Self-Enforcing Trade Agreements: Evidence from Time-Varying Trade Policy

Chad P. Bown Meredith A. Crowley

World Bank

Federal Reserve Bank of Chicago

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The Big Picture

1. How should we think about the World Trade Organization as an institution?
2. Can we view the WTO as a contingent contract over import tariffs that must be self-policed?

WTO tariff commitments and usage of contingent tariffs

	Percent of products with tariff promise	Average promised tariff rate 1995-2010	Percent of products with contingent tariff 1995	Percent of products with contingent tariff 2010	Average contingent tariff rate 1997-2006
U.S.	100	3.6	3.3	5.7	89.7
EU	100	4.2	3.4	2.9	-
China	100	10.0*	0.0	1.4	-
India	73.8	49.4	0.2	6.6	-
Brazil	100	31.4	0.4	1.6	-

Source: Bown and Crowley (2012b), *2001-2010

Questions

1. What explains time-variation in tariffs for a country that participates in a trade agreement?
2. Are antidumping tariffs and other temporary trade barriers used to “manage” trade shocks within a self-enforcing trade agreement?

Findings

The likelihood of a US antidumping and safeguard tariffs:

- increases with import growth
- increases in the inverse of the sum of the import demand and export supply elasticities
- decreases in the standard deviation of import growth

These finding provide empirical support for the self-enforcing trade agreements model of Bagwell and Staiger (1990, AER).

Theoretical Literature

Trade policy choices are best understood as the outcome of a non-cooperative game.

- Johnson (REStud 1953-4), Bagwell and Staiger (AER 1990, AER 1999), Grossman and Helpman (JPE 1995), Maggi (AER 1999), Bond and Park (REStud 2002), Syropolous (REStud 2002), Ossa (2011)

Trade agreements deliver higher welfare by internalizing the terms of trade externality.

- Bagwell and Staiger (AER 1990, AER 1999, QJE 2001), Maggi and Rodriguez-Clare (AER 2007), Maggi and Staiger (QJE 2011)

Theoretical Literature

Trade agreement help solve a time-consistency problem in tariff setting.

- Maggi and Rodriguez-Clare (AER 2007)

Trade agreements help governments internalize a production relocation externality.

- Ossa (JPE 2011)

Trade agreements that focus on terms of trade externalities can fail to deliver efficiency in the presence of offshoring and domestic political pressure.

- Antras and Staiger (AER 2012)

Empirical Literature

International market power is an important determinant of tariff formation.

- Broda, Limão and Weinstein (AER 2008): Cross-sectionally, the level of the tariff is decreasing in the export supply elasticity for non-WTO members.
- Bagwell and Staiger (AER 2011): Cross-sectionally, tariff reductions made by newly acceding WTO members are increasing in pre-negotiation import volume.

Our paper: Can the pattern of time-variation in tariffs be understood as a country's optimal cooperative response to import volume shocks?

A self-enforcing trade agreement: Bagwell and Staiger (1990)

Overview

- A self-enforcing trade agreement is the lowest set of trade taxes that can be supported as a subgame perfect Nash equilibrium in an infinitely repeated game between two players, country *i* and country *j*.
- When trade volumes rise unexpectedly, the lowest tariff that can be supported under the self-enforcing trade agreement will rise.

Bagwell and Staiger (1990)

Two large countries with general import demand and export supply functions:

$$M(k^*, P^*) \qquad \partial M(k^*, P^*)/\partial k^* > 0$$
$$X(k, P) \qquad \partial X(k, P)/\partial k > 0$$

- P^* is the importer's local price
- P is the exporter's local price
- k and k^* are general shift parameters

Bagwell and Staiger (1990)

Importer chooses an import tariff, τ^*:

$$\max_{\tau^*} W^*(k, k^*, \tau^*, \tau)$$

Exporter chooses an export tax, τ:

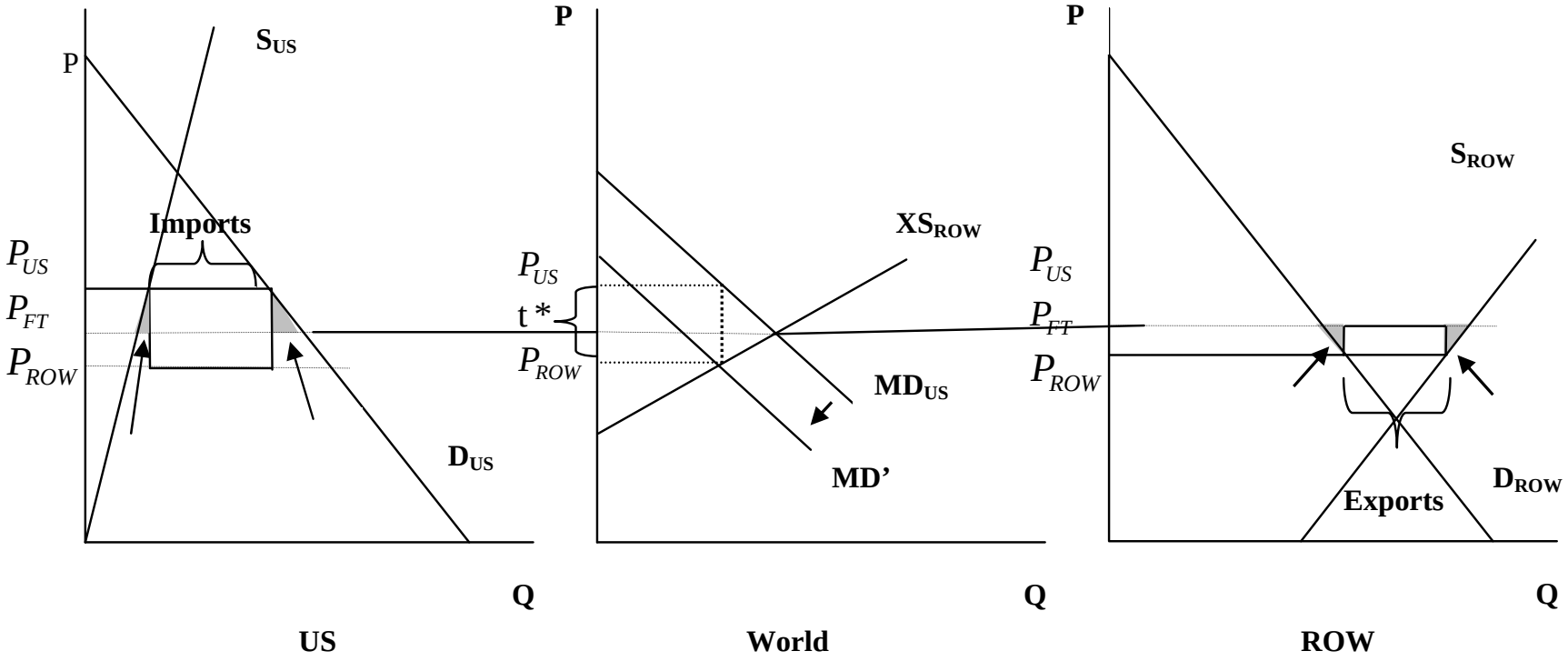
$$\max_{\tau} W(k, k^*, \tau, \tau^*)$$

In equilibrium, $P^* - P = \tau^* + \tau$.

Nash equilibrium in the one-shot game

1. Each country maximizes its own welfare taking its trading partner's tariff as given.
2. The optimal tariff chosen by the importing country is positive and increasing in the inverse of the sum of elasticities of import demand and export supply.
   - The exporting country bears some of the tax burden of the tariff.
   - Efficiency losses in the importing economy are small relative to the gains from taxing foreigners.
3. The Nash equilibrium of the one-shot game consists of trade taxes that are too high and trade volumes that are too low relative to the social planner's for maximizing joint welfare.

The terms of trade gain vs. efficiency losses from a tariff



Infinitely repeated game

Cooperative trade taxes, (τ_c^*, τ_c), can be supported as a SPNE with the threat of infinite Nash reversion if

$$\Omega^*(k, k^*, \tau_c(k, k^*), \tau_D^*(k, k^*, \tau_c(\cdot)) \leq \omega^*(\tau_c(k, k^*), \tau_c^*(k, k^*)) \qquad (1)$$

where

- $\Omega^*(\cdot)$ is the gain to defecting,
- $\omega^*(\cdot)$ is the gain to cooperating, and
- $\tau_D^*(\cdot)$ is the tariff to which the importing country defects.

What is the incentive for the importing country to defect from a cooperative equilibrium of free trade?

$$\Omega^*(k,k^*,0,\tau_D^*) = [P^f - P(k,k^*,0,\tau_D^*)]M(k^*,P^*(k,k^*,0,\tau_D^*)) - \int_{P^f}^{P^*(k,k^*,0,\tau_D^*)} [M(k^*,P^*) - M(k^*,P^*(k,k^*,0,\tau_D^*))]dP^* \quad (2)$$

where

- $\tau_c^* = 0, \tau_c = 0$ are the cooperative trade policies,
- $\tau_D^*(\cdot)$ is the tariff to which the importing country defects,
- P^f is the free trade price, and
- $M(\cdot)$ is the volume of imports.

The incentive to defect: An unexpected increase in imports

$$\frac{d\Omega^*(\cdot)}{dk^*} > 0 \text{ iff } \frac{\partial M(k^*, P^f)}{\partial k^*}\left[\frac{P^f}{\eta_x^f + \eta_m^f}\right] > \int_{P^f}^{P^*(k,k^*,0,\tau_D)} \frac{\partial M(k^*, P^*)}{\partial k^*} dP^*, \tag{3}$$

where

- η_x^f is the export supply elasticity evaluated at free trade
- η_m^f is the import demand elasticity evaluated (positively) at free trade.

The discounted present value of maintaining cooperation

$$\omega^*(\tau_c(k,k^*),\tau_c^*(k,k^*)) \equiv \frac{\delta}{1-\delta}[EW^*(k,k^*,\tau_c(k,k^*),\tau_c^*(k,k^*)) - EW^*(k,k^*,\tau_N(k,k^*),\tau_N^*(k,k^*))] \quad (4)$$

where δ is the discount factor.

Special case: Linear import demand and export supply

Rewriting the symmetric, cooperative trade policies as functions of free trade volume, $\tau_c(V^f) = \tau_c^*(V^f)$, we have...

$$\omega^*(\tau_c(V^f)) = \frac{\delta}{1-\delta}\left\{\frac{5}{12a}\left(\sigma_{V^f}^2 + [EV^f]^2\right) - \frac{a}{4}\left(\sigma_{\tau^c}^2 + [E\tau^c(V^f)]^2\right)\right\} \quad (5)$$

where

- EV^f and $\sigma_{V^f}^2$ are the mean and variance of the underlying free trade volume and
- $E\tau^c(V^f)$ and $\sigma_{\tau^c}^2$ are the mean and variance of the cooperative tariff function.

The time-varying cooperative tariff rule

$$\tau_c^*(V^f, \omega^*) = \begin{cases} 0 & \text{if } V^f \in [0, \overline{V}^f] \\ \frac{1}{2a}(V^f - \overline{V}^f) & \text{if } V^f \geq \overline{V}^f \end{cases} \tag{6}$$

where $\overline{V}^f$ is a cutoff volume of trade below which the most cooperative policy is free trade.

Empirical Strategy

Combine the comparative static predictions of the Bagwell-Staiger model into a single estimating equation.

- (3) implies the incentive to defect will vary intertemporally with changes in import flows and cross-sectionally with the elasticities of supply and demand.
- (5) and (6) imply that, cross-sectionally, cooperative tariff increases will be more likely and/or larger in sectors with less volatile imports.

Empirical model of time-varying US tariffs

$$y_{ikt} = \beta_0 + \beta_1 M_{ikt} + \beta_2 \left(\frac{1}{\eta_{xk} + \eta_{mk}} \right) + \beta_3 \left(M_{ikt} * \frac{1}{\eta_{xk} + \eta_{mk}} \right) + \beta_4 \sigma_{ik}^m + \varepsilon_{ikt}, \tag{7}$$

- y_{ikt} is a measure of a trade policy change,
- M_{ikt} is a measure of the change in imports,
- $1/(\eta_{xk} + \eta_{mk})$ is the inverse of the sum of the export supply and import demand elasticities,
- σ_{ik}^m is a measure of the variance of imports.

where i denotes country, k denotes industry, t denotes year, and $\beta_1 + \beta_3 \frac{1}{\eta_{xk}+\eta_{mk}} > 0$, $\beta_2 + \beta_3 M_{ikt} > 0$, and $\beta_4 < 0$.

Data: Global Antidumping Database

Trade policy data, 1997-2006

- antidumping and safeguard tariffs at accused country (i) and tariff line (8-10 digit) level
- concorded to 5 and 6 digit NAICS2002 manufacturing industry (k)
- detailed information on filing dates, various outcome dates
- outcomes: dummy for tariff/no tariff and tariff rates

Summary Statistics NAICS examples

Data: Annual Survey of Manufacturers and US Imports

Domestic industry data and country-specific imports, 1997-2006

- 283 5 and 6 digit NAICS2002 manufacturing industries (k) in the US
- industry concentration, shipments, employment, value added, inventories
- imports by country and industry (ik)

Summary Statistics Country List

Data: Trade Elasticities

Trade Elasticities

- Import demand elasticities for the US at the 3 digit HS product level from Broda, Greenfield, and Weinstein (2006) concorded to NAICS2002 (k)
- Export supply elasticities facing the US at the 4 digit HS product level from Broda, Limão and Weinstein (2008) concorded to NAICS2002 (k)

Summary Statistics

	Full sample		Top 10 trading partners only		China only	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Dependent Variables						
Antidumping (AD) tariff imposed	0.0017	0.0418	0.0046	0.0675	--	--
AD or safeguard tariff imposed	0.0032	0.0562	0.0060	0.0770	0.0323	0.1768
ln(1+AD tariff)	--	--	0.0030	0.0547	--	--
AD tariff conditional on a positive value	89.7	94.4	116.7	104.0	161.5	99.4
Explanatory Variables						
Growth of imports_ikt-1	0.102	0.947	0.084	0.567	--	--
Change in US market share_ikt-1	0.000	0.004	0.001	0.006	0.005	0.012
$\ln\left[1/\left(\eta_x^f+\eta_m^f\right)\right]\_k$	-1.991	1.517	-1.995	1.526	-1.982	1.523
$1/\left(\eta_x^f+\eta_m^f\right)\_k$	0.241	0.170	--	--	--	--
Standard deviation of import growth_ik	0.723	0.660	0.378	0.435	0.393	0.425
Percent change in real exchange rate_it-1	0.007	0.116	0.001	0.087	0.017	0.015
Domestic industry variables						
ln(Four firm concentration ratio)_k*	3.468	0.608	--	--	--	--
Value-added/Shipments_kt-1*	0.513	0.118	--	--	--	--
Inventories/Shipments_kt-1*	0.129	0.063	--	--	--	--
Indicator for industry k is steel*	0.013	0.113	--	--	--	--
Indicator for industry k is chemicals*	0.021	0.144	--	--	--	--
Observations	82,341		20,775		2,075	

Notes: * These variables are based on only 81,943 observations.

Table 2a: US Antidumping Imposition: Marginal Effects from a Binary Model: Import Growth

	Baseline specification (1)	Substitute alternative elasticity measures (2)	Remove elasticity outliers (3)	Top 10 trading partners only (4)	Logit model with multiway clustering (5)
Growth of imports_ikt-1	4.44***	4.86***	5.66***	28.93***	27.58***
Marginal effect of import growth	(1.55)	(1.75)	(1.63)	(8.59)	(9.69)
$\ln\left[1/\left(\eta_x^f + \eta_m^f\right)\right]\_k$	0.58***	--	0.86***	1.36***	1.31*
	(0.14)		(0.20)	(0.39)	(0.75)
$1/\left(\eta_x^f + \eta_m^f\right)\_k$	--	0.36***	--	--	--
		(0.05)			
Standard deviation of import growth_ik	-0.16***	-0.18***	-0.18***	-0.54***	-0.54
	(0.02)	(0.02)	(0.03)	(0.16)	(0.45)
Percent change in real exchange rate_it-1	1.09**	1.15**	1.07*	13.91***	12.05*
	(0.55)	(0.58)	(0.59)	(2.91)	(7.13)
Observations	82,341	82,341	67,262	20.775	20,775
Log-likelihood	-1002.19	-998.17	-857.30	-582.18	-582.23

Notes: Dependent variable is a binary indicator that a US antidumping tariff was imposed on exporting country i in industry k after an investigation initiated in year t. Probit model used to estimate all specifications except for the logit model used to estimate specification (5). Huber-White robust standard errors in parentheses, except for specification (5) which implements Cameron, Gelbach and Miller (2011) multiway clustering on industry and trading partner. ***, **,* indicate statistical significance of marginal effects at the 1%, 5% and 10% levels, respectively.

	Baseline specification (1)	Substitute alternative elasticity measures (2)	Remove elasticity outliers (3)	Top 10 trading partners only (4)	Logit model with multiway clustering (5)
Predicted probability of antidumping tariff, expressed in percent,[a] ...					
...at means	0.17	0.17	0.19	0.46	0.46
…for one standard deviation increase to growth of imports	0.23	0.24	0.27	0.69	0.71
…for one standard deviation increase to elasticities	0.32	0.26	0.35	0.73	0.74
…for one standard deviation increase to standard deviation of import growth	0.04	0.04	0.04	0.22	0.22
…for one standard deviation increase to real exchange rate	0.20	0.20	0.21	0.61	0.60
Observations	82,341	82,341	67,262	20.775	20,775

Notes: [a]Predicted probabilities expressed in percent terms; e.g., 0.17 is a predicted probability of seventeen hundredths of one percent, or 0.0017.

Results on US antidumping imposition using import growth

For antidumping tariffs, a one s.d. increase in...

- lagged import growth increases Pr(tariff) by 35%.
- the inverse of $\eta_{xk} + \eta_{mk}$ increases Pr(tariff) by 88%.
- the std. dev. of import growth decreases Pr(tariff) by 76%.

For antidumping or safeguard tariffs, a one s.d. increase in...

- lagged import growth increases Pr(tariff) by 22%.
- the inverse of $\eta_{xk} + \eta_{mk}$ increases Pr(tariff) by 106%.
- the std. dev. of import growth decreases Pr(tariff) by 75%.

Commitments over negotiated market access?

Some papers in the literature on trade agreements emphasize market access as the key variable that countries are contracting over.

- Bagwell and Staiger (AER 1999, JEP 2001, QJE 2001)
- Horn (AER 2006)

Empirically, we explore this by assuming that reciprocal trade tax concessions map into commitments to provide a trading partner with a specific market share in the importing country's market. Thus, an unanticipated increase in an exporter's share of the importing country's market would lead the cooperative tariff to rise.

Table 3a: US Antidumping Imposition: Marginal Effects from a Binary Model: Change in Market Share

	Substitute change in US market share for import growth	Top 10 trading partners only	AD and safeguard tariff policies[a]	China only[a]	Tobit model with dependent variable as ln(1+AD tariff)
	(1)	(2)	(3)	(4)	(5)
Change in US market share_ikt-1	5.48***	14.41***	15.82***	18.28	2800.09***
	(0.87)	(2.80)	(3.13)	(22.67)	(553.22)
$\ln\left[1/\left(\eta_x^f + \eta_m^f\right)\right]$_k	0.58***	1.35***	1.86***	6.76**	244.10***
	(0.14)	(0.42)	(0.48)	(2.95)	(77.78)
Standard deviation of import growth_ik	-0.15***	-0.38***	-0.60***	-3.26***	-73.25***
	(0.02)	(0.12)	(0.15)	(1.06)	(24.64)
Percent change in real exchange rate_it-1	1.20**	14.82***	22.50***	582.99***	2777.37***
	(0.61)	(3.08)	(3.56)	(217.19)	(518.14)
Observations	82,341	20,775	20,775	2,075	20,775
Log-likelihood	-995.40	-579.51	-716.28	-285.03	-634.95

Notes: Dependent variable for specifications (1) and (2) is a binary indicator that a US antidumping tariff was imposed on exporting country i in industry k after an investigation initiated in year t. [a] Antidumping or safeguard tariff indicator used as dependent variable in specifications (3) and (4). Huber-White robust standard errors in parentheses. ***, **,* indicate statistical significance of marginal effects at the 1 percent, 5 percent and 10percent levels, respectively.

	Substitute change in US market share for import growth (1)	Top 10 trading partners only (2)	AD and safeguard tariff policies[a] (3)	China only[a] (4)
Predicted probability of antidumping (or safeguard) tariff[a], expressed in percent,[b]				
...at means	0.17	0.46	0.60	3.23
…for one std. dev. increase to change in US market share	0.20	0.56	0.72	3.44
…for one std. dev. increase to elasticities	0.32	0.72	0.99	4.38
…for one std. dev. increase to std. dev. of import growth	0.05	0.27	0.29	1.79
…for one std. dev. increase to percent change in real exchange rate	0.20	0.61	0.85	4.19
Observations	82,341	20,775	20,775	2,075

Notes: [a] Antidumping or safeguard tariff indicator used as dependent variable in specifications (3) and (4).
[b]Predicted probabilities expressed in percent terms; e.g., 0.17 is a predicted probability of seventeen hundredths of one percent, or 0.0017.

Results on US antidumping imposition using change in market share

For antidumping tariffs, a one s.d. increase in...

- the change in market share increases Pr(tariff) by 18%.
- the inverse of $\eta_{xk} + \eta_{mk}$ increases Pr(tariff) by 88%.
- the std. dev. of import growth decreases Pr(tariff) by 71%.

For antidumping or safeguard tariffs against top ten trading partners, a one s.d. increase in...

- the change in market share increases Pr(tariff) by 20%.
- the inverse of $\eta_{xk} + \eta_{mk}$ increases Pr(tariff) by 65%.
- the std. dev. of import growth decreases Pr(tariff) by 52%.

Political-economic determinants of tariffs?

- Goldberg and Maggi (AER 1999) provide evidence that the cross-sectional distribution of US import tariffs in 1983 is broadly consistent with the Grossman and Helpman (AER 1994) “Protection for Sale” model.
- An empirical literature on antidumping emphasizes variables associated with political economy. Finger, Hall and Nelson (AER 1982), Feinberg (REStat 1989), Staiger and Wolak (Brookings 1994), Knetter and Prusa (JIE 2003) .

We augment our empirical specification to incorporate measures of industry-specific political economy.

Table 4: US Antidumping and Safeguard Tariff Imposition: Import Growth and Industry Effects

	AD and SG tariff policies	Add political-economy covariates	Add industry indicators	Predicted probability of antidumping or safeguard tariff for one std. dev. increase in each explanatory variable, percent		
	(1)	(2)	(3)	(1)	(2)	(3)
Growth of imports_ikt-1	6.11***	3.44***	3.34**	0.39	0.38	0.39
	(1.71)	(1.14)	(1.37)			
$\ln\left[1/\left(\eta_x^f + \eta_m^f\right)\right]\_k$	1.19***	0.71***	0.24***	0.66	0.63	0.39
	(0.19)	(0.12)	(0.06)			
Standard deviation of import growth_ik	-0.25***	-0.14***	-0.16***	0.08	0.10	0.09
	(0.03)	(0.02)	(0.02)			
Percent change in real exchange rate_it-1	4.91***	2.70***	2.75***	0.42	0.40	0.40
	(0.65)	(0.48)	(0.43)			
Domestic industry variables						
ln(Four firm conc. ratio)_k	--	0.25***	0.13	--	0.38	0.35
		(0.10)	(0.11)			
ln(Employment)_kt-1	--	1.04***	0.70***	--	0.62	0.47
		(0.14)	(0.10)			
Value-added/Shipments_kt-1	--	-3.58***	-1.08**	--	0.20	0.28
		(0.64)	(0.54)			
Inventories/Shipments_kt-1	--	6.82***	4.98***	--	0.47	0.41
		(0.98)	(0.75)			
Indicator for industry k is steel		--	0.04***	--	--	0.33
			(0.01)			
Indicator for industry k is chemicals		--	0.01***	--	--	0.39
Predicted probability of antidumping or safeguard tariff at means, percent				0.32	0.32	0.32
Observations	81,943	81,943	81,943			
Log-likelihood	-1631.52	-1512.05	-1346.50			

Results using import growth and industry variables

For antidumping or safeguard tariffs, a one s.d. increase in...

- lagged import growth increases Pr(tariff) by 19%.
- the inverse of $\eta_{xk} + \eta_{mk}$ increases Pr(tariff) by 97%.
- the std. dev. of import growth decreases Pr(tariff) by 69%.
- the industry concentration ratio increases Pr(tariff) by 19%.
- the logged level of employment increases Pr(tariff) by 94%.
- the value-added/shipments ratio decreases Pr(tariff) by 38%.
- the inventories/shipments ratio increases Pr(tariff) by 47%.

Conclusions

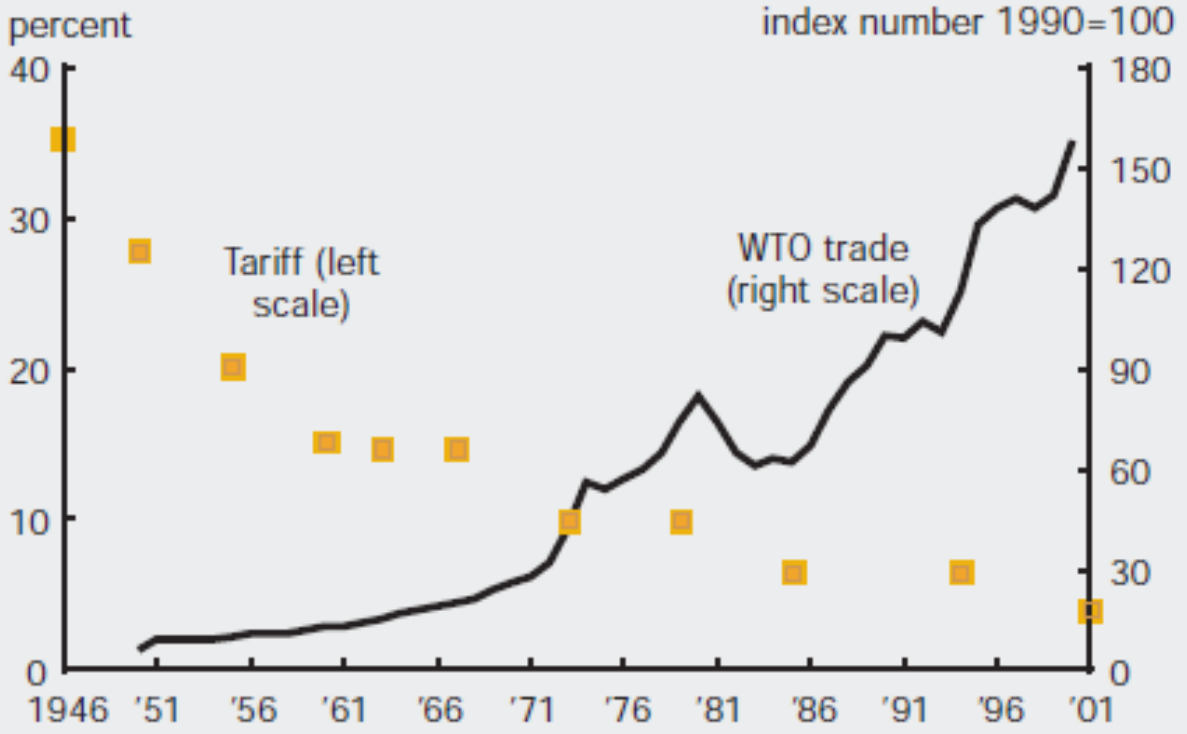
For the United States (1997-2006), the likelihood of a time-varying contingent tariff:

- increases with import growth
- increases in the inverse sum of the import demand and export supply elasticities
- decreases in the standard deviation of import growth

These finding provide empirical support for the self-enforcing trade agreements model of Bagwell and Staiger (1990).

FIGURE 1

Growth of trade among WTO members and the decline of tariffs, 1946–2001



Sources: Tariff rates—Hoekman and Kostecki (1995); WTO trade—World Trade Organization (2001).

Data: US Trading Partners

- 49 countries: Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Ecuador, Egypt, El Salvador, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Malaysia, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Trinidad, Turkey, United Kingdom, and Venezuela.
- Top 10 trading partners: Canada, China, France, Germany, Italy, Japan, Mexico, South Korea, Taiwan, and the United Kingdom.

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Data: Examples of NAICS 5 and 6 digit products

NAICS 2002	Product description
32212	Paper / Newsprint Mills
32513	Inorganic Dye and Pigment/ Synthetic Organic Dye and Pigment Manufacturing
324122	Asphalt Shingle and Coating Materials Manufacturing
327113	Porcelain Electrical Supply Manufacturing
333314	Optical Instrument and Lens Manufacturing
33994	Pen and Mechanical Pencil /Lead Pencil and Art Good / Marking Device Manufacturing

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For each specification, we report the *total* marginal effect of bilateral import growth as:

$$\frac{\partial Pr(y_{ikt} = AD|\mathbf{x})}{\partial M_{ikt}} = \phi(\boldsymbol{\beta}'\mathbf{x})\left(\beta_1 + \beta_3\left(\frac{1}{\eta_{xk} + \eta_{mk}}\right)\right) \quad (8)$$

Table 2a