

# Quantitative Analysis of Multi-Party Tariff Negotiations

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- In this paper we develop a model of international tariff negotiations to study the institutional rules of the GATT/WTO
- The GATT/WTO has made extensive use of simultaneous bilateral tariff bargains subject to
  - a non-discrimination rule (MFN)
  - principal supplier and reciprocity norms
- These features shape the network of bilateral bargaining pairs that form and the spillovers stemming from the bilateral tariff bargains
- The MFN requirement in particular has long been criticized for inviting free-riding behavior as a result of the positive third-party spillovers from tariff liberalization that it induces
- We embed a multi-sector model of international trade into a model of interconnected bilateral negotiations over tariffs
- We assess the value of the MFN principle for the GATT Uruguay Round (1986-94)
  - the last completed GATT/WTO multilateral negotiating round

- We build on the quantitative trade model of Caliendo and Parro (2015) to determine welfare payoffs for each country given a set of tariffs, factual or counterfactual
  - we take the welfare of each country to be defined by its real national income
  - we abstract from political economy and distributional concerns, and from the broader set of non-tariff issues at play in the Uruguay Round
- To model bilateral tariff bargaining in this environment, we adopt the “Nash-in-Nash” solution concept of Horn and Wolinsky (1988)
  - each bilateral negotiation results in the Nash bargaining solution taking as given the outcomes of the other negotiations
- We use our quantitative trade model to calculate the HW bargaining solution beginning from the 1990 (pre-Uruguay Round) tariffs and under three institutional constraints
  - MFN
  - principal supplier rule
  - tariff bindings

- We use predicted principal supplier patterns to identify the viable bargaining pairs and tariffs that were under negotiation in the Uruguay Round according to our model
- Solve the model for the HW solution under different values of bargaining powers for each country in each of its bilaterals
- Select as our estimates of bargaining power parameters
  - the set of parameters that generates the HW solution within our model that best matches the tariff outcomes of the Uruguay Round

- Our model benchmarks indicate that the prior GATT rounds collectively achieved roughly 50% of the potential world-wide real income gains from negotiating over the tariffs that were under negotiation in Uruguay
- With our chosen bargaining parameters, our HW model solution
  - predicts an average tariff reduction of 3.0 percentage points across the 158 country-sector tariffs negotiated in the Uruguay Round compared to the 3.1 percentage point reduction according to the data
  - indicates that the Uruguay Round itself achieved an additional 20% of the remaining potential world-wide real income gains from negotiating over these tariffs
- ⇒ “Unfinished business” for the WTO
  - roughly 40% of the potential world-wide welfare gains from negotiating over the tariffs that were under negotiation in Uruguay went unrealized
  - countries did not liberalize enough to reach the efficiency frontier
  - conjecture: the positive third-party spillovers from tariff liberalization under MFN and the “free-riding” that these spillovers invite contributed to the failure of countries to do so

- What would have been the outcome of tariff bargaining in the Uruguay Round if countries had abandoned MFN and bargained over discriminatory tariff cuts?
- We remove the MFN requirement and the principal supplier rule
  - we solve for the HW solution when countries can bargain over discriminatory tariff changes
- We show that positive third-party spillovers from tariff liberalization turn to negative third-party spillovers when the MFN requirement is removed
  - creating the potential for beggar-thy-neighbor bilateral discriminatory tariff liberalization
- We find that if tariff bargaining in the Uruguay Round had proceeded without MFN
  - it would have wiped out the real world income gains from MFN tariff bargaining in the Uruguay Round
  - and would have instead led to a 0.33% reduction in real world income relative to the 1990 status quo due to the excessive tariff liberalization and the tariff discrimination that results
- $\Rightarrow$  While positive third-party spillovers from MFN tariff cuts lead to too little tariff liberalization and keep countries from the efficiency frontier, the negative spillovers from discriminatory tariff cuts would lead to tariff bargaining outcomes that are far worse for world welfare

- Our model consists of two parts
- A quantitative trade model of the world economy
  - based on Caliendo and Parro (2015), a multisector version of Eaton and Kortum (2002) extended to include intermediate goods
- A model of simultaneous bilateral tariff bargaining
  - based on Nash-in-Nash solution concept of Horn and Wolinsky (1988)

- A  $K$ -sector  $N$ -country Ricardian trade model
  - $K_{traded}$  tradable composite-good sectors
  - a continuum of intermediate varieties indexed by  $\omega^k$  within each sector, produced under CRS with labor and composite goods from all sectors
- Production technology for each variety drawn from a Frechet distribution with CDF

$$F_i^k(z) = \exp\left(-\left(\frac{z}{z_i^k}\right)^{-\theta^k}\right)$$

$z_i^k$  is country  $i$ 's productivity parameter in sector  $k$ ;  $\theta^k$  a sector-specific shape parameter

- higher  $\theta^k \Rightarrow$  less within-sector comparative advantage and more responsiveness of trade to trade costs
- Price of sector  $k$ 's variety  $\omega$  in country  $i$

$$p_i^k(\omega) = \min_{j \in \{1, \dots, N\}} \frac{c_j^k}{z_j^k(\omega)} d_{ji}^k (1 + t_{ji}^k)$$

$c_j^k$  is country  $j$ 's cost of sector- $k$  input bundle;  $d_{ji}^k$  the iceberg cost;  $t_{ji}^k$  the ad valorem import tariff (possibly discriminatory) imposed by country  $i$  on imports from  $j$  at the sector level

- Utility for a representative consumer in country  $i$

$$u_i = \prod_{k=1}^K C_i^k \alpha_i^k$$

$C_i^k$  is country  $i$ 's consumption of the sector- $k$  composite good;  $\alpha_i^k$  a taste parameter

- Equilibrium of the model for given set of tariffs
  - a vector of wages  $\mathbf{w}$  and a vector of sector- and country-level price indexes  $\mathbf{P}$  such that all markets clear and consumers and firms behave optimally
- To perform counterfactuals
  - we will first set all trade deficits to zero (Ossa, 2016)
  - we will constrain counterfactual discriminatory tariffs to satisfy the “round-trip” inequality

$$(1 + t_{ji}^k) \times (1 + t_{ij}^k) \geq \frac{1}{d_{ji}^k d_{ij}^k}$$

- We model tariff negotiations in the Uruguay Round as a web of simultaneous bilateral negotiations over vectors of tariffs
- We measure welfare by real national income, and apply the Nash-in-Nash solution concept
  - each pair of negotiating countries maximizes its Nash product given the actions of the other pairs
- Let  $\pi_i(\mathbf{t})$  be country  $i$ 's welfare when the world vector of tariffs is  $\mathbf{t}$
- When country  $i$  negotiates with  $j$ , they select the levels of the tariffs that they negotiate  $\mathbf{t}_{ij}$  to maximize their Nash product

$$\max_{\mathbf{t}_{ij}} \left( \pi_i(\mathbf{t}_{ij}, \mathbf{t}_{-ij}) - \pi_i(\mathbf{t}_{ij}^0, \mathbf{t}_{-ij}) \right)^{\zeta_{ij}} \left( \pi_j(\mathbf{t}_{ij}, \mathbf{t}_{-ij}) - \pi_j(\mathbf{t}_{ij}^0, \mathbf{t}_{-ij}) \right)^{1-\zeta_{ij}} \quad (1)$$

$$\text{s.t. } \pi_i(\mathbf{t}_{ij}, \mathbf{t}_{-ij}) - \pi_i(\mathbf{t}_{ij}^0, \mathbf{t}_{-ij}) \geq 0$$

$$\pi_j(\mathbf{t}_{ij}, \mathbf{t}_{-ij}) - \pi_j(\mathbf{t}_{ij}^0, \mathbf{t}_{-ij}) \geq 0$$

$\zeta_{ij}$  is  $i$ 's bargaining power in its bilateral with  $j$ ;  $\mathbf{t}_{ij}^0$  is the disagreement (1990) level of  $\mathbf{t}_{ij}$

## Definition (Tariff Bargaining Equilibrium)

An equilibrium in tariffs consists of a vector of tariffs  $\mathbf{t}^{HW}$  such that for each pair  $ij$  the tariffs  $\mathbf{t}_{ij}^{HW}$  negotiated by this pair maximizes the program in (1) when  $\mathbf{t}_{-ij} = \mathbf{t}_{-ij}^{HW}$ .

- The key assumption: if  $ij$  were to not reach agreement, or were to deviate from a tariff vector specified by the equilibrium, then the other tariffs do not adjust
  - most directly interpreted in terms of a “delegated agent” model
- To reflect the tariff bargaining environment of the Uruguay Round, we introduce three institutional constraints
  - MFN
  - principal supplier rule
  - tariff bindings

- We aggregate the world economy into
  - the 6 largest countries by GDP in 1990 with the rest of the world aggregated into 5 additional regions; 49 traded sectors and 18 non-traded sectors
- Assemble data on 1990 (pre-Uruguay Round) trade flows, production, input-output shares, value-added and tariffs at the country-sector level
  - together with data on a set of gravity variables
- We use the 1990 MFN applied tariffs from TRAINS for the pre-Uruguay Round tariffs, and the 2000 MFN applied tariffs to represent the negotiated tariff outcomes from the Round
  - we ignore an important distinction between applied and bound tariffs
  - we also abstract from Uruguay Round phase-in periods
  - our representation of Uruguay Round tariff outcomes with applied MFN tariffs in 2000 is an attempt to capture these complexities while maintaining tractability

- To impose the round-trip inequality

$$(1 + t_{ji}^k) \times (1 + t_{ij}^k) \geq \frac{1}{d_{ji}^k d_{ij}^k}$$

in our discriminatory tariff counterfactuals, we need estimates of iceberg trade costs  $d_{ji}^k$

- Our approach to estimation deviates from typical estimation employed in the “exact hat algebra” approach to counterfactuals
  - we estimate all model parameters, including iceberg trade costs
  - we do not have to drop zero-trade observations
- We parameterize iceberg trade costs as

$$d_{ji}^k = 1 + \exp \beta_{0,j} + \beta_{0,i} + \beta_0^k + \beta_d^k \text{dist}_{ji} + \sum_{n \in Q} \beta_{q,n} \text{Quad}_{n,ji}$$

- The trade model parameters to estimate consist of vectors of
  - taste parameters ( $\alpha$ )
  - input-output shares ( $\gamma$ )
  - productivity parameters ( $\mathbf{z}$ )
  - dispersion of productivity parameters ( $\theta$ )
  - trade deficits  $\mathbf{D}$
  - and iceberg cost parameters ( $\beta$ )

- We estimate  $\alpha$  and  $\gamma$  “off-line”
- We set wages equal to the observed value added per worker of each country, and require that the model parameters satisfy the market clearing conditions for equilibrium at these wages.
- Given the  $\alpha$  and  $\gamma$  estimates, and where a hat denotes model prediction, we define

$$G(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D}) = \left[ \begin{array}{c} \frac{\hat{x}_{ij}^k(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D})}{\sum_i \hat{x}_{ij}^k(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D})} - \frac{x_{ij}^k}{\sum_i x_{ij}^k} \\ \hat{b}_i(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D}) - b_i \end{array} \right]$$

$\frac{x_{ij}^k}{\sum_i x_{ij}^k}$  is  $i$ 's exports of sector- $k$  goods to  $j$  as a share of  $j$ 's consumption of sector- $k$  goods;  $b_i$  is the ratio of country  $i$ 's trade deficit to its tariff revenue

- We choose the remaining parameters to solve the following optimization problem

$$\begin{aligned} \min_{\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D}} \quad & G(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D})' WG(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D}) + \lambda \sum_{i \in P} \beta_i^2 \\ \text{s.t.} \quad & F(\mathbf{z}, \boldsymbol{\theta}, \boldsymbol{\beta}, \mathbf{D}, \mathbf{w}) = 0 \end{aligned}$$

- And we estimate the vector of bargaining parameters  $\zeta$  by minimizing the distance between model prediction and data of the mean tariffs negotiated by each partner in each bilateral

$$\min_{\zeta} \sum_{h=1}^R \sum_{i \in B_h} n_i^h (\bar{t}_{MFN,i}(\zeta) - \bar{t}_{MFN,i})^2$$

$R$  is the number of bilaterals in the Uruguay Round;  $B_h$  is the set containing the pair of countries negotiating in bilateral  $h$ ; and a bar over a variable denotes its mean

- Trade parameter estimates
  - Estimated average iceberg cost across all sectors and country pairs in 1990 is 320%
  - 97% among Quad countries, consistent with Novy's (2013) estimate of 108% for same year and similar set of countries
  - $z_i^k$ : Figure 1
  - $\theta^k$ : Table 2
- Model benchmarks – welfare change relative to status quo 1990 tariffs
  - autarky, zero trade frictions; free trade, world-income maximizing tariffs, Nash tariffs: Table 3

- We let predicted principal supplier patterns guide our set of bilateral bargains
  - observed v predicted principal supplier patterns: Table 4
  - observed: 12 bargaining pairs involving each of our 6 countries covering 61% of 1990 world trade in industrialized goods
  - predicted: 8 bargaining pairs involving 5 countries covering 55% of 1990 world trade in industrialized goods
  - Canada the only major industrialized country in 1990 that does not make the cut
  
- Bargaining parameter estimates: Table 5
  - point estimates indicate interior bargaining power for 4 bilaterals and take-or-leave for the remaining 4, but some standard errors are large
  - overall, based on bargaining strength with most important partners, South Korea appears to be in the strongest bargaining position and Australia in the weakest bargaining position in the Uruguay Round

- Bargaining parameters reflect how evenly the surplus in a bilateral is split *and* slope of bilateral bargaining frontier
- The slope of the bilateral bargaining frontier not necessarily  $-1$ : Figure 2
- The ratio of national price indexes affects the slope: Figure 2
- But the slope is also a function of degree of asymmetries in market power, position of initial tariffs relative to best-response, and third-party spillovers from tariff cuts: Table 6
  - notice that third-party spillovers from MFN tariff cuts are substantial and uniformly positive
- Bargaining parameters reflect split of surplus relative to position of HW disagreement point, *not* 1990 status quo welfares

- We find that real world income rose by 0.08% as a result of an average 26.2% reduction in tariffs negotiated in the Uruguay Round: Table 7
  - roughly half of the real world income gains that would have occurred if these tariffs been reduced to zero; a little over 20% of the gains compared to the real-world-income maximizing potential
  - $\Rightarrow$  substantial “unfinished business” for the WTO
  
- We find that all countries and regional entities gain from the Uruguay Round: Table 7
  - for our 5 bargaining countries, these gains reflect efficiency benefits from own liberalization and terms-of-trade movements from the Round’s negotiated MFN tariff cuts
  - for non-participants, these gains reflect improved terms-of-trade from the MFN tariff cuts of others
  - the “free-rider” gains from MFN accruing to non-participants amount to roughly a third of the total real world income gains generated by the Round

- We find that interactions across bilaterals account for roughly 20% of the increases in real world income generated by the Uruguay Round: Table 8
  - between one half and two thirds of the welfare gains enjoyed as a result of the Round by the US, the EU, South Korea and Australia occur as a result of these interactions
  - by contrast, the interaction effects for Japan are slightly negative
- We find that the Uruguay Round bargaining outcomes conformed broadly to a multilateral reciprocity norm
  - deviations from reciprocity reflect our estimated pattern of bargaining powers and positive spillovers to non-participants

# Tariff Bargaining in the Absence of MFN

- What would have been the outcome of tariff bargains in the Uruguay Round if countries had bargained over discriminatory tariff cuts?
- We consider an alternative bargaining protocol under which the MFN requirement and the principal supplier rule are removed
  - HW solution when countries bargain over discriminatory tariff cuts
- We focus primarily on the intensive margin
  - for each country, the set of its tariffs being negotiated is constrained to include only the sectors that were negotiated under MFN
  - and the set of countries negotiating on these tariffs is constrained to include only the countries that it negotiated with under MFN
  - but it can now negotiate with each of these countries on each of these (discriminatory) tariffs

# Tariff Bargaining in the Absence of MFN

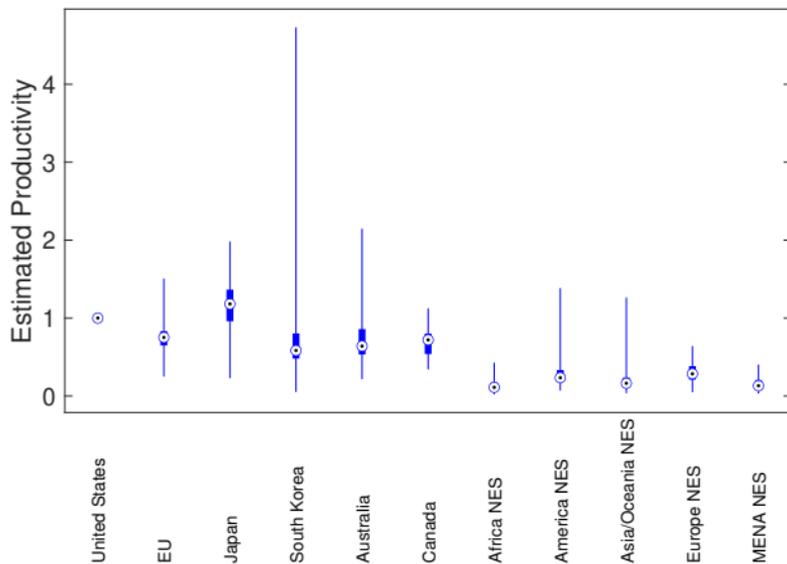
- We find that abandoning MFN introduces a strong liberalizing force into tariff bargaining
  - average tariffs would fall by 170.72% if MFN were abandoned 26.2% under MFN
  - many import subsidies, some of which hit the round-trip inequality constraint
- But the liberalizing force is *overly* strong, wiping out the real world income gains from MFN tariff bargaining in the Uruguay Round and leading to a 0.33% decline in real world income relative to the 1990 status quo: Table 7
  - half the poor performance is attributable to excessive liberalization, half attributable to the tariff discrimination that results
- What accounts for this overly strong liberalizing force?
  - abandoning MFN converts positive third-party spillovers to negative third-party spillovers: Table 9
  - the negative third-party spillovers create beggar-thy-neighbor incentives to negotiate bilateral discriminatory tariff reductions: Intuition
  - as a result, tariff bargaining without MFN is roughly as bad for real world income as non-cooperative Nash tariffs that are constrained by MFN

- Our results also suggest that, while most countries lose from discriminatory tariff bargaining, abandoning MFN unleashes the bargaining power of the strong on the weak
  - under our estimated bargaining parameters, South Korea is the biggest gainer and Australia is the biggest loser, while under symmetric bargaining powers this would no longer be true: Table 7
- And our results suggest that the true cost of abandoning MFN only becomes apparent when the full equilibrium consequences of that abandonment are taken into account
  - if each bargaining country were to consider its discriminatory bilaterals in isolation, that is, as a collection of single-pair discriminatory bargains, abandoning MFN would look like a winning proposition: Table 10

- The free-rider issue created by the positive third-party spillovers from the GATT/WTO's MFN requirement is widely emphasized as a shortcoming of the GATT/WTO approach
- While we find evidence that the positive third-party spillovers associated with MFN tariff cuts are quantitatively important
  - we find that the abandonment of MFN in tariff bargaining would create negative third-party spillovers that are even more powerful
  - and that would ultimately lead to tariff bargaining outcomes that are substantially worse from the perspective of world welfare

- Framework for trade negotiations that features
  - comparative advantage and distance driven trade patterns
  - multi-party bilateral bargaining with externalities
  - flexible bargaining parameters
- Findings:
  - MFN, despite its shortcomings, performs better for tariff liberalization than the alternative of discriminatory tariffs
  - demonstration of method that can be used for other eras and bargaining protocols
- Avenues for future work
  - more granularity in product and country classifications
  - bargaining under the reciprocity norm
  - additional multilateral elements to the bargaining protocol, and the broader set of non-tariff issues at play in the Uruguay Round
  - political economy and distributional concerns

Figure 1: Productivity Distributions by Country



Notes: For each country, the target is the median estimated productivity across sectors. The box represents the interquartile range. The line represents the full range. Each sector in the US is normalized to a productivity level one.

**Table 2:  $\theta$  Estimates by Industry.**

Sector	$\hat{\theta}$	SE	Sector	$\hat{\theta}$	SE
Sugar	16.46	1.86	Resins	5.47	1.06
Travel goods and bags	12.36	2.88	Footwear	5.41	1.04
Plumbing, heating and lighting	11.93	1.59	Animal oils and fats	5.29	0.83
Feeding stuff	10.95	1.41	Scientific instruments	5.17	0.69
Live animals	9.02	2.85	Non-metallic mineral manufactures	5.12	0.58
Coal	8.70	2.42	Vegetables and fruit	5.04	0.53
Other transport equipment	8.15	1.08	Non-ferrous metals	4.95	0.75
Meat	7.76	1.05	All others	4.76	0.58
Electrical machinery	7.73	0.82	Office machines	4.74	0.69
Furniture and parts thereof	7.51	1.04	Pharmaceutical	4.73	0.75
Road vehicles	7.39	2.02	Textile fibres	4.48	0.90
Pulp and waste paper	7.38	1.71	Iron and steel	4.32	0.61
Dairy	7.03	0.90	Specialized Machinery	4.26	0.56
Misc. Edible	6.99	0.69	Misc manufactures	4.16	0.70
Cereals	6.94	1.05	Inorganic chemicals	4.13	0.49
Petroleum	6.64	0.99	Organic chemicals	3.99	0.61
Tobacco	6.43	1.57	Dyeing and tanning	3.61	0.48
Paper manufactures	6.11	1.07	Rubber manufactures	3.53	1.19
Cork and wood	6.09	1.26	Fertilizers	3.47	0.49
Beverages	6.06	1.55	Chemical	3.42	0.44
Hides and skins	5.85	1.00	Crude rubber	2.78	0.47
Wood manufactures	5.70	1.03	Coffee, Tea, Spices	2.66	0.26
Seafood	5.59	1.53	Fabrics	2.03	0.20
Crude materials,n.e.s.	5.51	0.58	Metal Ores	1.65	0.22
Power generating machinery	5.48	0.75			
Overall Mean	6.02	0.44			

*Notes: Estimates of  $\theta$  by sector in descending order of estimate.*

**Table 3: Model Benchmarks**

	Autarky	Frictionless Trade	Free Trade	World Income Maximizing	Nash
Welfare by Country					
US	-3.05%	32.50%	-0.04%	1.16%	-0.35%
EU	-3.07%	38.66%	-0.05%	-6.15%	-0.21%
Japan	-3.05%	31.14%	0.18%	0.36%	-0.20%
South Korea	-8.78%	77.77%	0.92%	6.30%	-0.63%
Australia	-6.89%	100.75%	0.15%	0.96%	-0.65%
Canada	-10.73%	86.51%	0.10%	1.18%	-0.39%
Africa NES	-2.80%	99.43%	0.05%	1.23%	-0.20%
America NES	-2.62%	132.08%	0.08%	1.70%	-0.15%
Asia NES	-4.07%	66.47%	0.53%	4.92%	-0.54%
Europe NES	-7.20%	96.25%	0.60%	1.89%	-1.34%
MENA NES	-8.54%	161.18%	0.56%	1.12%	-1.44%
Mean	-4.39%	81.27%	0.38%	2.69%	-0.57%
Real World Income	-3.72%	54.46%	0.17%	0.38%	-0.35%

*Notes: All changes are relative to model-predicted 1990 status quo. In column 1 we set iceberg costs for all countries in all sectors to 5000%. In column 2 we set iceberg costs and tariffs to zero for all countries in all sectors. In column 3 we set to zero all non-agricultural tariffs that were under negotiation in the Uruguay Round according to our model, while in column 4 we solve for the real-world-income maximizing levels of these tariffs and in column 5 we compute a Nash equilibrium in these tariffs. Tariffs in columns 4 and 5 are non-discriminatory. The mean across countries is weighted by population.*

**Table 4: Principal Supplier Relationships**

	US	EU	Japan	South Korea	Australia	Canada	Africa NES	America NES	Asia NES	Europe NES
US										
EU	[27,27]									
Japan	[19,5]	[13,3]								
South Korea	[13,2]	[5,2]	[16,4]							
Australia	[10,1]	[22,1]	[3,3]	[1,2]						
Canada	0,0	[30,3]	3,0	1,0	[1,1]					
Africa NES	2,0	34,0	0,0	0,0	0,0	0,0				
America NES	34,0	4,0	1,0	0,0	0,0	0,0	0,0			
Asia/Oceania NES	6,0	16,0	12,0	0,0	2,0	0,0	0,0	0,0		
Europe NES	0,0	39,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
MENA NES	3,0	34,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

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	US	EU	Japan	South Korea	Australia	Canada	Africa NES	America NES	Asia NES	Europe NES
US										
EU	[31,26]									
Japan	[14,7]	[21,5]								
South Korea	[13,1]	3,0	[19,2]							
Australia	[7,1]	22,0	[7,1]	[2,1]						
Canada	0,0	31,0	3,0	0,0	1,0					
Africa NES	2,0	35,0	0,0	0,0	0,0	0,0				
America NES	15,0	20,0	1,0	0,0	0,0	0,0	0,0			
Asia/Oceania NES	3,0	19,0	6,0	0,0	2,0	0,0	0,0	0,0		
Europe NES	0,0	39,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
MENA NES	4,0	33,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

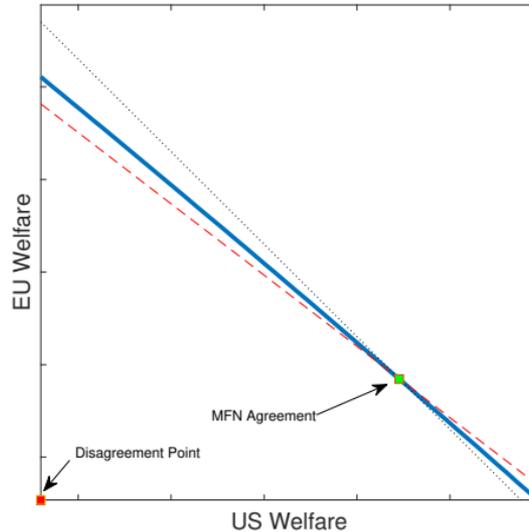
*Notes: The top panel presents principal supplier relationships according to the data. The bottom panel represents principal supplier relationships according to the trade model at the estimated parameter vector. For each cell in the table, the first entry gives the number of products for which the column country is the principal supplier into the row country, and the second entry gives the number of products for which the row country is the principal supplier into the column country. For the numbers in this table, trade with fellow PTA members and NES entities has been netted out. Square brackets indicate the bilateral relationships where both entries are positive.*

**Table 5: Bargaining Model Parameter Estimates**

Country Pair	Bargaining Parameter	SE
US - EU	0.72	0.42
US - Japan	0.72	0.37
US - Australia	0.98	0.39
US - South Korea	0.01	0.24
EU - Japan	0.01	0.23
Japan - Australia	0.99	0.06
Japan - South Korea	0.16	0.39
Australia - South Korea	0.85	0.09

*Notes: Estimated bargaining parameters for the first country in each pair.*

**Figure 2: US and EU Bargaining Frontier**



*Notes: The blue curve represents the frontier of feasible welfare pairs for the US-EU bilateral negotiations holding the other pairs fixed at the equilibrium outcomes. The black dotted line pass through the agreement point and has slope equal to  $-1$ . The red dashed line passes through the agreement point and has slope equal to the negative of the ratio of the US price level to the EU price level.*

**Table 6: Spillover Benefits to Third Parties (MFN Negotiations)**

Country 1	Country 2	Reducing Country	$\Delta$ Welfare	$\Delta$ Welfare	$\Delta$ Welfare	$\Delta$ Welfare	$\Delta$ Welfare
			Country 1 (1)	Country 2 (2)	3rd Parties (3)	Partner + 3rd Parties (4)	Partner / (Partner + 3rd Parties) (5)
US	EU	US	-1.00	0.76	0.92	1.68	0.45
US	EU	EU	0.88	-1.00	1.15	2.03	0.43
US	Japan	US	-1.00	1.11	0.53	1.64	0.68
US	Japan	Japan	0.40	-1.00	0.57	0.97	0.41
US	Aus	US	-1.00	0.89	1.52	2.42	0.37
US	Aus	Aus	0.34	-1.00	1.10	1.45	0.24
US	Korea	US	-1.00	2.52	6.53	9.06	0.28
US	Korea	Korea	0.38	-1.00	0.66	1.04	0.36
EU	Japan	EU	-1.00	1.76	1.31	3.07	0.57
EU	Japan	Japan	0.30	-1.00	0.60	0.91	0.34
Japan	Aus	Japan	-1.00	0.42	0.27	0.69	0.61
Japan	Aus	Aus	1.54	-1.00	1.04	2.58	0.60
Japan	Korea	Japan	-1.00	1.33	0.76	2.10	0.64
Japan	Korea	Korea	0.72	-1.00	0.40	1.13	0.64
Aus	Korea	Aus	-1.00	2.24	10.91	13.15	0.17
Aus	Korea	Korea	0.44	-1.00	0.14	0.58	0.75

*Notes: Each row corresponds to a unilateral marginal decrease in tariffs by the “reducing country.” The reducing country reduces tariffs on all goods that it negotiates with the partner country in that row from the negotiated agreement level. The welfare changes are normalized so that the reducing country experiences a reduction in welfare equal to one.*

**Table 7: Estimated Uruguay Round and Counterfactual Outcomes**

	Estimated Bargaining Parameters		All 0.5 Bargaining Parameters	
	MFN	No MFN	MFN	No MFN
	$\Delta\%$ 1990	$\Delta\%$ 1990	$\Delta\%$ 1990	$\Delta\%$ 1990
$\Delta$ Mean Tariff	-33.65%	-47.55%	-38.58%	-34.24%
$\Delta$ Trade Wgt'd Mean Tariff	-26.20%	-170.72%	-27.14%	-117.53%
Country Welfare				
US	0.02%	-0.90%	0.03%	0.06%
EU	0.02%	0.21%	0.04%	0.09%
Japan	0.06%	0.17%	0.06%	-0.13%
South Korea	0.61%	3.35%	0.40%	-0.16%
Australia	0.11%	-22.97%	0.11%	-0.09%
Canada	0.02%	-0.08%	0.03%	-0.17%
Africa NES	0.02%	-0.00%	0.02%	-0.01%
America NES	0.03%	-0.02%	0.03%	-0.03%
Asia NES	0.19%	-0.32%	0.17%	-0.29%
Europe NES	0.06%	-0.05%	0.06%	-0.03%
MENA NES	0.06%	-0.02%	0.05%	-0.13%
Mean	0.12%	-0.24%	0.11%	-0.16%
Real World Income	0.08%	-0.33%	0.07%	-0.05%

*Notes: Each column represents changes in the row relative to the pre-Uruguay tariff levels. Tariff averages are computed among non-agriculture sectors for the bargaining countries.*

**Table 8: MFN Bargaining Outcomes**

	MFN Equil- ibrium (1)	Single Bargains US-EU (2)	US-Japan (3)	US-Aus (4)	US-SK (5)	EU-Japan (6)	Japan-Aus (7)	Japan-SK (8)	Aus-SK (9)	Sum of Single Bargains (10)
US	0.023%	0.009%	0.000%	0.000%	0.000%	0.009%	0.000%	0.004%	0.000%	0.010%
EU	0.024%	0.006%	0.000%	0.000%	0.005%	0.001%	0.000%	0.007%	0.000%	0.007%
Japan	0.063%	0.012%	0.001%	0.000%	-0.001%	0.031%	0.002%	0.031%	0.002%	0.065%
South Korea	0.608%	0.043%	0.000%	0.000%	0.031%	0.007%	0.002%	0.139%	0.008%	0.178%
Australia	0.109%	0.015%	0.000%	0.000%	0.006%	0.011%	0.003%	0.007%	0.057%	0.059%
Canada	0.025%	0.001%	0.001%	0.000%	0.000%	0.010%	0.001%	0.005%	0.001%	
Africa NES	0.020%	0.005%	0.000%	0.000%	0.001%	0.004%	0.000%	0.002%	0.001%	
America NES	0.033%	0.027%	0.000%	0.000%	0.001%	0.002%	0.000%	0.009%	0.001%	
Asia NES	0.192%	0.031%	0.000%	0.000%	0.032%	0.006%	0.001%	0.069%	0.009%	
Europe NES	0.064%	0.040%	0.000%	0.000%	0.000%	0.013%	0.000%	0.001%	0.000%	
MENA NES	0.064%	0.038%	0.000%	0.000%	0.003%	0.015%	0.000%	-0.004%	0.001%	
Mean	0.122%	0.026%	0.000%	0.000%	0.018%	0.007%	0.001%	0.039%	0.005%	
Real World Income	0.080%	0.016%	0.000%	0.000%	0.007%	0.012%	0.001%	0.025%	0.003%	0.063%

*Notes: Each column represents changes in the row relative to the pre-Uruguay tariff levels. The first set of columns represents the Horn-Wolinsky MFN equilibrium at the estimated bargaining parameters. The next columns represent the outcomes of single pair MFN bargains holding the other pair's at their 1990 levels. Tariff average changes for the MFN equilibrium are computed among non-agriculture sectors for the bargaining countries.*

**Table 7: Estimated Uruguay Round and Counterfactual Outcomes**

	Estimated Bargaining Parameters		All 0.5 Bargaining Parameters	
	MFN	No MFN	MFN	No MFN
	$\Delta\%$ 1990	$\Delta\%$ 1990	$\Delta\%$ 1990	$\Delta\%$ 1990
$\Delta$ Mean Tariff	-33.65%	-47.55%	-38.58%	-34.24%
$\Delta$ Trade Wgt'd Mean Tariff	-26.20%	-170.72%	-27.14%	-117.53%
Country Welfare				
US	0.02%	-0.90%	0.03%	0.06%
EU	0.02%	0.21%	0.04%	0.09%
Japan	0.06%	0.17%	0.06%	-0.13%
South Korea	0.61%	3.35%	0.40%	-0.16%
Australia	0.11%	-22.97%	0.11%	-0.09%
Canada	0.02%	-0.08%	0.03%	-0.17%
Africa NES	0.02%	-0.00%	0.02%	-0.01%
America NES	0.03%	-0.02%	0.03%	-0.03%
Asia NES	0.19%	-0.32%	0.17%	-0.29%
Europe NES	0.06%	-0.05%	0.06%	-0.03%
MENA NES	0.06%	-0.02%	0.05%	-0.13%
Mean	0.12%	-0.24%	0.11%	-0.16%
Real World Income	0.08%	-0.33%	0.07%	-0.05%

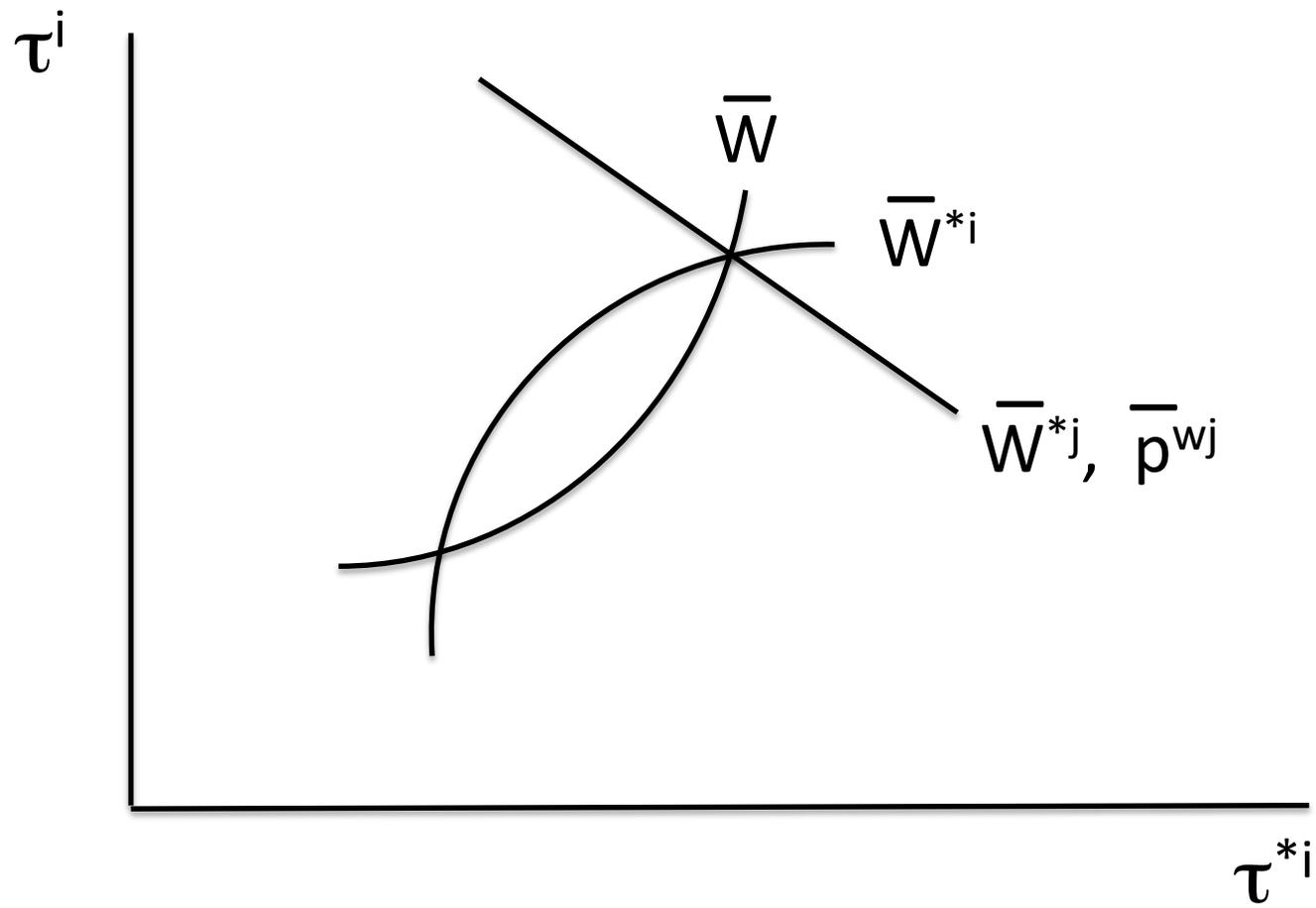
*Notes: Each column represents changes in the row relative to the pre-Uruguay tariff levels. Tariff averages are computed among non-agriculture sectors for the bargaining countries.*

**Table 9: Spillover Benefits to Third Parties (Discriminatory Negotiations)**

Country 1	Country 2	Reducing Country	$\Delta$ Welfare Country 1	$\Delta$ Welfare Country 2	$\Delta$ Welfare 3rd Parties	$\Delta$ Welfare Partner + 3rd Parties	$\Delta$ Welfare Partner / (Partner + 3rd Parties)
			(1)	(2)	(3)	(4)	(5)
US	EU	US	-1.00	0.71	-0.71	0.01	99.39
US	EU	EU	1.20	-1.00	-0.06	1.14	1.05
US	Japan	US	-1.00	1.64	-0.36	1.28	1.28
US	Japan	Japan	0.50	-1.00	-0.19	0.30	1.64
US	Aus	US	-1.00	1.82	-1.40	0.42	4.32
US	Aus	Aus	0.44	-1.00	-0.26	0.18	2.40
US	Korea	US	-1.00	2.29	-1.16	1.13	2.03
US	Korea	Korea	0.41	-1.00	-0.33	0.08	5.06
EU	Japan	EU	-1.00	1.74	-0.02	1.71	1.01
EU	Japan	Japan	0.39	-1.00	-0.23	0.16	2.47
Japan	Aus	Japan	-1.00	1.42	-0.54	0.88	1.62
Japan	Aus	Aus	0.80	-1.00	-0.23	0.58	1.39
Japan	Korea	Japan	-1.00	1.48	-0.19	1.29	1.15
Japan	Korea	Korea	0.43	-1.00	-0.12	0.31	1.40
Aus	Korea	Aus	-1.00	1.57	-1.01	0.56	2.80
Aus	Korea	Korea	0.66	-1.00	-0.46	0.21	3.21

*Notes: Each row corresponds to a unilateral marginal decrease in tariffs by the “reducing country.” The reducing country reduces tariffs on all goods that it negotiates with the partner country in that row from the discriminatory agreement. The welfare changes are normalized so that the reducing country has an absolute welfare change equal to one.*

Figure 1  
Efficient Tariffs



**Table 7: Estimated Uruguay Round and Counterfactual Outcomes**

	Estimated Bargaining Parameters		All 0.5 Bargaining Parameters	
	MFN	No MFN	MFN	No MFN
	$\Delta\%$ 1990	$\Delta\%$ 1990	$\Delta\%$ 1990	$\Delta\%$ 1990
$\Delta$ Mean Tariff	-33.65%	-47.55%	-38.58%	-34.24%
$\Delta$ Trade Wgt'd Mean Tariff	-26.20%	-170.72%	-27.14%	-117.53%
Country Welfare				
US	0.02%	-0.90%	0.03%	0.06%
EU	0.02%	0.21%	0.04%	0.09%
Japan	0.06%	0.17%	0.06%	-0.13%
South Korea	0.61%	3.35%	0.40%	-0.16%
Australia	0.11%	-22.97%	0.11%	-0.09%
Canada	0.02%	-0.08%	0.03%	-0.17%
Africa NES	0.02%	-0.00%	0.02%	-0.01%
America NES	0.03%	-0.02%	0.03%	-0.03%
Asia NES	0.19%	-0.32%	0.17%	-0.29%
Europe NES	0.06%	-0.05%	0.06%	-0.03%
MENA NES	0.06%	-0.02%	0.05%	-0.13%
Mean	0.12%	-0.24%	0.11%	-0.16%
Real World Income	0.08%	-0.33%	0.07%	-0.05%

*Notes: Each column represents changes in the row relative to the pre-Uruguay tariff levels. Tariff averages are computed among non-agriculture sectors for the bargaining countries.*

**Table 10: Discriminatory Bargaining Outcomes**

	Discrim. Equil- ilibrium (1)	Single Bargains US-EU (2)	US-Japan (3)	US-Aus (4)	US-SK (5)	EU-Japan (6)	Japan-Aus (7)	Japan-SK (8)	Aus-SK (9)	Sum of Single Bargains (10)
US	-0.901%	0.073%	0.007%	0.001%	0.000%	-0.018%	0.000%	-0.004%	0.000%	0.082%
EU	0.214%	0.046%	-0.012%	0.000%	-0.007%	0.002%	0.000%	-0.002%	0.000%	0.048%
Japan	0.168%	-0.020%	0.034%	-0.002%	-0.011%	0.100%	0.002%	0.042%	-0.002%	0.178%
South Korea	3.353%	-0.125%	0.002%	-0.003%	0.459%	0.006%	0.002%	0.204%	0.008%	0.671%
Australia	-22.965%	-0.008%	-0.112%	0.037%	0.000%	-0.059%	0.003%	0.004%	0.090%	0.130%
Canada	-0.085%	-0.032%	-0.023%	-0.002%	-0.007%	-0.010%	0.001%	0.000%	-0.001%	
Africa NES	-0.002%	-0.002%	-0.012%	0.000%	0.001%	0.001%	0.000%	0.002%	-0.002%	
America NES	-0.023%	-0.022%	-0.004%	0.000%	-0.016%	-0.002%	0.000%	0.000%	-0.002%	
Asia NES	-0.322%	-0.076%	-0.024%	-0.001%	-0.056%	-0.009%	0.001%	-0.020%	-0.006%	
Europe NES	-0.047%	-0.014%	-0.010%	0.000%	0.001%	0.007%	0.000%	0.001%	0.000%	
MENA NES	-0.023%	-0.025%	-0.046%	0.000%	0.015%	-0.045%	0.000%	0.010%	0.000%	
Pop. Wgt. Mean	-0.244%	-0.039%	-0.019%	0.000%	-0.025%	-0.007%	0.001%	-0.007%	-0.003%	
Real World Income	-0.334%	0.002%	0.001%	0.000%	0.004%	0.018%	0.001%	0.013%	0.000%	0.039%

*Notes: Each column represents changes in the row relative to the pre-Uruguay tariff levels. The first set of columns represents the Horn-Wolinsky discriminatory equilibrium at the estimated bargaining parameters. The next columns represent the outcomes of single pair discriminatory bargains holding the other pair's at their 1990 levels. RWI stands for real world income. Tariff average changes for the discriminatory equilibrium are computed among non-agriculture sectors for the bargaining countries.*

**Table 1: Summary Statistics**

Country	Pop(M)	Mnfctring V.A. per capita(000)	Import ratio	1990 Average Tariffs	1990 Trade Weighted Tariffs	2000 Average Tariffs	2000 Trade Weighted Tariffs	Largest Trading Partner
USA	249.6	4258.8	0.187	0.045	0.048	0.032	0.043	Canada
Argentina	32.6	768.9	0.017	0.115	0.099	0.142	0.118	USA
Australia	17.1	2546.9	0.096	0.136	0.109	0.069	0.054	Japan
Austria	7.7	3265.8	0.503	0.061	0.066	0.033	0.034	Germany
Belgium	10.0	3428.3	0.386	0.061	0.054	0.033	0.028	Germany
Brazil	149.4	742.1	0.019	0.259	0.169	0.136	0.094	USA
Canada	27.8	3138.7	0.336	0.080	0.081	0.041	0.030	USA
China	1140.9	72.1	0.084	0.102	0.111	0.076	0.071	USA
Denmark	5.1	3596.6	0.213	0.061	0.057	0.033	0.029	Germany
France	56.7	2315.9	0.241	0.061	0.059	0.033	0.030	Germany
Germany	79.4	5421.1	0.228	0.061	0.062	0.033	0.032	France
India	849.5	23.8	0.038	0.772	0.576	0.323	0.238	MENA NES
Indonesia	178.2	61.6	0.058	0.196	0.133	0.076	0.052	Japan
Italy	56.7	2051.8	0.259	0.061	0.052	0.033	0.027	Germany
Japan	123.5	5804.5	0.122	0.053	0.027	0.035	0.019	USA
Mexico	83.2	226.5	0.081	0.118	0.110	0.149	0.124	USA
Netherlands	15.0	2425.4	0.240	0.061	0.057	0.033	0.028	Germany
Russia	148.3	236.1	0.128	0.087	0.056	0.104	0.076	Europe NES
S. Korea	42.9	1875.7	0.176	0.109	0.089	0.083	0.049	USA
Spain	38.8	1815.3	0.410	0.061	0.054	0.033	0.027	France
Sweden	8.6	3731.1	0.383	0.061	0.061	0.033	0.030	Germany
Switzerland	6.7	6255.8	0.299	0.199	0.113	0.063	0.033	Germany
Thailand	54.6	408.7	0.091	0.397	0.317	0.136	0.096	Japan
Turkey	56.2	413.3	0.134	0.079	0.067	0.052	0.034	Germany
UK	57.6	3541.4	0.305	0.061	0.061	0.033	0.031	Germany
America NES	183.1	243.9	0.077	0.119	0.100	0.107	0.087	USA
AsiaPac NES	671.3	104.7	0.207	0.129	0.108	0.068	0.049	USA
MENA NES	207.5	181.9	0.140	0.167	0.151	0.192	0.136	Japan
Africa NES	480.8	48.1	0.041	0.153	0.136	0.118	0.106	USA
Europe NES	207.5	608.7	0.273	0.075	0.059	0.074	0.055	Germany

*Notes: Trade and tariff summary statistics at the level aggregation used for the analysis.*