Trade Policy in General Equilibrium

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Motivation

- The analysis of trade policy is becoming increasingly important....
- Quantitative analysis of trade policy requires taking into account prominent features of the world economy
  - Intermediate goods
  - Sectoral heterogeneity across countries
  - Input-Output linkages
- Goal: A model to quantify effects of changes to trade policy in general equilibrium taking into account these margins
- Plan:
  - Basic building blocks and solution method in a simple model
  - Model with multiple sectors and sectoral linkages

Building blocks

- We will start with a simple trade model
- Gravity, country n's expenditure on goods from i :

$$\pi_{ni} = \frac{A_i \left[w_i \kappa_{ni}\right]^{-\theta}}{\sum_{h=1}^{N} A_h \left[w_h \kappa_{nh}\right]^{-\theta}}$$

  where i, n, h index countries, w_i are wages at i , $\kappa_{ni} \geq 1$ are trade costs to ship goods from i to n, and θ is the trade elasticity, and A_i represents technology of county i

- Price index, in county n

$$P_n = \gamma \left[\sum_{i=1}^{N} A_i (w_i \kappa_{ni})^{-\theta}\right]^{-1/\theta}$$

  where γ is a constant

General Equilibrium

Given L_n, D_n,A_i and κ_{ni} , an equilibrium is a wage vector $\boldsymbol{w} \in \boldsymbol{R}^N_{++}$ and prices$\{P_n\}_{n=1}^N$ such that: markets clear, agents maximize utility and firms maximize profits taking prices as given

$$x_n = w_n$$

$$P_n = \gamma[\sum_{i=1}^{N} A_i (x_i \kappa_{ni})^{-\theta}]^{-1/\theta}$$

$$\pi_{ni} = \frac{A_i [x_i \kappa_{ni}]^{-\theta}}{\sum_{h=1}^{N} A_h [x_h \kappa_{nh}]^{-\theta}}$$

$$\sum_{i=1}^{N} \pi_{ni} X_n - D_n = \sum_{i=1}^{N} \pi_{in} X_i$$

where $X_n = w_n L_n + D_n$ is total expenditure

Adding tariffs

- Consider now the case in which countries need to pay tariffs
- Trade costs are now

$$\kappa_{ni} = (1 + \tau_{ni}) d_{ni}$$

  - Now, d_{ni} "iceberg" trade cost (physical loss of resources)
  - $1 + \tau_{ni}$ ad valorem tariff applied in n to goods from i (impact relative prices of goods)

- Note that **Gravity** and **Price index** are the same as before
- However, need to consider R_n, (revenue from tariffs):

$$R_n = \sum_{i=1}^{N} \tau_{ni} M_{ni}$$

where

$$M_{ni} = X_n \frac{\pi_{ni}}{1+\tau_{ni}}$$

are country n's imports of goods from country i in country n, where total expenditure is given by

$$X_n = w_n L_n + R_n + D_n$$

General Equilibrium

Given L_n, D_n, A_i and κ_{ni},equilibrium under tariff structure τ is a wage vector $\boldsymbol{w} \in \boldsymbol{R}^N_{++}$ and prices $\{P_n\}_{n=1}^N$ such that: markets clear, agents maximize utility and firms maximize profits taking prices as given

$$x_n = w_n$$

$$P_n = \gamma[\sum_{i=1}^N A_i(x_i\kappa_{ni})^{-\theta}]^{-1/\theta}$$

$$\pi_{ni} = \frac{A_i[x_i\kappa_{ni}]^{-\theta}}{\sum_{h=1}^N A_h[x_h\kappa_{nh}]^{-\theta}}$$

$$\sum_{i=1}^N \frac{\pi_{ni}}{1+\tau_{ni}}X_n - D_n = \sum_{i=1}^N \frac{\pi_{in}}{1+\tau_{in}}X_i$$

$$X_n = w_nL_n + \sum_{i=1}^N \tau_{ni}X_n\frac{\pi_{ni}}{1+\tau_{ni}} + D_n$$

Equilibrium - Change in trade policy

- Let $(\boldsymbol{w}, P)$ be an equilibrium under tariff structure τ and let $(\boldsymbol{w}', P')$ be an equilibrium under tariff structure τ'
- Define $(\hat{\boldsymbol{w}}, \hat{P})$as an equilibrium under τ' relative to τ, where a variable with a hat "$\hat{x}$"represent the relative change of the variable, namely $\hat{x} = x'/x$. For instance $\hat{\pi} = \frac{\pi'}{\pi}$
- In this way we can solve the model without knowing all parameters (only need trade elasticities, θ)

General Equilibrium in Changes

- Follow the idea in Dekle, Eaton, and Kortum (2007)
- Let the counterfactual changes in trade flows given by

$$\pi'_{ni} = \frac{A_i[x'_i \kappa'_{ni}]^{-\theta}}{\sum_{h=1}^{N} A_h[x'_h \kappa'_{nh}]^{-\theta}}$$

- Now use the factual trade flows

$$\pi_{ni} = \frac{A_i[x_i \kappa_{ni}]^{-\theta}}{\sum_{h=1}^{N} A_h[x_h \kappa_{nh}]^{-\theta}}$$

- Express the system in changes

$$\frac{\pi'_{ni}}{\pi_{ni}} = \frac{(A_i[x'_i \kappa'_{ni}]^{-\theta})/(A_i[x_i \kappa_{ni}]^{-\theta})}{(\sum_{h=1}^{N} A_h[X'_h \kappa'_{nh}]^{-\theta})/\sum_{h=1}^{N} A_h[x_h \kappa_{nh}]^{-\theta}}$$

General Equilibrium in Changes

- Express the system in changes

$$\frac{\pi'_{ni}}{\pi_{ni}} = \frac{(A_i[x'_i\kappa'_{ni}]^{-\theta})/(A_i[x_i\kappa_{ni}]^{-\theta})}{(\sum_{h=1}^{N} A_h[x'_h\kappa'_{nh}]^{-\theta})/\sum_{h=1}^{N} A_h[x_h\kappa_{nh}]^{-\theta}}$$

- Or

$$\frac{\pi'_{ni}}{\pi_{ni}} = \frac{[\hat{X}_i\hat{\kappa}_{ni}]^{-\theta}}{\sum_{h=1}^{N} \frac{A_h[X'_h\kappa'_{nh}]^{-\theta}}{\sum_{h=1}^{N} A_h[X_h\kappa_{nh}]^{-\theta}}}$$

- Now multiply and divide each element of the denominator by $A_h[x_h\kappa_{nh}]^{-\theta}$ to obtain

$$\frac{\pi'_{ni}}{\pi_{ni}} = \frac{[\hat{x}_i\hat{\kappa}_{ni}]^{-\theta}}{\sum_{h=1}^{N} \frac{A_h[X_h\kappa_{nh}]^{-\theta}}{\sum_{h=1}^{N} A_h[X_h\kappa_{nh}]^{-\theta}}[\hat{X}_h\hat{\kappa}_{nh}]^{-\theta}} = \frac{[\hat{x}_i\hat{\kappa}_{ni}]^{-\theta}}{\sum_{h=1}^{N} \pi_{nh}[\hat{x}_h\hat{\kappa}_{nh}]^{-\theta}}$$

Equilibrium Conditions

$$\hat{x}_n = \hat{w}_n$$

$$\hat{P}_n = [\textstyle\sum_{i=1}^N \pi_{ni}(\hat{x}_i \hat{\kappa_{ni}})^{-\theta}]^{-1/\theta}$$

$$\pi'_{ni} = \frac{\pi_{ni}[\hat{x}_i \hat{\kappa_{ni}}]^{-\theta}}{\sum_{h=1}^N \pi_{nh}[\hat{x}_h \hat{\kappa_{nh}}]^{-\theta}}$$

$$X'_n = \hat{w}_n w_n L_n + \textstyle\sum_{i=1}^N \tau'_{ni} X'_n \frac{\pi'_{ni}}{1+\tau'_{ni}} + D_n$$

$$\sum_{i=1}^N = \frac{\pi'_{ni}}{1+\tau'_{ni}} X'_n - D_n = \sum_{i=1}^N \frac{\pi'_{in}}{1+\tau'_{in}} X'_i$$

Algorithm: Alvarez and Lucas (2007)

Data - Calibration

- Note that we can now solve the model without knowing all parameters (only need trade elasticities, θ) and data

Need data on:

X_{ni}	bilateral trade flows
τ_{ni}	tariffs
$w_n L_n$	value added

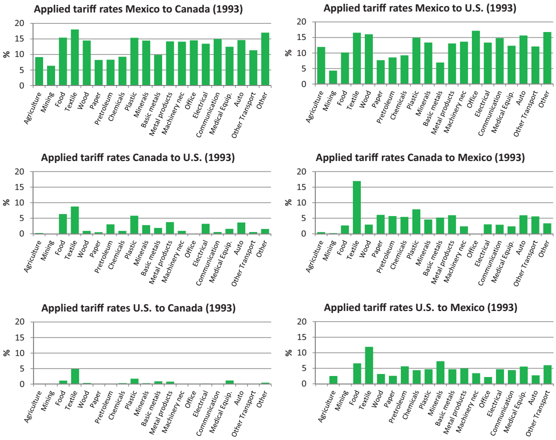
Estimate:

θ	dispersion of productivity

NAFTA

- North American Free Trade Agreement (NAFTA) between Mexico, Canada, and the U.S. (effective 1994)
  - it is among the largest free trade area in the world
  - it involves countries with very different structures of production
  - an agreement that resulted in the creation of a cross-border production chain (the large share of intermediate goods and intra-industry trade across members)
- In 1993, sectoral tariff rates applied by Mexico, Canada, and the U.S. to NAFTA members were, on average, 12.5%, 4.2%, and 2.7%, respectively, with a large heterogeneity across sectors.
- In 1993, 68% of Mexico's imports from countries not belonging to NAFTA were intermediate goods (Canada 61.5%; US 64.6%)
- 82.1% of Mexico's imports from NAFTA were intermediate goods (Canada 72.3%; US 72.8%)

Pre-Nafta Tariffs



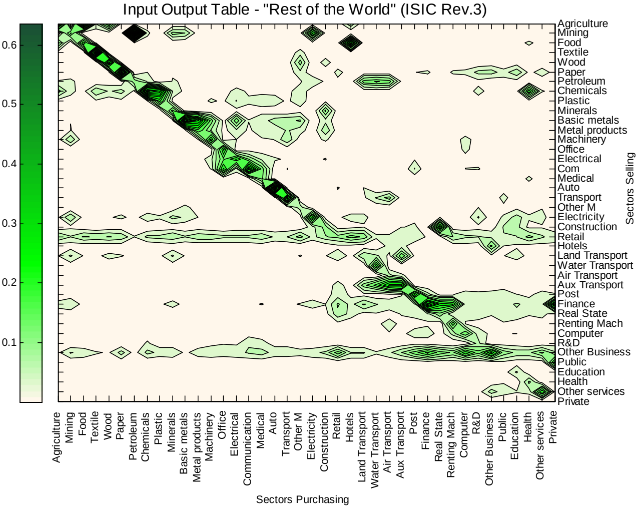
Source: UNCTAD-TRAINS)

FIGURE A1

Effective applied tariff rates before NAFTA

Sectors, intermediates and I-O linkages (CP 2015)

- Let $j = 1, .., J$ sectors



Caliendo and Parro

- Enrich the benchmark model – multiple sectors, IO linkages, trade in intermediate goods
  - There are N countries and J sectors
    - ★ denote countries by i and n and sectors by j and k
  - Sectors are of two types - tradable or non-tradable
  - One factor of production, labour - L_n
  - All markets are perfectly competitive
  - Labour is mobile across sectors and not mobile across countries.

Sectors, intermediates and I-O linkages (CP 2015)

- Households consume C_n^j (consumption of sector j goods)

$$U_i = \prod_{j=1}^{J} \left(C_n^j\right)^{\alpha_n^j}, \text{ with } \sum_{i=1}^{J} \alpha_n^j$$

- A continuum of intermediate goods is produced in each sector - $\omega^j \in [0, 1]$
- Production of each ω^j requires labor and a composite intermediate goods (materials)
- Efficiency of a producer in country $n - z_n^j(\omega^j)$

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

- $m_n^{k,j}(\omega^j)$ - *composite intermediate* good from sector k used in sector j
- $\gamma_n^{k,j}$ - share of material, $\sum_{k=1}^{J} \gamma_n^{k,j} = 1 - \gamma_n^j$, $\gamma_n^j$is value added share
- We have not yet specified how different goods produced in a sector are aggregated into the composite good of sector j
- All we know is that this composite good is demanded by consumers and producers of goods in each sector.

Sectors, intermediates and I-O linkages (CP 2015)

- Cost of an input bundle

$$x_n^j = \Upsilon_n^j w_n^{\gamma_n^j} \prod_{k=1}^{j} (P_n^k)^{\gamma_n^{k,j}} \tag{1}$$

  - P_n^k is the price of a composite intermediate good from sector k in country n
  - Υ_n^j is a constant

- The cost of the input bundle depends on wages and on the price of all the composite intermediate goods in the economy, tradable and non-tradable
- A change in policy that affects the price in any single sector will affect indirectly all the sectors in the economy via the input bundle

Trade Costs

- Trade costs – iceberg costs and tariff

$$\kappa^j_{ni} = (1+\tau^j_{ni})d^j_{ni} = \tilde{\tau}^j_{ni} d^j_{ni}$$

  - τ^j_{ni}- add-valorem flat-rate tariff
- A unit of a tradable intermediate good ω^j produced in country i is available in country n at unit prices - $c^j_i \kappa^j_{ni} / z^j_i(\omega^j)$
- Price of good ω^jin country n

$$p^j_n(\omega^j) = min_i \left\{ \frac{x^j_i \kappa^j_{ni}}{z^j_i(\omega^j)} \right\}$$

- Non-tradable sector

$$\kappa^j_{ni} = \infty, p^j_n(\omega^j) = \frac{x^j_n}{z^j_n(\omega^j)}$$

Price Indices

- The efficiency of producing a good ω^j in country n is the realization of a Fréchet distribution
  - with a location parameter that varies by country and sector, $A_n^j \geq 0$
  - shape parameter that varies by sector, θ^j [again same across countries]
- Price of composite intermediate good [same tricks as EK(2002)]

$$P_n^j = \Gamma^j \left[\sum_{i=1}^{N} A_i^j (x_i^j \kappa_{ni}^j)^{-\theta^j} \right]^{-1/\theta^j} \tag{2}$$

  - Γ^j is a constant
- Consumption price index for final goods

$$P_n = \prod_{j=1}^{J} \left(P_n^j / \alpha_n^j \right)^{\alpha_n^j}$$

Expenditure Shares

- Expenditure on sector j goods from country i in country n - X_{ni}^j

$$\pi_{ni}^j = X_{ni}^j / X_n^j$$

- Using Frechet

$$\pi_{ni}^j = \frac{A_i^j (x_i^j \kappa_{ni}^j)^{-\theta^j}}{\sum_{h=1}^N A_h^j (x_h^j \kappa_{nh}^j)^{-\theta^j}} \tag{3}$$

Trade Balance

- Total expenditure on goods j is the sum of the expenditure on composite intermediate goods by firms and expenditure by households

$$X_n^j = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} X_i^k \frac{\pi_{in}^k}{(1+\tau_{in}^k)} + \alpha_n^j I_n \tag{4}$$

  - I_n final absorption in country n

$$I_n = w_n L_n + R_n + D_n$$

  - R_n tariff revenue

$$R_n = \sum_{j=1}^{J} \sum_{i=1}^{N} \tau_{ni}^j M_{ni}^j \text{ where } M_{ni}^j = X_n^j \frac{\pi_{ni}^j}{(1+\tau_{ni}^k)}$$

    - ★ M_{ni}^j - country n's imports of sector j goods from country i

Trade Balance

- D_n – Trade deficit in country n

$$\sum_{n=1}^{N} D_n = 0$$

- D_n is the sum of sectoral deficits

$$D_n = \sum_{k=1}^{J} D_n^k$$

- Sectoral deficits

$$D_n^j = \sum_{i=1}^{N} M_{ni}^j - \sum_{i=1}^{N} E_{ni}^j$$

  - where E_{ni}^j is country n's exports of sector j goods to country i

$$E_{ni}^j = X_i^j \frac{\pi_{in}^j}{(1+\tau_{in}^k)}$$

- D_n is exogenous in the model

Trade Balance

- Finally, using the definition of expenditure and trade deficit

$$\sum_{j=1}^{J}\sum_{i=1}^{N} X_n^j \frac{\pi_{ni}^j}{(1+\tau_{ni}^j)} - D_n = \sum_{j=1}^{J}\sum_{i=1}^{N} X_i^j \frac{\pi_{in}^j}{(1+\tau_{in}^j)} \tag{5}$$

- Total expenditure, excluding tariff payments, in country n minus trade deficits equals the sum of each country's total expenditure, excluding tariff payments, on tradable goods from country n.
- We are adding over all sectors whether a sector is tradable or non-tradable. The non-tradable sectors will appear in both sides of the equation and cancel out.

Equilibrium conditions

$$x_n^j(\boldsymbol{w}) = \Upsilon_n^j w_n^{\gamma_n^j} \prod_{k=1}^J [P_n^k(\boldsymbol{w})]^{\gamma_n^{k,j}}$$

$$P_n^j(\boldsymbol{w}) = \Gamma^j [\sum_{i=1}^N A_i^j (x_i^j(\boldsymbol{w})\kappa_{ni}^j)^{-\theta^j}]^{-1/\theta^j}$$

$$\pi_{ni}^j(\boldsymbol{w}) = \frac{A_i^j [x_i^j(\boldsymbol{x})\kappa_{ni}^j]^{-\theta^j}}{\sum_{h=1}^N A_h^j [x_h^j(\boldsymbol{w})\kappa_{nh}^j]^{-\theta^j}}$$

$$X_n^j(\boldsymbol{w}) = \sum_{k=1}^J \gamma_n^{j,k} (\sum_{i=1}^N \frac{\pi_{in}^k(\boldsymbol{w})}{1+\tau_{in}^k} x_i^k(\boldsymbol{w})) + \alpha_n^j I_n(\boldsymbol{w})$$

$$\sum_{j=1}^J \sum_{i=1}^N \frac{\pi_{ni}^j(\boldsymbol{w})}{1+\tau_{ni}^j} x_n^j(\boldsymbol{w}) - D_n = \sum_{j=1}^J \sum_{i=1}^N \frac{\pi_{in}^j(\boldsymbol{w})}{1+\tau_{in}^j} x_i^j(\boldsymbol{w})$$

Equilibrium conditions (relative terms)

$$\hat{x}_n^j(\hat{\boldsymbol{w}}) = \hat{w}_n{}^{\gamma_n^j} \prod_{k=1}^J [\hat{P}_n^k(\hat{\boldsymbol{w}})]^{\gamma_n^{k,j}}$$

$$\hat{P}_n^j(\hat{\boldsymbol{w}}) = [\sum_{i=1}^N \pi_{ni}^j [\hat{\kappa}_{ni}^j \hat{x}_i^j(\hat{\boldsymbol{w}})]^{-\theta^j}]^{-1/\theta^j}$$

$$\hat{\pi}_{ni}^j(\hat{\boldsymbol{w}}) = \frac{\left[\hat{x}_i(\hat{\boldsymbol{w}})\hat{\kappa}_{ni}^j\right]^{-\theta^j}}{\sum_{i=1}^N \pi_{ni}^j [\hat{\kappa}_{ni}^j \hat{x}_i^j(\hat{\boldsymbol{w}})]^{-\theta^j}}$$

$$\sum_{j=1}^J \sum_{i=1}^N \frac{\pi'^j_{ni}(\hat{\boldsymbol{w}})}{1+\tau'^j_{ni}} X'^j_n(\hat{\boldsymbol{w}}) - D_n = \sum_{j=1}^J \sum_{i=1}^N \frac{\pi'^j_{in}(\hat{\boldsymbol{w}})}{1+\tau'^j_{in}} X'^j_n(\hat{\boldsymbol{w}})$$

$$X'^j_n(\hat{\boldsymbol{w}}) = \sum_{k=1}^J \gamma_n^{j,k} (\sum_{i=1}^N \frac{\pi'^k_{in}(\hat{\boldsymbol{w}})}{1+\tau'^k_{in}} X'^k_i(\hat{\boldsymbol{w}})) + \alpha_n^j I'_n(\hat{\boldsymbol{w}})$$

Algorithm: Extension of Alvarez and Lucas (2007)
Remark: Hat-algebra works in nested CES environments as well

Data - Calibration

- Model with $N = 31$, add "rest of the world" $J = 40$ (20 Tradable and 20 non- Tradable)

Need data on:

X_{ni}^{j}	bilateral trade flows
τ_{ni}^{j}	tariffs
γ_n^{j}	share of value added in production for each sector j and country n
$\gamma_n^{k,j}$	share of sector k goods employed in the production of goods j

Calculate:

α_n^{j}	share of final good j in country n consumed

Estimate:

θ^{j}	dispersion of production

Data - Calibration

- X_{ni}^{j},γ_n^j from the World-Input Output Dataset (WIOD).
- τ_{ni}^{j} Tariff Data - UNCTAD - TRAINS (Trade Analysis and Information System)

Estimating the Trade Elasticity - CP 2015

- We exploit the multiplicative property of bilateral trade shares
- Consider 3 countries n, h and i. The cross-product of goods form sector j shipped in one direction between the three countries, from n to h, from h to i, and from i to n is

$$\pi^j_{nh}\pi^j_{hi}\pi^j_{in}$$

and the cross-product of the same goods shipped in the opposite direction, from h to n, from i to h, and from n to i is

$$\pi^j_{hn}\pi^j_{ih}\pi^j_{ni}$$

Take the ratio of both and obtain

$$\frac{X^j_{nh}X^j_{hi}X^j_{in}}{X^j_{hn}X^j_{ih}X^j_{ni}} = \left(\frac{\kappa^j_{ni}}{\kappa^j_{in}}\frac{\kappa^j_{ih}}{\kappa^j_{hi}}\frac{\kappa^j_{hn}}{\kappa^j_{nh}}\right)^{-\theta^j}$$

Estimating the Trade Elasticity - CP 2015

- From the definition of κ_{ni}^{j} , trade costs are divided between tariffs (non-symmetric) and iceberg (also non-symmetric) trade costs:

$$\ln \kappa_{ni}^{j} = \ln \tilde{\tau}_{ni}^{j} + \ln d_{ni}^{j}$$

where $\tilde{\tau}_{ni}^{j} = \left(1 + \tau_{ni}^{j}\right)$

- $\log d_{ni}^{j}$, can be modeled quite generally as linear functions of cross-country characteristics:

$$\log d_{ni}^{j} = v_{ni}^{j} + \mu_{n}^{j} + \delta_{i}^{j} + \varepsilon_{ni}^{j}$$

- $v_{ni}^{j} = v_{in}^{j}$ captures symmetric bilateral trade costs like distance, language, common border, FTA or not
- μ_{n}^{j} captures an importer sectoral fixed effect common to all trading partners of country n
- δ_{i}^{j} exporter sectoral fixed effect common to all trading partners of i
- ε_{ni}^{j} is a random distribution term, assumed orthogonal to tariffs

Estimating the Trade Elasticity - CP 2015

- We then obtain the following specification

$$\log \frac{X^j_{nh} X^j_{hi} X^j_{in}}{X^j_{hn} X^j_{ih} X^j_{ni}} = -\theta^j \ln \left(\frac{\tilde{\tau}^j_{ni} \tilde{\tau}_{ih} \tilde{\tau}^j_{hn}}{\tilde{\tau}^j_{in} \tilde{\tau}_{hi} \tilde{\tau}^j_{nh}} \right) + \tilde{\varepsilon}^j$$

where $\tilde{\varepsilon}^j = \varepsilon^j_{in} - \varepsilon^j_{ni} + \varepsilon^j_{hi} - \varepsilon^j_{ih} + \varepsilon^j_{nh} - \varepsilon^j_{hn}$

- Estimation requires only trade and tariff data (no assumption of bilaterally symmetric trade costs)
- Estimating using maximum number of countries with tariff data (16) for the year 1993
    - 20 Sectors 2 digit ISIC rev. 3

Estmated Values of θ

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

Quantifying the trade and welfare effects of NAFTA

- CP 2015 perform two counterfactual exercises
- NAFTA's Tariff Reductions, the effect of NAFTAs tariffs reductions conditional on no other tariff changing
  - How? change tariff structure from 1993 to the year 2005 between NAFTA members and the tariff structure for the rest of the world to the levels in 1993
- *The Effects of NAFTA given World Tariff Changes*, the effects of NAFTAs tariffs reductions given observed world tariff reductions
  - How? first introduce observed change in world tariffs from 1993 to 2005 (effects of observed world tariff changes); second recalibrate the model to the year 1993 and introduce change in world tariffs from 1993 to 2005 holding NAFTA 1993 tariffs fixed (effects of observed world tariff changes excluding NAFTA); finally compare the gains between these two exercises, namely the gains from world tariff reductions with and without NAFTA

The effects of NAFTA across different models

	Welfare			
		Multi sector		
Country	One sector	No materials	No I-O	Benchmark
Mexico	0.41%	0.50%	0.66%	1.31%
Canada	-0.08%	-0.03%	-0.04%	-0.06%
U.S.	0.05%	0.03%	0.04%	0.08%

	Imports growth from NAFTA members			
		Multi sector		
Country	One sector	No materials	No I-O	Benchmark
Mexico	60.99%	88.09%	98.96%	118.28%
Canada	5.98%	9.95%	10.14%	11.11%
U.S.	17.34%	26.91%	30.70%	40.52%