The Challenge of Predicting the Impact of Trade Reform

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NAFTA at 20: Effects on the North American Market

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Applied general equilibrium models built to predict the impact of the North American Free Trade Agreement failed in predicting the impact of NAFTA on trade by industry.

Recent research:

K. E. R. Heerman and T. J. Kehoe, “Flexible Estimates of Comparative Advantage in Applied General Equilibrium Models of Trade Reform.”

T. J. Kehoe and K. J. Ruhl, “How Important is the New Goods Margin in International Trade,” *Journal of Political Economy*, 2013.

T. J. Kehoe, J. M. Rossbach, and K. J. Ruhl “Using the New Products Margin to Predict the Industry-Level Impact of Trade Reform.”

Spain: **Kehoe-Polo-Sancho (1992) evaluation of the performance of the Kehoe-Manresa-Noyola-Polo-Sancho-Serra MEGA model of the Spanish economy: A Shoven-Whalley type model with perfect competition, modified to allow government and trade deficits and unemployment (Kehoe-Serra). Spain's entry into the European Community in 1986 was accompanied by a fiscal reform that introduced a value-added tax (VAT) on consumption to replace a complex range of indirect taxes, including a turnover tax applied at every stage of the**

production process. What would happen to tax revenues? Trade reform was of secondary importance.

Canada-U.S.: **Fox (1999) evaluation of the performance of the Brown-Stern (1989) model of the 1989 Canada-U.S. FTA.**

1.1.1. Other changes besides policy changes are important!

Changes in Consumer Prices in the Spanish Model
(Percent)

sector	data 1985-1986	model policy only	model shocks only	model policy&shocks
food and nonalcoholic beverages	1.8	-2.3	4.0	1.7
tobacco and alcoholic beverages	3.9	2.5	3.1	5.8
clothing	2.1	5.6	0.9	6.6
housing	-3.3	-2.2	-2.7	-4.8
household articles	0.1	2.2	0.7	2.9
medical services	-0.7	-4.8	0.6	-4.2
transportation	-4.0	2.6	-8.8	-6.2
recreation	-1.4	-1.3	1.5	0.1
other services	2.9	1.1	1.7	2.8
weighted correlation with data		-0.08	0.87	0.94
variance decomposition of change		0.30	0.77	0.85
regression coefficient *a*		0.00	0.00	0.00
regression coefficient *b*		-0.08	0.54	0.67

Measures of Accuracy of Model Results

Weighted correlation coefficient.

Estimated coefficients a and b from the (weighted) regression

$$x_i^{data} = a + bx_i^{model} + e_i.$$

Public Finances in the Spanish Model
(Percent of GDP)

variable	data 1985-1986	model policy only	model shocks only	model policy&shocks
indirect taxes and subsidies	2.38	3.32	-0.38	2.98
tariffs	-0.58	-0.82	-0.04	-0.83
social security payments	0.04	-0.19	-0.03	-0.22
direct taxes and transfers	-0.84	-0.66	0.93	0.26
government capital income	-0.13	-0.06	0.02	-0.04
correlation with data		0.99	-0.70	0.92
variance decomposition of change		0.93	0.08	0.86
regression coefficient *a*		-0.06	0.35	-0.17
regression coefficient *b*		0.74	-1.82	0.80

Kehoe and Ruhl (2013) show that products that are traded very little or not at all account disproportionately for aggregate changes in bilateral trade following trade liberalization.

Hypothesis in Kehoe, Rossbach, and Ruhl (2014): Industries with more trade due to these little-traded products should experience more growth following trade liberalization.

Product: A 5-digit SITC, rev. 2 code. There are 1,836 products.

Industry: A 3-digit ISIC code. There are 38 industries. (We are only interested in industries that produce goods in merchandise trade — agriculture, mining and extraction, and manufacturing.)

Notice that each industry, on average, consists of 48.3 products.

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

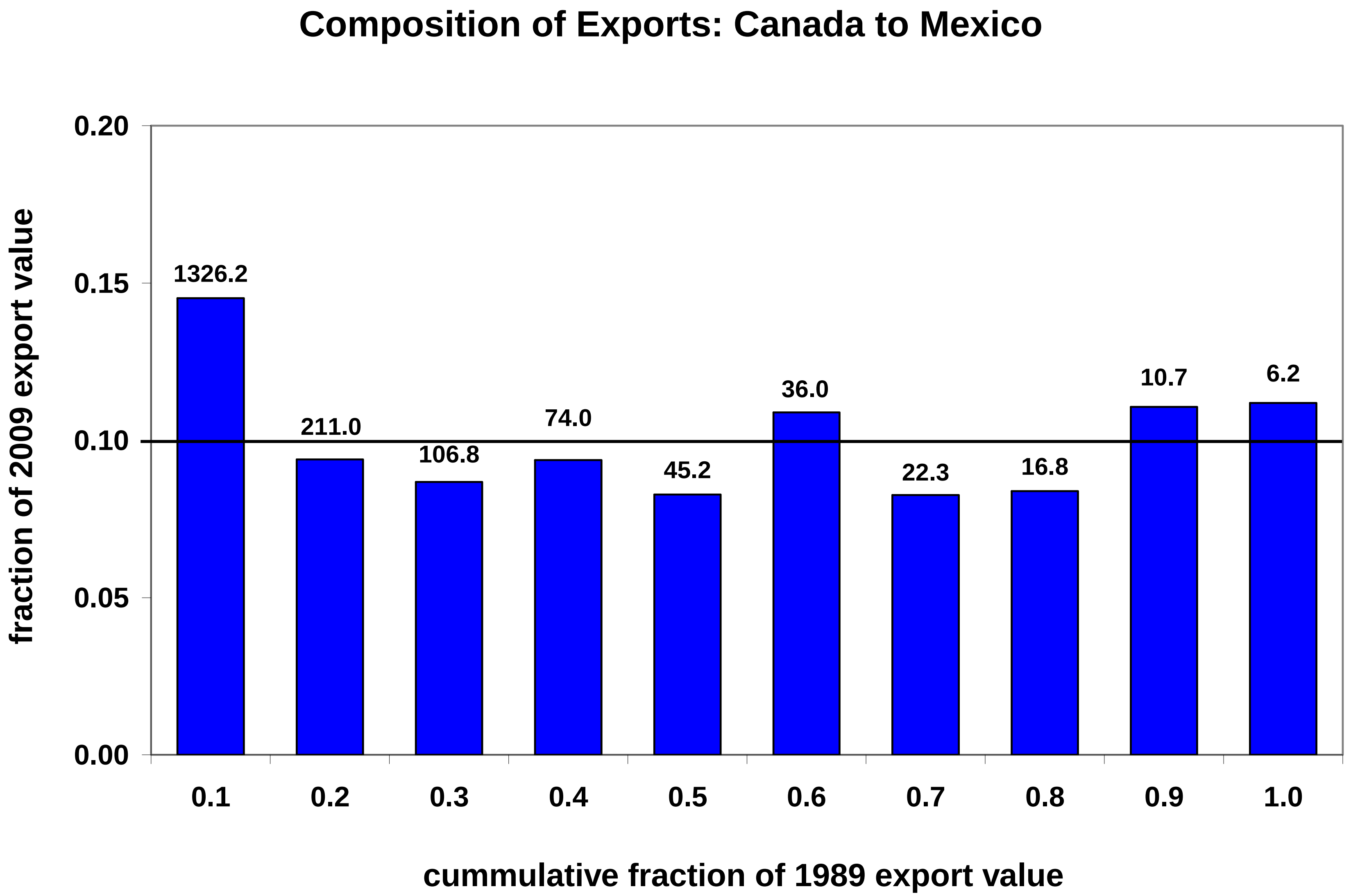
342	Printing, publishing and allied industries
351	Manufacture of industrial chemicals
352	Manufacture of other chemical products
353	Petroleum refineries
354	Manufacture of miscellaneous products of petroleum and coal
355	Manufacture of rubber products
356	Manufacture of plastic products not elsewhere 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

The New Product, or Extensive, Margin

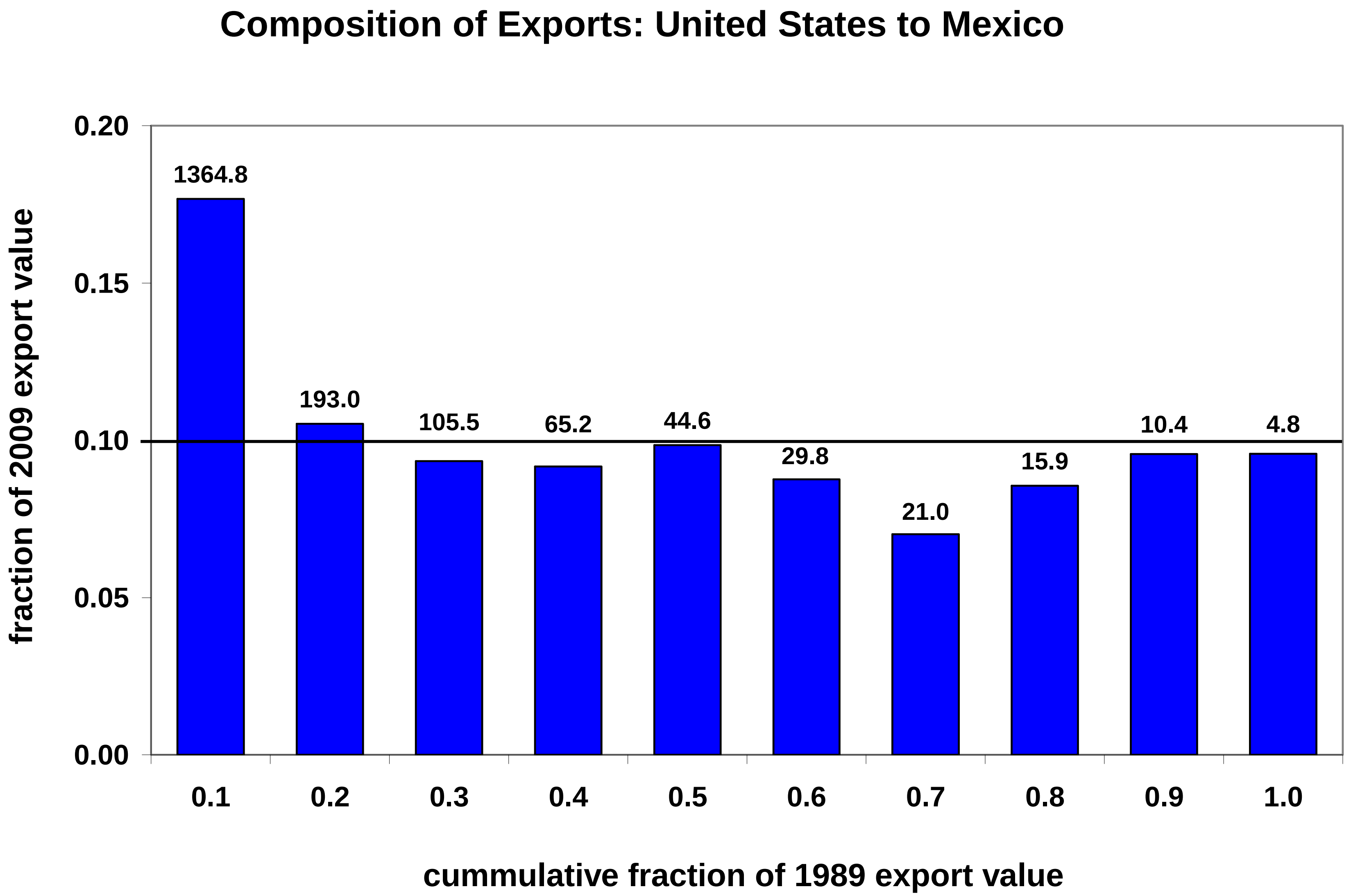
We sort each of the 1,836 products by average amount of trade over the first three years of our period, 1989–1991.

We then place each product into bins sequentially until each bin accounts for 10 percent of total trade in the base year, 1989.

We define Least Traded Products (LTP) to be the products in the final 10 percent bin, the products with the least amount of trade over the first three years, 1989–2009.



Composition of Exports: Canada to Mexico
0.20
0.15
0.10
0.05
0.00
1326.2
211.0
106.8
74.0
45.2
36.0
22.3
16.8
10.7
6.2
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
fraction of 2009 export value
cummulative fraction of 1989 export value


Composition of Exports: United States to Mexico
0.20
0.15
0.10
0.05
0.00
fraction of 2009 export value
1364.8
193.0
105.5
65.2
44.6
29.8
21.0
15.9
10.4
4.8
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
cummulative fraction of 1989 export value

Predicting changes in trade by industry

Compute the fraction of trade in each industry accounted for by LTP s_j in the base period t_0. Predict

$$z_j = \alpha + \beta s_j$$

$$z_j = \frac{X_{jit}^{k} / GDP_{it}}{X_{jit_0}^{k} / GDP_{it_0}} - 1$$

and X_{jit}^{k} are exports of industry j from country i to country k in year t.

Our hypothesis is that $\beta > 0$.

Kehoe (2005) showed that several of the leading models built to predict the industry level effects of NAFTA performed poorly

Kehoe, Rossbach, and Ruhl (2014) confirm this finding for Brown-Deardorff-Stern, Cox-Harris, and Sobarzo models over the 1989–2009 period.

Focus on Canadian and U.S. exports to Mexico 1989–2009 in the Sobarzo model.

Methodology for evaluating the NAFTA models

We compute the weighted correlation coefficient between the model predictions and the results from the data

We also compute the weighted regression coefficients *a* and *b* from

$$z_j^{data} = a + bz_j^{model} + \varepsilon_j$$

Here *a* indicates how well the models did in matching average change ($a = 0$ is ideal) and *b* indicates how well the models did in matching the signs and magnitudes of the changes ($b = 1$ is ideal)

Changes in Mexican trade 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 data		−0.12	0.47
regression coefficient *a*		104.22	24.08
regression coefficient *b*		−0.77	0.94
Sobarzo-LTP weighted correlation			−0.32

Metal products

Actual growth: 94.8 percent, LTP predicted growth rate: 90.9 percent, Sobarzo predicted growth rate: 9.5 percent

Metal products is made up of 79 products, 55 of which were LTP for U.S. exports to Mexico and 72 of which were LTP for Canadian exports.

Of 1989 exports LTP make up 72.9 percent of Canadian exports and 13.8 percent of U.S. exports. We predict a 237.6 percent increase in Canadian exports and a 90.3 percent increase in U.S. exports. We observe a 2699.2 percent increase in Canadian exports in the data, and an 85.7 percent increase in U.S. exports. U.S. exports initially make up 99.7 percent of exports of metal products to Mexico, so the predictions for U.S. exports dominate.

In 2009, 5.4 percent of Canadian metal product exports to Mexico exports were in products that were not exported at all in 1989. In 2009, 0.6 percent of U.S. metal product exports to Mexico exports were in products that were not exported at all in 1989.

There is significant variation among products:

SITC code 69532 (Wrenches and spanners) declined by 5.9 percent for U.S. exports and increased by 2,901.7 percent for Canadian exports for an overall decline of 2.5 percent and is an LTP for both countries.

SITC code 69604 (Scissors and blades therefor) grows by 175.4 percent for U.S. exports and declines by 69.2 percent for Canadian exports, for an overall growth rates of 174.8 percent and is an LTP for both countries.

The fastest growing product overall is SITC code 69982 (Articles of nickel not elsewhere specified), which is an LTP for both countries and grows by 1,827.1 percent for the United States and 742.5 percent for Canada for an overall growth rate of 1,807.2 percent.

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

Our exercise shows that looking at the share of least traded products in an industry is a useful predictor of which industries will experience the most growth following trade liberalization.

Major downside to our method: As of now it is atheoretical.

We intend our results to spur the development of models able to account for the importance of the new product margin in trade.

Turning the LTP exercise into predictions

$$z_{ij}^k = \alpha_i^k + \beta s_{ij}^k$$

Run a gravity equation (on data available before reform!) of the form

$$\log x_i^k = \lambda_\tau \log(1+\tau_i^k) + \lambda_2 \log y_i + \lambda_3 \log y_k + \lambda_4 \log\left(\frac{y_i}{Pop_i}\right) + \lambda_5 \log\left(\frac{y_k}{Pop_k}\right)$$
$$+\lambda_6 \log d_i^k + \lambda_7 \text{border}_i^k + \lambda_8 \text{common\_lang}_i^k + \lambda_9 \text{colony}_i^k + \lambda_{10} + \varepsilon_i^k$$

Focus on λ_τ and γ, the fraction of trade accounted for by LTPs after trade reforms multiplied by 10 (on data available before the reform!)

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

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

$$\frac{\beta_i^k}{\alpha_i^k + 0.1\beta_i^k} = \gamma.$$

Trade liberalization leads to booms in industries not previously heavily involved in trade and expansions of small and medium sized firms.

Least traded products with largest expansions in U.S. exports to Canada

Petroleum gases and other gaseous hydrocarbons n.e.s.
Lemonade, flavored spa waters, flavored waters
Other acyclic hydrocarbons
Iron/steel coils of other than high carbon/alloy steel
Malt extract; preparations of flour etc., for infant food
Meat of swine, fresh, chilled or frozen
Carboxyimide-function compounds etc.
Prepared foods obtained by the swelling or roasting
Articles of jewellery & parts of precious metal
Sheets & plates of other than high carbon/alloy steel

Least traded products with largest expansions in U.S. exports to Mexico

Petroleum gases and other gaseous hydrocarbons n.e.s.
Antisera and microbial vaccines
Articles of jewellery & parts of precious metal
Polyethylene in the form of monofil, seamless tubes
Parts of the pumps & compressors of air pumps
Bonded fibre fabrics, similar bonded yarn fabrics
Rice in the husk (paddy or rough rice)
Other sugars; sugar syrups; artificial honey; caramel
Reciprocating pumps, other than fuel pumps
Textile fabrics coated, with preparation of cellulose derivatives

General lessons

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 (Arkolakis 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, Rodriguez-Clare 2012).

Modifying Eaton-Kortum to allow flexible comparative advantage

Berry, Levinsohn, and Pakes (1995)

Allow the productivity of an exporter's factors to vary across products due to deterministic differences in their suitability for a particular product.

Examples: Characteristics of an exporter's land and climate affects the set of agricultural products in which it has a comparative advantage. Education and skills of workforce affects the set of manufactured products in which it has a comparative advantage.

Food products industry in U.S.-Mexico Trade Reform

Free Trade Market Share / Base Solution Market Share

	standard model		flexible model	
Exporter	Mex. market	U.S. market	Mex. market	U.S. market
United States	12.69	1.00	2.41	0.99
Mexico	0.94	19.20	0.84	13.51
Germany	0.95	1.22	0.46	1.02
Denmark	0.96	1.24	0.47	1.03
Finland	0.93	1.21	0.36	1.05
France	0.95	1.23	0.33	0.88
UK	0.95	1.23	0.26	0.96
Italy	0.94	1.22	0.50	1.02
Japan	0.94	1.22	0.45	1.10
Korea	0.93	1.21	0.44	0.96