Chapter 1:
The Challenges of Predicting the Impact of Trade Reforms

Timothy J. Kehoe[4]

In his keynote address, "The Challenge of Predicting the Impact of Trade Reform," Timothy J. Kehoe, University of Minnesota professor and advisor to the Federal Reserve Bank of Minneapolis, declared that applied general equilibrium models that had been built to predict the impact of the North American Free Trade Agreement (NAFTA) "failed in predicting the agreement's impact on trade by industry." During his speech, Kehoe addressed the question of how to make such predictions better. He started by showing that applied general equilibrium models, an area in which he's been working for a long time, can do a good job, but noted that it is international trade that we don't understand well. To illustrate this, he compared some model predictions with actual data, using Spain's entry into the European Union as an example (Kehoe, Polo, and Sancho 1994). Next, he evaluated the performance of applied general equilibrium models of the impact of NAFTA (Kehoe 2005 and Kehoe, Rossbach, and Ruhl 2014). Finally, Kehoe discussed some of his recent findings (Kehoe and Ruhl 2013 and Kehoe, Rossbach, and Ruhl 2014), described lessons learned, and provided some insights into his forthcoming work.

Applied General Equilibrium Models Predicting NAFTA's Impact: How Did They Perform?

To evaluate the performance of applied general equilibrium models, Kehoe used an atheoretical approach (described below) to predict the impact of NAFTA. He then compared those predictions to the predictions of well-known models, using correlation coefficients and regression analysis to measure their goodness of fit. Looking back at the papers presented at a 1992 conference on NAFTA held by the United States International Trade Commission (USITC),[5] Kehoe commented that "if we look at the correlations of what we predicted with what happened, they average about zero." One of the reasons for this is that the models available at the time were based on the Armington elasticities of substitution. For these models, he said, everything depends on the size of the elasticity and the size of the tariff or trade barrier. But how, then, he asked, do you infer comparative advantage? According to these models, said Kehoe, comparative advantage is revealed by noting which goods are heavily traded while the trade barriers are still in place. Surprisingly, he added, that is not what the data show. Citing a 2013 study he conducted with Kim Ruhl, after a trade agreement enters into force, trade increases disproportionately in goods that were not traded or in goods that traded only in small amounts before the agreement—goods known as being in the

[4] The views in this article are solely the opinions of the author and should not be interpreted as reflecting the views of Federal Reserve Bank of Minneapolis.
[5] USITC, Economy-wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Mexico and Canada, USTC publication 2516, May 1992.

"extensive margin" (Kehoe and Ruhl 2013).[6] And that, he said, just does not fit with the kind of models economists were using at the time, which did not take into account the growth in newly traded goods or goods in the extensive margin. Kehoe explained that, taking Canadian and U.S. exports to Mexico as an illustration, he and Ruhl found that out of 1,855 products that Canada exports to Mexico, 1,326 products make up 10 percent of trade, whereas at the very top only 6 products make up 10 percent of trade.

This picture is typical—in fact, it understates the typical pattern, Kehoe noted. He remarked that every time there's a trade agreement, the biggest jump is always in the first set, and it never consists of just one or two products. "It's always hundreds of products. That is a shocking fact," Kehoe said. Further, Kehoe noted, "We looked at every country we could find data on, every bilateral pair that we could find any decent data on from the period 1980 to 2005, and this was always the pattern we found." So, given that products that were traded very little or not at all account disproportionately for aggregate changes in bilateral trade following trade liberalization, Kehoe modeled the prediction of trade growth as a linear function of the share of exports accounted for by least-traded products (LTPs) in an industry.[7] Next, he hypothesized that industries that trade more heavily in these little-traded products should experience higher growth following trade liberalization (see Kehoe, Rossbach, and Ruhl 2014).

Kehoe decided to compare results from using his new model (the "atheoretical model") with the models discussed at the 1992 USITC conference, focusing on the one he had worked on with Horacio Sobarzo (Kehoe 2005 and Kehoe, Rossbach, and Ruhl 2014). Kehoe said that he scrutinized data on Canadian and U.S. exports to Mexico over the period 1989–2009, comparing these data with the predictions of the Sobarzo model and the atheoretical model. To evaluate the model's predictions, Kehoe used the weighted correlation coefficient between the predictions and the actual data. In addition, he used weighted regression analysis, taking what actually happened and regressing it on what the model predicted. The results are reported in table 1. They show that disproportionally the increases in trade were in the goods that were traded little or not at all before the trade liberalization. The Sobarzo model poorly predicted the growth in Mexican imports from North America, with a negative (-0.12) correlation between its predictions and the data. On the other hand, the correlation between the share of LTPs in an industry before liberalization and the industry's actual growth was positive (about 0.5). "This is not great but it is better than zero. It gives me hope that there's something systematic going on," Kehoe said.

[6] In Kehoe and Ruhl (2013), the authors looked at bilateral trade of panels of 1,900 country pairs over 25 years. They found that trade in goods in the extensive margin accounted for 10 percent of the growth in trade for NAFTA countries and 26 percent of the growth in trade between the United States and Chile, China, and Korea after their respective free trade agreements went into effect.
[7] In Kehoe, Rossbach, and Ruhl (2014), the authors also make predictions for industry-level changes in trade for the United States and Korea following the U.S.-Korea Free Trade Agreement (KORUS).

Table 1. Changes in Mexican Imports from North America Relative to Mexican GDP (percent)

Industry	1989–2009 data	Sobarzo predicted growth rate	LTP-based predicted growth rate
Agriculture	61.0	3.4	77.2
Beverages	189.0	−1.8	143.2
Chemicals	218.5	−2.7	115.9
Electrical machinery	66.3	9.6	53.2
Food	128.8	−5.0	94.7
Iron and steel	92.0	17.7	115.7
Leather	60.0	−0.4	245.5
Metal products	94.8	9.5	90.9
Mining	79.4	13.2	97.3
Nonelectrical machinery	115.8	20.7	76.9
Nonferrous metals	113.9	9.8	84.2
Nonmetallic mineral products	64.3	10.9	215.0
Other manufactures	96.7	4.2	95.3
Paper	49.7	−4.7	70.9
Petroleum	−71.2	−6.8	68.1
Rubber	178.2	−0.1	67.1
Textiles	131.3	−1.2	175.7
Tobacco	575.5	−11.6	340.5
Transportation equipment	97.7	11.2	56.7
Wearing apparel	29.2	4.5	107.9
Wood	2.9	11.7	65.6
Weighted correlation with		−0.12	0.47
Regression coefficient a		104.22	24.08
Regression coefficient b		−0.77	0.94
Sobarzo-LTP weighted			−0.32

Source: Kehoe, Rossbach, and Ruhl (2014) and Kehoe (2014).

This is not to say that every LTP goes up, according to Kehoe. He cautioned that with about 1,300 LTPs in question, naturally some went up and some went down; on average, though, LTPs went up a lot more than non-LTP products. As an example, Kehoe invited participants to look at Mexico's exports of metal products, for which actual growth was 94.8 percent: the atheoretical model predicted 90.9 percent growth, but the Sobarzo model predicted only 9.5 percent growth (table 1). Within the metal products industry, wrenches and spanners actually went down (5.9 percent), while scissors and blades went up a lot (174.8 percent). In fact, the biggest single product increase (1,807.2 percent) in this industry was articles of nickel not elsewhere specified. The latter two products are in the LTP category. This is the pattern that dominates in both Mexican imports and exports. "But I want to insist, it is never one or two goods," Kehoe added. "It is always hundreds of goods."

Kehoe then pointed to the correlations between the LTP predictions and actual data results of the six trade relationships in North American trade (table 2). He noted that while the correlations are not 0.8 or 0.9, they are not zero either, by contrast with the average correlations of the models he and others had built in the 1990s. However, he said, there is much more to be done. He concluded that "a major downside to our method is that as of now it is atheoretical. But I hope our results spur the development of models able to account for the importance of the new product margin in trade."

Table 2. Correlation Results for the LTP Exercise

Exporter	Importer	Correlation
Canada	Mexico	0.55
Canada	United States	0.30
Mexico	Canada	0.33
Mexico	United States	0.19
United States	Canada	0.54
United States	Mexico	0.47
Weighted average		0.39
Pooled regression		0.24

Source: Kehoe (2014).

General Lessons and Future Research

Regarding future research, Kehoe noted some general lessons to consider, which would enable future models to fit the data better:

- Short-run elasticities are very different from long-run elasticities because of fixed costs in the export decision (Ruhl 2008).
- Fixed costs are an increasing function of market penetration (Arkilakis, 2010).
- Eaton-Kortum models with Fréchet distributions for productivities for products within industries and Melitz models with Pareto distributions are not very different from Armington models or models with monopolistic competition and homogenous firms (Arkolakis, Costinot, and Rodriguez-Clare 2012). These models, as presently structured, are unlikely to be more helpful than the ones in use in 1990s.

Finally, Kehoe noted his intention of modifying the Eaton-Kortum model to allow flexible comparative advantage and to apply the estimation methodology developed by Berry, Levinsohn, and Pakes (1995), which will give very difference cross-elasticities. He explained that this method of estimation allows the productivity of an exporter's factors to vary across products due to deterministic differences in their suitability for a particular product. Examples would include the characteristics of an exporter's land and climate, which affect the set of agricultural products in which it has a comparative advantage, or the education and skills of the workforce, which affect the set of manufactured products in which it has a comparative advantage. This will be the subject of Kehoe's forthcoming work with Kari E. Heerman.

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