Applied general equilibrium models that put the standard theory to work do not well in predicting the impact of trade liberalization experiences like NAFTA.

Applied general equilibrium models were the only analytical game in town when it came to analyzing the impact of NAFTA in 1992-1993.

Typical sort of model: Static applied general equilibrium model with large number of industries and imperfect competition (Dixit-Stiglitz or Eastman-Stykolt) and finite number of firms in some industries. In some numerical experiments, new capital is placed in Mexico owned by consumers in the rest of North America to account for capital flows.

Examples:
Brown-Deardorff-Stern model of Canada, Mexico, and the United States
Cox-Harris model of Canada
Sobarzo model of Mexico

T. J. Kehoe, "An Evaluation of the Performance of Applied General Equilibrium Models of the Impact of NAFTA," in T. J. Kehoe, T. N. Srinivasan, and J. Whalley, editors, *Frontiers in Applied General Equilibrium Modeling: Essays in Honor of Herbert Scarf*, Cambridge University Press, 2005, 341-77.

Research Agenda:

- Compare results of numerical experiments of models with data.
- Determine what shocks — besides NAFTA policies — were important.
- Construct a simple applied general equilibrium model and perform experiments with alternative specifications to determine what was wrong with the 1992-1993 models.

Applied GE Models Can Do a Good Job!

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.

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

1. Weighted correlation coefficient.
2. Variance decomposition of the (weighted) variance of the changes in the data:

$$vardec(y^{data}, y^{model}) = \frac{var(y^{model})}{var(y^{model}) + var(y^{data} - y^{model})}.$$

3, 4. Estimated coefficients a and b from the (weighted) regression

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

Changes in Value of Gross Output/GDP in the Spanish Model (Percent)

sector	data 1985-1986	model policy only	model shocks only	model policy&shocks
agriculture	-0.4	-1.1	8.3	6.9
energy	-20.3	-3.5	-29.4	-32.0
basic industry	-9.0	1.6	-1.8	-0.1
machinery	3.7	3.8	1.0	5.0
automobile industry	1.1	3.9	4.7	8.6
food products	-1.8	-2.4	4.7	2.1
other manufacturing	0.5	-1.7	2.3	0.5
construction	5.7	8.5	1.4	10.3
commerce	6.6	-3.6	4.4	0.4
transportation	-18.4	-1.5	1.0	-0.7
services	8.7	-1.1	5.8	4.5
government services	7.6	3.4	0.9	4.3
weighted correlation with data		0.16	0.80	0.77
variance decomposition of change		0.11	0.73	0.71
regression coefficient *a*		-0.52	-0.52	-0.52
regression coefficient *b*		0.44	0.75	0.67

Changes in Trade/GDP in the Spanish Model (Percent)

direction of exports	data 1985-1986	model policy only	model shocks only	model policy&shocks
Spain to rest of E.C.	-6.7	-3.2	-4.9	-7.8
Spain to rest of world	-33.2	-3.6	-6.1	-9.3
rest of E.C. to Spain	14.7	4.4	-3.9	0.6
rest of world to Spain	-34.1	-1.8	-16.8	-17.7
weighted correlation with data		0.69	0.77	0.90
variance decomposition of change		0.02	0.17	0.24
regression coefficient *a*		-12.46	2.06	5.68
regression coefficient *b*		5.33	2.21	2.37

Changes in Composition of GDP in the Spanish Model (Percent of GDP)

variable	data 1985-1986	model policy only	model shocks only	model policy&shocks
wages and salaries	-0.53	-0.87	-0.02	-0.91
business income	-1.27	-1.63	0.45	-1.24
net indirect taxes and tariffs	1.80	2.50	-0.42	2.15
correlation with data		0.998	-0.94	0.99
variance decomposition of change		0.93	0.04	0.96
regression coefficient *a*		0.00	0.00	0.00
regression coefficient *b*		0.73	-3.45	0.85
private consumption	-0.81	-1.23	-0.51	-1.78
private investment	1.09	1.81	-0.58	1.32
government consumption	-0.02	-0.06	-0.38	-0.44
government investment	-0.06	-0.06	-0.07	-0.13
exports	-3.40	-0.42	-0.69	-1.07
-imports	3.20	-0.03	2.23	2.10
correlation with data		0.40	0.77	0.83
variance decomposition of change		0.20	0.35	0.58
regression coefficient *a*		0.00	0.00	0.00
regression coefficient *b*		0.87	1.49	1.24

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

Models of NAFTA
Did Not Do a Good Job!

Ex-post evaluations of the performance of applied GE models are essential if policy makers are to have confidence in the results produced by this sort of model.

Just as importantly, they help make applied GE analysis a scientific discipline in which there are well-defined puzzles and clear successes and failures for alternative hypotheses.

Changes in Trade/GDP in Brown-Deardorff-Stern Model (Percent)

variable	data 1988-1999	model
Canadian exports	52.9	4.3
Canadian imports	57.7	4.2
Mexican exports	240.6	50.8
Mexican imports	50.5	34.0
U.S. exports	19.1	2.9
U.S. imports	29.9	2.3
weighted correlation with data		0.64
variance decomposition of change		0.08
regression coefficient *a*		23.20
regression coefficient *b*		2.43

Changes in Canadian Exports/ GDP in the Brown-Deardorff-Stern Model (Percent)

	exports to Mexico		exports to United States	
sector	1988–1999	model	1988–1999	model
agriculture	122.5	3.1	106.1	3.4
mining and quarrying	-34.0	-0.3	75.8	0.4
food	89.3	2.2	91.7	8.9
textiles	268.2	-0.9	97.8	15.3
clothing	1544.3	1.3	237.1	45.3
leather products	443.0	1.4	-14.4	11.3
footwear	517.0	3.7	32.8	28.3
wood products	232.6	4.7	36.5	0.1
furniture and fixtures	3801.7	2.7	282.6	12.5
paper products	240.7	-4.3	113.7	-1.8
printing and publishing	6187.4	-2.0	37.2	-1.6
chemicals	37.1	-7.8	109.4	-3.1
petroleum and products	678.1	-8.5	-42.5	0.5
rubber products	647.4	-1.0	113.4	9.5
nonmetal mineral products	333.5	-1.8	20.5	1.2
glass products	264.4	-2.2	74.5	30.4
iron and steel	195.2	-15.0	92.1	12.9
nonferrous metals	38.4	-64.7	34.7	18.5
metal products	767.0	-10.0	102.2	15.2
nonelectrical machinery	376.8	-8.9	28.9	3.3
electrical machinery	633.9	-26.2	88.6	14.5
transportation equipment	305.8	-4.4	30.7	10.7
miscellaneous manufactures	1404.5	-12.1	100.0	-2.1
weighted correlation with data		-0.91		-0.43
variance decomposition of change		0.003		0.02
regression coefficient *a*		249.24		79.20
regression coefficient *b*		-15.48		-2.80

Changes in Mexican Exports/GDP in the Brown-Deardorff-Stern Model (Percent)

	exports to Canada		exports to United States	
sector	1988–1999	model	1988–1999	model
agriculture	-20.5	-4.1	-15.0	2.5
mining and quarrying	-35.5	27.3	-22.9	26.9
food	70.4	10.8	9.4	7.5
textiles	939.7	21.6	832.3	11.8
clothing	1847.0	19.2	829.6	18.6
leather products	1470.3	36.2	618.3	11.7
footwear	153.0	38.6	111.1	4.6
wood products	4387.6	15.0	145.6	-2.7
furniture and fixtures	4933.2	36.2	181.2	7.6
paper products	23.9	32.9	70.3	13.9
printing and publishing	476.3	15.0	122.1	3.9
chemicals	204.6	36.0	70.4	17.0
petroleum and products	-10.6	32.9	66.4	34.1
rubber products	2366.2	-6.7	783.8	-5.3
nonmetal mineral products	1396.1	5.7	222.3	3.7
glass products	676.8	13.3	469.8	32.3
iron and steel	32.5	19.4	40.9	30.8
nonferrous metals	-35.4	138.1	111.2	156.5
metal products	610.4	41.9	477.2	26.8
nonelectrical machinery	570.6	17.3	123.6	18.5
electrical machinery	1349.2	137.3	744.9	178.0
transportation equipment	2303.4	3.3	349.0	6.2
miscellaneous manufactures	379.4	61.1	181.5	43.2
weighted correlation with data		0.19		0.71
variance decomposition of change		0.01		0.04
regression coefficient *a*		120.32		38.13
regression coefficient *b*		2.07		3.87

Changes in U.S. Exports/GDP in the Brown-Deardorff-Stern Model (Percent)

sector	exports to Canada 1988–1999	exports to Canada model	exports to Mexico 1988–1999	exports to Mexico model
agriculture	-24.1	5.1	6.5	7.9
mining and quarrying	-23.6	1.0	-19.8	0.5
food	62.4	12.7	37.7	13.0
textiles	177.2	44.0	850.5	18.6
clothing	145.5	56.7	543.0	50.3
leather products	29.9	7.9	87.7	15.5
footwear	48.8	45.7	33.1	35.4
wood products	76.4	6.7	25.7	7.0
furniture and fixtures	83.8	35.6	224.1	18.6
paper products	-20.5	18.9	-41.9	-3.9
printing and publishing	50.8	3.9	507.9	-1.1
chemicals	49.8	21.8	61.5	-8.4
petroleum and products	-6.9	0.8	-41.1	-7.4
rubber products	95.6	19.1	165.6	12.8
nonmetal mineral products	56.5	11.9	55.9	0.8
glass products	50.5	4.4	112.9	42.3
iron and steel	0.6	11.6	144.5	-2.8
nonferrous metals	-20.7	-6.7	-28.7	-55.1
metal products	66.7	18.2	301.4	5.4
nonelectrical machinery	36.2	9.9	350.8	-2.9
electrical machinery	154.4	14.9	167.8	-10.9
transportation equipment	36.5	-4.6	290.3	9.9
miscellaneous manufactures	117.3	11.5	362.3	-9.4
weighted correlation with data		-0.01		0.50
variance decomposition of change		0.14		0.02
regression coefficient *a*		37.27		190.89
regression coefficient *b*		-0.02		3.42

Changes in Canadian Trade/GDP in Cox-Harris Model (Percent)

variable	data 1988-2000	model
total trade	57.2	10.0
trade with Mexico	280.0	52.2
trade with United States	76.2	20.0
weighted correlation with data		0.99
variance decomposition of change		0.52
regression coefficient *a*		38.40
regression coefficient *b*		1.93

Changes in Canadian Trade/GDP in the Cox-Harris Model (Percent)

sector	total exports 1988-2000	total exports model	total imports 1988-2000	total imports model
agriculture	-13.7	-4.1	4.6	7.2
forestry	215.5	-11.5	-21.5	7.1
fishing	81.5	-5.4	107.3	9.5
mining	21.7	-7.0	32.1	4.0
food, beverages, and tobacco	50.9	18.6	60.0	3.8
rubber and plastics	194.4	24.5	87.7	13.8
textiles and leather	201.1	108.8	24.6	18.2
wood and paper	31.9	7.3	97.3	7.2
steel and metal products	30.2	19.5	52.2	10.0
transportation equipment	66.3	3.5	29.7	3.0
machinery and appliances	112.9	57.1	65.0	13.3
nonmetallic minerals	102.7	31.8	3.6	7.3
refineries	20.3	-2.7	5.1	1.5
chemicals and misc. manufactures	53.3	28.1	92.5	10.4
weighted correlation with data		0.49		0.85
variance decomposition of change		0.32		0.08
regression coefficient *a*		41.85		22.00
regression coefficient *b*		0.81		3.55

Changes in Mexican Trade/GDP in the Sobarzo Model (Percent)

sector	exports to North America 1988–2000	exports to North America model	imports from North America 1988–2000	imports from North America model
agriculture	-15.3	-11.1	-28.2	3.4
mining	-23.2	-17.0	-50.7	13.2
petroleum	-37.6	-19.5	65.9	-6.8
food	5.2	-6.9	11.8	-5.0
beverages	42.0	5.2	216.0	-1.8
tobacco	-42.3	2.8	3957.1	-11.6
textiles	534.1	1.9	833.2	-1.2
wearing apparel	2097.3	30.0	832.9	4.5
leather	264.3	12.4	621.0	-0.4
wood	415.1	-8.5	168.9	11.7
paper	12.8	-7.9	68.1	-4.7
chemicals	41.9	-4.4	71.8	-2.7
rubber	479.0	12.8	792.0	-0.1
nonmetallic mineral products	37.5	-6.2	226.5	10.9
iron and steel	35.9	-4.9	40.3	17.7
nonferrous metals	-40.3	-9.8	101.2	9.8
metal products	469.5	-4.4	478.7	9.5
nonelectrical machinery	521.7	-7.4	129.0	20.7
electrical machinery	3189.1	1.0	749.1	9.6
transportation equipment	224.5	-5.0	368.0	11.2
other manufactures	975.1	-4.5	183.6	4.2
weighted correlation with data		0.61		0.23
variance decomposition of change		0.0004		0.002
regression coefficient *a*		495.08		174.52
regression coefficient *b*		30.77		5.35

What Do We Learn from these Evaluations?

The Spanish model seems to have been far more successful in predicting the consequences of policy changes than the three models of NAFTA, but

- Kehoe, Polo, and Sancho (KPS) knew the structure of their model well enough to precisely identify the relationships between the variables in their model with those in the data;

- KPS were able to use the model to carry out numerical exercises to incorporate the impact of exogenous shocks.

KPS had an incentive to show their model in the best possible light.

3. Much of the growth of trade after a trade liberalization experience is growth on the extensive margin. Models need to allow for corner solutions or fixed costs.

T. J. Kehoe and K. J. Ruhl, "How Important is the New Goods Margin in International Trade?" Federal Reserve Bank of Minneapolis, 2002.

K. J. Ruhl, "Solving the Elasticity Puzzle in International Economics," University of Texas at Austin, 2005.

What happens to the **least-traded** goods:

Over the business cycle?
During trade liberalization?

Indirect evidence on the extensive margin

How Does Trade Grow?

- **Intensive Margin:** growth in goods already traded

- **Extensive Margin:** trade in goods not traded before

The Extensive Margin

- The Extensive Margin has recently gained attention

- **Models**
    - Melitz (2003)
    - Alessandria and Choi (2003)
    - Ruhl (2004)

- **Empirically**
    - Hummels and Klenow (2002)
    - Eaton, Kortum and Kramarz (2004)

What Happens to the Extensive Margin?

- During trade liberalization?
    - Large changes in the extensive margin
- Over the business cycle?
    - Little change in extensive margin

Evidence from Trade Agreements

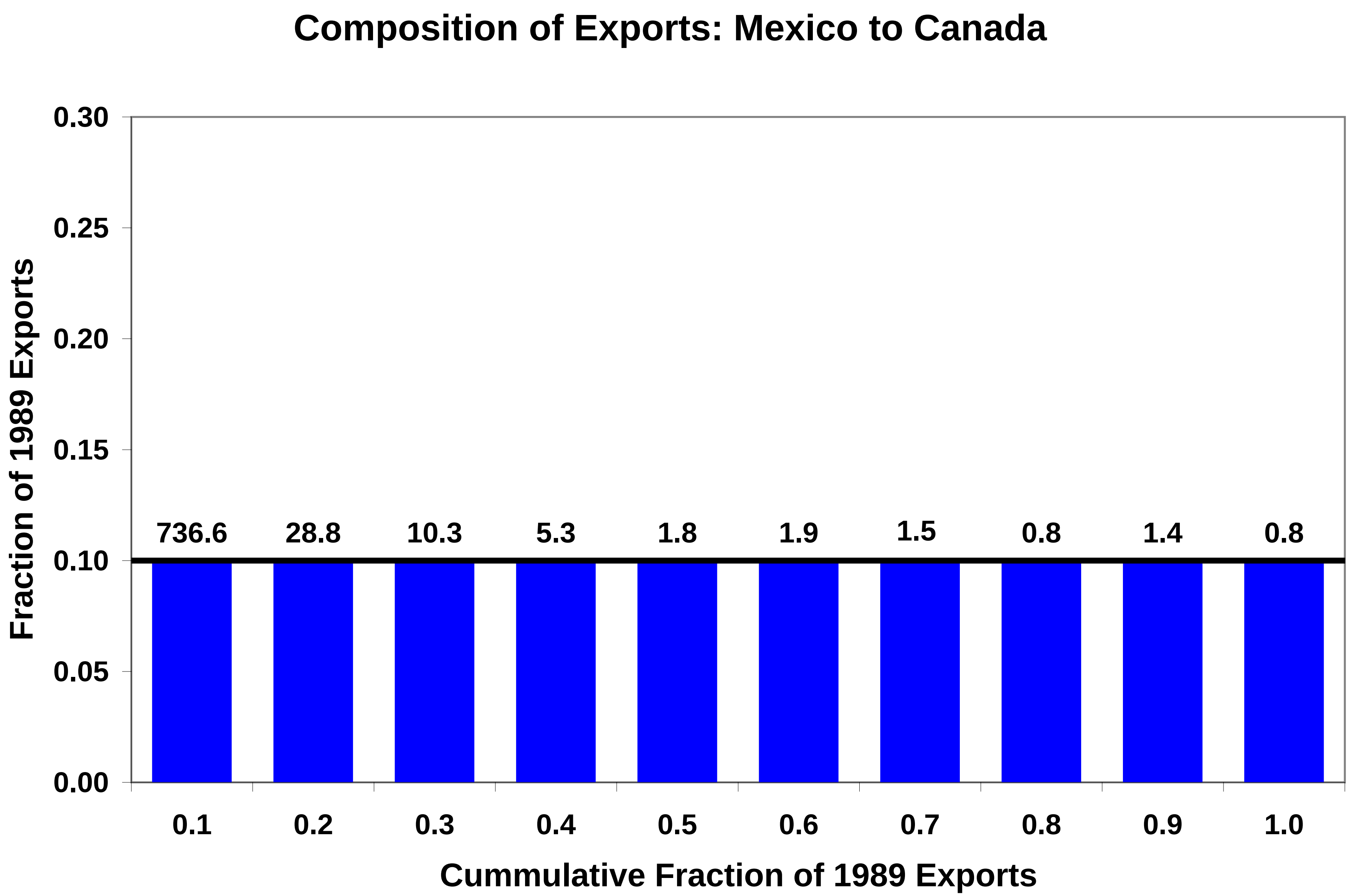
- **Events**
  - Greece's Accession to the European Econ. Community - 1981
  - Portugal's Accession to the European Community - 1986
  - Spain's Accession to the European Community - 1986
  - U.S.-Canada Free Trade Agreement - 1989
  - North American Free Trade Agreement - 1994
- **Data**
  - Four-digit SITC bilateral trade data (OECD)
    - 789 codes in revision 2
- Indirect Evidence

Measure One

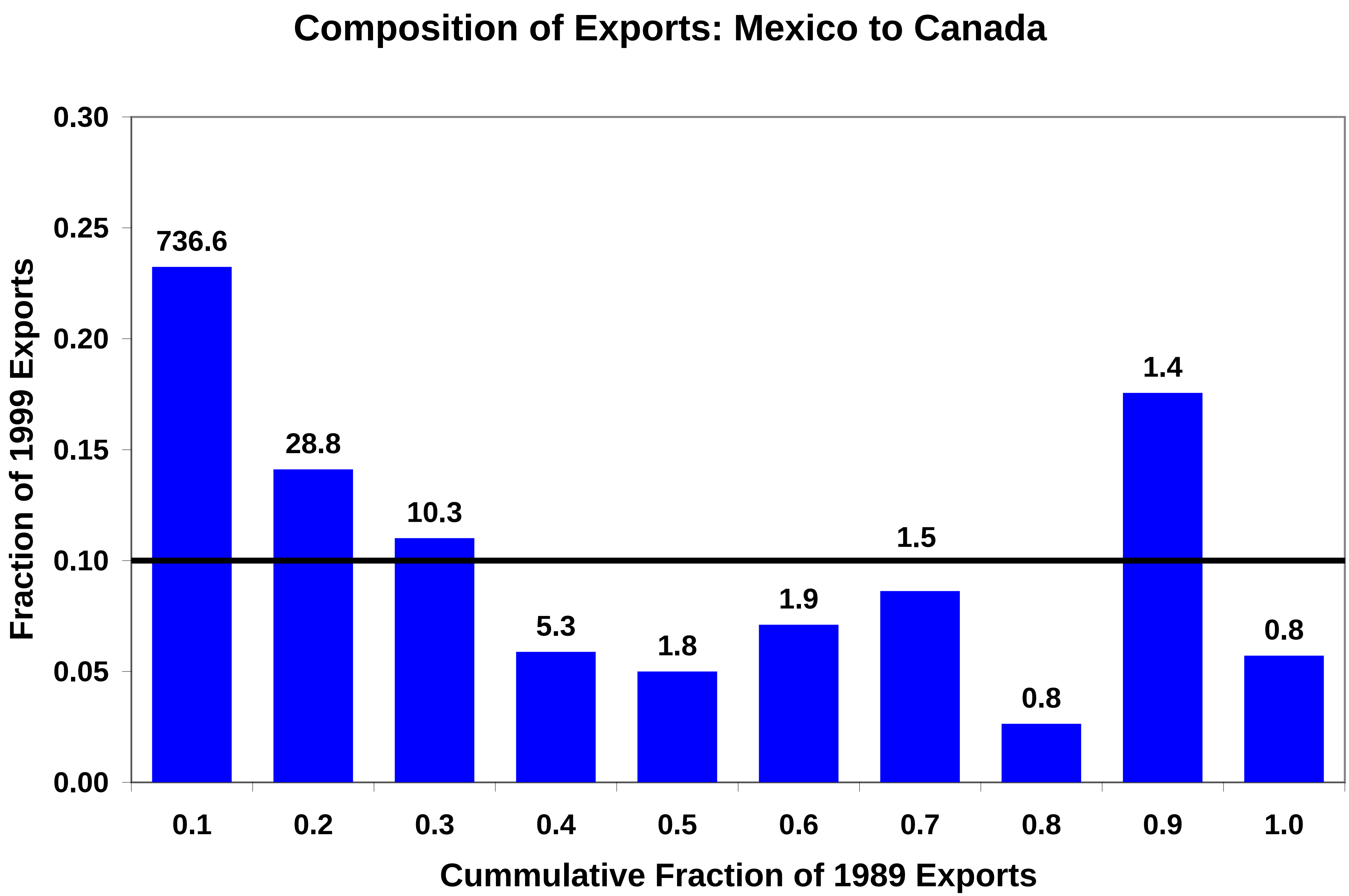
1. Rank codes from lowest value of exports to highest value of exports based on average of first 3 years

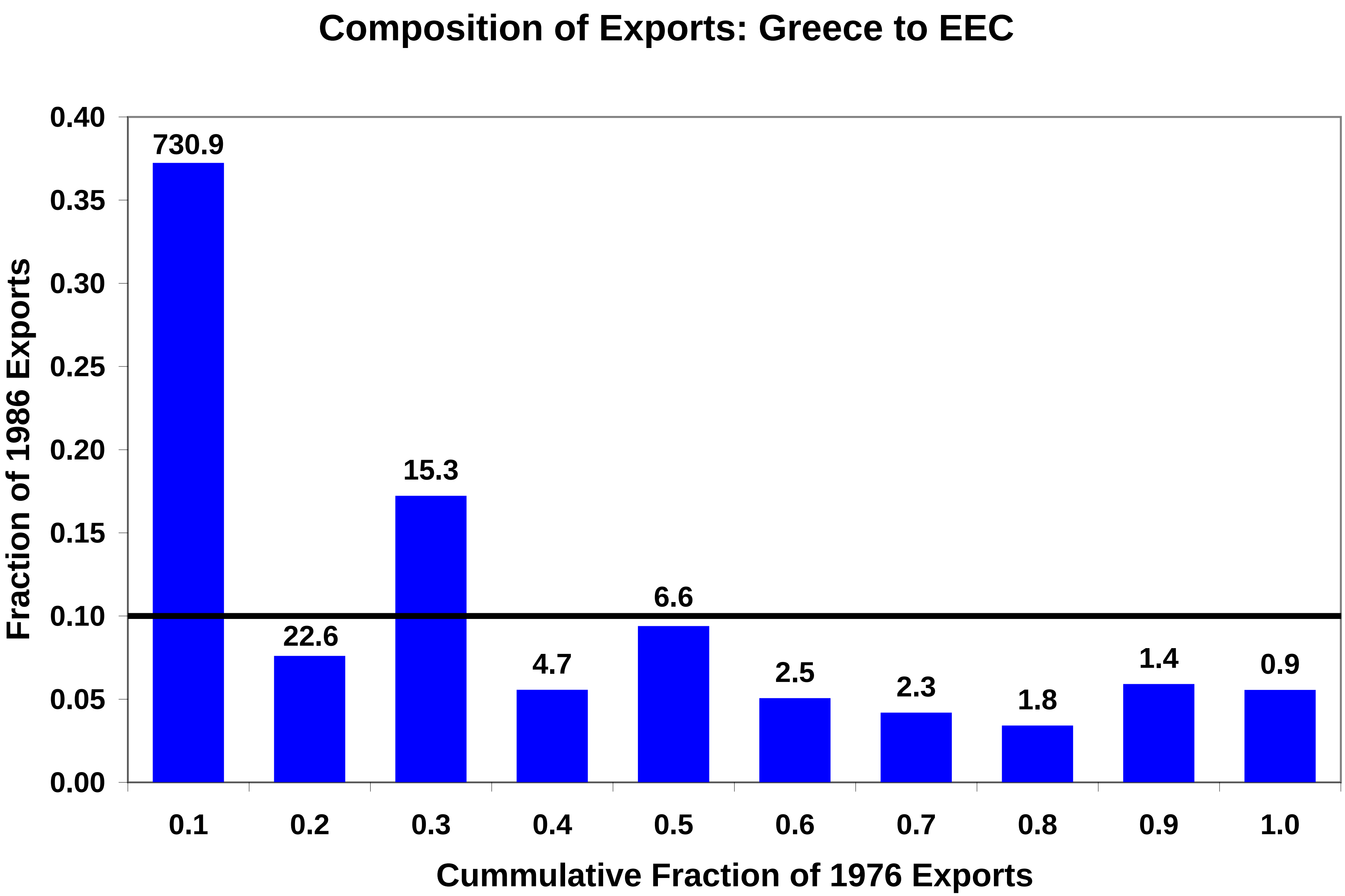
2. Form sets of codes by cumulating exports: the first 742.9 codes make up 10 percent of exports; the next 24.1 codes make up 10 percent of exports; and so on.

3. Calculate each set's share of export value at the end of the sample period.



Composition of Exports: Mexico to Canada
Fraction of 1989 Exports
0.30
0.25
0.20
0.15
0.10
0.05
0.00
736.6
28.8
10.3
5.3
1.8
1.9
1.5
0.8
1.4
0.8
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1989 Exports


Composition of Exports: Mexico to Canada
Fraction of 1999 Exports
0.30
0.25
0.20
0.15
0.10
0.05
0.00
736.6
28.8
10.3
5.3
1.8
1.9
1.5
0.8
1.4
0.8
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1989 Exports


Composition of Exports: Greece to EEC
Fraction of 1986 Exports
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
730.9
22.6
15.3
4.7
6.6
2.5
2.3
1.8
1.4
0.9
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1976 Exports

Measure Two

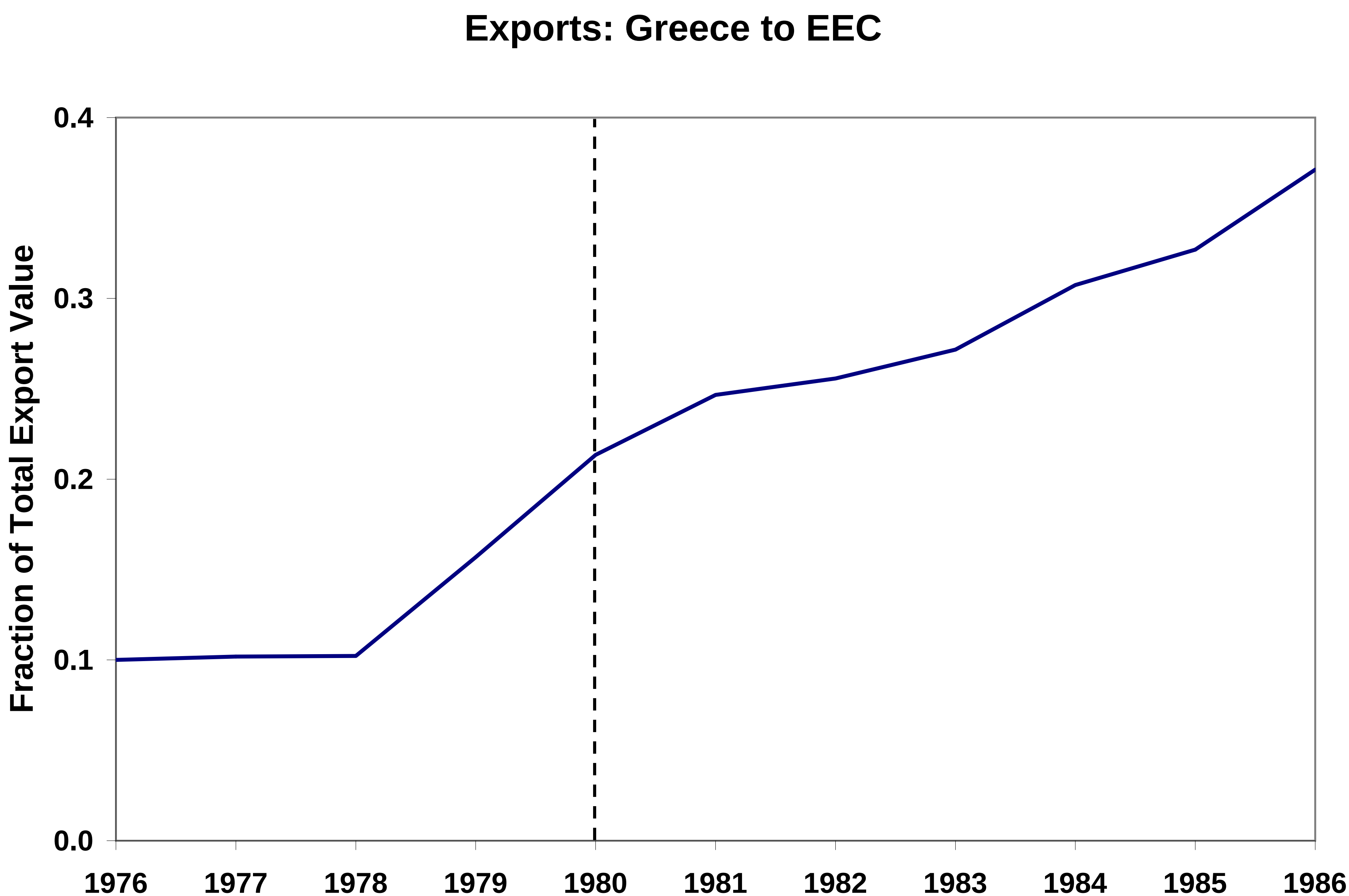
1. Order codes as before.

2. Cumulate exports as before.

3. Follow the evolution of the first (least-traded) set's share of total exports before, during, and after the liberalization.

Exports: Mexico to Canada
Fraction of Total Export Value
0.30
0.20
0.10
0.00
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999

Exports: Canada to Mexico
Fraction of Total Export Value
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999



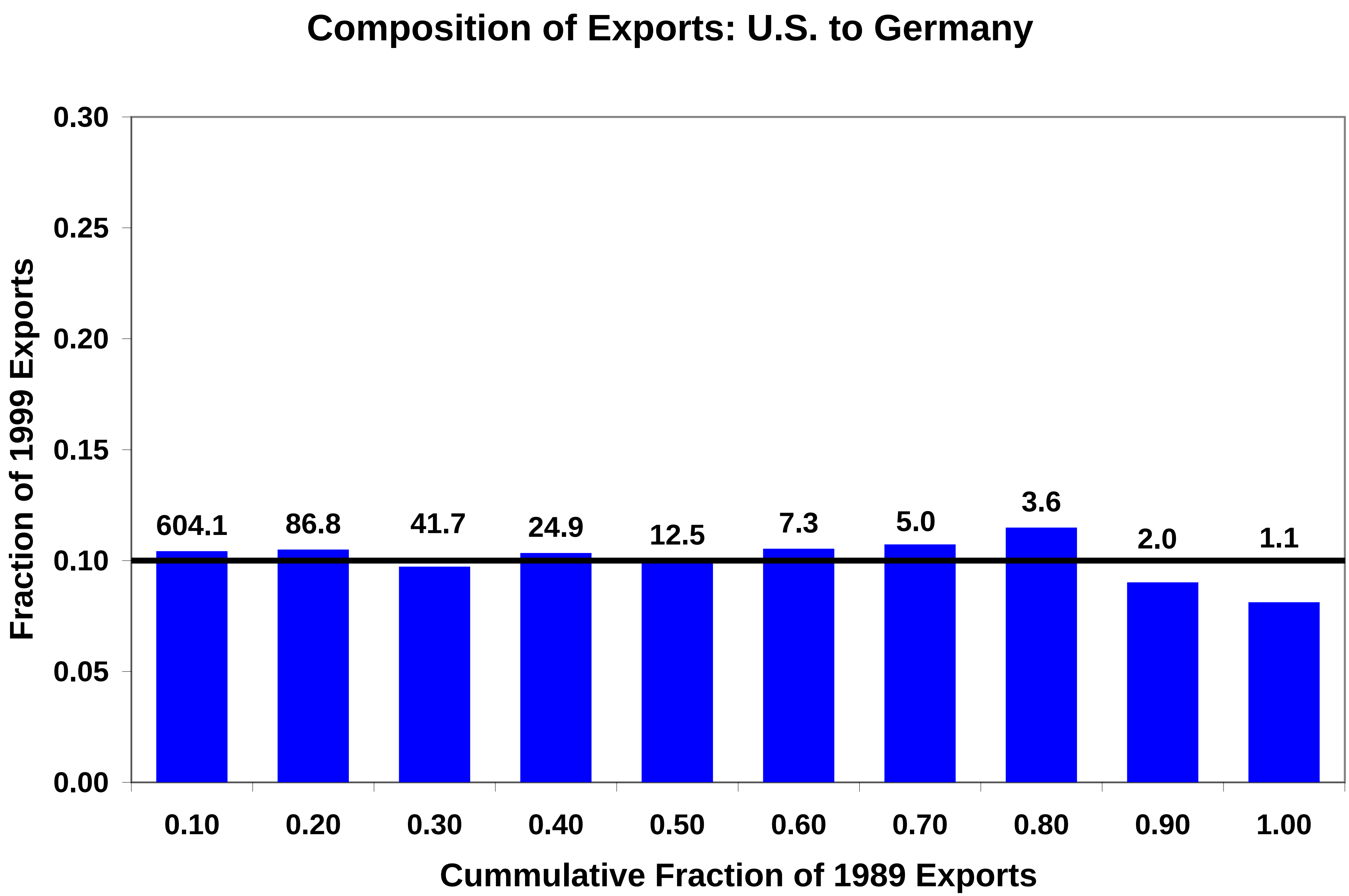
Exports: Greece to EEC
Fraction of Total Export Value
0.4
0.3
0.2
0.1
0.0
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986

Trade Liberalization and the Extensive Margin

Period	Trade Flow	Share of Export Growth
1989-1999	Mexico - U.S.	0.153
1989-1999	U.S. – Mexico	0.118
1989-1999	Mexico - Canada	0.231
1989-1999	Canada - Mexico	0.307
1989-1999	Canada - U.S.	0.162
1989-1999	U.S. – Canada	0.130
1978-1986	Greece to the EEC	0.371
1982-1987	Spain to the EC	0.128
1982-1987	Portugal to the EC	0.147

Business Cycles and the Extensive Margin

- Over same period, consider countries with stable policy
  - U.S. – Japan
  - U.S. – U.K.
  - U.S. – Germany


Composition of Exports: U.S. to Germany
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Fraction of 1999 Exports
604.1
86.8
41.7
24.9
12.5
7.3
5.0
3.6
2.0
1.1
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Cummulative Fraction of 1989 Exports

Exports: United States to Germany
Fraction of Total Export Value
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
U.S. Exports to Germany

Exports: Germany and the United States
Fraction of Total Export Value
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
German Exports to U.S.
U.S. Exports to Germany

Business Cycles and the Extensive Margin

Period	Trade Flow	Share of Export Growth
1989-1999	U.S. - U.K.	0.096
1989-1999	U.K. - U.S.	0.128
1989-1999	U.S. - Japan	0.130
1989-1999	Japan - U.S.	0.103
1989-1999	U.S. - Germany	0.104
1989-1999	Germany - U.S.	0.103

The Model

- Countries: foreign and home
- Continuum of goods:

$$y_i(x) = \frac{1}{a_i(x)} l_i(x) \qquad x \in [0,1]$$

- Stand-in consumer in each country with labor L_i.
- Preferences:

$$U = \int_0^1 \log[c_i(x)]dx$$

- *ad valorem* tariffs: τ_i

Determination of Exports

- x is exported by foreign if

$$a_h(x) > w_f a_f(x)(1+\tau_h) \quad \Leftrightarrow \quad \frac{a_h(x)}{a_f(x)} > w_f(1+\tau_h)$$

- x is exported by home if

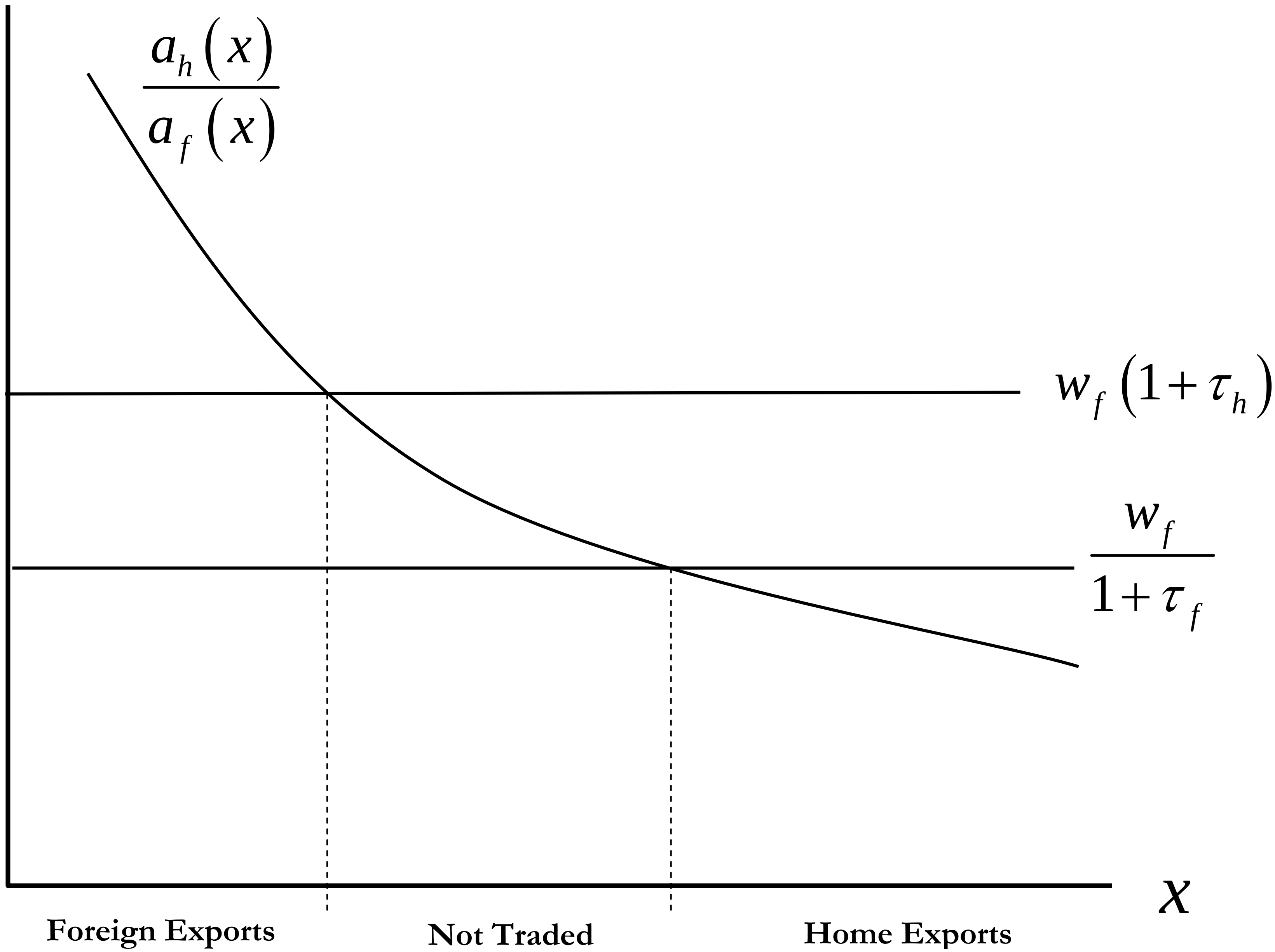
$$\frac{a_h(x)}{a_f(x)} < \frac{w_f}{1+\tau_f}$$

- x is not traded if

$$\frac{w_f}{1+\tau_h} > \frac{a_h(x)}{a_f(x)} > w_f(1+\tau_f)$$

Dornbusch, Fisher, Samuelson (1977)

- Order goods according to the relative unit costs.


$\frac{a_h(x)}{a_f(x)}$
$w_f(1+\tau_h)$
$\frac{w_f}{1+\tau_f}$
x
Foreign Exports
Not Traded
Home Exports

Dornbusch, Fisher, Samuelson (1977)

- Order goods according to the relative unit costs.

- Problems
  - Trade data is collected in aggregates.
  - Difficult to obtain data on relative unit costs.
  - Both countries may export the same aggregate.

Our Approach

- SITC ordering: an aggregate is an interval in $[0,1]$
- Take J evenly spaced points in $[0,1]$.
- Randomly assign log-productivities.

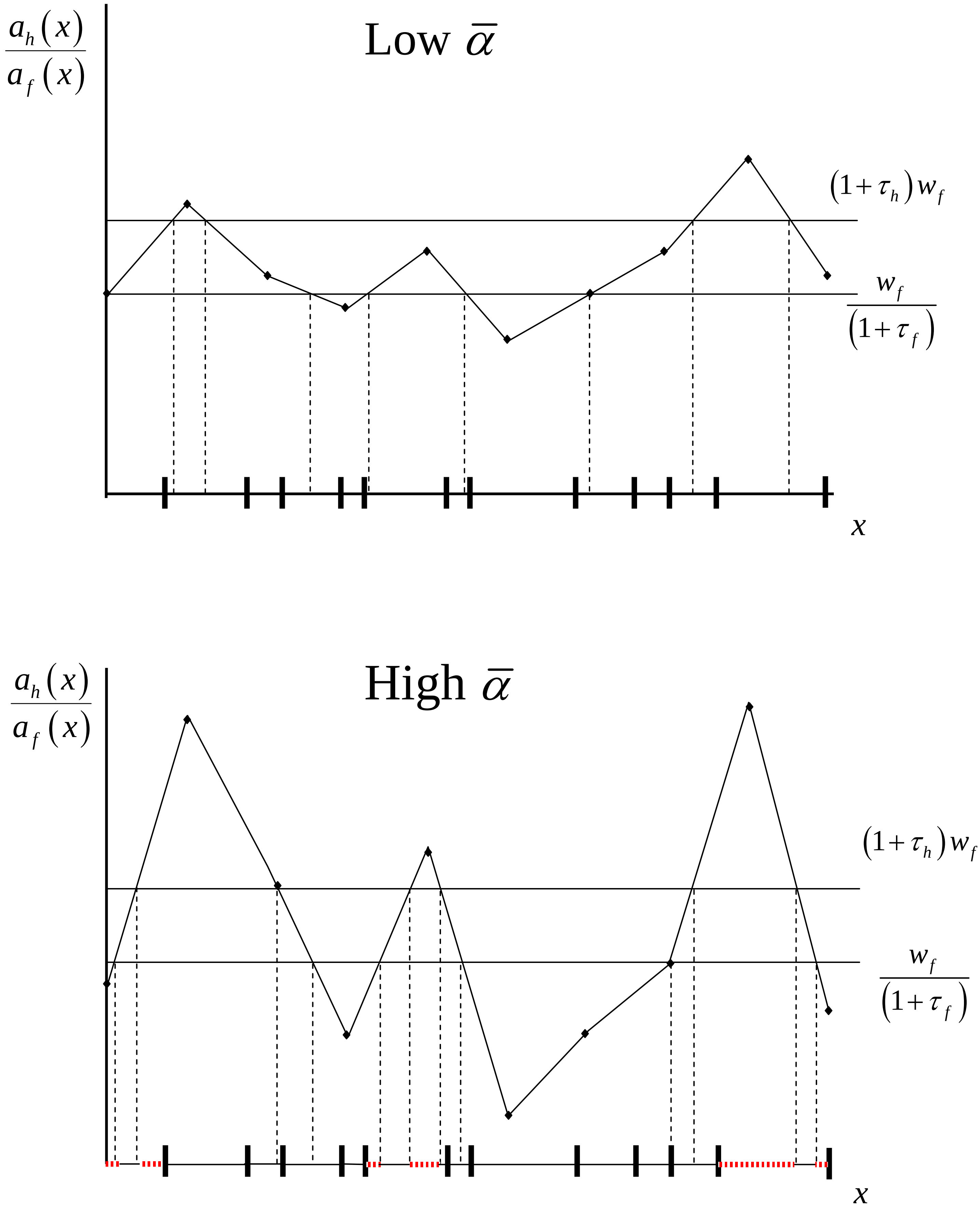
$$\alpha_j = \log\left[\frac{a_h(j)}{a_f(j)}\right] \qquad \alpha_j \sim u[-\bar{\alpha}, \bar{\alpha}]$$

- Points not on the grid are filled in by linear interpolation.

Relative Productivity Curve

- Steeper segments
  - less trade growth
  - more intra-industry trade

- For a given J larger $\bar{\alpha}$ imply steeper segments.
- For a given $\bar{\alpha}$, larger J imply steeper segments.



Low $\bar{\alpha}$
$\frac{a_h(x)}{a_f(x)}$
$(1+\tau_h)w_f$
$\frac{w_f}{(1+\tau_f)}$
x
High $\bar{\alpha}$
$\frac{a_h(x)}{a_f(x)}$
$(1+\tau_h)w_f$
$\frac{w_f}{(1+\tau_f)}$
x

Model Solution

1. Choose J and $\bar{\alpha}$.

2. Draw a realization of the relative productivity curve.

3. Solve the model and compute extensive margin measures.

4. Repeat for 5000 simulations.

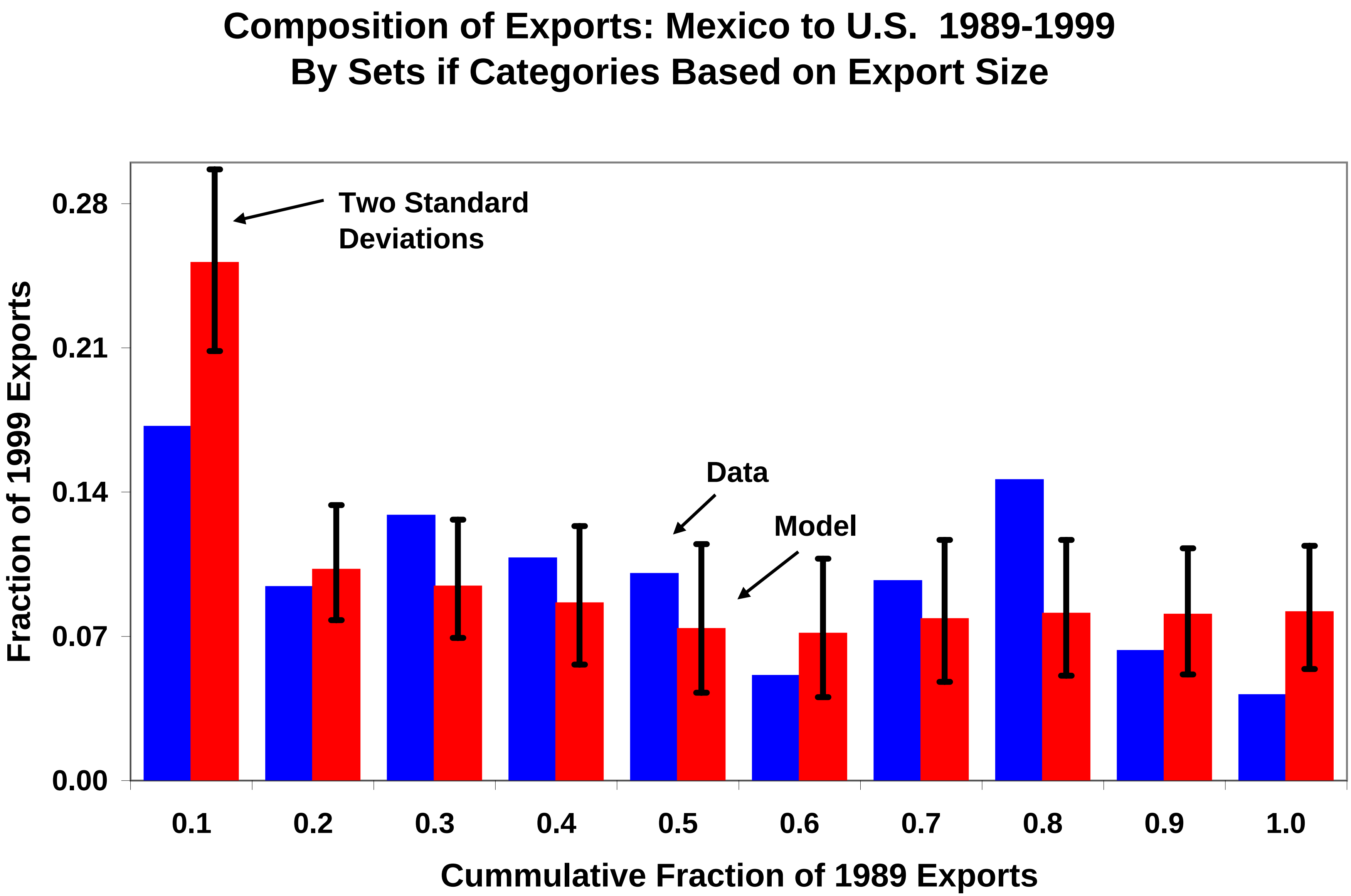
5. Calculate means over simulations.

Calibration

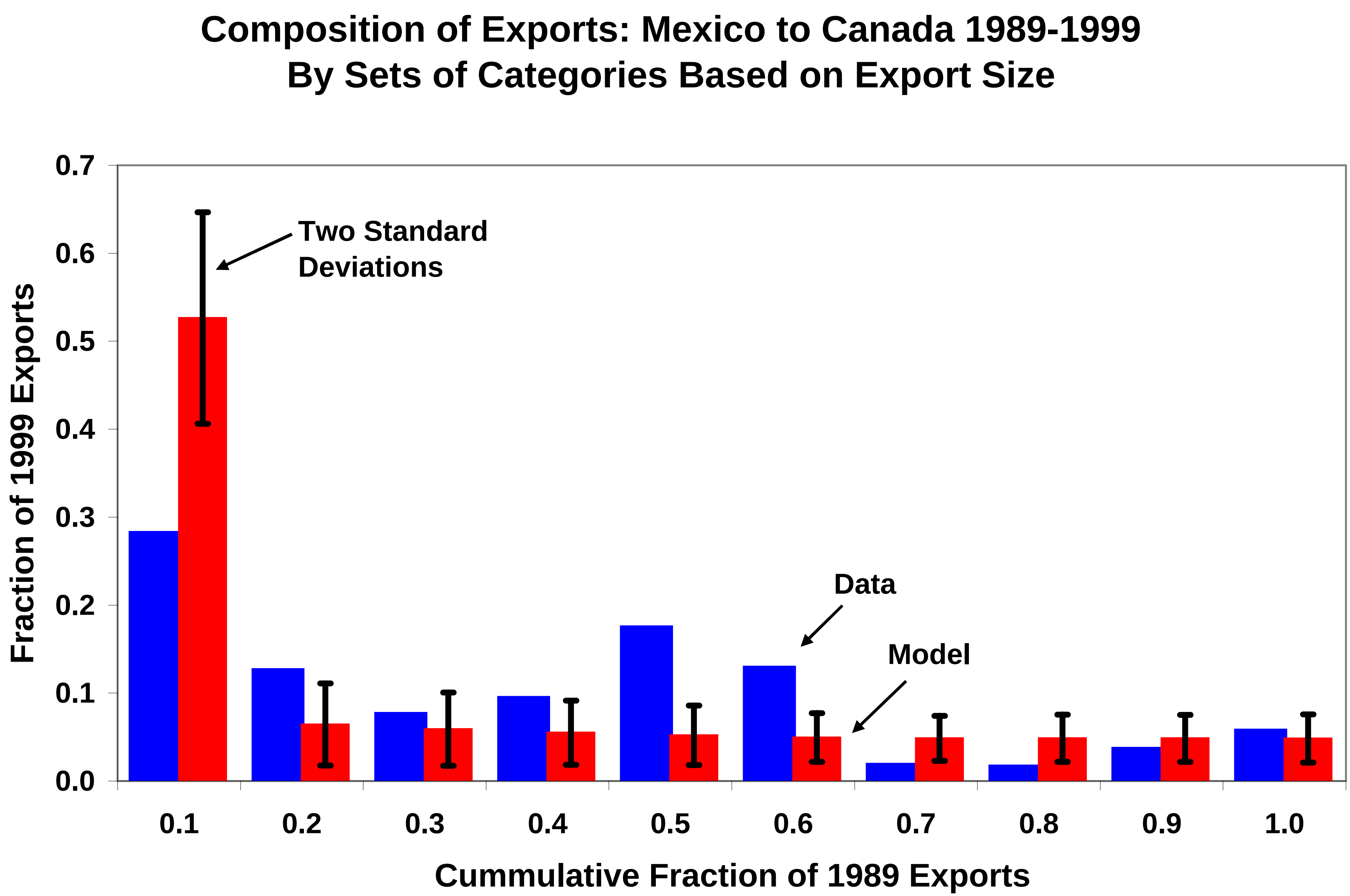
- Parameters: $\bar{\alpha}$, J, L_f / L_h, SITC endpoints
- Country size is measured by gross output of commodities.
- Codes are ordered by their SITC number.
- Code size is determined by its world export value.

$$size_k = \frac{EX_{WORLD,k}^{MEX} + EX_{WORLD,k}^{US}}{\sum_k EX_{WORLD,k}^{MEX} + \sum_k EX_{WORLD,k}^{US}}$$

- J and $\bar{\alpha}$ determined by aggregate trade growth and Intra-industry trade



Composition of Exports: Mexico to U.S. 1989-1999
By Sets if Categories Based on Export Size
Two Standard Deviations
Data
Model
0.28
0.21
0.14
0.07
0.00
Fraction of 1999 Exports
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1989 Exports

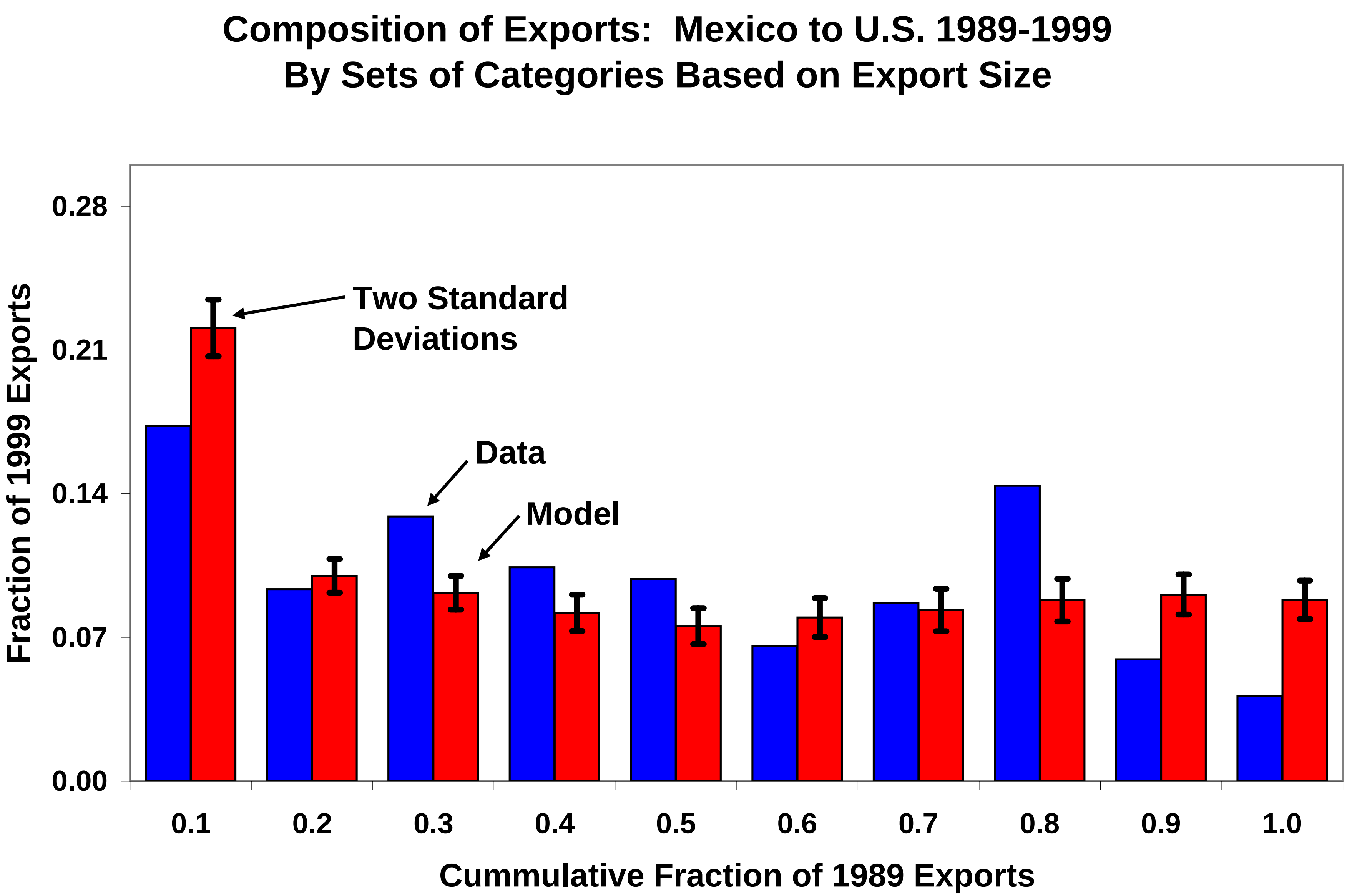

Composition of Exports: Mexico to Canada 1989-1999
By Sets of Categories Based on Export Size
Fraction of 1999 Exports
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Two Standard Deviations
Data
Model
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1989 Exports

Model with Intensive and Extensive Margins

- Same Environment
- New Preferences

$$U = \left[\int_0^1 c^i(x)^\rho dx \right]^{1/\rho} \qquad \sigma = \frac{1}{1-\rho}$$

- **Expenditure on Goods**
  - Old Model $\quad c^i(x)p^i(x) = w^i L^i$
  - New Model $\quad c^i(x)p^i(x) = w^i L^i \left(\frac{p^i(x)}{P^i} \right)^{1-\sigma}$


Composition of Exports: Mexico to U.S. 1989-1999
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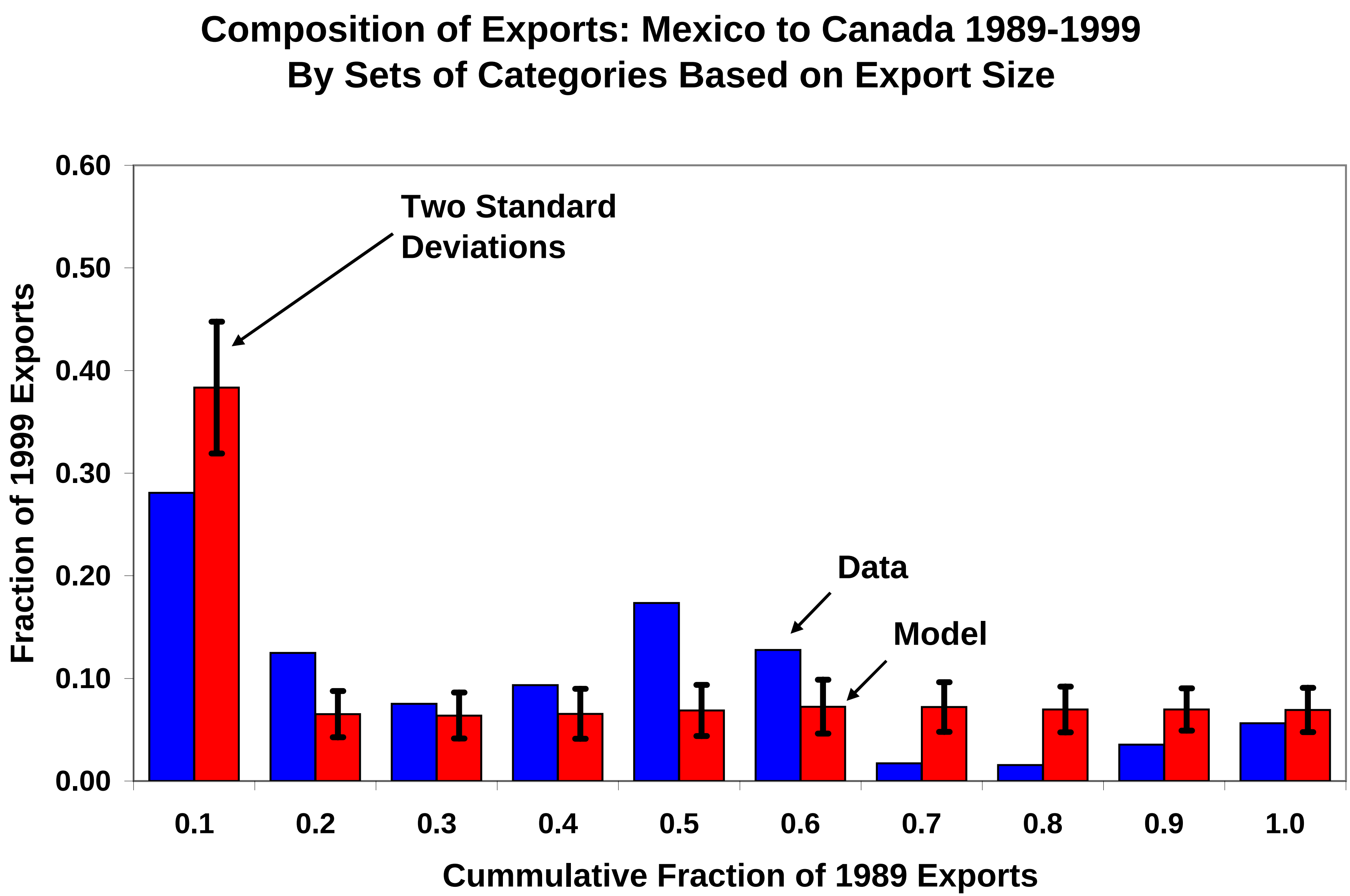
Data
Model
Fraction of 1999 Exports
0.28
0.21
0.14
0.07
0.00
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1989 Exports


Composition of Exports: Mexico to Canada 1989-1999
By Sets of Categories Based on Export Size
Two Standard
Deviations
Data
Model
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Fraction of 1999 Exports
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Cummulative Fraction of 1989 Exports

Conclusions

1. The extensive margin is important.

- Average increase in export share: 67%
- Correct timing

2. Simple model can produce extensive margin growth.

- Calibration uses aggregate production data.

Relative Productivity Parameters

J	Growth in Trade's Share of Production and Grubel-Lloyd Index
$\bar{\alpha}$	

- Grubel-Lloyd Index

$$GL_{MEX}^{US} = 1 - \frac{\sum_{k \in SITC} \left| EX_{MEX}^{US} - EX_{US}^{MEX} \right|}{\sum_{k \in SITC} \left[EX_{US}^{MEX} + EX_{MEX}^{US} \right]}$$

Calibration Values

	Grubel-Lloyd Index (1989)	Growth in Trade/Production (1989-1999)	Relative Output (1989)
MEX-US	.487	201%	.06
MEX-CAN	.147	299%	.66

	$\bar{\alpha}$	J	L^f / L^h
MEX-US	.223	3215	.06
MEX-CAN	.208	63	.66

Calibration Sensitivity

- Ideal SITC Measure:

$$size_k = \frac{y_k^h + y_k^f}{\sum_k y_k^h + \sum_k y_k^f}$$

- Our Proxy:

$$size_k = \frac{EX_{w,k}^h + EX_{w,k}^f}{\sum_k EX_{w,k}^h + \sum_k EX_{w,k}^f}$$