Trade-Policy Dynamics: Evidence from 60 Years of U.S.-China Trade

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How do trade policy dynamics affect trade?

- Trade depends on past, present, and future policy
  - Gradual adjustment to past policy changes
  - Expectations about future policy changes will affect trade today

- Effects of past and future tariffs often intertwined
  - Size and speed of adjustment to past depends on expectations about future
  - Changes in expectations may be correlated with previous policy changes

- Today
  1. Develop a methodology to disentangle past and future
  2. Use U.S.-China trade as case study
     + New narrative on timing and size of trade policy uncertainty, 1950–2008

Brief history of U.S.-China trade

1950–1970: Complete embargo

1971–1979: Non-normal trade relations (NNTR); large, exogenous, cross-industry tariff variation (tariffs set by 1930 Smoot-Hawley Act)

1980–2000: **Conditional** normal trade relations (NTR/MFN); Access to NTR tariffs granted on unilateral basis

- Required annual President renewal
- Starting in 1990, Congress also voted on renewal

2001–2018: China joins WTO, gains permanent normal trade relations (PNTR) status

2018–????: Trump-Biden trade war

Roadmap

1. Empirical features
- Slow adjustment to tariff changes: $\sigma^{LR} \approx 8$, $\sigma^{SR} \approx 2.3$
- Effects of uncertainty: 1970/80s $>>$ 1990s

2. Quantitative model: Trade policy uncertainty $+$ slow adjustment
- Estimate model to match empirical evidence from #1
- Recover agent beliefs over trade regime uncertainty
- Disentangle TPU effects from slow transitions

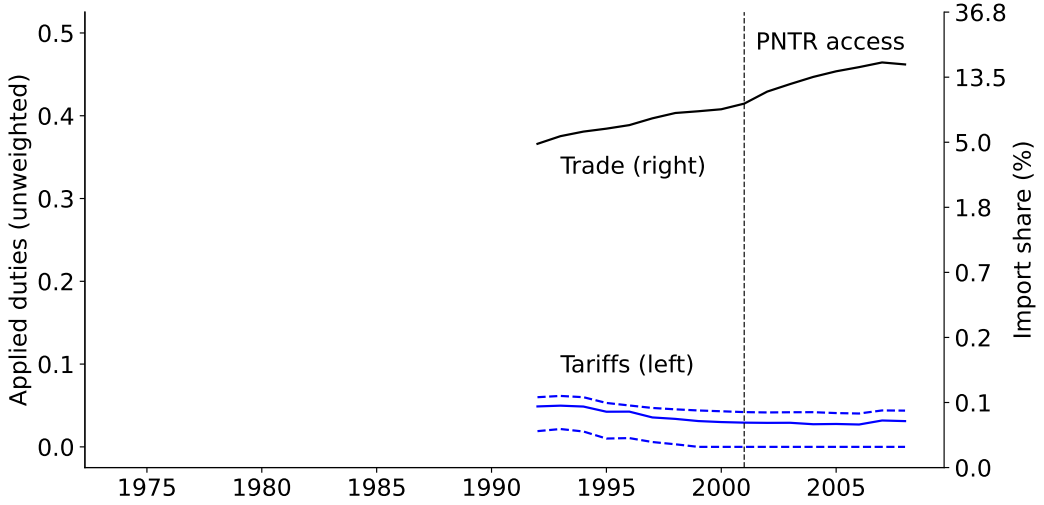
Related Literature

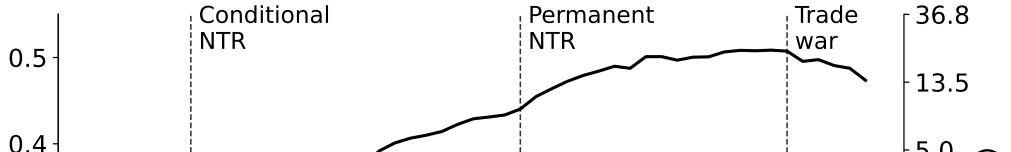
1. Peso Problem/Rare Events
   - Rogoff (1977, 1980), Krasker (1980), Lewis (1989), Rietz (1988), Barro (2006)
2. Trade dynamics: data
   - Eaton and Kortum (2002), Gallaway et al. (2003), Baier and Bergstrand (2007), Romalis (2007), Hillberry and Hummels (2013), Simonovska and Waugh (2014), Caliendo and Paro (2015), Yilmazkuday (2019), Anderson and Yotov (2020), Khan and Khederlarian (2021), Boehm et al. (2023)
3. Trade dynamics: models
   - Baldwin (1986), Baldwin and Krugman (1989), Das et al. (2007), Alessandria and Choi (2007), Drozd and Nosal (2012), Fitzgerald et al. (2023), Ruhl and Willis (2017), Alessandria et al. (2021), Steinberg (2022)
4. Trade policy uncertainty (TPU)
   - Ruhl (2011), Handley (2014), Handley and Limão (2015, 2017), Pierce and Schott (2016), Crowley et al. (2018), Steinberg (2019), Alessandria et al. (2019), Caldara et al. (2020), Handley et al. (2020), Bianconi et al. (2021)

Empirics: Introduction

- Two main goals:
  1. Show that trade responds gradually to trade policy
  2. Revisit effects of tariff risk from the TPU literature

U.S.-China trade & policy dynamics





Empirics: Introduction

- Two main goals:
  1. Show that trade responds gradually to trade policy
  2. Revisit effects of tariff risk from the TPU literature
- Data sources:
  - U.S. Customs trade data, includes import values and applied tariffs
  - Statutory tariffs (NNTR, NTR rates) from Feenstra et al. (2002)
- Unit of observation: source country (j) - good (g) - year (t)
  - 1974–2008, SITC 5-digit level (1,700 goods)
  - Exclude textile goods (non-tariff trade barriers)
  - Exclude all non-NTR countries other than China (other reforms)
- Results are summarized as a set of elasticities
  - These are not structural elasticities

#1: Slow adjustment to tariff changes

- Error correction model (Johnson et al., 1992; Gallaway et al., 2003):

$$\begin{aligned}\Delta v_{jgt} = &\left[\sigma^{SR}_{China}\Delta\tau_{jgt} + \gamma_{China}\left(v_{jg,t-1} - \sigma^{LR}_{China}\tau_{jg,t-1}\right)\right]\mathbb{1}_{\{j=China\}} \\ &+ \left[\sigma^{SR}_{Others}\Delta\tau_{jgt} + \gamma_{Others}\left(v_{jg,t-1} - \sigma^{LR}_{Others}\tau_{jg,t-1}\right)\right]\mathbb{1}_{\{j=Others\}} \\ &+ \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}\end{aligned}$$

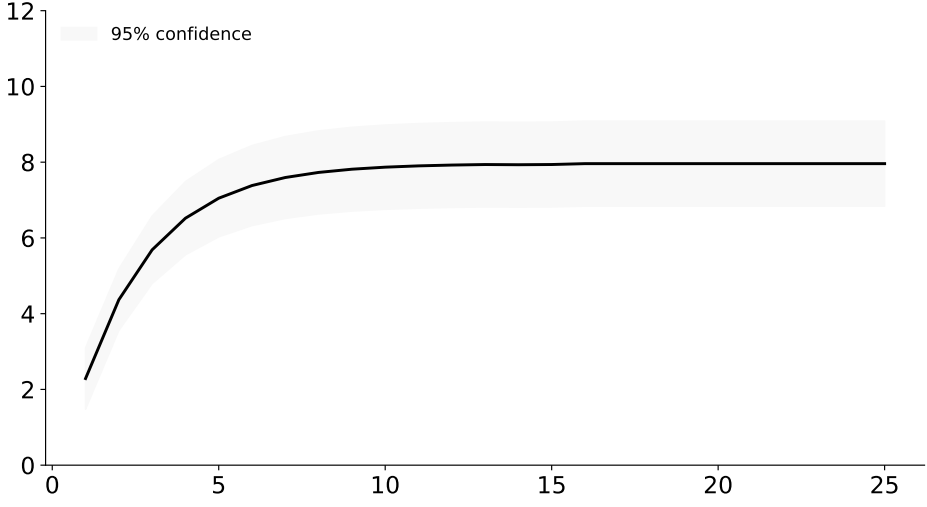
- v_{jgt}: U.S. imports from source j of good g
- τ_{jgt}: U.S. applied tariff on source j of good g
- Control for the following (using fixed effects)
  - jt: source-country aggregate shocks (exchange rates, structural changes, etc.)
  - gt: good-level U.S. demand shocks, NTR trade policy
  - jg: imports of each good-country relative to a base period
- Cluster at country-good level

#1: Slow adjustment to tariff changes

	Cross-section	ECM
	v_{jgt}	Δv_{jgt}
$\mathbb{1}\{j = China\}\tau_{jgt}$	-6.64 ***	
$\mathbb{1}\{j = China\}\Delta\tau_{jgt}$		-2.29 ***
$\mathbb{1}\{j = China\}v_{jg,t-1}$		-0.37 ***
$\mathbb{1}\{j = China\}\tau_{jg,t-1}$		-2.92 ***
Long-Run China		-7.96 ***
Long-/Short-Run China		3.48
FE	gt, jt, gj	gt, jt, gj
Observations	934,554	934,554
Adjusted R^2	0.79	0.27

Countries: China + all countries with NTR for 1974–2008 that did not have FTA with United States (excludes: Canada, Mexico, and several communist countries)

#1: Slow adjustment to tariff changes



- SR elasticity $<<$ LR elasticity
- Calibrate to σ^{LR}
- Local projections model similar (in paper)

#2: The effect of future tariff risk

- Pierce and Schott (2016) measure of tariff risk pre-PNTR access:

$$\text{NTR gap}_g = \text{NNTR tariff}_g - \text{NTR tariff}_{g,1999}$$

  - Tariff increase if China lost NTR status
  - Exogenous to U.S.-China relationship

- Literature: estimate effect of NTR gap on trade:

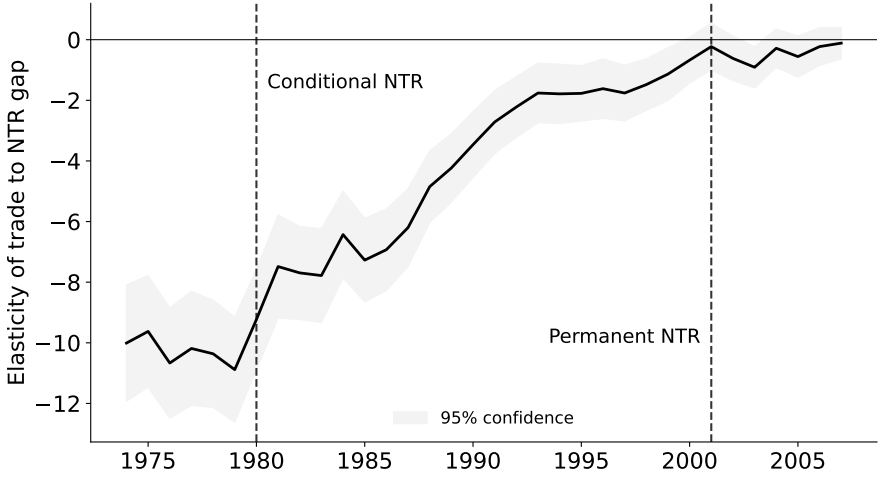
$$v_{jgt} = \beta \mathbb{1}\{t > 2000\} \mathbb{1}\{j = \textit{China}\} \text{NTR gap}_g + \sigma \tau_{jgt} + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$

- $\beta > 0$: high-gap imports grow more relative to low-gap imports after PNTR, relative to other NTR countries

- Extend to estimate year-by-year elasticity of trade to NTR gap:

$$v_{jgt} = \sum_{t'=1974}^{2007} \beta_t \mathbb{1}_{\{t=t' \wedge j=\textit{China}\}} \text{NTR gap}_g + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$

Time-varying NTR-gap elasticities



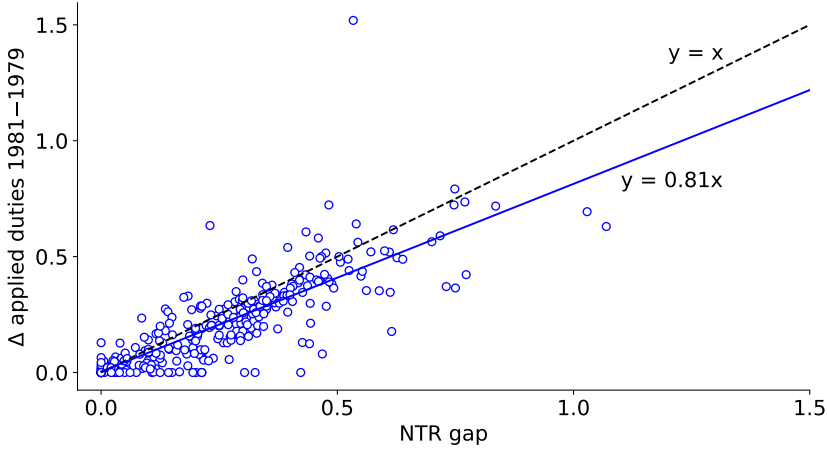
- Coefficients capture both initial reform and expectations (1970s vs. 1980s)
- Flat before 1980; Jumps in 1980 with NTR; stalls in early 1980s
- 1990s growth small share of overall growth
- Calibrate to these elasticities

Interpreting β_t

- Conventional interpretation: Effect of TPU reduction due to 2001 WTO accession
  - Compared to other NTR countries, China more sensitive to NTR gap
- Alternative interpretations:
  1. Delayed effect of 1980 liberalization

$$\text{NTR gap}_g = \text{NNTR tariff}_g - \text{NTR tariff}_{g,1999}$$

The NTR gap and the 1980 liberalization



- NTR gap highly correlated with change in tariffs from 1980 liberalization
- High-gap goods: greater exposure to TPU, but also larger initial liberalizations (and likely, slower adjustments to those liberalizations)

Interpreting β_t

- Conventional interpretation: Effect of TPU reduction due to 2001 WTO accession
  - Compared to other NTR countries, China more sensitive to NTR gap
- Alternative interpretations:
  1. Delayed effect of 1980 liberalization
  2. Delayed effect of prior changes in credibility
- β_t reflect both future uncertainty and lagged adjustment
  - An identification problem that the structural model will help solve...

NTR Gap elasticity results robust to:

- China supply effects (δ_{jgt})
- Level of aggregation (TSUSA8/HS8)
- Sample of countries (NTR countries/all countries)
- Alternative gap measures (NNTR statutory, NNTR applied)
- Sample of goods (balanced/unbalanced)
- Inclusion of other trade costs (applied tariffs, shipping costs)
- Life cycle controls (entry/exit dummies, age, age^2)

The model

- Two key ingredients
  1. Slow adjustment (exporter life cycle, as in ACR 2021)
  2. Time-varying uncertainty over policy
- G goods, matched to SITC 5-digit tariffs
- In each g, fixed mass of producers (no entry)
  - Standard monopolistic-competition setup
  - Fixed cost to enter export market and continue (f_0, f_1)
  - Heterogenous in productivity (z), variable trade cost (ξ)
  - New exporter ξ_H, with prob ρ_ξ transition to ξ_L
- Two policy regimes: NNTR ($s = 2$) and NTR ($s = 1$)
  - At each t, regime-specific tariff schedule $\tau_{gt}(s)$
  - Probability of switching regimes $\omega_t(s', s)$

Chinese producers: Static optimization

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

$$y = z\ell \qquad z \sim \text{AR(1)}$$

- Firm-level demand ($\tau =$ tariff; $D =$ aggregate shifter)

$$d_g(p, s) = \left(\tau_g(s)\, p\right)^{-\theta} D$$

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

$$\pi_g(z, \xi, s) = \max_{p,\ell} p\, d_g(p, s) - w\ell$$
$$\text{s.t.} \quad z\ell \geq d_g(p, s)\, \xi$$

Chinese producers: Exporter life cycle, dynamic optimization

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

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

- Export threshold, $\widehat{z}_t(\xi, s)$, increases in current & future trade barriers

Aggregation, trade elasticities

- Aggregate exports in good g:

$$Y_{gt}(s) = \sum_{\xi \in \{\xi_L, \xi_H\}} \int_z p\left(z, \xi, s\right) d_{gt}\left(z, s\right) \varphi_{gt}\left(z, \xi\right) dz.$$

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

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

Calibration: Timing and beliefs

- Model begins in 1971; all firms are nonexporters
- Benchmark model ("with TPU")
  - 1971: Learn that autarky is over, in NNTR regime ($s = 2$)
  - 1971: Observe tariff paths $\{\tau_{gt}(2), \tau_{gt}(1)\}_{t=0}^{\infty}$
  - 1971: Observe regime-switching probs $\{\omega_t(2,1), \omega_t(1,2)\}_{t=0}^{\infty}$

Calibration: overview

1. Set common parameters to standard values from literature
2. Set tariff schedules directly to data
3. Calibrate exporter life-cycle parameters to match moments from Chinese firm-level data in terminal steady state
4. Calibrate export transition + regime-switching probs to match our estimates of aggregate trade dynamics

Calibration: Assigned parameters

Parameter	Meaning	Value	Source/target
w	Wage	1	Normalization
r	Interest rate	4 pct.	Standard
ρ_z	Persistence of productivity	0.65	Alessandria et al. (2021)
δ_0	Corr. of survival with productivity	21.04	”
δ_1	Minimum death probability	0.023	”
$\tau_{g,t}(2)$	NNTR tariff	Varies	Data
$\tau_{g,t}(1)$	NTR tariff	Varies	Data
θ_g	Demand Elasticity	Varies	Soderberry (2018)

- Probability of export exit

$$1 - \delta(z) = \max\{0, \min\{e^{-\delta_0 z} + \delta_1, 1\}\}$$

Calibration: Exporter life cycles

- Assign goods to 15 industries, compute industry-level exporter dynamics moments using Chinese firm-level data for 2004–2007
- Calibrate entry cost (f_0), continuation cost (f_1), high iceberg cost (ξ), prod. dispersion (σ_z) for each industry to match moments in terminal steady state

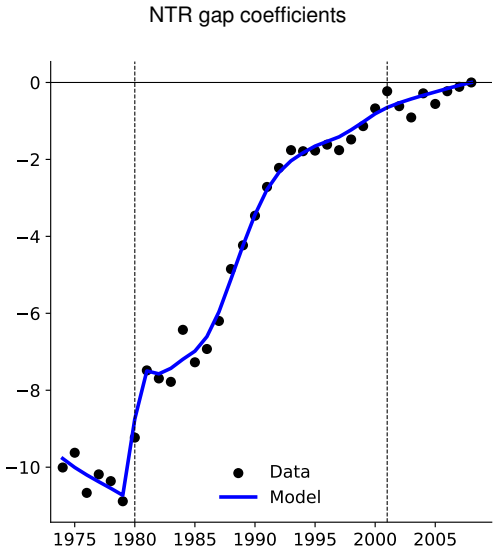
	Firms	Export part. rate (%)	Exit rate (%)	Incumbent size prem.	Log CV exports
Base metal manufacturing	49,070	12	21	3.96	1.15
Calendered metal manufacturing	59,774	29	10	2.48	1.24
Computer, electronic and optica..	52,913	48	7	4.82	1.94
Electrical equipment manufactur..	65,832	32	10	3.35	1.55
Energy products and chemicals	112,272	19	15	3.23	1.48
Food, beverage and tobacco	98,180	19	16	2.71	0.91
Furniture and other manufacturing	50,222	59	7	1.76	0.95
Non-metallic mineral products	83,944	16	18	2.26	0.85
Other machinery and equipment	132,758	23	13	3.33	1.54
Paper and printing products	49,724	12	17	3.10	1.30
Rubber and plastic products	64,662	29	10	2.69	1.08
Textile, clothing, leather	174,957	45	10	1.99	1.06
Vehicle manufacturing	47,995	23	12	4.07	1.31
Wood and straw products	24,075	24	13	2.05	1.09

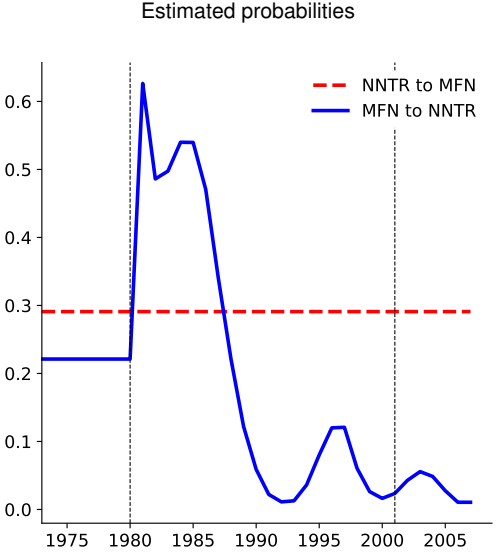
Calibrating to aggregate transition dynamics

- Match estimates of
  1. Aggregate trade elasticity dynamics
  2. Annual NTR-gap coefficients
- Indirect inference approach
  1. Run ECM regressions in the model $\rightarrow \sigma^{LR}$
  2. Run DiD regressions in the model $\rightarrow$ NTR gap coefficients 1974–2008
- Note: σ_{LR} is **not** an elasticity to unanticipated, once-and-for-all reforms
  - Reduced-form estimate, not structural parameter
  - Affected by presence of TPU

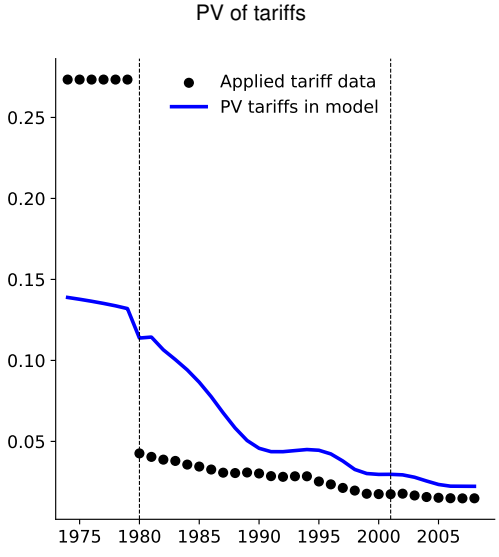
Parameter	Meaning	Value	Source/target
ρ_ξ	Prob. of keeping iceberg cost	0.87	ECM estimate of LR trade elasticity = 7.96
$\omega(1,1)$	Prob. NNTR to NTR	0.29	Avg. NTR gap during 1974–1979
$\omega_t(1,2)$	Prob. NTR to NNTR	Varies	NTR gap during 1980–2008

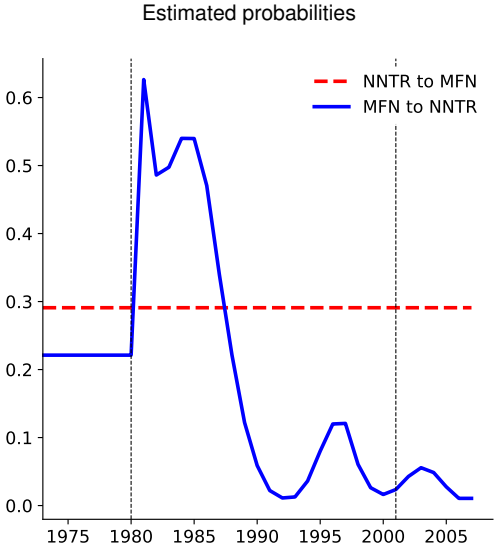
Model fit and estimated probabilities





Present value of tariffs





- Present value of tariffs $= (1-\beta)\sum_{n=t}^{\infty}\beta^{n-t}\mathbb{E}_t[\tau_n]$

Large uncertainty in 1980s: Background

1979: Carter normalizes relations with China; severs relations with Taiwan (keeps commercial & defense relations)

- Congress resoundingly passes Taiwan Relations Act

1980: Carter makes China the 3rd non-market economy to receive a waiver through the Jackson-Vanik Amendment, following Romania (1975) and Hungary (1978)

- For 10 years, no other country gains access and Romania lost it in 1988
- Poland loses NTR in 1982 (granted in 1962)

1981: Reagan elected; campaigned on restoring relations with Taiwan

1982/83: China gains observer status at GATT; joins the multi fibre arrangement

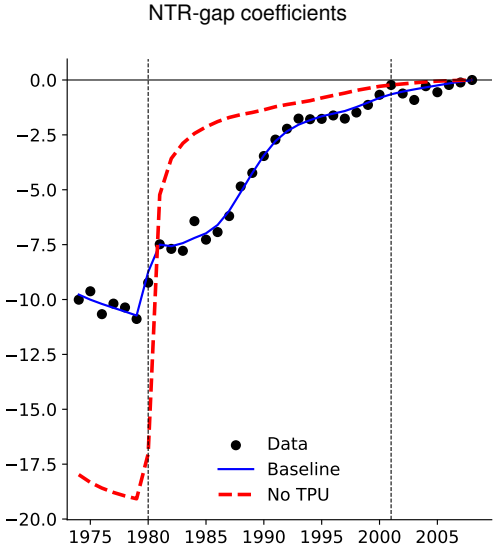
1985: China undertakes major market-oriented reforms following key agricultural reforms

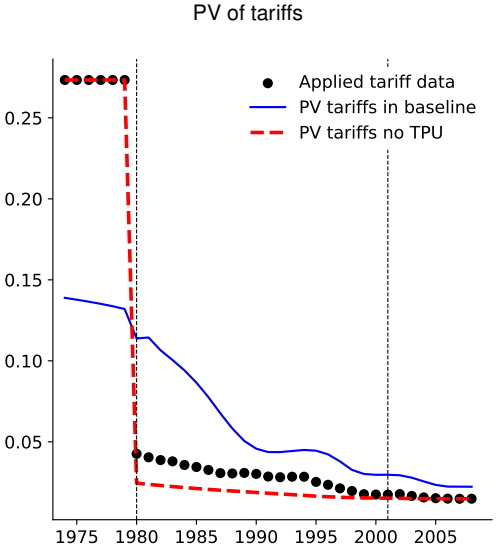
1986: China applies for membership in GATT; negotiations expected to last a few years

The effects of policy uncertainty

- Compare benchmark model to a model with no policy uncertainty
- Model begins in 1971; all firms are nonexporters
- Counterfactual model: “no TPU”
  - 1971: Learn that autarky is over, in NNTR regime
  - 1980: Learn that NTR status has been granted (unforeseen)
  - No uncertainty, perfect foresight (no ω_t to calibrate)

The effects of policy uncertainty





Understanding time-varying uncertainty and slow adjustment

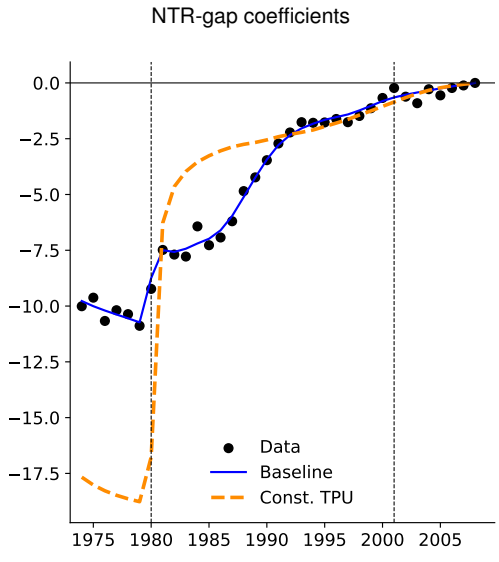
Key features of the model: time-varying uncertainty & slow adjustment

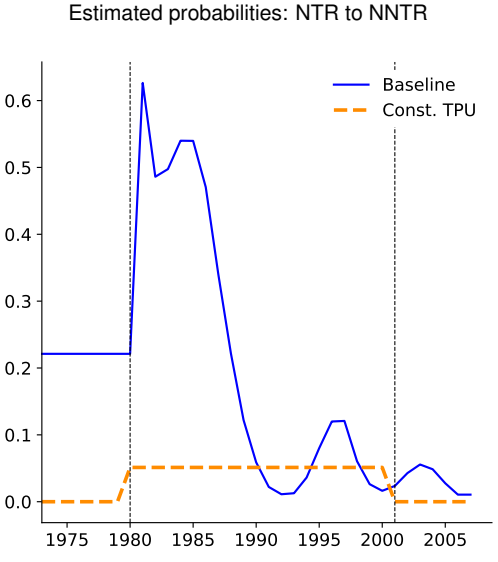
1. The role of time-varying uncertainty
   - *Constant*: Probabilities only change in 1980 and 2000
2. The role of slow adjustment
   - Remove exporter life cycle $\rightarrow$ standard sunk-cost structure

The role of time-varying policy uncertainty

- Model begins in 1971; all firms are nonexporters
- 1971: Learn that autarky is over, in NNTR regime
- 1980: Learn that NTR status has been granted (unforeseen)
- Counterfactual models
  - *Constant*: Constant probability from 1980–2000
- Calibrate $\omega(2, 1)$ to match average NTR-gap coefficient pre-2001/post-2001

The role of time-varying policy uncertainty

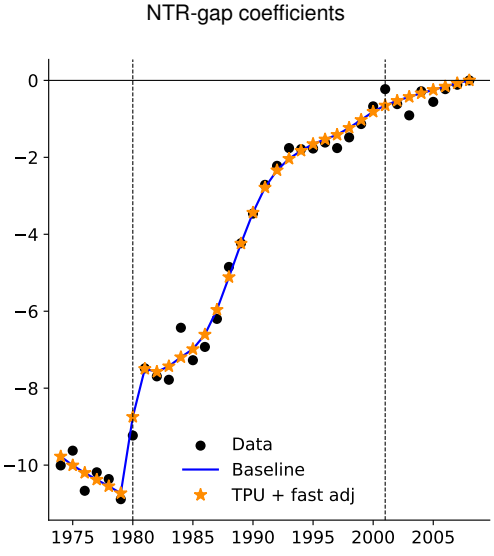


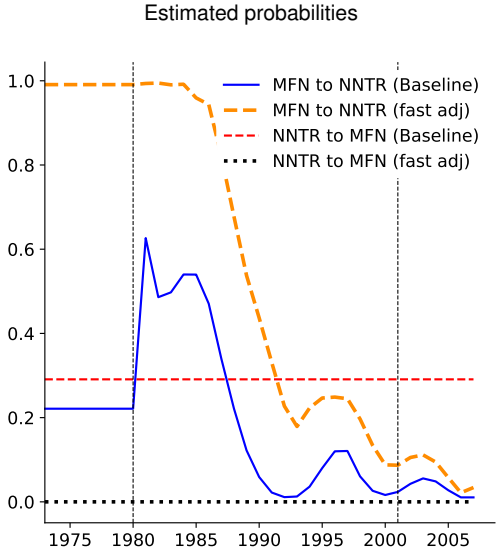


The role of slow adjustment

- Model begins in 1971; all firms are nonexporters
- Counterfactual model: “fast adjustment”
  - Timing is the same as in the benchmark model
  - No exporter life cycle, no endogenous exit (Calvo exporting)
  - Sunk-cost model; similar to Handley and Limão (2017)

The role of slow adjustment





Wrapping up

Conventional narrative on U.S. trade policy on China needs amending

- In 1970s, possible future tariff cuts boosted trade in high tariff goods
- In early 1980s, lack of credibility reduced trade response to tariff cuts
- WTO ascension had a small impact, especially when compared to mid-1980s

References

Alessandria, George, and Horag Choi (2007) 'Do sunk costs of exporting matter for net export dynamics?' *The Quarterly Journal of Economics* 122(1), 289–336

Alessandria, George, Horag Choi, and Kim J. Ruhl (2021) 'Trade adjustment dynamics and the welfare gains from trade.' *Journal of International Economics* 131, Article 103458

Alessandria, George, Shafaat Y. Khan, and Armen Khederlarian (2019) 'Taking stock of trade policy uncertainty: Evidence from China's pre-WTO accession.' Working Paper 25965, National Bureau of Economic Research

Baldwin, Richard (1986) 'Hysteresis in trade.' *MIT mimeo prepared for 1986 NBER Summer Institute, April 1986*

Baldwin, Richard, and Paul Krugman (1989) 'Persistent trade effects of large exchange rate shocks.' *The Quarterly Journal of Economics* 104(4), 635–654

Barro, Robert (2006) 'Rare disasters and asset markets in the twentieth century.' *The Quarterly Journal of Economics* 121(3), 823–866

Bianconi, Marcelo, Federico Esposito, and Marco Sammon (2021) 'Trade policy uncertainty and stock returns.' *Journal of International Money and Finance* 19, Article 102492

Boehm, Christoph E., Andrei A. Levchenko, and Nitya Pandalai-Nayar (2023) 'The long and short (run) of trade elasticities.' *American Economic Review* 113(4), 861–905

References

Caldara, Dario, Matteo Iacoviello, Patrick Molligo, Andrea Prestipino, and Andrea Raffo (2020) 'The economic effects of trade policy uncertainty.' *Journal of Monetary Economics* 109, 38–59

Crowley, Meredith, Ning Meng, and Huasheng Song (2018) 'Tariff scares: Trade policy uncertainty and foreign market entry by chinese firms.' *Journal of International Economics* 114, 96–115

Das, Sanghamitra, Mark J. Roberts, and James R. Tybout (2007) 'Market entry costs, producer heterogeneity, and export dynamics.' *Econometrica* 75(3), 837–873

Drozd, Lukasz A., and Jaromir B. Nosal (2012) 'Understanding international prices: Customers as capital.' *American Economic Review* 102(1), 364–395

Eaton, Jonathan, and Samuel Kortum (2002) 'Technology, geography, and trade.' *Econometrica* 70(5), 1741–1779

Feenstra, Robert C., John Romalis, and Peter K. Schott (2002) 'U.S. imports, exports, and tariff data, 1989–2001.' Working Paper 9387, National Bureau of Economic Research

Fitzgerald, Doireann, Stefanie Haller, and Yaniv Yedid-Levi (2023) 'How exporters grow.' *The Review of Economic Studies.* Article rdad070

Gallaway, Michael P., Christine A. McDaniel, and Sandra A. Rivera (2003) 'Short-run and long-run industry level estimates of U.S. Armington elasticities.' *The North American Journal of Economics and Finance* 14(1), 49–68

References

Handley, Kyle (2014) 'Exporting under trade policy uncertainty: Theory and evidence.' *Journal of International Economics* 94(1), 50–66

Handley, Kyle, and Nuno Limão (2015) 'Trade and investment under policy uncertainty: Theory and firm evidence.' *American Economic Journal: Economic Policy* 7(4), 189–222

__ (2017) 'Policy uncertainty, trade, and welfare: Theory and evidence for China and the United States.' *American Economic Review* 107(9), 2731–2783

Handley, Kyle, Nuno Limão, Rodney Ludema, and Zhi Yu (2020) 'Firm input choice under trade policy uncertainty.' *Working Paper*

Hillberry, Russell, and David Hummels (2013) 'Trade elasticity parameters for a computable general equilibrium model.' In *Handbook of Computable General Equilibrium Modeling,* ed. Peter B. Dixon and Dale W. Jorgenson, vol. 1 (Elsevier) pp. 1213–1269

Johnson, James A., Ernest H. Oksanen, Michael R. Veall, and Deborah Fretz (1992) 'Short-run and long-run elasticities for Canadian consumption of alcoholic beverages: An error-correction mechanism/cointegration approach.' *The Review of Economics and Statistics* 74(1), 64–74

Khan, Shafaat Y., and Armen Khederlarian (2021) 'How does trade respond to anticipated tariff changes? Evidence from NAFTA.' *Journal of International Economics* 133, Article 103538

Krasker, William S. (1980) 'The 'peso problem' in testing the efficiency of forward exchange markets.' *Journal of Monetary Economics* 6(2), 269–276

References

Lewis, Karen K. (1989) 'Changing beliefs and systematic rational forecast errors with evidence from foreign exchange.' *The American Economic Review* 79(4), 621–636

Pierce, Justin, and Peter K. Schott (2016) 'The surprisingly swift decline of U.S. manufacturing employment.' *American Economic Review* 106(7), 1632–1662

Rietz, Thomas A. (1988) 'The equity risk premium a solution.' *Journal of Monetary Economics* 22(1), 117–131

Ruhl, Kim (2011) 'Trade dynamics under policy uncertainty.' *American Journal of Agricultural Economics: Papers and Proceedings* 93 (2), 450–456

Ruhl, Kim J., and Jonathan L. Willis (2017) 'New exporter dynamics.' *International Economic Review* 58(3), 703–726

Simonovska, Ina, and Michael E. Waugh (2014) 'The Elasticity of Trade: Estimates and Evidence.' *Journal of International Economics* 92(1), 34–50

Steinberg, Joseph B. (2019) 'Brexit and the macroeconomic impact of trade policy uncertainty.' *Journal of International Economics* 117, 175–195