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Using the New Products Margin to Predict the Sectoral 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 (2-digit ISIC) based on the distribution of exports before the reform by product (5-digit SITC). Using the results of Kehoe and Ruhl (2009) that much of the growth in trade after trade liberalization is in products that are traded very little or not at all, we characterize industries in Canada, Mexico, and the United States by the fractions of exports in 1988 accounted for by these least traded products. We show that a prediction of trade growth 1988–2007 by industry based on these data performs significantly better than the leading applied general models that were originally used for the policy evaluation of North American Free Trade Agreement.

* The data used here are available at http://www.econ.umn.edu/~tkehoe/. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

1. Introduction

As Fox (2004) and Kehoe (2005) have shown, many of the leading models built to predict the effects of the North American Free Trade Agreement (NAFTA) failed in their efforts to do so. Since then there has been much focus on trade models that take place at the product or firm level instead of the industry level. Recently, however Arkolakis, Costinot, and Rodríguez-Clare (2012) show that many of these models (Melitz 2003; Eaton and Kortum 2002) yield empirically the same results as models that completely ignore product and firm level trade. Employing the insight from Kehoe and Ruhl (2009) that products that are traded very little or not at are disproportionately responsible for changes in aggregate trade, we hypothesize that they are important for predicting industry-level trade as well and at least empirically avoid the critiques of Arkolakis, Costinot, and Rodríguez-Clare. To evaluate our hypothesis we compare the actual changes in bilateral industry level trade between Canada, Mexico, and the United States during NAFTA to the predictions of a standard model built to predict the effects of NAFTA as well as with a simple accounting exercise that takes into account only the differences between products that were not traded much before NAFTA was implemented to those that were.

2. Evaluating the Predictions of NAFTA models

Following Kehoe (2005), we 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 to the observed growth in trade following NAFTA.

The BDS model made predictions at the industry level, where an industry is defined as an ISIC 2-digit aggregate. Trade data are not collected according to the ISIC system, so we map SITC-classified trade data to the ISIC. (The details of this operation can be found in the appendix.) After converting our data into the BDS industries, we compute the percentage growth in exports for each industry, normalized by gross domestic product,

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

where $\mathrm{x}_{\mathrm{ij,t}}^{\mathrm{k}}$ is exports from country i to country k, in industry j at time t, and y_{it} is current price GDP in country i. We take $\mathrm{T}_1 = 2007$, and $\mathrm{T}_0 = 1988$ if country i or j is Canada and

$T_0 = 1989$ otherwise. We report the export growth rates and the predictions of the BDS model in tables 1–3.

The difference in base years is due to Canada adopting the harmonized system in 1988 while Mexico and the United States adopted the harmonized system in 1989. As pointed out in Kehoe and Ruhl (2009), finely disaggregated trade data is not comparable before and after the adoption of the harmonized system. For this reason, we use data reported by Canada when available, otherwise we use the data from the importing country. We use 2007 as our endpoint to avoid entangling the effects of NAFTA with the effects of the recession and the fall in trade that accompanied it, even though 2009 was the actual year for full implementation of the NAFTA.

To compare the predictions of the BDS model with the changes in trade patterns in the data, we calculate the weighted correlation coefficient between the model prediction and the data, where the weights, α_j, are the 1988 trade volumes. We also calculate the weighted regression coefficients from solving

$$\min_{a,b} \sum_{j=1}^{23} \alpha_j \left(a + b z_j^{model} - z_j^{data} \right)^2 \tag{2}$$

over the 23 industries in the BDS model. The deviation of the estimated coefficient b from 1 indicates how poorly the model does in predicting the signs and the absolute magnitude of the changes in the data. The deviation of the estimated coefficient a from 0 indicates how poorly the model does in matching the average change in the data. (Notice that the squared correlation coefficient is the R^2 of this simple regression.) We report the calculated coefficients for export from Canada to the United States in table 1. The BDS model does a poor job of predicting Canadian exports to the United States: The weighted correlation between the prediction and the data is negative (–0.15) and the linear function of the prediction that comes closest to the data involves multiplying all of the predicted growth rates by −2.7 and adding 64.8. The BDS model does somewhat better in predicting exports from the Unites States to Canada.

Table 4 contains the corresponding statistics for all six of the bilateral North American trade 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 0.02, and when we allow b to differ by country pair, the weighted average is −0.01. It is worth stressing that this failure of the BDS model is not specific to this particular model. Kehoe (2005) shows 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), perform similarly in this sort of exercise. We focus on the BDS model because it is the best model built to analyze the impact of NAFTA. 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. See, for example, Brown, Kiyota, and Stern (2005), Ciuriak and Chen (2007), DeRosa and Gilbert (2004), Francois, Rivera, and Rojas-Romagosa (2008), Kiyota and Stern (2007), Lips and Rieder (2005), and U.S. International Trade Commission (2004).

3. Growth in Trade at the Product Level on the Extensive Margin

In this section we develop a simple accounting exercise based on the insight from Kehoe and Ruhl (2009): 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. Growth in trade from products that were not previously traded, or traded vary little is referred to as growth on the extensive margin. Growth in trade from products that were previously traded is referred to as growth on the intensive margin. The methodology adopted from Kehoe and Ruhl (2009) allows our cutoff for what products we consider to be not traded to vary across country pairs in order to take into account the relative importance of each product for a country’s trade. In contrast, other papers use a fixed cutoff value below which a product is considered not to be traded. For example Feenstra (1994) considers products as not traded if the value of trade is $0 and Evenett and Venables (2002) consider products with less than $50,000 of trade in a year as not traded.

We define a *product* as a 5-digit SITC code. Following Kehoe and Ruhl (2009), 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 3 years to minimize the measure’s dependence on any particular year.) We then sum together the value of trade in the base period of the products with the least amount of trade over the first three years of the sample, until we reach a set of products that accounts for 10 percent of total trade in the base period. If a product is in that set we classify it as a *least-traded product*. Within the set of least-traded products are products from different industries, where an industry—as we defined it above— is a collection of products. How prevalent are these least-traded products across industries? In table 1 we report the fraction of trade in an industry accounted for by least-traded products in 1988. There are substantial differences across industries. For example, least-traded products made up 84 percent of total textile exports from Canada to the United States in 1988, but only 2 percent of exports in the wood products industry.

How is the level of least-traded goods in an industry related to the growth in trade in that industry following liberalization? Kehoe and Ruhl (2009) show that growth in the 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 an industry with fewer least-traded products. To quantify the predictive power of this relationship, we follow the same methodology as we did for evaluating the BDS model, except instead of the BDS predictions we use the proportion of trade within each industry that comes from least traded products to compare with the results from the data.

We find that the initial fraction of least-traded products in an industry is performs good predictor of future trade growth, considerably outperforming the DBS model for each country pair. The least-traded products prediction is best for exports from the United States to Canada: The weighted correlation between the proportions of least-traded products and the changes in trade that occurred is 0.58. This implies that any prediction for increases in exports of the form $a+bs_i$, where s_i is the fraction of exports of industry i accounted for by least-traded products in 1988, would have a correlation of 0.58 with the changes that occurred in the data if $\mathrm{b}>0$ is positive. Setting $a=-17.38$ and $b=195.68$ would have been the best linear prediction based on the least traded products data. Had we used 1988 trade data to predict 2007 U.S. exports to Canada by simply guessing that exports in the least traded set would grow by 178.30 ($=-17.38+195.68$) percent more than U.S. GDP, while other exports would grow 17.38 percent less, we would account for 0.34 ($=0.58^2$) of the variation in export patterns. Table 4 summarizes the results of performing this exercise for all six of the North American trade relations. None of these exercises do as well as that for U.S. exports to Canada, but they still do better than that for the BDS model in all cases. As Kehoe (2005) explains, the models used to predict the impact of NAFTA could not pick up increases in exports on the extensive 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.

To get some idea of what drives our results, let us examine an industry where the simple least traded products exercise does far better than the BDS model: Canadian exports of chemicals to the United States, which grew 105.9 percent while the BDS model predicted −3.1 percent. Looking at the disaggregated trade data for this industry shows that the chemicals industry is made up of 316 5-digit SITC categories. Of the 316 categories, 291 are least traded Canadian exports. Compared to Canadian GDP, the 35 percent of 1988 exports of chemicals that are least traded increase by 207 percent, while the other 65 percent increase by only 5 percent. The growth in least traded products is far from uniform: for example, exports of the code 51572 (Sulphonamides) increases by 7,907 percent more than Canadian GDP and 58241 (Polyamides in primary forms) increases by 176 percent, while 52213 (Chlorine) decreases by 29 percent.

4. Conclusions

This paper has shown that researchers must take into account the extensive margin when predicting the effects of trade reform. In the case of NAFTA, paying attention to exclusively to least traded products would have yielded better predictions than the premiere general equilibrium models employed at the time. This paper also provides a push for researchers to develop new models of product-level trade that are immune to the stark results of Arkolakis, Costinot, and Rodríguez-Clare. Taking into account least traded products is vitally important for developing predictions of industry level trade, therefore future models must be built that are consistent with this fact if we wish to improve our ability to predict the effects of trade reforms.

Appendix

Our trade data is at the 5-digit (leaf) level in the SITC revision 2 classification system and the BDS industries are constructed using the ISIC revision2 classification system, we modify the four-digit SITC to ISIC concordance created by Muendler (2009) to create a 5-digit SITC to ISIC concordance. To do this we replace parent four-digit SITC codes with their children 5-digit SITC codes.

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Table 1
Changes in Canada-U.S. trade relative to exporter's GDP (percent)

	Canada to United States			United States to Canada		
sector	**1988–2007 data**	**BDS model growth rate**	**1988 fraction least traded**	**1988–2007 data**	**BDS model growth rate**	**1988 fraction least traded**
agriculture	27.0	3.4	0.29	-8.7	5.1	0.20
mining and quarrying	244.0	0.4	0.04	93.9	1.0	0.17
food	94.4	8.9	0.26	105.8	12.7	0.28
textiles	90.2	15.3	0.84	-8.0	44.0	0.48
clothing	126.4	45.3	0.42	113.5	56.7	1.00
leather products	-16.2	11.3	1.00	-56.7	7.9	0.60
footwear	37.6	28.3	1.00	-54.6	45.7	0.32
wood products	-9.3	0.1	0.01	-8.2	6.7	0.09
furniture and fixtures	158.8	12.5	0.00	132.0	35.6	0.00
paper products	-57.5	-1.8	0.02	31.2	18.9	0.17
printing and publishing	17.6	-1.6	0.19	-2.8	3.9	0.05
rubber products	130.1	9.5	0.16	36.2	19.1	0.06
chemicals	105.9	-3.1	0.34	74.4	21.8	0.29
petroleum and products	-79.3	0.5	0.06	-45.4	0.8	0.07
glass products	-0.7	30.4	0.31	-18.4	4.4	0.24
nonmetal mineral products	8.2	1.2	0.29	4.2	11.9	0.64
iron and steel	15.9	12.9	0.38	118.6	11.6	0.26
nonferrous metals	47.9	18.5	0.07	-0.5	-6.7	0.13
metal products	66.4	15.2	0.22	21.4	18.2	0.19
nonelectrical machinery	16.3	3.3	0.20	-24.8	9.9	0.08
electrical machinery	22.3	14.5	0.17	-27.5	14.9	0.06
transportation equipment	-15.1	10.7	0.01	-12.0	-4.6	0.01
misc. manufactures	70.3	-2.1	0.49	-0.2	11.5	0.15
weighted correlation with data		-0.15	0.26		0.36	0.58
regression coefficient *a*		39.77	11.73		-6.58	-17.77
regression coefficient *b*		-1.83	154.16		1.30	195.08

Table 2
Changes in Canada-Mexico trade relative to exporter's GDP (percent)

	Canada to Mexico			Mexico to Canada		
sector	**1988–2007 data**	**BDS model growth rate**	**1988 fraction least traded**	**1988–2007 data**	**BDS model growth rate**	**1988 fraction least traded**
agriculture	191.8	3.1	0.05	35.9	-4.1	0.09
mining and quarrying	-22.2	-0.3	0.00	21.2	27.3	0.07
food	215.4	2.2	0.07	266.1	10.8	0.15
textiles	73.2	-0.9	0.75	-8.4	21.6	0.32
clothing	883.9	1.3	1.00	2665.7	19.2	1.00
leather products	11587.5	1.4	1.00	505.5	36.2	1.00
footwear	0.0	3.7	0.00	-53.2	38.6	0.08
wood products	1490.1	4.7	1.00	443.2	15.0	1.00
furniture and fixtures	3190.2	2.7	1.00	1953.5	36.2	0.00
paper products	45.1	-4.3	0.04	-11.0	32.9	0.08
printing and publishing	2896.7	-2.0	1.00	1953.5	15.0	1.00
chemicals	196.3	-1.0	0.61	1466.6	-6.7	1.00
petroleum and products	401.8	-7.8	0.16	273.5	36.0	0.80
rubber products	4164.3	-8.5	1.00	-99.6	32.9	1.00
nonmetal mineral products	-2.9	-2.2	1.00	-22.6	13.3	0.15
glass products	315.8	-1.8	1.00	38.2	5.7	0.43
iron and steel	153.2	-15.0	0.06	-44.1	19.4	0.54
nonferrous metals	2437.4	-64.7	0.58	-53.7	138.1	0.02
metal products	374.6	-10.0	0.49	359.4	41.9	0.49
nonelectrical machinery	153.7	-8.9	0.18	135.1	17.3	0.10
electrical machinery	564.7	-26.2	0.18	297.2	137.3	0.07
transportation equipment	711.5	-4.4	0.03	105.0	3.3	0.00
misc. manufactures	761.1	-12.1	0.71	872.2	61.1	0.46
weighted correlation with data		-0.38	0.35		0.22	0.26
regression coefficient *a*		204.31	191.25		110.33	113.38
regression coefficient *b*		-13.77	758.85		0.89	350.61

Table 3
Changes in Mexico-U.S. trade relative to exporter's GDP (percent)

	Mexico to United States			United States to Mexico		
sector	**1989–2007 data**	**BDS model growth rate**	**1989 fraction least traded**	**1989–2007 data**	**BDS model growth rate**	**1989 fraction least traded**
agriculture	-35.7	2.5	0.07	44.2	7.9	0.10
mining and quarrying	49.9	26.9	0.01	91.9	0.5	0.18
food	63.4	7.5	0.27	123.2	13.0	0.17
textiles	103.0	11.8	0.72	166.8	18.6	0.43
clothing	519.1	18.6	0.42	60.9	50.3	0.24
leather products	-66.7	11.7	0.53	227.9	15.5	0.67
footwear	-68.4	4.6	0.03	-61.5	35.4	0.10
wood products	-66.5	-2.7	0.12	-2.9	7.0	0.09
furniture and fixtures	137.2	7.6	0.00	24.6	18.6	0.00
paper products	-59.6	13.9	0.23	28.2	-3.9	0.07
printing and publishing	285.2	3.9	1.00	197.0	-1.1	0.13
chemicals	123.7	-5.3	0.43	223.8	12.8	0.06
petroleum and products	27.3	17.0	0.59	203.9	-8.4	0.23
rubber products	-98.7	34.1	0.12	-67.8	-7.4	0.06
nonmetal mineral products	15.5	32.3	0.16	59.0	42.3	0.39
glass products	-0.5	3.7	0.26	108.3	0.8	0.57
iron and steel	86.0	30.8	0.28	92.4	-2.8	0.24
nonferrous metals	1.6	156.5	0.12	171.4	-55.1	0.12
metal products	95.8	26.8	0.30	129.8	5.4	0.14
nonelectrical machinery	152.6	18.5	0.14	89.0	-2.9	0.09
electrical machinery	50.5	178.0	0.02	75.6	-10.9	0.01
transportation equipment	146.5	6.2	0.02	158.5	9.9	0.02
misc. manufactures	72.7	43.2	0.24	76.1	-9.4	0.13
weighted correlation with data		-0.16	0.09		0.02	0.33
regression coefficient *a*		73.15	58.64		104.16	83.32
regression coefficient *b*		-0.15	44.38		0.07	207.25

Table 4
Changes in North American trade relative to exporter's GDP:
BDS model versus least traded products exercise

			BDS model			fraction least traded		
exporter	**importer**	**period**	**correlation with data**	***a***	***b***	**correlation with data**	***a***	***b***
Canada	Mexico	88–07	-0.38	204.31	-13.77	0.35	191.25	758.85
Canada	United States	88–07	-0.15	39.77	-1.83	0.26	11.73	154.16
Mexico	Canada	88–07	0.22	110.33	0.89	0.26	113.38	350.61
Mexico	United States	88–07	-0.16	73.15	-0.15	0.09	58.64	44.38
United States	Canada	89–07	0.36	-6.58	1.30	0.58	-17.77	195.08
United States	Mexico	89–07	0.02	104.16	0.07	0.33	83.32	207.25
weighted average			0.05	36.20	-0.33	0.36	16.72	162.63
pooled regression			0.04	31.94	0.08	0.25	17.67	154.20

Table 5
Changes in North American trade relative to exporter's GDP:
Estimates from industry data versus estimates from product data

			industry data		product data	
exporter	**importer**	**period**	a_j^k	b_j^k	α_j^k	β_j^k
Canada	Mexico	88–07	191.25	758.85	114.18	1529.48
Canada	United States	88–07	11.73	154.16	15.45	117.03
Mexico	Canada	88–07	113.38	350.61	102.15	462.88
Mexico	United States	88–07	58.64	44.38	53.70	93.73
United States	Canada	89–07	-17.77	195.08	-3.70	54.35
United States	Mexico	89–07	83.32	207.25	95.75	82.97
correlation $a_j^k - \alpha_j^k$			0.93			
correlation $b_j^k - \beta_j^k$				0.97		

Figure 1
Changes in North American trade relative to exporter's GDP: