. Since Sobarzo does not provide a concordance between ISIC and its industries, we adapt the concordance given in Kehoe (2005). We use the same base 5-digit SITC data as we did for the BDS exercise, constructing the share of least traded products for imports and exports between Mexico and the United States and Mexico and Canada separately. We then predict the increase in trade by industry separately for Mexico-U.S. and Mexico-Canada before combining the predictions to generate overall predictions for growth in imports and exports between Mexico and North America. After that we again follow the same methodology as we did for the BDS exercise, and we find that the Sobarzo model does poorly in predicting both imports and exports between North America and Mexico. As summarized in table A2, the weighted correlation between the Sobarzo model's predictions and the data is negative (−0.12) for imports from North America to Mexico, whereas the correlation between the share of least traded products in an industry and the industry's growth is much higher (0.47). For exports to North America from Mexico, the correlation between the predictions and the data is much better (0.43) and in fact does better than using the share of least traded products (0.05). The poor performance of the least traded exercise seems to stem from considering the predictions for Mexico with Canada and the United States jointly rather than Mexico-Canada and Mexico-U.S. separately. In particular, in table 18 we see that when we consider them separately, the weighted correlation between our predictions and the data is 0.33 for Mexican exports to Canada and 0.17 for Mexican exports to the United States. When the predictions are computed separately and then aggregated together, however, the weighted correlation drops to 0.05 (see table A2). How the aggregation of individual countries into regions affects the predictions from our least traded exercise is something that merits further study.

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Table 1
ISIC industry codes and descriptions

ISIC code	industry name
111	Agriculture and livestock production
113	Hunting, trapping and game propagation
121	Forestry
122	Logging
130	Fishing
210	Coal mining
220	Crude petroleum and natural gas production
230	Metal ore mining
290	Other mining
311–312*	Food manufacturing
313	Beverage industries
314	Tobacco manufactures
321	Manufacture of textiles
322	Manufacture of wearing apparel, except footwear
323	Manufacture of leather and products of leather, leather substitutes and fur
324	Manufacture of footwear
331	Manufacture of wood and wood and cork products, except furniture
332	Manufacture of furniture and fixtures, except primarily of metal
341	Manufacture of paper and paper products
342	Printing, publishing and allied industries
351	Manufacture of industrial chemicals
352	Manufacture of other chemical products
353	Petroleum refineries
354	Manufacture of miscellaneous products of petroleum and coal
355	Manufacture of rubber products
356	Manufacture of plastic products not elsewhere classified
361	Manufacture of pottery, china and earthenware
362	Manufacture of glass and glass products
369	Manufacture of other non-metallic mineral products
371	Iron and steel basic industries
372	Non-ferrous metal basic industries
381	Manufacture of fabricated metal products
382	Manufacture of machinery except electrical
383	Manufacture of electrical machinery apparatus, appliances and supplies
384	Manufacture of transport equipment
385	Manufacture of professional and scientific equipment
390	Other manufacturing industries

*311–312 is considered by the United Nations to be one Major Group (3-digit code) within the Division (2-digit code) 31, Manufacture of Food, Beverages and Tobacco, within the Major Division (1-digit code) 3, Manufacturing. It has eleven Groups (4-digit codes).

Table 2
Gravity regression results

variable	estimate (std error)	estimate (std error)	estimate (std error)	estimate (std error)
Initial tariffs	−2.755	−2.085	−3.511	−3.371
	(0.454)	(0.617)	(0.411)	(0.440)
Exporter GDP	1.191	1.112	1.252	1.215
	(0.026)	(0.032)	(0.011)	(0.014)
Importer GDP	0.743	0.690	0.986	0.994
	(0.040)	(0.048)	(0.013)	(0.015)
Distance	−1.135	−0.987	−1.520	−1.312
	(0.098)	(0.105)	(0.034)	(0.036)
Exporter GDP per capita		0.260		0.093
		(0.049)		(0.020)
Importer GDP per capita		0.100		−0.032
		(0.078)		(0.023)
Border		1.108		1.208
		(0.382)		(0.168)
Common language		0.820		0.988
		(0.162)		(0.065)
Colonial relationship		−0.517		0.638
		(0.270)		(0.143)
Constant	6.173	3.164	4.413	2.177
	(1.101)	(1.271)	(0.334)	(0.383)
Year	1989	1989	2005	2005
Observations	1,280	1,280	9,833	9,833

Notes: Bilateral aggregate trade data downloaded from UN Comtrade.

Gravity regression uses effectively applied average tariff rates obtained from the TRAINS (Trade Analysis and Information System) database accessed through WITS (World Integrated Trade Solution).

All other gravity variables are from the CEPII Gravity Dataset from Head, Mayer, and Ries (2010) and Head and Mayer (2013). Common_lang is if a common language is spoken by at least 9 percent of the population. Colony is if a colonial relationship has ever existed.

Sample includes all countries with data available for all variables in the given year.

Table 3
Initial tariffs (τ_i^k) and our predicted changes in U.S.-Korea trade relative to exporter's GDP (percent)

exporter	importer	initial tariffs	predicted change in trade	estimated α	estimated β
United States	Korea	10.85	43.57	27.92	156.46
Korea	United States	3.84	14.14	9.06	50.78

Table 4
Our predicted changes in Korea-U.S. trade relative to exporter's GDP (percent)

Korea to United States						United States to Korea					
ISIC code	pred. growth	share least traded	ISIC code	pred. growth	share least traded	ISIC code	pred. growth	share least traded	ISIC code	pred. growth	share least traded
111	59.8	1.00	**342**	32.8	0.47	**111**	36.5	0.05	**342**	52.8	0.16
113	59.8	1.00	**351**	26.4	0.34	**113**	34.0	0.04	**351**	55.9	0.18
121	59.8	1.00	**352**	32.5	0.46	**121**	33.1	0.03	**352**	48.0	0.13
122	59.8	1.00	**353**	13.2	0.08	**122**	51.7	0.15	**353**	33.2	0.03
130	59.8	1.00	**354**	59.8	1.00	**130**	55.7	0.18	**354**	184.4	1.00
210	-	-	**355**	14.2	0.10	**210**	27.9	0.00	**355**	117.0	0.57
220	59.8	1.00	**356**	11.8	0.05	**220**	30.8	0.02	**356**	32.6	0.03
230	59.8	1.00	**361**	59.8	1.00	**230**	37.2	0.06	**361**	39.2	0.07
290	59.8	1.00	**362**	59.8	1.00	**290**	84.0	0.36	**362**	100.9	0.47
311*	38.3	0.58	**369**	15.3	0.12	**311***	56.3	0.18	**369**	122.2	0.60
313	59.8	1.00	**371**	14.4	0.11	**313**	95.0	0.43	**371**	121.7	0.60
314	9.1	0.00	**372**	30.1	0.41	**314**	184.4	1.00	**372**	43.8	0.10
321	32.2	0.46	**381**	29.8	0.41	**321**	132.8	0.67	**381**	52.8	0.16
322	25.2	0.32	**382**	12.9	0.08	**322**	184.4	1.00	**382**	42.6	0.09
323	59.8	1.00	**383**	10.1	0.02	**323**	58.1	0.19	**383**	33.6	0.04
324	59.8	1.00	**384**	9.4	0.01	**324**	184.4	1.00	**384**	32.6	0.03
331	59.8	1.00	**385**	34.1	0.49	**331**	60.8	0.21	**385**	36.2	0.05
332	14.3	0.10	**390**	26.4	0.34	**332**	78.4	0.32	**390**	68.6	0.26
341	59.8	1.00				**341**	39.1	0.07			

*311 is the single Major Group 311–312.

Table 5
Predicted changes in Korean trade relative to Korean GDP
in the Kiyota-Stern model (percent)

industry	**Korean exports to World**			**Korean imports from World**		
	Kiyota-Stern predictions	**predictions using fraction least traded**	**2005 fraction least traded**	**Kiyota-Stern predictions**	**predictions using fraction least traded**	**2005 fraction least traded**
Agriculture	−0.6	6.9	1.00	10.6	11.0	0.05
Chemicals	1.0	2.0	0.25	3.5	9.8	0.15
Food, bev., and tobacco	6.9	4.8	0.50	7.6	10.0	0.19
Leather and footwear	7.7	3.0	1.00	0.6	3.3	0.34
Machinery and equip.	−0.2	1.7	0.04	1.8	6.4	0.06
Metal products	0.4	2.3	0.24	1.7	3.9	0.18
Mining	−1.8	6.2	1.00	1.0	0.3	0.08
Misc. manufactures	5.3	2.1	0.27	4.2	7.9	0.08
Natural resources	0.6	3.0	1.00	1.3	5.3	0.16
Nonmetallic min. prod.	0.2	4.8	0.47	3.4	9.5	0.46
Textiles	8.6	2.9	0.44	3.6	6.2	0.67
Transportation equip.	2.7	1.9	0.01	2.1	9.7	0.03
Wearing apparel	27.7	11.6	0.33	−6.0	3.1	1.00
Wood products	0.2	3.9	0.39	2.0	8.1	0.11
KS-LTP weighted correlation			**0.82**			**0.64**

Note: 2005 fraction least traded is for U.S.-Korea trade, not total trade with World.

Table 6
Predicted changes in United States trade relative to U.S. GDP in the Kiyota-Stern model (percent)

industry	U.S. exports to World			U.S. imports from World		
	Kiyota-Stern predictions	predictions using fraction least traded	2005 fraction least traded	Kiyota-Stern predictions	predictions using fraction least traded	2005 fraction least traded
Agriculture	4.4	1.4	0.07	0.2	0.1	1.00
Chemicals	0.4	1.7	0.15	0.0	0.5	0.26
Food, bev., and tobacco	2.0	1.9	0.19	0.1	0.2	0.56
Leather and footwear	0.4	2.4	0.23	−0.1	0.2	1.00
Machinery and equip.	0.3	1.4	0.05	0.0	0.5	0.04
Metal products	0.3	1.7	0.24	0.0	0.4	0.22
Mining	0.1	0.6	0.15	0.0	0.0	1.00
Misc. manufactures	0.5	1.4	0.08	0.0	0.3	0.40
Natural resources	0.4	4.2	0.15	0.0	0.3	1.00
Nonmetallic min. prod.	0.6	3.5	0.71	0.0	0.3	0.27
Textiles	−0.1	1.6	0.64	−0.4	1.1	0.46
Transportation equip.	0.0	0.6	0.02	−0.1	0.4	0.01
Wearing apparel	−0.1	2.0	0.70	−0.5	0.4	0.32
Wood products	0.1	1.3	0.23	0.0	0.2	0.58
KS-LTP weighted correlation			**0.20**			**−0.27**

Note: 2005 fraction least traded is for U.S.-Korea trade, not total trade with World.

Table 7
Predicted changes in Korean trade relative to Korean GDP in the Yaylaci-Shikher model (percent)

industry	Korea to United States			United States to Korea		
	Yaylaci-Shikher predictions	predictions using fraction least traded	2005 fraction least traded	Yaylaci-Shikher predictions	predictions using fraction least traded	2005 fraction least traded
Chemicals	28.2	27.3	0.36	30.3	53.3	0.16
Electrical machinery	15.5	10.1	0.02	41.0	33.6	0.04
Food	70.1	37.7	0.56	422.3	57.9	0.19
Other machinery	8.9	12.9	0.08	31.9	42.6	0.09
Medical	9.9	34.1	0.49	45.0	36.2	0.05
Metals	9.3	15.9	0.13	17.0	59.7	0.20
Nonmetals	20.5	23.0	0.27	38.7	100.4	0.46
Other	11.8	26.4	0.34	28.5	68.6	0.26
Paper	1.4	43.4	0.68	5.5	41.8	0.09
Petroleum	2.2	15.4	0.12	7.2	33.2	0.03
Metal products	14.2	29.8	0.41	33.8	52.8	0.16
Rubber	19.8	13.6	0.09	48.0	55.0	0.17
Textile	56.3	29.0	0.39	63.5	130.0	0.65
Transportation equip.	23.3	9.4	0.01	33.9	32.6	0.03
Wood	7.9	19.5	0.21	21.1	66.5	0.25
KS-LTP weighted correlation			**0.43**			**0.19**

Table 8
Initial tariffs (τ_i^k) and our predicted changes in North American trade relative to exporter's GDP (percent)

exporter	importer	initial tariffs	predicted change in trade	estimated α	estimated β
Canada	Mexico	7.81	23.02	14.62	84.05
Canada	United States	4.26	12.18	7.73	44.47
Mexico	Canada	7.27	21.33	3.54	77.88
Mexico	United States	5.62	16.26	10.32	59.36
United States	Canada	13.85	42.96	27.27	156.84
United States	Mexico	13.70	42.44	26.95	154.95

Table 9
Changes in Canada-U.S. trade relative to exporter's GDP (percent)

Canada to United States						United States to Canada					
ISIC code	**1989–2009 growth**	**1989 share least traded**	**ISIC code**	**1989–2009 growth**	**1989 share least traded**	**ISIC code**	**1989–2009 growth**	**1989 share least traded**	**ISIC code**	**1989–2009 growth**	**1989 share least traded**
111	63.6	0.38	**342**	0.7	0.12	**111**	−3.1	0.17	**342**	−19.6	0.05
113	−19.2	1.00	**351**	42.1	0.35	**113**	−64.1	0.56	**351**	16.7	0.29
121	−4.5	1.00	**352**	502.8	0.58	**121**	7.1	1.00	**352**	116.6	0.16
122	−17.8	1.00	**353**	−80.3	0.07	**122**	−10.3	0.05	**353**	−43.1	0.13
130	−35.8	0.03	**354**	318.6	1.00	**130**	−12.3	0.21	**354**	−89.9	1.00
210	38.5	1.00	**355**	19.8	0.10	**210**	−53.6	0.00	**355**	7.1	0.05
220	291.3	0.00	**356**	77.6	0.09	**220**	457.6	0.04	**356**	62.5	0.06
230	−52.6	0.13	**361**	−79.9	1.00	**230**	−15.4	0.08	**361**	−11.0	1.00
290	−14.1	0.46	**362**	−45.7	0.40	**290**	−38.9	0.71	**362**	−20.0	0.23
311*	154.5	0.29	**369**	1.6	0.37	**311***	113.3	0.25	**369**	−0.8	0.54
313	−39.8	0.09	**371**	−12.7	0.36	**313**	350.4	0.22	**371**	53.5	0.28
314	−16.8	0.07	**372**	−20.9	0.07	**314**	−6.5	1.00	**372**	−20.8	0.11
321	42.4	0.77	**381**	17.7	0.20	**321**	−35.9	0.52	**381**	−5.3	0.16
322	50.2	0.59	**382**	−8.4	0.21	**322**	−3.0	1.00	**382**	−38.9	0.08
323	−67.7	1.00	**383**	−16.4	0.15	**323**	−64.0	0.61	**383**	−42.6	0.05
324	−49.9	1.00	**384**	−44.3	0.01	**324**	−67.2	0.34	**384**	−37.8	0.01
331	−54.5	0.01	**385**	91.9	0.42	**331**	−30.6	0.07	**385**	−6.0	0.14
332	−46.6	0.00	**390**	−14.9	0.51	**332**	22.5	0.00	**390**	−48.1	0.17
341	−65.9	0.04				**341**	13.7	0.15			
weighted correlation with data					0.23	**weighted correlation with data**					0.28
regression coefficient *a*					−42.75	**regression coefficient *a***					−48.31
regression coefficient *b*					3.35	**regression coefficient *b***					1.36

*311 is the single Major Group 311–312.

Table 10
Changes in Canada-Mexico trade relative to exporter's GDP (percent)

Canada to Mexico						Mexico to Canada					
ISIC code	1989–2009 growth	1989 share least traded	ISIC code	1989–2009 growth	1989 share least traded	ISIC code	1989–2009 growth	1989 share least traded	ISIC code	1989–2009 growth	1989 share least traded
111	415.2	0.03	**342**	1887.8	1.00	**111**	109.6	0.08	**342**	2412.5	1.00
113	-	-	**351**	953.9	0.20	**113**	−94.8	1.00	**351**	248.5	1.00
121	360.1	1.00	**352**	2122.2	0.39	**121**	64.8	1.00	**352**	304.0	0.80
122	-	-	**353**	489.2	1.00	**122**	-	-	**353**	-	-
130	247.4	0.07	**354**	-	-	**130**	−26.3	1.00	**354**	-	-
210	-	-	**355**	2709.5	0.44	**210**	-	-	**355**	2814.8	1.00
220	-	-	**356**	3707.4	0.00	**220**	140.1	0.00	**356**	899.7	0.11
230	242.8	0.26	**361**	1924.5	1.00	**230**	199.2	1.00	**361**	145.6	0.10
290	−41.9	0.01	**362**	519.7	1.00	**290**	−77.6	0.01	**362**	−13.0	1.00
311*	171.3	0.02	**369**	1491.8	1.00	**311***	174.9	0.48	**369**	140.9	1.00
313	4799.7	1.00	**371**	190.2	0.02	**313**	175.6	0.00	**371**	52.3	0.07
314	-	-	**372**	442.0	0.07	**314**	668.1	1.00	**372**	−50.9	0.45
321	656.4	0.49	**381**	2843.9	0.73	**321**	−39.2	0.29	**381**	276.9	0.05
322	3553.9	1.00	**382**	1360.5	0.19	**322**	703.5	1.00	**382**	124.0	0.08
323	165.1	1.00	**383**	2293.0	0.23	**323**	71.5	1.00	**383**	263.7	0.00
324	23.6	1.00	**384**	6352.2	0.27	**324**	−41.2	0.15	**384**	119.3	1.00
331	16636.0	0.97	**385**	1333.9	0.44	**331**	419.1	1.00	**385**	2784.4	0.44
332	12913.0	1.00	**390**	29.1	0.07	**332**	1402.1	0.01	**390**	−7.3	0.07
341	214.7	0.04				**341**	46.1	0.14			
weighted correlation with data					0.55	**weighted correlation with data**					0.32
regression coefficient *a*					−465.38	**regression coefficient *a***					45.44
regression coefficient *b*					27.09	**regression coefficient *b***					4.61

*311 is the single Major Group 311–312.

Table 11
Changes in Mexico-U.S. trade relative to exporter's GDP (percent)

Mexico to United States						United States to Mexico					
ISIC code	**1989–2009 growth**	**1989 share least traded**	**ISIC code**	**1989–2009 growth**	**1989 share least traded**	**ISIC code**	**1989–2009 growth**	**1989 share least traded**	**ISIC code**	**1989–2009 growth**	**1989 share least traded**
111	−10.0	0.05	**342**	212.3	1.00	**111**	48.5	0.08	**342**	194.9	0.13
113	31.2	1.00	**351**	−5.7	0.62	**113**	1.8	1.00	**351**	177.7	0.21
121	−8.1	1.00	**352**	150.2	0.48	**121**	−36.8	0.30	**352**	336.5	0.27
122	−94.7	1.00	**353**	−98.0	0.12	**122**	−71.2	1.00	**353**	−71.5	0.06
130	−66.2	0.08	**354**	50.8	1.00	**130**	63.9	0.18	**354**	−95.3	1.00
210	−99.9	1.00	**355**	110.4	1.00	**210**	1457.8	1.00	**355**	242.2	0.16
220	35.5	0.00	**356**	173.3	0.03	**220**	109.1	0.00	**356**	138.4	0.02
230	−75.3	0.25	**361**	82.0	0.41	**230**	37.6	0.19	**361**	39.0	0.47
290	−78.3	0.10	**362**	12.1	0.16	**290**	26.3	0.51	**362**	53.8	0.39
311*	98.8	0.41	**369**	−37.2	0.24	**311***	125.9	0.16	**369**	66.5	0.61
313	161.1	0.01	**371**	18.5	0.28	**313**	179.9	0.32	**371**	84.0	0.24
314	−61.8	1.00	**372**	53.8	0.12	**314**	504.2	1.00	**372**	104.6	0.12
321	89.6	0.72	**381**	80.4	0.30	**321**	125.7	0.43	**381**	84.7	0.14
322	449.4	0.42	**382**	171.3	0.14	**322**	63.9	0.24	**382**	102.8	0.09
323	−66.8	0.53	**383**	46.5	0.02	**323**	58.4	0.67	**383**	59.5	0.01
324	−62.1	0.03	**384**	127.0	0.02	**324**	−58.5	0.10	**384**	79.3	0.02
331	−74.8	0.12	**385**	235.3	0.24	**331**	−21.6	0.09	**385**	122.5	0.11
332	64.9	0.00	**390**	−59.8	0.24	**332**	6.6	0.00	**390**	51.0	0.17
341	−61.0	0.23				**341**	29.4	0.07			
weighted correlation with data					0.08	**weighted correlation with data**					0.41
regression coefficient *a*					48.50	**regression coefficient *a***					22.92
regression coefficient *b*					0.66	**regression coefficient *b***					1.55

*311 is the single Major Group 311–312.

Table 12
Changes in North American trade relative to exporter's GDP:
Estimates from industry data versus estimates from product data

			estimated coefficients		optimal coefficients	
exporter	**importer**	**period**	α	β	$\tilde{\alpha}$	$\tilde{\beta}$
Canada	Mexico	89–09	27.27	156.84	273.46	4248.75
Canada	United States	89–09	7.73	44.47	−16.81	149.13
Mexico	Canada	89–09	13.54	77.88	107.89	359.12
Mexico	United States	89–09	10.32	59.36	55.34	39.35
United States	Canada	89–09	14.62	84.05	−28.41	114.46
United States	Mexico	89–09	26.95	154.95	64.78	240.70
correlation between estimates					0.66	0.63

Table 13
Average tariff rates (τ_i^k) before and after the implementation of NAFTA:
Least traded products versus non–least traded products (percent)

		average tariff rates			
		least traded products		non–least traded products	
exporter	**importer**	**1989**	**2009**	**1989**	**2009**
Canada	Mexico	13.22	0.00	6.29	0.00
Canada	United States	2.62	0.05	0.78	0.02
Mexico	Canada	6.20	0.09	4.17	0.00
Mexico	United States	4.73	0.01	4.11	0.00
United States	Canada	6.30	0.65	5.57	0.18
United States	Mexico	12.99	0.21	11.80	0.16

Table 14
Changes in North American trade relative to exporter's GDP:
Optimal coefficients from industry data versus estimates from product data

		industry data				product data			
		original coefficients		conditional on initial tariffs		original coefficients		conditional on initial tariffs	
exporter	**importer**	$\tilde{\alpha}$	$\tilde{\beta}$	$\tilde{\alpha}$	$\tilde{\beta}$	$\tilde{\alpha}$	$\tilde{\beta}$	$\tilde{\alpha}$	$\tilde{\beta}$
Canada	Mexico	273.46	4248.75	−306.08	3890.50	530.41	1114.80	50.13	951.02
Canada	United States	−16.81	149.13	23.57	273.88	−13.54	116.17	−39.94	114.66
Mexico	Canada	107.89	359.12	101.94	354.89	96.89	316.06	67.19	273.55
Mexico	United States	55.34	39.35	36.71	3.86	46.31	92.82	37.48	88.17
United States	Canada	−28.41	114.46	−32.78	111.59	−22.10	48.82	−41.73	46.26
United States	Mexico	64.78	240.70	61.61	241.03	77.69	83.27	38.76	74.84

Table 15
Changes in Canada-U.S. trade relative to exporter's GDP (percent):
Observed changes versus BDS predictions and share of least traded products

	Canada to United States			United States to Canada		
industry	**1989–2009 data**	**BDS pred. growth rate**	**1989 share least traded**	**1989–2009 data**	**BDS pred. growth rate**	**1989 share least traded**
Agriculture	12.5	3.4	0.26	−6.4	5.1	0.19
Mining and quarrying	237.6	0.4	0.05	51.3	1.0	0.16
Food	101.2	8.9	0.24	124.1	12.7	0.25
Textiles	42.4	15.3	0.77	−35.9	44.0	0.52
Clothing	50.2	45.3	0.59	−3.0	56.7	1.00
Leather products	−67.7	11.3	1.00	−64.0	7.9	0.61
Footwear	−49.9	28.3	1.00	−67.2	45.7	0.34
Wood products	−54.5	0.1	0.01	−30.6	6.7	0.07
Furniture and fixtures	−46.6	12.5	0.00	22.5	35.6	0.00
Paper products	−65.9	−1.8	0.04	13.7	18.9	0.15
Printing and publishing	0.7	−1.6	0.12	−19.6	3.9	0.05
Rubber products	45.8	9.5	0.10	30.2	19.1	0.05
Chemicals	99.6	−3.1	0.38	50.2	21.8	0.24
Petroleum products	−79.8	0.5	0.07	−43.1	0.8	0.13
Glass products	−45.7	30.4	0.40	−20.0	4.4	0.23
Nonmetal mineral prod.	−0.4	1.2	0.38	−1.9	11.9	0.59
Iron and steel	−12.7	12.9	0.36	53.5	11.6	0.28
Nonferrous metals	−20.9	18.5	0.07	−20.8	−6.7	0.11
Metal products	17.7	15.2	0.20	−5.3	18.2	0.16
Nonelectrical machinery	−8.4	3.3	0.21	−38.9	9.9	0.08
Electrical machinery	−16.4	14.5	0.15	−42.6	14.9	0.05
Transportation equip.	−44.3	10.7	0.01	−37.8	−4.6	0.01
Misc. manufactures	56.1	−2.1	0.45	−19.2	11.5	0.15
weighted correlation with data		−0.28	0.30		0.39	0.54
regression coefficient *a*		21.82	−52.64		−26.62	−65.12
regression coefficient *b*		−3.33	4.17		1.34	2.09
BDS-LTP weighted correlation			−0.11			0.70

Table 16
Changes in Canada-Mexico trade relative to exporter's GDP (percent):
Observed changes versus BDS predictions and share of least traded products

industry	**Canada to Mexico**			**Mexico to Canada**		
	1989–2009 data	**BDS pred. growth rate**	**1989 share least traded**	**1989–2009 data**	**BDS pred. growth rate**	**1989 share least traded**
Agriculture	410.8	3.1	0.04	105.5	−4.1	0.11
Mining and quarrying	6.9	−0.3	0.03	77.8	27.3	0.03
Food	181.2	2.2	0.02	175.3	10.8	0.22
Textiles	656.4	−0.9	0.49	−39.2	21.6	0.29
Clothing	3553.9	1.3	1.00	703.5	19.2	1.00
Leather products	165.1	1.4	1.00	71.5	36.2	1.00
Footwear	23.6	3.7	1.00	−41.2	38.6	0.15
Wood products	16636.0	4.7	0.97	419.1	15.0	1.00
Furniture and fixtures	12913.0	2.7	1.00	1402.1	36.2	0.01
Paper products	214.7	−4.3	0.04	46.1	32.9	0.14
Printing and publishing	1887.8	−2.0	1.00	2412.5	15.0	1.00
Rubber products	3185.0	−1.0	0.23	1416.2	−6.7	1.00
Chemicals	1249.4	−7.8	0.25	272.7	36.0	0.91
Petroleum products	489.2	−8.5	1.00	-	32.9	-
Glass products	519.7	−2.2	1.00	−13.0	13.3	0.10
Nonmetal mineral prod.	1497.6	−1.8	1.00	143.8	5.7	0.45
Iron and steel	190.2	−15.0	0.02	52.3	19.4	1.00
Nonferrous metals	442.0	−64.7	0.07	−50.9	138.1	0.07
Metal products	2843.9	−10.0	0.73	276.9	41.9	0.45
Nonelectrical machinery	1360.5	−8.9	0.19	124.0	17.3	0.05
Electrical machinery	2293.0	−26.2	0.23	263.7	137.3	0.08
Transportation equip.	6352.2	−4.4	0.27	119.3	3.3	0.00
Misc. manufactures	409.9	−12.1	0.18	523.4	61.1	0.55
Weighted correlation with data		−0.10	0.55		0.06	0.33
Regression coefficient *a*		645.29	−522.81		135.79	65.36
Regression coefficient *b*		−7.94	28.49		0.16	3.68
BDS-LTP weighted correlation			−0.12			0.02

Table 17
Changes in Mexico-U.S. trade relative to exporter's GDP (percent):
Observed changes versus BDS predictions and share of least traded products

	Mexico to United States			United States to Mexico		
industry	**1989–2009 data**	**BDS pred. growth rate**	**1989 share least traded**	**1989–2009 data**	**BDS pred. growth rate**	**1989 share least traded**
Agriculture	−20.1	2.5	0.07	46.6	7.9	0.10
Mining and quarrying	27.0	26.9	0.01	86.2	0.5	0.18
Food	119.5	7.5	0.27	129.5	13.0	0.17
Textiles	89.6	11.8	0.72	125.7	18.6	0.43
Clothing	449.4	18.6	0.42	63.9	50.3	0.24
Leather products	−66.8	11.7	0.53	58.4	15.5	0.67
Footwear	−62.1	4.6	0.03	−58.5	35.4	0.10
Wood products	−74.8	−2.7	0.12	−21.6	7.0	0.09
Furniture and fixtures	64.9	7.6	0.00	6.6	18.6	0.00
Paper products	−61.0	13.9	0.23	29.4	−3.9	0.07
Printing and publishing	212.3	3.9	1.00	194.9	−1.1	0.13
Rubber products	147.1	−5.3	0.43	165.9	12.8	0.06
Chemicals	27.9	17.0	0.59	208.2	−8.4	0.23
Petroleum products	−98.0	34.1	0.12	−71.6	−7.4	0.06
Glass products	12.1	32.3	0.16	53.8	42.3	0.39
Nonmetal mineral prod.	−19.5	3.7	0.26	57.8	0.8	0.57
Iron and steel	18.5	30.8	0.28	84.0	−2.8	0.24
Nonferrous metals	53.8	156.5	0.12	104.6	−55.1	0.12
Metal products	80.4	26.8	0.30	84.7	5.4	0.14
Nonelectrical machinery	171.3	18.5	0.14	102.8	−2.9	0.09
Electrical machinery	46.5	178.0	0.02	59.5	−10.9	0.01
Transportation equip.	127.0	6.2	0.02	79.3	9.9	0.02
Misc. manufactures	92.8	43.2	0.24	96.6	−9.4	0.13
weighted correlation with data		−0.13	0.17		0.06	0.33
regression coefficient *a*		66.64	38.04		88.47	16.15
regression coefficient *b*		−0.11	1.31		−0.24	1.71
BDS-LTP weighted correlation			−0.32			0.21

Table 18
Changes in North American trade relative to exporter's GDP:
Observed changes versus BDS predictions and least traded products based predictions

			BDS model predictions			least traded predictions		
exporter	**importer**	**period**	**correlation with data**	***a***	***b***	**correlation with data**	***a***	***b***
Canada	Mexico	89–09	−0.10	645.29	−7.94	0.55	−522.81	28.49
Canada	United States	89–09	−0.28	21.82	−3.33	0.30	−52.64	4.17
Mexico	Canada	89–09	0.06	135.79	0.16	0.33	65.36	3.68
Mexico	United States	89–09	−0.13	66.64	−0.11	0.17	38.04	1.31
United States	Canada	89–09	0.39	−26.62	1.34	0.54	−65.12	2.09
United States	Mexico	89–09	−0.06	88.47	−0.24	0.47	16.15	1.71
weighted average			−0.00	19.83	−0.94	0.39	−38.03	2.85
pooled regression			0.06	10.53	0.17	0.24	−36.97	2.49

Table 19
Mean absolute percentage change between predicted growth and actual growth:
Observed changes versus BDS predictions, least traded products based predictions,
and least traded products based "predictions" using estimates from post-NAFTA data

			Predictions		LTP with Optimal Coefficients
exporter	**importer**	**period**	**BDS**	**LTP**	
Canada	Mexico	89–09	14929.4	1226.3	46.9
Canada	United States	89–09	8417.9	633.2	382.5
Mexico	Canada	89–09	1517.5	741.7	52.4
Mexico	United States	89–09	386.5	567.4	74.5
United States	Canada	89–09	617.7	244.1	156.3
United States	Mexico	89–09	1734.5	131.4	33.7
weighted average			3919.8	435.0	223.6

Table 20
Changes in North American trade deflated by exporter's PPI:
Growth decomposed into changes in quantities and changes in prices (percent)

			average share of total growth	
exporter	**importer**	**period**	***P***	***Q***
Canada	Mexico	89–09	−9.1	109.1
Canada	United States	89–09	32.3	67.7
Mexico	Canada	89–09	24.4	75.6
Mexico	United States	89–09	8.9	91.1
United States	Canada	89–09	−3.2	103.2
United States	Mexico	89–09	−1.3	101.3
weighted average			13.1	86.9
pooled			16.2	83.8

Figure 1

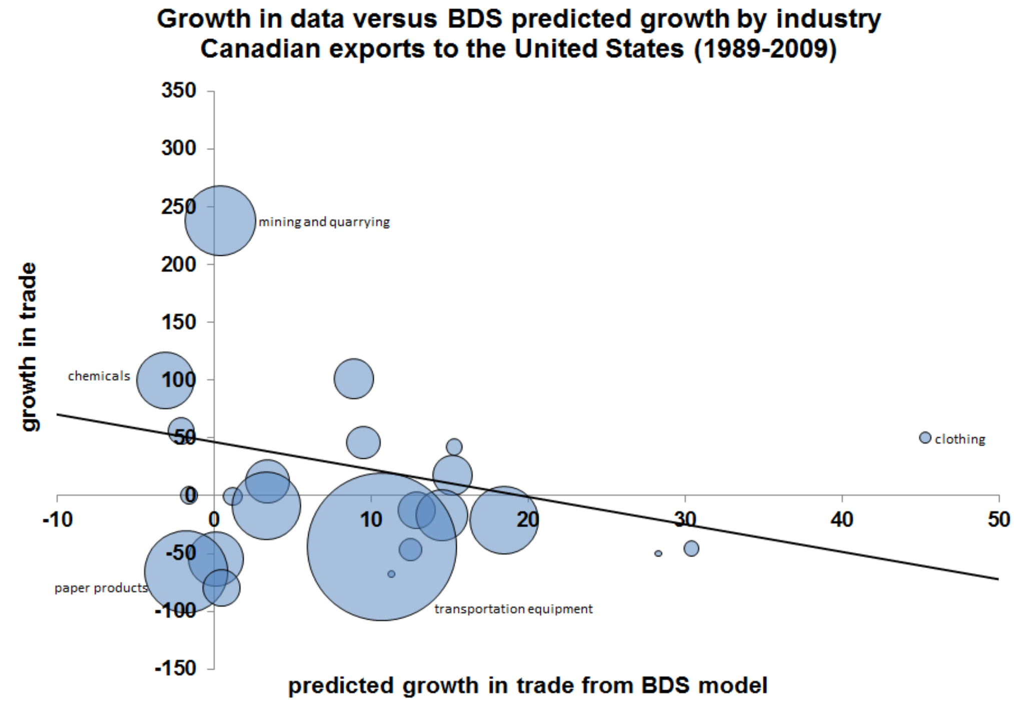

Figure 2

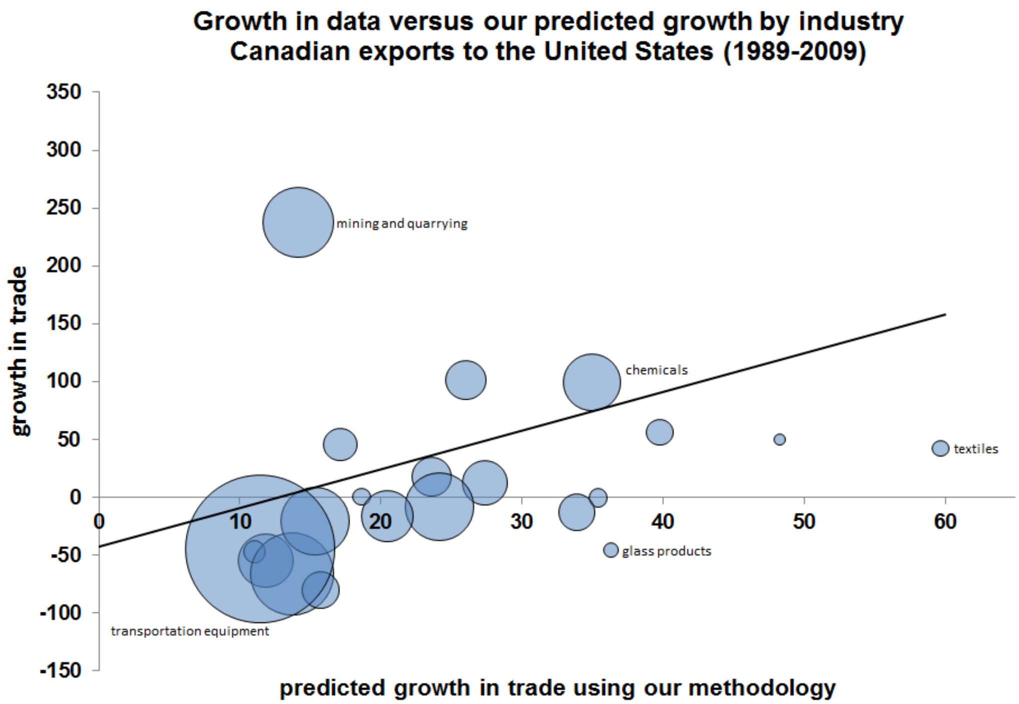

Table A1
Changes in Canadian trade relative to Canadian GDP (percent):
Observed changes vs. Cox-Harris predictions and least traded products based predictions

industry	**exports to World**			**imports from World**		
	1989–2009 growth	**Cox-Harris predicted growth rate**	**LTP-based predicted growth rate**	**1989–2009 growth**	**Cox-Harris predicted growth rate**	**LTP-based predicted growth rate**
Agriculture	39.1	−4.1	6.3	−7.6	7.2	19.9
Chem. & misc. man.	70.9	28.1	16.0	29.7	10.4	22.3
Fishing	−30.9	−5.4	5.6	8.3	9.5	18.2
Food, bev., and tobacco	95.5	18.6	11.5	52.0	3.8	17.6
Forestry	−24.8	−11.5	13.8	−14.8	7.1	24.8
Machinery and appl.	11.7	57.1	12.7	−23.9	13.3	13.8
Mining	117.0	−7.0	5.6	65.4	4.0	9.3
Nonmetallic minerals	20.9	31.8	24.9	−15.8	7.3	31.3
Refineries	−67.8	−2.7	9.6	−77.1	1.5	10.9
Rubber and plastics	107.3	24.5	16.3	27.1	13.8	14.0
Steel and metal products	6.6	19.5	10.7	8.5	10.0	19.0
Textiles and leather	18.4	108.8	30.3	−20.1	18.2	16.1
Transportation equip.	−37.5	3.5	7.7	−34.6	3.0	12.1
Wood and paper	−58.5	7.3	6.2	−8.1	7.2	17.7
weighted correlation with data		0.06	0.24		0.04	0.42
regression coefficient *a*		2.00	−28.68		−10.57	−57.65
regression coefficient *b*		0.16	3.60		0.24	3.20
CH-LTP weighted correlation			0.81			0.30

Table A2
Changes in Mexican trade relative to Mexican GDP (percent):
Observed changes versus Sobarzo predictions and least traded products based predictions

industry	**exports to North America**			**imports from North America**		
	1989–2009 data	**Sobarzo predicted growth rate**	**LTP-based predicted growth rate**	**1989–2009 data**	**Sobarzo predicted growth rate**	**LTP-based predicted growth rate**
Agriculture	−15.3	−11.1	14.8	61.0	3.4	41.4
Beverages	161.8	5.2	11.0	189.0	−1.8	76.5
Chemicals	34.1	−4.4	46.2	218.5	−2.7	62.0
Electrical machinery	54.7	1.0	11.8	66.3	9.6	28.4
Food	100.8	−6.9	35.0	128.8	−5.0	50.8
Iron and steel	19.6	−4.9	28.8	92.0	17.7	62.1
Leather	−64.6	12.4	42.6	60.0	−0.4	131.3
Metal products	86.2	−4.4	28.6	94.8	9.5	48.6
Mining	27.7	−17.0	11.0	79.4	13.2	52.3
Nonelectrical machinery	166.5	−7.4	18.6	115.8	20.7	41.1
Nonferrous metals	36.8	−9.8	17.9	113.9	9.8	45.1
Nonmetallic min. prod.	−16.0	−6.2	26.5	64.3	10.9	115.0
Other manufactures	88.4	−4.5	24.5	96.7	4.2	51.0
Paper	−35.9	−7.9	28.0	49.7	−4.7	38.0
Petroleum	−98.0	−19.5	17.2	−71.2	−6.8	36.4
Rubber	158.9	12.8	36.6	178.2	−0.1	35.9
Textiles	69.5	1.9	50.4	131.3	−1.2	94.0
Tobacco	−61.3	2.8	69.7	575.5	−11.6	181.9
Transportation equip.	126.1	−5.0	12.0	97.7	11.2	30.3
Wearing apparel	197.2	30.0	24.9	29.2	4.5	57.7
Wood	30.8	−8.5	13.0	2.9	11.7	35.1
weighted correlation with data		0.43	0.05		−0.12	0.47
regression coefficient *a*		81.13	58.36		104.22	24.18
regression coefficient *b*		3.06	0.32		−0.77	1.75
Sobarzo-LTP weighted correlation			0.20			−0.32