Recovering Credible Trade Elasticities from Incredible Trade Reforms

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Intro

- Unifying question: How much does trade change when policy changes?
- Dynamic response: gradual adjustment $\implies$ short run $<$ long run
- Policy—and expectations about policy—also dynamic
  - Anticipation (e.g. PTAs)
  - Uncertainty (e.g. Brexit, US-China trade war)
- This paper:
  - How do policy dynamics shape trade dynamics?
  - How do empirical estimates relate to structural parameters?
  - How much would trade respond to unanticipated & permanent reforms?

The Standard View

- Object of interest: cumulative trade elasticity

$$\varepsilon_h = \frac{\log Y_{t+h} - \log Y_{t-1}}{\log \tau_{t+h} - \log \tau_{t-1}} = \frac{\Delta_h y_t}{\Delta_h \tau_t}, \; h = 0, \ldots, \infty$$

  - ε_0: short-run response holding export participation (and other accumulatable factors)
  - ε_∞: long-run response once export participation has fully adjusted

- Estimates interpreted as responses to unanticipated & permanent ("canonical") reform

- Appropriate for predicting effects of potential policy changes, measuring welfare consequences, calibrating models, etc.

Our view

- Wide range of estimates (and estimation methods) in literature
- We argue: variation in estimates driven by variation in policy dynamics!
- Fix ideas:
  - *Measured elasticity*: Observed ε_h given realized paths of trade and tariffs
  - *Structural elasticity*: ε_h if reform is unanticipated & permanent ("canonical")
- Measured elasticities inappropriate for prediction, welfare analysis, calibration, etc. (unless you use estimates from reforms that are similar to the one you are studying)
- However, can be used to recover structural elasticities through quantitative model

Preview: model experiments

- Model w/forward-looking export participation decisions. Exporters care about expected future policy, not just current policy.
- Study anticipated and/or uncertain reforms with same realized tariff path
- Compare measured trade elasticity to canonical reform
- Anticipation: exporters respond before policy changes
  - Increases SR elasticity
  - Reduces LR elasticity
- Uncertainty: Δ EPV of future policy $<$ Δ current policy
  - Lowers LR elasticity

Preview: empirics

- Estimate measured trade elasticities for different groups of reforms
  - Statutory regime switches (e.g. MFN to PTA) vs. within-MFN tariff changes
  - Goods with many transitory tariff changes vs. few persistent changes
  - Case studies: China vs. Vietnam
- Rare, persistent regime switches: high measured elasticities
- Frequent, transitory within-MFN changes: low measured elasticities
- Differences especially pronounced in LR
- Sample mostly comprised of within-MFN changes $\Rightarrow$ full-sample estimates get responses to major reforms wrong

Preview: quantification

- Study transitions for China vs. Vietnam: embargo $\rightarrow$ NNTR $\rightarrow$ conditional NTR $\rightarrow$ PNTR
  - Calibrate firm distribution + exporting technology to match firm-level panel data
  - Calibrate time-varying Markov process for trade policy to match NTR-gap elasticity dynamics as in Alessandria et al. (2024)
  - Infer structural LR elasticity by conducting canonical-reform counterfactual
- Structural LR elasticity $\approx 15 >$ measured LR elasticity
- Difference due to anticipation of initial NTR grant + uncertainty about duration
- Higher measured SR elasticity for Vietnam due to rising anticipation of NTR grant

Roadmap

1. Model + numerical experiments
2. Empirical evidence
3. Calibration + recover structural elasticity

Overview of the model

- Partial equilibrium version of Alessandria, Choi and Ruhl 2021 (ACR 2021)
  - Slow adjustment due to exporter life-cycle, large gap between SR and LR response
  - Expectations about future trade policy, not current policy, drive export participation
- Firms
  - Heterogeneous in productivity (z), variable trade cost (ξ)
  - Die with probability $1-\delta$, replaced by new firm (fixed mass)
  - Pay sunk cost to export next period, smaller fixed cost to continue
  - New exporters start with low export capacity (ξ_H)
  - Longer tenure as exporter $\Rightarrow$ greater chance of low iceberg cost (ξ_L w.p. $1-\rho_\xi$)
- Trade policy
  - Allow for innovations to current tariffs (τ) and expectations about future tariffs ($\mathbb{E}\tau'$)
  - Exporting threshold depends on expected z, ξ and trade policy

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Production, demand, static optimization

- Production technology ($z =$ productivity; $\ell =$ labor):

$$y_t = z_t \ell_t$$

- Export demand curve ($p_t =$ price; $\tau =$ tariff):

$$d_t(p_t, \tau_t) = (p_t \tau_t)^{-\theta}$$

- Resource constraint ($\xi =$ variable trade cost):

$$y_t \geq \xi d_t(p_t, \tau_t)$$

- Given z, ξ, choose p, ℓ to max flow profits

$$\pi(z_t, \xi_t, \tau_t) = \max_{p,\, \ell} p d_t(p_t \tau_t) - w_t \ell_t \quad \textbf{s.t.} \quad z_t \ell_t \geq d_t(p_t, \tau_t) \xi_t$$

Exporter life cycle, dynamic optimization

- Variable trade cost (ξ) captures current export status
  - ∞: non-exporter
  - ξ_H: High iceberg (low-capacity) exporter
  - ξ_L: low iceberg (high-capacity) exporter
- Costs of exporting in $t+1$ depend on current export status in t
  - New exporters: pay f_0, start with low export capacity (ξ_H)
  - Continuing exporters: pay f_1, switch to higher/lower export capacity with prob. $1-\rho_\xi$
- Given z, ξ, τ, choose whether to export at $t+1$ to max PV of profits:

$$V(z,\xi,\tau) = \pi_{gt}(z,\xi,\tau) + \max\left\{ \underbrace{-f(\xi) + \frac{\delta(z)}{1+r}\mathbb{E}_{z',\xi',\tau'} V(z',\xi',s')}_{\text{export}}, \underbrace{\frac{\delta(z)}{1+r}\mathbb{E}_{z',\xi',\tau'} V(z',\infty,\tau')}_{\text{don't export}} \right\}$$

- Solution characterized by entry + exit thresholds that depend on firm state and $\mathbb{E}[\tau']$

Aggregation, trade elasticities

- Aggregate exports:

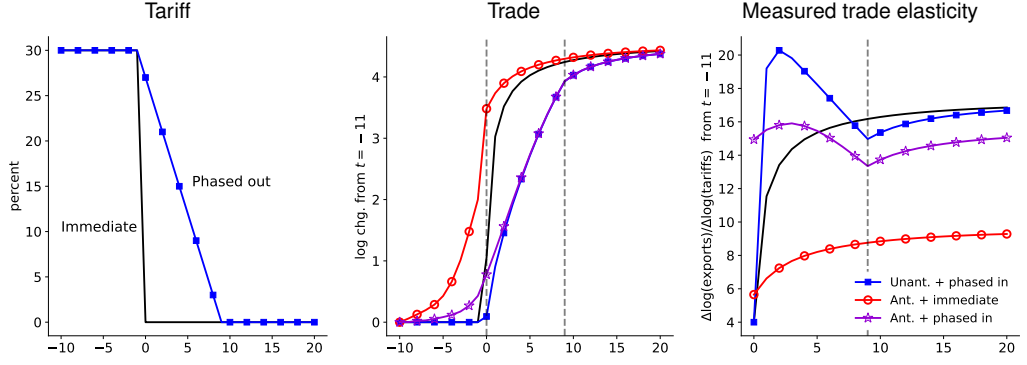
$$Y_t = \sum_{\xi \in \{\xi_L, \xi_H\}} \int_z p\left(z, \xi, \tau_t\right) d_t\left(z, \tau_t\right) \varphi_t\left(z, \xi\right) dz.$$

  - Per-firm sales (pd) depend on current tariffs
  - Distribution of productivity and export status (φ) depend on past and future tariffs

- Mapping to structural trade elasticities:
  - SR response to *unanticipated* reform: demand elasticity $= \theta$
  - LR response to *permanent* reform: $> \theta$, increasing in ξ_H/ξ_L and ρ_ξ

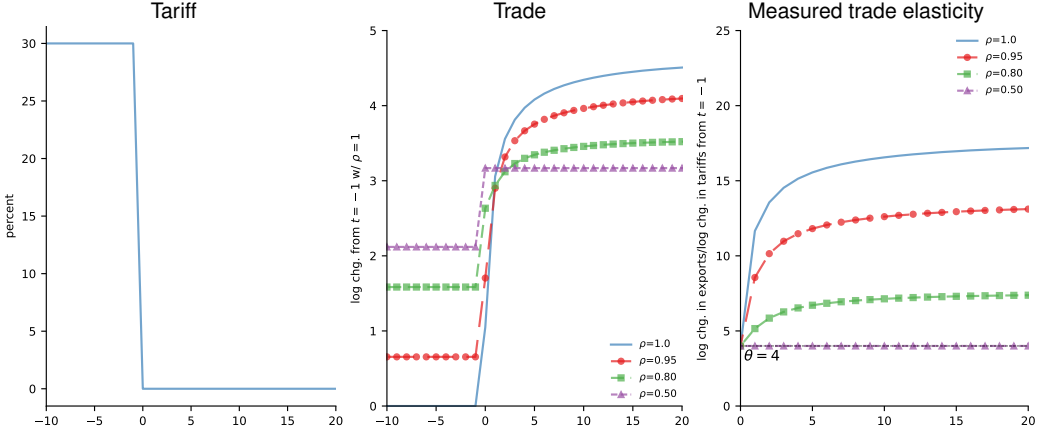
Experiment # 1: deterministic reforms w/ anticipation

- Start in steady state with $\tau = 30\%$. Announcement in t_A that free trade begins in period t_R.
  1. Unanticipated: $t_A = t_R$
  2. Anticipated: $t_A = t_R - 10$
  A. Immediate: free trade from t_R onward
  B. Phased-in: τ falls to 0 over 10 periods
- Combine 1–2 with A–B (e.g. unanticipated + phased-in)



Experiment # 2: stochastic reforms

- Markov process with two states: high tariffs (30%) and low tariffs (0%)
  - Start with high tariffs for many periods, then switch to low tariffs for many periods
  - Vary transition probability $\rho \in (0.5, 1)$



Takeaways

- Anticipation
  - Increases SR elasticity, decreases LR elasticity
  - Channel: exporters begin entering earlier, exports already high at t_R
  - Phase-ins further increase SR elasticity, generate non-monotonic dynamics
- Uncertainty
  - Reduces LR elasticity
  - Two channels: suppressing post-reform trade and boosting pre-reform trade
  - Second channel is really anticipation; applies to reforms that may happen, not just reforms that will happen for sure

Roadmap

1. Model + numerical experiments
2. **Empirical Evidence**
3. Calibration + recover structural elasticity

Data

- Goal: Study how trade responds differently to different kinds of tariff changes
- Sample: U.S. imports from 1974–2017
  - Captures transition from higher tariffs in 70s & 80s to low tariffs today
  - Covers major reforms: China's NTR grant, NAFTA, GATT rounds, GSP, etc.
- Aggregation: 5-digit SITC rev. 2
  - 1974–1988 U.S. imports at 8-digit TS-USA level: Concordance by Feenstra (1996)
  - 1989–2017 U.S. imports at 8-digit HTS level: Concordance using UNCTAD
- 44 years (t), 163 countries (j), 2,032 goods (g), 2,279,579 observations (jgt)
- Policy at jgt level: applied tariff ($=$duties$/$FOB imports)
  - Potentially different from scheduled tariffs due to aggregation, measurement error, etc.
  - Same jgt can have transactions under different schedules due to rules of origin, GSP requirements, etc.

Estimating equations

- Trade elasticity: *"h-on-h"* differences

$$\Delta_h y_{jgt} = \varepsilon_h^{hh} \Delta_h \tau_{jgt} + \delta_{jt} + \delta_{gt} + u_{jgt}$$

  - Standard fixed effects that absorb aggregate shocks in exporting countries and good-level changes in U.S. multilateral resistance
  - Local projections and ECM yield same results (see paper)

- Tariff autocorrelation: local projections

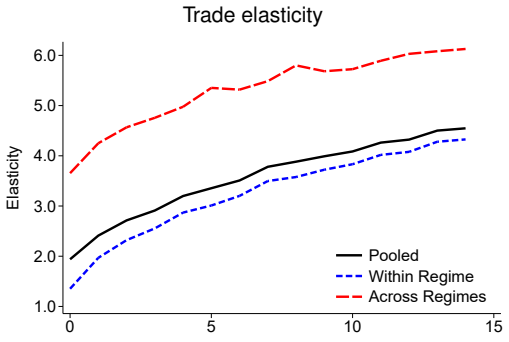
$$\Delta_h \tau_{jgt} = \rho_h^{\tau} \Delta_0 \tau_{jgt} + \delta_{jt} + \delta_{gt} + u_{jgt}$$

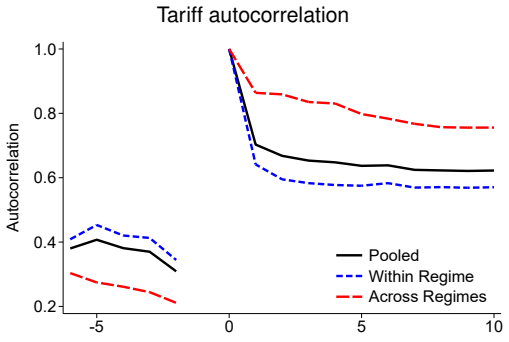
  - Similar results without fixed effects (see paper)

Approach 1: statutory regime changes

- Classify each *jgt* observation into one of four regimes:
  - MFN
  - Non-Normal Trade Relations (NNTR)
  - Preferential Trade Agreement (PTA)
  - Unilateral Trade Preference Program (UTPP)
- Estimate ε_h separately for
  - Within-MFN tariff changes
  - Tariff changes that occur during regime switches

Trade & tariff dynamics for transitions across/within statutory regimes





Regime transition frequencies (percent)

$t-1/t$	NTR	NNTR	PTA	UTPP
NTR	96.87	0.04	0.71	2.38
NNTR	18.88	79.76	0.00	1.36
PTA	9.97	0.00	90.02	0.01
UTPP	17.06	0.01	0.95	81.99

Approach 2: frequent vs. rare tariff changes

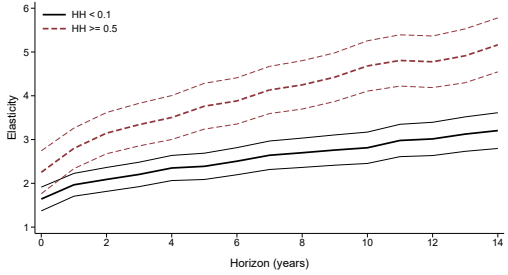
- Trade policy applied at country-good level
- For each *jg* pair, calculate HH concentration index of rel. tariff changes:

$$HH_{jg} = \sum_t \left(\frac{|\Delta_0 \tau_{jgt}|}{\sum_s |\Delta_0 \tau_{jg,s}|} \right)^2$$

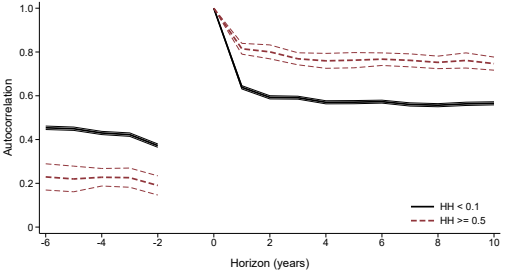
  - $HH_{jg} \to 1$: one major tariff change, closest to canonical reform
  - $HH_{jg} \to 0$: many similar-sized tariff changes, closest to i.i.d. Markov reform
- Estimate ϵ_h separately for *jg* with high vs. low low-concentration estimates
- Note: low-concentration *jg* constitute vast majority of sample

Trade & tariff dynamics for high vs. low concentration

Trade elasticity



Tariff autocorrelation



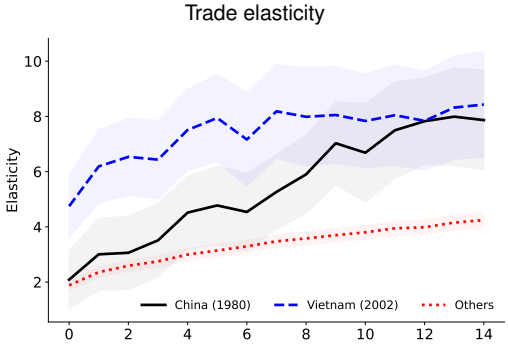
Approach 3: case studies of China and Vietnam

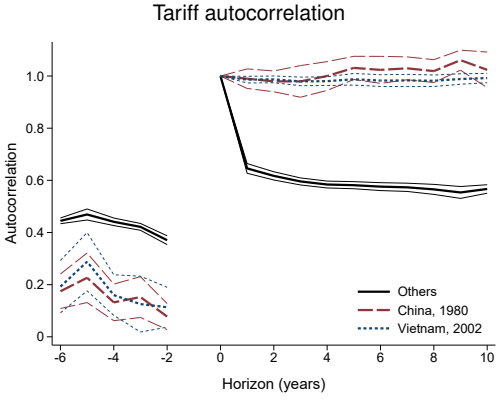
- Same observed policy trajectory: embargo $\rightarrow$ NNTR $\rightarrow$ conditional NTR $\rightarrow$ PNTR

Country	NNTR	CNTR	PNTR
China	1971	1980	2001
Vietnam	1994	2001	2006

- Examples featuring both anticipation and uncertainty
  - Literature: moving from CNTR to PTNR reduced chance of going back to NNTR
  - Alessandria et al. (2024): CNTR not total surprise, initially very unlikely to last long
- Estimate ϵ_h for China and Vietnam versus always-NTR countries

Trade & tariff dynamics for China (1980 onward) & Vietnam (2001 onward)





Takeaways

- Rare, persistent tariff changes have very high LR trade elasticities
  - Often occur during statutory regime switches
  - Certain regime switches (e.g. PTAs and Vietnam's NTR access) have somewhat higher SR elasticities. Consistent with anticipation.
- Frequent, transitory tariff changes have small elasticities, especially in LR
  - Mostly within-NTR changes
  - Constitute vast majority of overall sample
  - Inappropriate for analyzing major reforms

Roadmap

1. Model + numerical experiments
2. Empirical Evidence
3. Calibration + recover structural elasticity

Overview of quantitative approach

- Leverage China + Vietnam case studies using Alessandria et al. (2024) methodology
- Model overview
  - Many goods g with tariffs $\tau_{gt}(s)$ that depend on trade-policy state s
  - Two states: NNTR ($s = 0$) and MFN ($s = 1$)
  - Time-varying stochastic process $\{\omega_t(s, s')\}_{t=0}^{\infty}$
- Estimate trade technology to match modern-day steady state
  - Key input: exporter-level panel data
- Estimate ω_t to match transition from embargo
  - Key input: Time-varying elasticity of trade to NNTR-MFN tariff gap
- Use calibrated model to conduct canonical reform, measure long-run trade elasticity

Step 1: Calibrate steady state to firm-level trade dynamics

- For each country, use firm-level panel data to compute facts about cross-sectional distribution and life-cycle dynamics of export participation
- Calibrate production & trade technologies so that PNTR steady state matches these facts

Exporter-dynamics statistics and model parameters

Country	Target statistics				Parameters			
	Export part. (%)	Exit rate (%)	Incumbent prem.	Log CV exports	f_0	f_1	ξ_H	σ_z
China	19	16	2.71	0.91	0.82	0.356	4.14	1.50
Vietnam	12	15	3.75	2.16	1.47	0.598	6.76	1.69

- Note: Assign demand elasticity θ externally based on Soderberry (2018) estimates
  - Reminder: $\theta =$ structural SR elasticity
  - Same as measured SR elasticity in experiments, except with anticipation shocks
  - Works for China and Vietnam, even though latter has higher measured SR elasticity

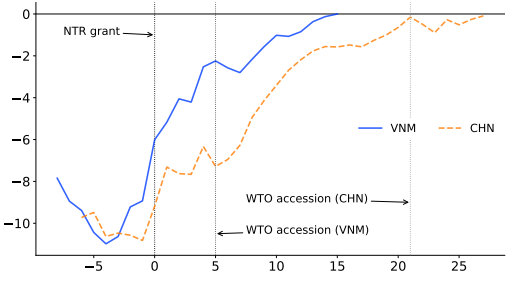
Step 2: Calibrate transition to aggregate trade dynamics

- Calibrate policy process to match elasticity of trade to NNTR gap

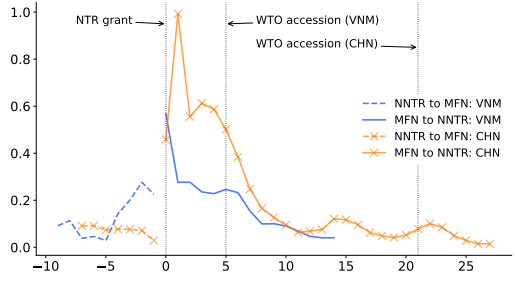
$$y_{jgt} = \sum_{t'} \mathbb{1}\{t = t'\} \left(\varepsilon_t^{ch} \mathbb{1}\{j = ch\} + \varepsilon_t^{vn} \mathbb{1}\{j = vn\} \right) \times \left(\tau_g^{NNTR} - \tau_g^{MFN} \right) + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$

  - Pre-NTR dynamics identify $\omega_t(NNTR, MFN)$
  - Post-NTR dynamics identify $\omega_t(MFN, NNTR)$

NTR-gap elasticities

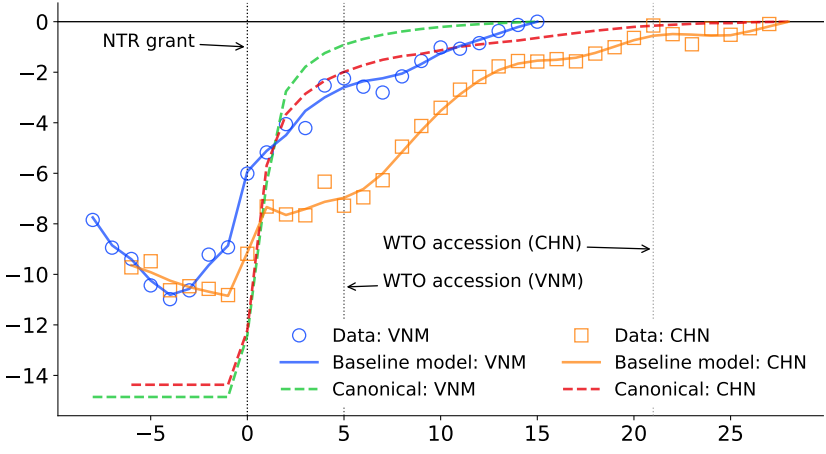


Estimated probabilities



Step 3: Measure canonical LR elasticities

- Start in NNTR steady state, then do unanticipated + permanent switch to NTR
- Measure canonical LR elasticity as SS-to-SS change in NTR-gap elasticity
  - China: -14.4
  - Vietnam: -15.0

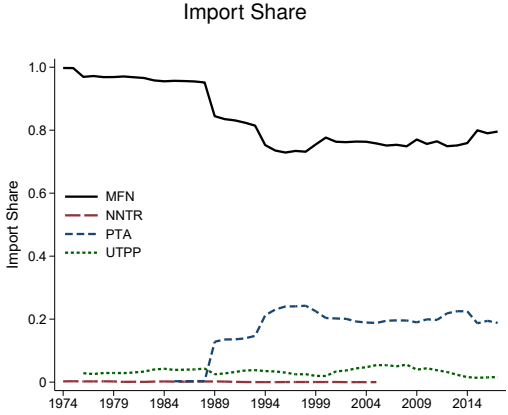


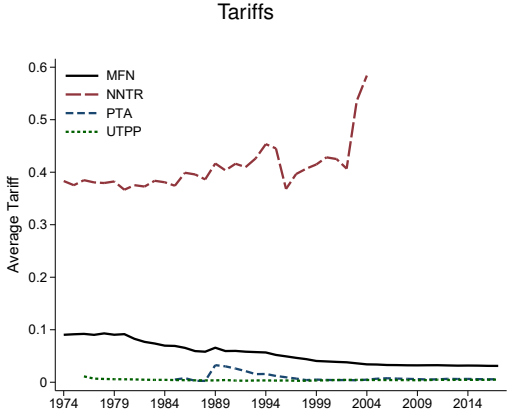
Summary & Conclusions

- Estimates of trade dynamics depend on nature of reform
  - Anticipation: Exporters react before policy changes. $\uparrow$ SR response, $\downarrow$ LR response.
  - Uncertainty: PV of future policy changes less than observed policy. $\downarrow$ LR response.
- Most policy changes in the data are both gradual and transitory
  - Conventional estimates do not correspond to structural parameters
  - Don't use them to predict effects of future reforms, measure welfare, etc.
- LR elasticities to "canonical" reform much larger than reduced-form estimates

Appendix

Imports and Tariffs by Regime





Top five country-year transitions across regimes

From	To	*jg*'s (# *g*)
NTR	NNTR	Poland-1983 (239), Poland-1984 (78), Poland-1985 (43), Afghanistan-1986 (46), Romania-1989 (126)
NTR	PTA	Canada-1989 (769), Mexico-1994 (389), South Korea - 2012 (344), Australia-2005 (243), Australia-2006 (192)
NTR	UTPP	Taiwan-1976 (282), Hong Kong-1976 (211), Israel-1976 (202), South Korea-1976 (195), Brazil-1976 (177)
NNTR	NTR	China-1980 (392), Vietnam-2002 (351), Poland-1989 (259), Soviet Union-1992 (239), Soviet Union-1993 (215)
NNTR	UTPP	Romania-1994 (33), Czechoslovakia-1992 (30), Czechoslovakia-1991 (28), Bulgaria-1992 (26), Poland-1990 (23)
PTA	NTR	Canada-1999 (224), Mexico-1999 (192), Israel-1999 (167), Colombia-2011 (151), Australia-2009 (141)
PTA	UTPP	Israel-1989 (1)
UTPP	NTR	South Korea-1989 (397), Taiwan-1989 (372), Hong Kong-1989 (264), Malaysia-1997 (268), Portugal-1986 (213)
UTPP	NNTR	Romania-1989 (7), Romania-1990 (6), Romania-1992 (5), Romania-1993 (5), Eastern Europe-1996 (5)
UTPP	PTA	Israel-1985 (343), Mexico-1994 (341), Peru-2007 (242), Colombia-2001 (234), Dominican republic-2007 (174)

Tariff Changes Across and Within Regimes

		Observations		Mean	Median	Std. Dev.	Coeff. Var.
From	To	# *jgt*'s	%	(p.p.)	(p.p.)	(p.p.)	
MFN	MFN	1,614,131	80.61	−0.19	0.00	17.04	89.82
MFN	NNTR	1,028	0.05	29.37	27.99	21.30	0.73
MFN	PTA	14,901	0.74	−3.20	−1.77	5.03	1.57
MFN	UTPP	45,990	2.30	−4.33	−3.18	12.26	2.83
NNTR	MFN	3,849	0.19	−30.37	−29.70	24.54	0.81
NNTR	NNTR	14,247	0.71	0.00	0.00	12.83	2,746.61
NNTR	UTPP	453	0.02	−33.71	−34.90	17.08	0.51
PTA	MFN	11,643	0.58	2.48	1.10	5.10	2.05
PTA	PTA	78,404	3.92	−0.12	0.00	1.53	13.15
PTA	UTPP	1	0.00	0.00	0.00		
UTPP	MFN	47,353	2.36	2.98	2.14	6.51	2.19
UTPP	NNTR	47	0.00	32.55	35.00	20.13	0.62
UTPP	PTA	2,837	0.14	0.09	0.00	3.34	36.54
UTPP	UTPP	167,426	8.36	−0.03	0.00	1.03	38.61