Technology, Geography and Trade

Eatom & Kortum (2002)

Overview

- Ricardian model that incorporates geographic features
- Simple bilateral structural equations for trade
- Exploits the gains from trade
- Reconciles basic facts about international trade:
  1. trade diminishes dramatically with distance
  2. prices vary across locations
  3. heterogeneity of productivity across industries
  4. factor rewards are different across countries

Model

Some assumptions

- a continuum of goods $j \in [0, 1]$
- countries have differential access to technology: $z_i(j)$
- a unique cost of a bundle across commodities within a country: c_i
- **Iceberg assumption:** $d_{ii} =$ and $d_{ni} > 0$, $(i \to n)$
- **triangle inequality:** $d_{ni} \leq d_{nk} \cdot d_{ki}$

Hence, delivering a unit of good j produced in country i to country n costs

$$p_{ni}(j) = \left(\frac{c_i}{z_i(j)} \right) d_{ni}$$

Model - Amount

The buyers pay the lowest price around all of the world

$$p_n(j) = \min\{p_{ni}(j); i = 1, \cdots, N\}$$

Facing these prices, buyers purchase individual goods in amounts $Q(j)$ to maximize a CES objective:

$$U = \left[\int_0^1 Q(j)^{(\sigma-1)/\sigma} dj\right]^{\sigma/(\sigma-1)}$$

Buyers can be final consumers or firms buying intermediate inputs

Model - Technology

Provide a probabilistic representation of technologies to relate trade flows to underlying parameters of goods across countries

- $z_i(j) \sim Z_i$, where $z_i(j)$ are iid, for each j
- $F_i(z)$ assume a Fréchet distribution

$$F_i(z) = e^{-T_i z^{-\theta}} = \Pr(Z_i \leq z)$$

- π_{ni}: probability of price i be the lowest
- T_i: country i's state of technology. It reflects the absolute advantage
- θ: heterogeneity across goods.

Model - Prices

$$G_n(p) = \Pr(P_n \leq p) = 1 - e^{-\phi_n p^\theta}$$

where $\phi_n = \sum_{i=1}^{N} T_i(c_i d_{ni})^{-\theta}$

- π_{ni} is also the fraction of goods that country n buys from country i

$$\pi_{n_i} = \frac{T_i(c_i d_{ni})^{-\theta}}{\phi_n}$$

- The exact price index for the CES objective function, assuming $\sigma < 1 + \theta$, is

$$p_n = \gamma \phi_n^{-1/\theta}$$

where $\gamma = \left[\Gamma(\frac{\theta+1-\sigma}{\theta})\right]^{1/(1-\sigma)}$

Model - Trade Flows

Let X_n be the country n's total spending and X_{ni} be the country n's spent on goods from i:

$$X_{ni} = \frac{\left(\frac{d_{ni}}{p_n}\right)^{-\theta} X_n}{\sum_{m=1}^{N} \left(\frac{d_{mi}}{p_m}\right)^{-\theta} X_m} Q_i$$

where

$$Q_i = \sum_{m=1}^{N} X_{mi}$$

Trade, Geography and Prices

- Trade flows and prices had already been analyzed extensively, but only in isolation
- The model provides us an expression for this relationship

$$\frac{X_{ni}/X_n}{X_{ii}/X_i} = \frac{\phi_i}{\phi_n} d_{ni}^{-\theta} = \left(\frac{p_i d_{ni}}{p_n}\right)^{-\theta}$$

- left-hand side: country i's share in country n relative to i's share at home
- comparative advantages weaken as θ become higher

Trade, Geography and Prices

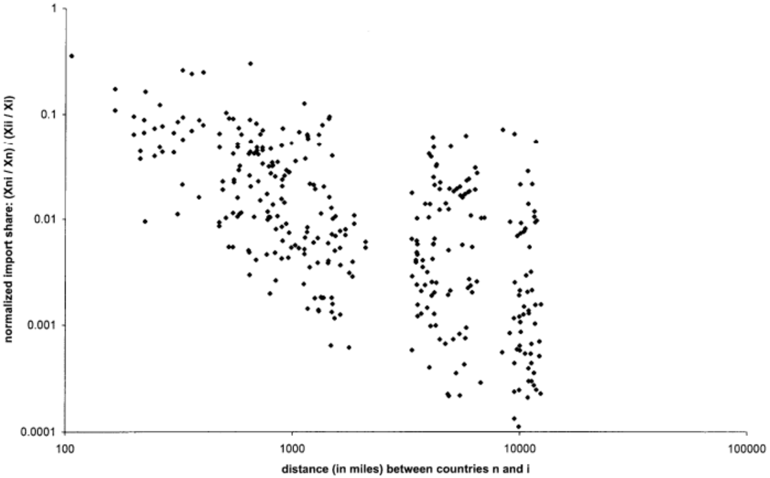

FIGURE 1.—Trade and geography.

Trade, Geography and Prices

Retail prices were used to estimate the *relative prices* of each pair i, n by calculating $r_{ni}(j) = \ln p_n(j) - \ln p_i(j)$

- The model predicts that for any commodity j, $r_{ni}(j)$ is bounded above by $\ln d_{ni}$
- Take the (second) highest value of r_{ni} across commodities to obtain a measure of $\ln d_{ni}$

$$D_{ni} = \frac{\max 2_j\{r_{ni}(j)\}}{\sum_{j=1}^{50}[r_{ni}(j)]/50}$$

- Correlation of -0.40 between normalized import share and D_{ni}

Trade, Geography and Prices

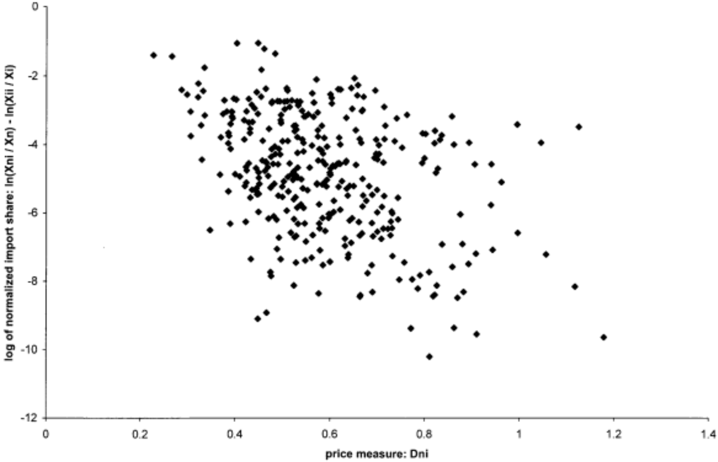

FIGURE 2.—Trade and prices.

Trade, Geography and Prices

TABLE II

PRICE MEASURE STATISTICS

	Foreign Sources		Foreign Destinations	
Country	Minimum	Maximum	Minimum	Maximum
Australia (AL)	NE (1.44)	PO (2.25)	BE (1.41)	US (2.03)
Austria (AS)	SW (1.39)	NZ (2.16)	UK (1.47)	JP (1.97)
Belgium (BE)	GE (1.25)	JP (2.02)	GE (1.35)	SW (1.77)
Canada (CA)	US (1.58)	NZ (2.57)	AS (1.57)	US (2.14)
Denmark (DK)	FI (1.36)	PO (2.21)	NE (1.48)	US (2.41)
Finland (FI)	SW (1.38)	PO (2.61)	DK (1.36)	US (2.87)
France (FR)	GE (1.33)	NZ (2.42)	BE (1.40)	JP (2.40)
Germany (GE)	BE (1.35)	NZ (2.28)	BE (1.25)	US (2.22)
Greece (GR)	SP (1.61)	NZ (2.71)	NE (1.48)	US (2.27)
Italy (IT)	FR (1.45)	NZ (2.19)	AS (1.46)	JP (2.10)
Japan (JP)	BE (1.62)	PO (3.25)	AL (1.72)	US (3.08)
Netherlands (NE)	GE (1.30)	NZ (2.17)	DK (1.39)	NZ (2.01)
New Zealand (NZ)	CA (1.60)	PO (2.08)	AL (1.64)	GR (2.71)
Norway (NO)	FI (1.45)	JP (2.84)	SW (1.36)	US (2.31)
Portugal (PO)	BE (1.49)	JP (2.56)	SP (1.59)	JP (3.25)
Spain (SP)	BE (1.39)	JP (2.47)	NO (1.51)	JP (3.05)
Sweden (SW)	NO (1.36)	US (2.70)	FI (1.38)	US (2.01)
United Kingdom (UK)	NE (1.46)	JP (2.37)	FR (1.52)	NZ (2.04)
United States (US)	FR (1.57)	JP (3.08)	CA (1.58)	SW (2.70)

Input Costs - Production

So far: flows relate to geography and to prices

- Decompose the input bundle into labor and intermediates
- Assume that production combines labor (share β) and intermediate inputs
- Intermediates comprise the full set of goods (CES)
- The cost of an input bundle in country i is

$$c_i = w_i^{\beta} p_i^{1-\beta}$$

- We can find an expression for the real wage

$$\frac{w_i}{p_i} = \gamma^{-1/\beta} \left(\frac{T_i}{\pi_{ii}} \right)^{1/\beta\theta}$$

Zero-Gravity and Autarky

Two special cases assume closed-form solution

1. **zero-gravity:** no geographic barriers ($d_{ni} = 1$). In this case (W_i: GDP per worker)

$$W_i = \gamma^{-1/\beta} T_i^{1/(1+\theta\beta)} \left[\sum_{k=1}^{N} T_k^{1/(1+\theta\beta)} (L_k/L_i)^{\theta\beta/(1+\theta\beta)} \right]^{1/\theta\beta}$$

2. **autarky:** prohibitive geographic barriers ($d_{ni} \to \infty$)

$$W_i = \gamma^{-1/\beta} T_i^{1/\theta\beta}$$

3. EVERYONE GAINS FROM TRADE!
4. however, the world is far from these scenarios.

General Equilibrium

- Prices:

$$p_n = \gamma \left[\sum_{i=1}^{N} T_i (d_{ni} w_i^{\beta} p_i^{1-\beta})^{-\theta} \right]^{-1/\theta}$$

- Trade Shares:

$$\frac{X_{ni}}{X_n} = \pi_{ni} = T_i \left(\frac{\gamma d_{ni} w_i^{\beta} p_i^{1-\beta}}{p_n} \right)^{-\theta}$$

- Manufacturing Employment

$$w_i L_i = \sum_{n=1}^{N} \pi_{ni} [(1-\beta) w_n L_n + \alpha \beta Y_n]$$

Next step: **Estimation!**

Estimation - State of Technology

TABLE VI

STATES OF TECHNOLOGY

Country	Estimated Source-country Competitiveness	Implied States of Technology		
		$\theta = 8.28$	$\theta = 3.60$	$\theta = 12.86$
Australia	0.19	0.27	0.36	0.20
Austria	−1.16	0.26	0.30	0.23
Belgium	−3.34	0.24	0.22	0.26
Canada	0.41	0.46	0.47	0.46
Denmark	−1.75	0.35	0.32	0.38
Finland	−0.52	0.45	0.41	0.50
France	1.28	0.64	0.60	0.69
Germany	2.35	0.81	0.75	0.86
Greece	−2.81	0.07	0.14	0.04
Italy	1.78	0.50	0.57	0.45
Japan	4.20	0.89	0.97	0.81
Netherlands	−2.19	0.30	0.28	0.32
New Zealand	−1.20	0.12	0.22	0.07
Norway	−1.35	0.43	0.37	0.50
Portugal	−1.57	0.04	0.13	0.01
Spain	0.30	0.21	0.33	0.14
Sweden	0.01	0.51	0.47	0.57
United Kingdom	1.37	0.49	0.53	0.44
United States	3.98	1.00	1.00	1.00

Estimation - Geographic Barriers

TABLE VII

GEOGRAPHIC BARRIERS

Source of Barrier	Estimated Geography Parameters	Implied Barrier's % Effect on Cost $\theta = 8.28$	$\theta = 3.60$	$\theta = 12.86$
Distance [0, 375)	−3.10	45.39	136.51	27.25
Distance [375, 750)	−3.66	55.67	176.74	32.97
Distance [750, 1500)	−4.03	62.77	206.65	36.85
Distance [1500, 3000)	−4.22	66.44	222.75	38.82
Distance [3000, 6000)	−6.06	108.02	439.04	60.25
Distance [6000, maximum]	−6.56	120.82	518.43	66.54
Shared border	0.30	−3.51	−7.89	−2.27
Shared language	0.51	−5.99	−13.25	−3.90
European Community	0.04	−0.44	−1.02	−0.29
EFTA	0.54	−6.28	−13.85	−4.09

Estimation - Geographic Barriers

TABLE III

BILATERAL TRADE EQUATION

Variable		est.	s.e.
Distance [0, 375)	$-\theta d_1$	−3.10	(0.16)
Distance [375, 750)	$-\theta d_2$	−3.66	(0.11)
Distance [750, 1500)	$-\theta d_3$	−4.03	(0.10)
Distance [1500, 3000)	$-\theta d_4$	−4.22	(0.16)
Distance [3000, 6000)	$-\theta d_5$	−6.06	(0.09)
Distance [6000, maximum]	$-\theta d_6$	−6.56	(0.10)
Shared border	$-\theta b$	0.30	(0.14)
Shared language	$-\theta l$	0.51	(0.15)
European Community	$-\theta e_1$	0.04	(0.13)
EFTA	$-\theta e_2$	0.54	(0.19)

Counterfactual - Eliminating Tariffs

What if members of the European Community (as of 1990) drop tariffs against each other

- With immobile labor the major losers are nonmembers nearby
  - Members of the EC benefit
- With mobile labor the losers are the northern EC members

TABLE XII

THE EUROPEAN COMMUNITY: WELFARE AND TRADE

	Effect of Removing all Tariffs on Intra-EC Trade			
	Aggregate Welfare		Imports from the EC	
Country	Mobile Labor	Immobile Labor	Mobile Labor	Immobile Labor
Australia	0.13	0.11	27.7	2.8
Austria	0.32	−0.07	−1.9	−3.4
Belgium*	−0.91	0.54	61.3	26.3
Canada	0.01	0.01	28.0	2.2
Denmark*	−0.27	0.18	49.9	30.8
Finland	0.28	−0.02	4.6	−2.9
France*	0.08	0.05	46.3	33.7
Germany*	−0.03	−0.03	58.5	41.9
Greece*	0.28	0.13	30.8	24.0
Italy*	0.14	0.04	44.9	36.4
Japan	0.07	−0.01	32.4	2.3
Netherlands*	−0.58	0.33	56.3	26.9
New Zealand	0.14	0.09	24.1	1.9
Norway	0.34	0.05	3.2	−2.9
Portugal*	0.03	0.10	44.0	32.8
Spain*	0.21	0.05	43.7	34.3
Sweden	0.31	−0.10	2.0	−3.3
United Kingdom*	−0.02	0.02	51.9	36.1
United States	0.10	0.03	27.8	2.2

Estimates of the Trade and Welfare Effects of NAFTA

Caliendo & Parro (2015)

Main Contributions

- Quantitative evaluation of the **North American Free Trade Agreement (NAFTA)**.
- Uses a **structural trade model** building directly on Eaton & Kortum (2002).
- Expands the framework to:
  - **Multiple sectors** (26 industries).
  - **Input-output linkages**: trade in intermediate goods matters.
  - **Sector-specific elasticities** of substitution.
- Data: bilateral tariffs (pre and post NAFTA), trade flows, and input-output matrices.

Advances in relation to EK (2002)

- EK (2002): one-sector, purely manufacturing; highlights productivity and trade costs.
- CP (2015): **generalizes EK to a multi-sector world** with rich production networks, making it more suitable to analyze policy (e.g., trade agreements).
- Emphasizes **propagation of tariff changes across sectors**.
- Highlights the importance of **intermediate goods** and **sectoral linkages** to evaluate tariff changes effects.
- Convenient approach do deal with data

Tariffs, Intermediate Goods and Sectoral Linkage

Motivation: Using a one sector model, trade and welfare effects of changes in tariffs can only be analyzed in average.

- Tariff rates vary substantially across sectors
- Most goods traded are intermediate goods
- I–O tables shows that sectors are strongly interrelated

Model

- **Households:** There are a measure of L_n representative households, consuming final goods C_n^j, that maximize

$$u(C_n) = \Pi_{j=1}^{J}(C_n^j)^{\alpha_n^j}$$

where $\sum_{j=1}^{J} \alpha_n^j = 1$

  - Income (I_n) sources: (i) labor supply (L_n) at wage w_n and (ii) lump-sum transfers from tariffs

- **Intermediate Goods:** A continuum of i.g. $\omega^j \in [0,1]$ is produced in each sector j. The inputs are **labor** and composite **intermediate goods** (materials)
  - $z_n^j(\omega^j)$: j's efficiency of producing intermediate good ω^j in country n
  - Technology:

$$q_n^j(\omega^j) = z_n^j(\omega^j)[\mathrm{l_n}^j(\omega^j)]^{\gamma_n^j}\Pi_{k=1}^{J}[m_n^{k,j}(\omega^j)]^{\gamma_n^{k,j}}$$

where $\gamma_n^{k,j}$ is the share of materials and γ_n^j is the share of value added, with $\sum_{k=1}^{J} \gamma_n^{k,j} = 1 - \gamma_n^j$.

Model

Composite Intermediate Goods: Supply of c.i.g. (Q_n^j) are given by an aggregation of intermediate goods

$$Q_n^j = \left[\int r_n^j(\omega^j)^{1-1/\sigma^j} d\omega^j \right]^{\sigma^j/(\sigma^j-1)}$$

where

- σ^j: elasticity of substitution within sector j
- $r_n^j(\omega^j)$: demand of intermediate goods ω^j from the lowest cost supplier
- $r_n^j(\omega^j) = \left(\frac{p_n^j(\omega^j)}{P_n^j} \right)^{-\sigma^j} Q_n^j$
- P_n^j is s unit price of the composite intermediate good

$$P_n^j = \left[\int p_n^j(\omega^j)^{1-\sigma^j} d\omega^j \right]^{\frac{1}{1-\sigma^j}}$$

Composite intermediate goods are used as materials for the production of intermediate goods and as final goods.

Model - Trade Costs

- τ_{ni}^{j}: 1 + *ad-valorem* flat-rate tariff
- d_{ni}^{j}: iceberg costs
- k_{ni}^{j}: trade costs. $k_{ni}^{j} = \tau_{ni}^{j} \cdot d_{ni}^{j}$
- as in EK (2002), the triangular inequality holds: $k_{ni}^{j} \leq k_{nh}^{j} \cdot k_{hi}^{j}$
- price of the intermediate good ω^{j}:

$$p_n^j(\omega^j) = \min_i \left\{ \frac{c_i k_{ni}^j}{z_i^j(\omega^j)} \right\}$$

- for non-tradable sectors, $k_{in}^{j} = \infty$

Model - Expenditures

As in EK (2002), we denote X_{ni}^j to the expenditure in country n of sector j goods from country i.

- country n's share of expenditure on goods from i: $\pi_{ni}^j = X_{ni}^j / X_n^j$

$$\pi_{ni}^j = \frac{\lambda_i^j [c_i^j k_{ni}^j]^{-\theta^j}}{\sum_{h=1}^N \lambda_h^j [c_h^j k_{nh}^j]^{-\theta^j}}$$

  a multi-sector version of a gravity equation. λ_i^j is the location parameter.

- changes in tariffs have a direct effect in trade shares via k_{ni}^j

Equilibrium Conditions

- $$X_n^j = \sum_{k=1}^{J} \gamma_n^{k,n} \sum_{i=1}^{N} X_i^k \frac{\pi_{in}^k}{1+\tau_{in}^k} + \alpha_n^j I_n \qquad (1)$$

  where $I_n = w_n L_n + R_n + D_n$

- $$\sum_{j=1}^{J} \sum_{i=1}^{N} X_n^j \frac{\pi_{ni}^j}{1+\tau_{ni}^j} - D_n = \sum_{j=1}^{J} \sum_{i=1}^{N} X_i^j \frac{\pi_{in}^j}{1+\tau_{in}^j} \qquad (2)$$

Def: Given L_n, D_n, λ_n^j and d_{ni}^j an equilibrium under tariff structure τ is a wage vector $\mathbf{w} \in \mathbb{R}_{++}^N$ and prices $\{P_n^j\}$ that satisfy equilibrium conditions 1, 2, and the expressions for π_{ni}^j and C_n^j.

Equilibrium in Relative Changes

- Solving for τ relies on parameters that are difficult to identify in the data
  - productivities λ_n^j
  - iceberg trade costs d_{ni}^j
- Instead, we can solve for an equilibrium under changes τ' from τ
  - easier to solve
  - difficult to observe parameters disappear
- Required information
  - two sets of tariff structures (τ and τ')
  - data on bilateral trade shares (π_{ni}^j)
  - share of value added in production (γ_n^j)
  - value added ($w_n L_n$)
  - share of intermediate consumption ($\gamma_n^{k,j}$) and sectoral dispersion of productivity (θ^j)

Effects from Tariff Changes

- Real wages effect

$$\ln \frac{\hat{w}_n}{\hat{P}_n} = -\underbrace{\sum_{j=1}^{J} \frac{\alpha_n^j}{\theta^j} \ln \hat{\pi}_{nn}^j}_{\text{Final goods}} - \underbrace{\sum_{j=1}^{J} \frac{\alpha_n^j}{\theta^j} \frac{1-\gamma_n^j}{\gamma_n^j} \ln \hat{\pi}_{nn}^j}_{\text{Intermediate goods}} - \underbrace{\sum_{j=1}^{J} \frac{\alpha_n^j}{\gamma_n^j} \ln \prod_{k=1}^{J} (\hat{P}_n^k / \hat{P}_n^j)^{\gamma_n^{k,j}}}_{\text{Sectoral linkages}},$$

- Welfare effects

$$d\ln W_n = \frac{1}{I_n} \sum_{j=1}^{J} \sum_{i=1}^{N} \underbrace{\left(E_{ni}^j d\ln c_n^j - M_{ni}^j d\ln c_i^j\right)}_{\text{Terms of trade}} + \frac{1}{I_n} \sum_{j=1}^{J} \sum_{i=1}^{N} \underbrace{\tau_{ni}^j M_{ni}^j \left(d\ln M_{ni}^j - d\ln c_i^j\right)}_{\text{Volume of trade}}.$$

Estimation - Dispersion of Productivity

TABLE 1
Dispersion-of-productivity estimates

	Full sample			99% sample			97.5% sample		
Sector	θ^j	s.e.	N	θ^j	s.e.	N	θ^j	s.e.	N
Agriculture	8.11	(1.86)	496	9.11	(2.01)	430	16.88	(2.36)	364
Mining	15.72	(2.76)	296	13.53	(3.67)	178	17.39	(4.06)	152
Manufacturing									
Food	2.55	(0.61)	495	2.62	(0.61)	429	2.46	(0.70)	352
Textile	5.56	(1.14)	437	8.10	(1.28)	314	1.74	(1.73)	186
Wood	10.83	(2.53)	315	11.50	(2.87)	191	11.22	(3.11)	148
Paper	9.07	(1.69)	507	16.52	(2.65)	352	2.57	(2.88)	220
Petroleum	51.08	(18.05)	91	64.85	(15.61)	86	61.25	(15.90)	80
Chemicals	4.75	(1.77)	430	3.13	(1.78)	341	2.94	(2.34)	220
Plastic	1.66	(1.41)	376	1.67	(2.23)	272	0.60	(2.11)	180
Minerals	2.76	(1.44)	342	2.41	(1.60)	263	2.99	(1.88)	186
Basic metals	7.99	(2.53)	388	3.28	(2.51)	288	−0.05	(2.82)	235
Metal products	4.30	(2.15)	404	6.99	(2.12)	314	0.52	(3.02)	186
Machinery n.e.c.	1.52	(1.81)	397	1.45	(2.80)	290	−2.82	(4.33)	186
Office	12.79	(2.14)	306	12.95	(4.53)	126	11.47	(5.14)	62
Electrical	10.60	(1.38)	343	12.91	(1.64)	269	3.37	(2.63)	177
Communication	7.07	(1.72)	312	3.95	(1.77)	143	4.82	(1.83)	93
Medical	8.98	(1.25)	383	8.71	(1.56)	237	1.97	(1.36)	94
Auto	1.01	(0.80)	237	1.84	(0.92)	126	−3.06	(0.86)	59
Other Transport	0.37	(1.08)	245	0.39	(1.08)	226	0.53	(1.15)	167
Other	5.00	(0.92)	412	3.98	(1.08)	227	3.06	(0.83)	135
Test equal parameters				$F(17, 7294) = 7.52$			$\text{Prob} > F = 0.00$		
Aggregate elasticity	4.55	(0.35)	7212	4.49	(0.39)	5102	3.29	(0.47)	3482

Welfare Effects of NAFTA

Two counterfactual exercises

1. **Only NAFTA:** introduce into the model the change in the tariff structure from 1993 to the year 2005 between NAFTA members and fix the tariff structure for the rest of the world to the levels in 1993
   - eliminates "contamination" on the effects from other trade agreements between a NAFTA member and another country
2. **NAFTA into the world:** measure the effects of NAFTA by quantifying the gains from NAFTA's tariff reductions given observed world tariff changes
   - first the effects of al tariff changes in the world from 1993 to 2005
   - then the effects of al tariff changes in the world from 1993 to 2005 holding NAFTA tariffs fixed to the year 1993

Counterfactual - Only NAFTA

TABLE 2
Welfare effects from NAFTA's tariff reductions

Country	Welfare			Real wages
	Total	Terms of trade	Volume of Trade	
Mexico	1.31%	−0.41%	1.72%	1.72%
Canada	−0.06%	−0.11%	0.04%	0.32%
U.S.	0.08%	0.04%	0.04%	0.11%

- Mexico: higher previous tariffs $\rightarrow$ higher gains
- USA: smallest previous tariffs $\rightarrow$ small gain in VoT, but due to its largest import market, was the only one to gain in ToT

Counterfactual - Only NAFTA

TABLE 3
Bilateral welfare effects from NAFTA's tariff reductions

	Terms of trade		Volume of Trade	
Country	NAFTA	Rest of the world	NAFTA	Rest of the world
Mexico	−0.39%	−0.02%	1.80%	−0.08%
Canada	−0.09%	−0.02%	0.08%	−0.04%
U.S.	0.03%	0.01%	0.04%	0.00%

- Narrower relations with the rest of the world
- Loss of ToT for Mexico and Canada due to higher changes (fall) in export prices
- Electrical Machinery, Communication Equipment, and Auto account for 76% of the Mexico ToT deterioration

Counterfactual - NAFTA given world tariff changes

TABLE 8
Bilateral welfare effects from world's tariff reductions

	Terms of trade		Volume of Trade	
Country	NAFTA	Rest of the world	NAFTA	Rest of the world
Mexico	−0.39%	−0.01%	1.64%	0.13%
Canada	−0.10%	0.02%	0.05%	0.12%
U.S.	0.03%	0.08%	0.04%	0.08%

- Now, volume of trade effects with respect to the rest of the world increase
- ToT for the USA are now mostly with countries outside of NAFTA
- Canada's ToT switched to positive with respect to countries outside NAFTA

The effects of NAFTA across different models

TABLE 11
Trade and welfare effects from NAFTA across different models

	Welfare			Imports growth from NAFTA members			
		Multi-sector			Multi-sector		
Country	One sector	No materials	No I–O	One sector	No materials	No I–O	Benchmark
Mexico	0.41%	0.50%	0.66%	60.99%	88.08%	98.96%	118.28%
Canada	−0.08%	−0.03%	−0.04%	5.98%	9.95%	10.14%	11.11%
U.S.	0.05%	0.03%	0.04%	17.34%	26.91%	30.70%	40.52%

TABLE 2
Welfare effects from NAFTA's tariff reductions

	Welfare			
Country	Total	Terms of trade	Volume of Trade	Real wages
Mexico	1.31%	−0.41%	1.72%	1.72%
Canada	−0.06%	−0.11%	0.04%	0.32%
U.S.	0.08%	0.04%	0.04%	0.11%

Conclusion

"We find that the trade and welfare effects from tariff reductions are lower if intermediate goods in production and I–O linkages are ignored in the analysis. With this results we hope to convey the message that modeling sectoral interrelations is not only feasible but also important for quantitative analysis."

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Caliendo & Parro, 2015