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

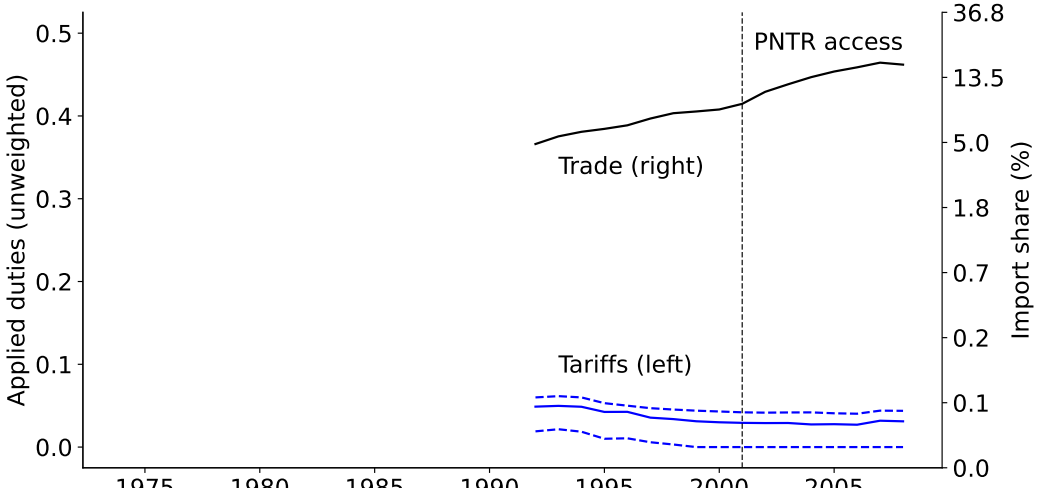
- Effects of past and future tariffs often intertwined
  - Size and speed of adjustment to past depends on expectations about future
  - Changes in expectations correlated with previous policy changes
  - Change in tariffs are rare with large aggregate component

- This paper
  - Develop a methodology to disentangle past and future
  - Use China-US trade as case study
    + New narrative on timing and size of “trade policy uncertainty”

Brief history of China-US 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); Access to MFN 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; US removes ability to revoke
- 2018–Present: Trade war (abstract from this as uncertainty is different)

China-US trade & policy dynamics



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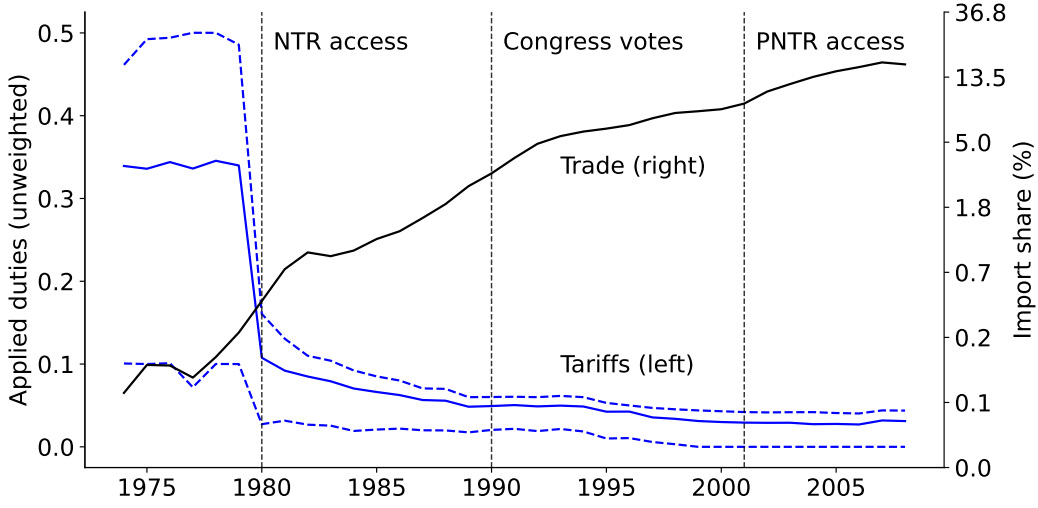

Roadmap

1. Empirical evidence
   - Slow adjustment to tariff changes (SR vs. LR elasticities)
   - Relationship between future tariff risk and trade over time
2. Quantitative model
   - Trade policy uncertainty $+$ slow adjustment
   - Estimate model to match NNTR-gap elasticities
   - Recover agent beliefs over trade regime uncertainty
   - Disentangle TPU effects from slow transitions
3. Sensitivity to i) expectations & ii) Exporter dynamics

Related Literature

1. Peso Problem/Rare Events
   - Rogoff (1977, 1980), Krasker (1980), Lewis (1989), Rietz (1989), 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. (2020)
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. (2016), 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 applied trade policy
  2. Revisit effects of tariff risk from the TPU literature
- Leverage cross-good variation in tariffs and tariff risk
- Data sources:
  - U.S. Customs trade data, includes import values and applied tariffs
  - Statutory tariffs (NNTR, MFN rates) from Feenstra et al. (2002)
- Unit of observation: source country (j) - good (g) - year (t)
  - 1974–2008, SITC 5-digit level
  - Exclude textile goods (non-tariff trade barriers)
  - Exclude all non-MFN countries other than China (other reforms)
- Results are summarized as a set of elasticities
  - These are not structural elasticities

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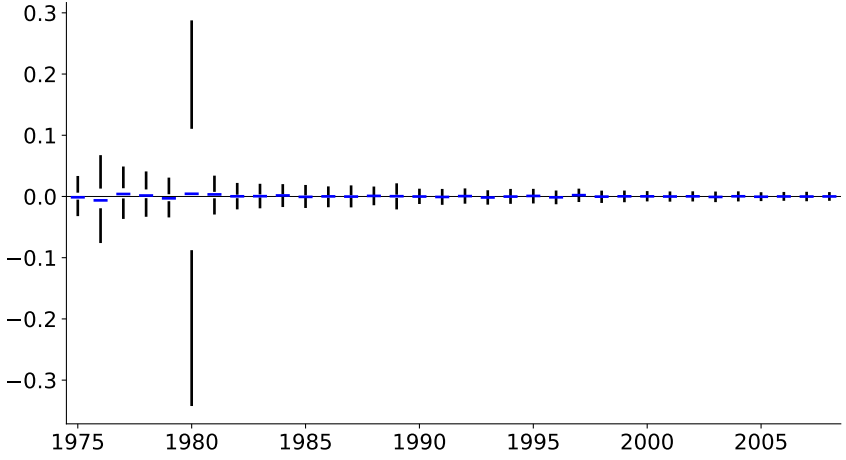
Slow adjustment to tariff changes: ECM

- 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}: US imports from source j of good g
- τ_{jgt}: US 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 US demand shocks, MFN trade policy
  - jg: imports of each good-country relative to a base period
- Cluster at country-good level

Residual variation of tariff changes



- Residuals $u_{China,g,t}$ from regressing 1-year changes in applied tariffs on fixed effects, i.e.,

$$\Delta_1 \tau_{jgt} = \delta_{jt} + \delta_{gj} + \delta_{gt} + u_{jgt}$$

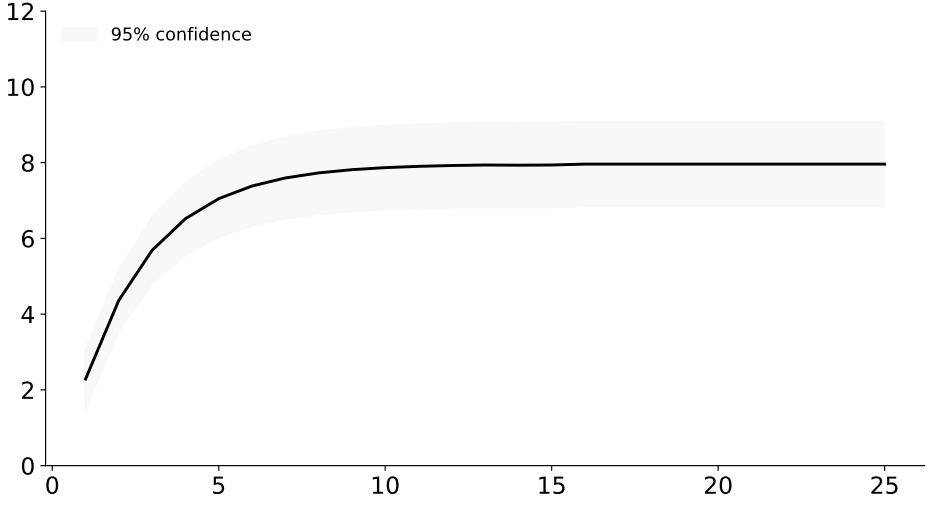
- Trade elasticities mostly identified by 1980 trade reform

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)

Trade elasticity dynamics



- SR elasticity $<<$ LR elasticity
- Calibrate to σ^{LR}

Slow adjustment to tariff changes: Local projections

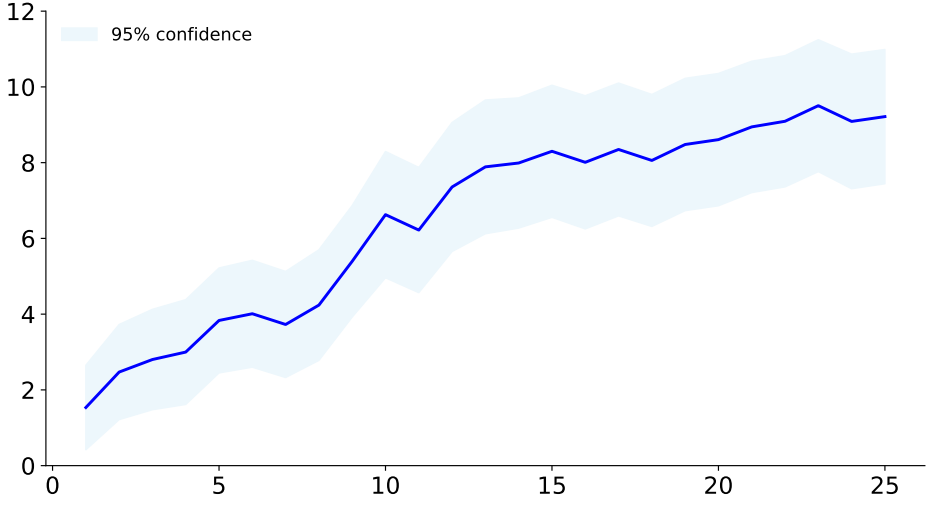
- Focus only on response to 1980 reform

- Local projections (Jordà, 2005; Boehm et al., 2020):

$$\Delta_h v_{jg,1979} = \sigma^h_{China} \mathbb{1}_{\{j=China\}} \Delta_1 \tau_{jg,1979} + \sigma^h_{Others} \mathbb{1}_{\{j\neq China\}} \Delta_1 \tau_{jg,1979} + \delta_j + \delta_g + u_{jg}$$

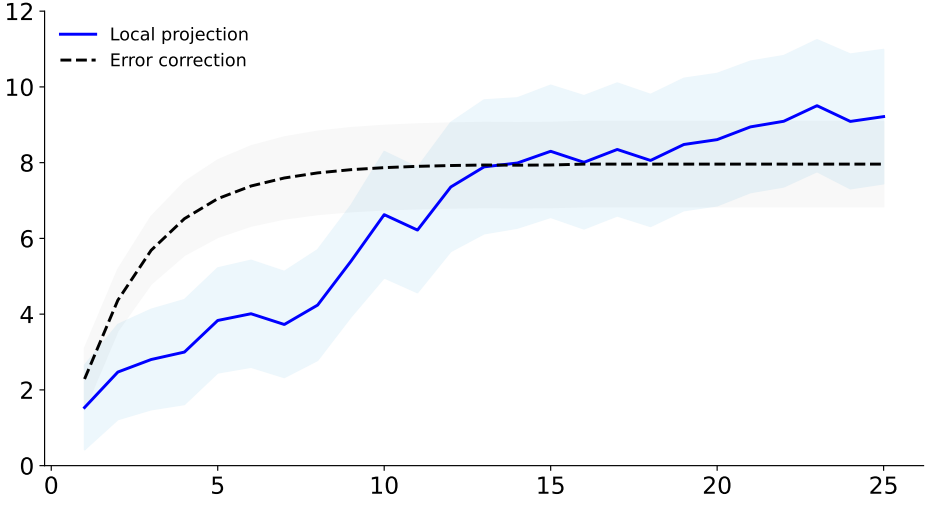
where $\Delta_h = x_{t+h} - x_t$ for $h = [1, 25]$ (cluster by country-good)

Trade elasticity dynamics



- Local projections: 90% of full adjustment achieved after 15 years

Trade elasticity dynamics



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Revisiting the effect of future tariff risk (NNTR Gap)

- Measure of tariff risk pre-PNTR access: NNTR gap = NNTR tariff – MFN tariff
  - How much would tariffs have risen if China had lost NTR status?
  - NNTR tariffs from 1934; exogenous to China–US relationship
- Literature applies DiD approach to estimate effect of NNTR gap on trade:

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

- $\beta =$ How much more did high-gap imports grow relative to low-gap imports after PNTR, relative to other NTR countries?
- Extend to estimate year-by-year elasticity of trade to NNTR gap:

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

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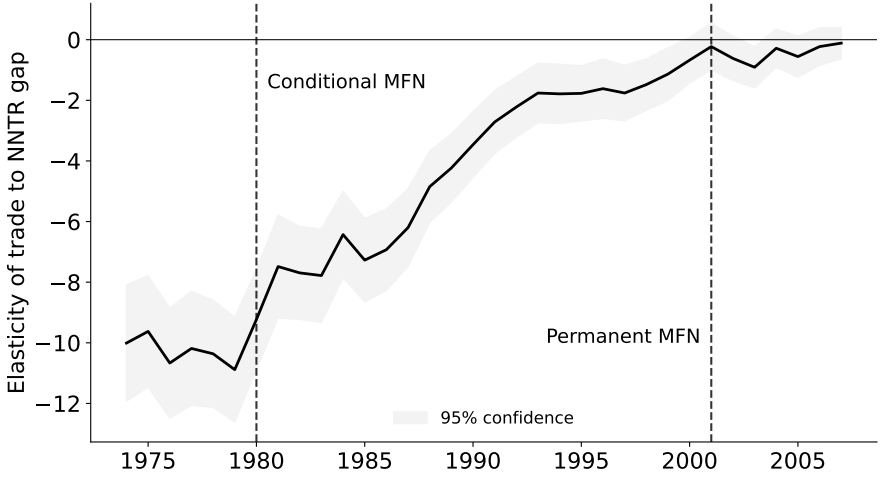
Time-varying NNTR-gap elasticities

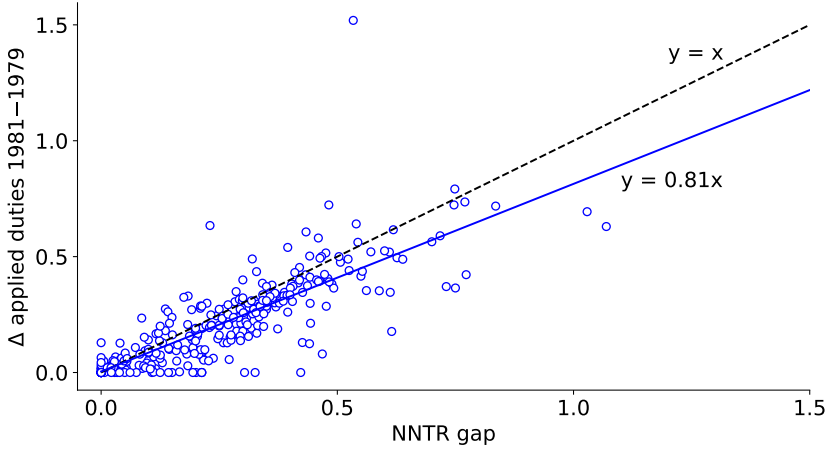


- Coefficients capture both initial reform and expectations (1970s vs. 1980s)
- Flat before 1980; Jumps in 1980 with MFN; stalls in early 1980s
- 1990s growth small share of overall growth
- Calibrate to these elasticities

Interpreting β_t

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

Revisiting the effect of future tariff changes



- NNTR 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

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- 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...
- ...but, as suggestive evidence, add lagged trade volumes

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

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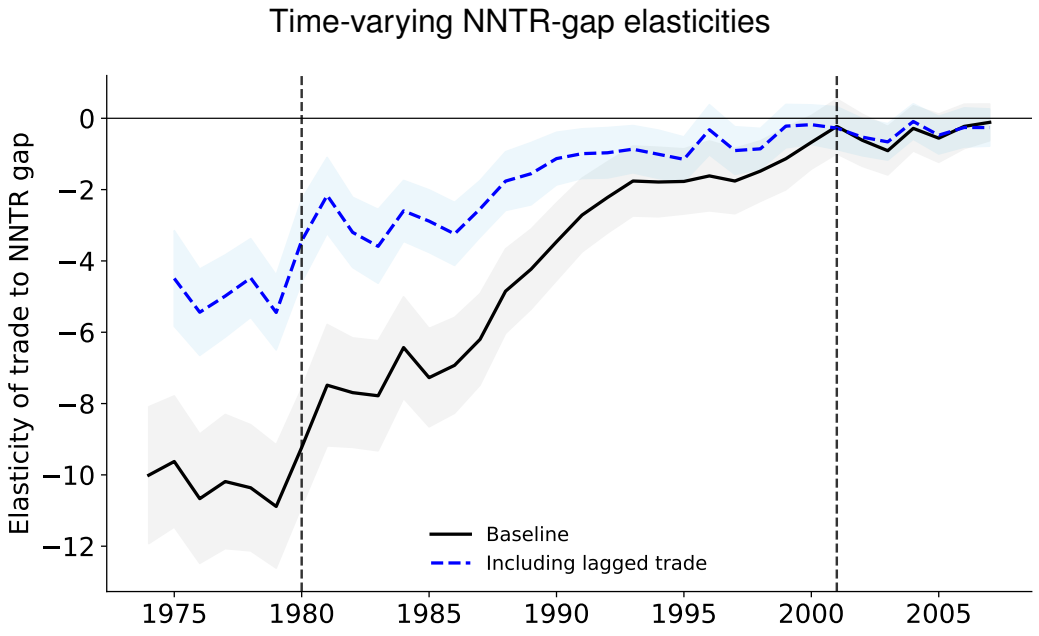
Time-varying NNTR-gap elasticities
Elasticity of trade to NNTR gap
0
−2
−4
−6
−8
−10
−12
1975
1980
1985
1990
1995
2000
2005
Baseline
Including lagged trade

NNTR Gap elasticity results robust to:

- China supply effects
- Level of aggregation (TSUSA8/HS8)
- Sample of countries (NTR countries/all countries)
- Alternative gap measures (NNTR statutory, NNTR applied)
- Sample of goods (balanced/unbalanced)
- Estimates at 1-digit SITC industry level
- 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 ($s = 0$) and MFN ($s = 1$)
  - 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; ℓ = labor)

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

- Firm-level demand (τ = tariff; D = aggregate shifter)

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

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

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

Chinese producers: Exporter life cycle, dynamic optimization

- Variable trade cost (ξ) captures current export status
  - ∞: non-exporter
  - ξ_H: low-capacity exporter
  - ξ_L: high-capacity 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 low export capacity (ξ_H)
  - Continuing exporters: pay f_1, switch to higher/lower export capacity 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, $z_t(\xi,\tau)$, increases in current & future trade barriers (exporter hysteresis).

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Aggregation, trade elasticities

- Aggregate exports in good g:

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

  - 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
  - Responses to anticipated reforms of uncertain duration also depend on stochastic process for future policy

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
  - 1971: Observe tariff paths $\{\tau_{gt}(0), \tau_{gt}(1)\}_{t=0}^{\infty}$. Taken directly from data.
  - 1971: Observe regime-switching probs $\{\omega_t(0,1), \omega_t(1,0)\}_{t=0}^{\infty}$. Inferred using model.

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	”
$\tau_{g,t}(0)$	NNTR tariff	Varies	Data
$\tau_{g,t}(1)$	MFN tariff	Varies	Data
θ_g	Demand Elasticity	Varies	Soderberry (2018)

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

Calibration: Exporter life cycles

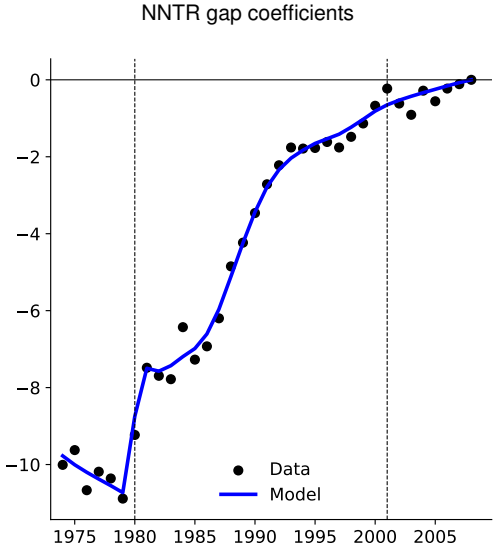
	f_0	f_1	ξ_H	σ_z
Base metal manufacturing	0.13	0.12	3.30	0.91
Calendered metal manufacturing	0.20	0.13	2.59	1.02
Computer, electronic and optica..	0.26	0.17	3.71	1.03
Electrical equipment manufactur..	0.19	0.16	3.47	1.08
Energy products and chemicals	0.27	0.20	4.56	1.17
Food, beverage and tobacco	0.19	0.12	3.40	0.99
Furniture and other manufacturing	0.16	0.14	3.55	0.90
Non-metallic mineral products	0.13	0.16	4.59	0.99
Other machinery and equipment	0.30	0.17	4.62	1.08
Paper and printing products	0.23	0.16	3.04	1.20
Rubber and plastic products	0.46	0.21	4.84	1.36
Textile, clothing, leather	0.31	0.16	3.88	1.20
Vehicle manufacturing	0.21	0.16	4.92	1.07
Wood and straw products	0.20	0.11	2.26	0.98

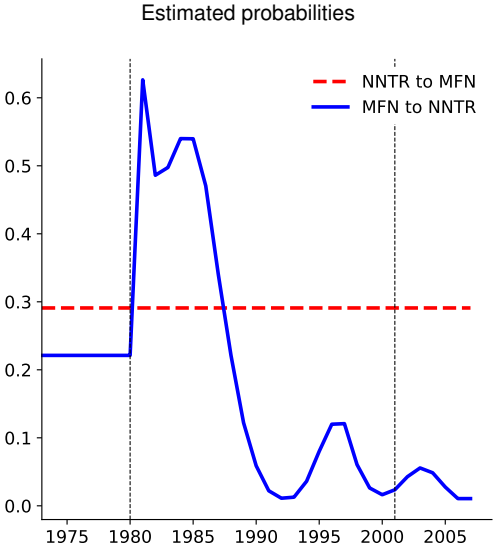
Calibrating to aggregate transition dynamics

- Match estimates of
  1. Aggregate trade elasticity dynamics
  2. Annual NNTR-gap coefficients
- Indirect inference approach
  1. Run ECM regressions in the model $\rightarrow \sigma^{LR}$
  2. Run DiD regressions in the model $\rightarrow$ NNTR 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

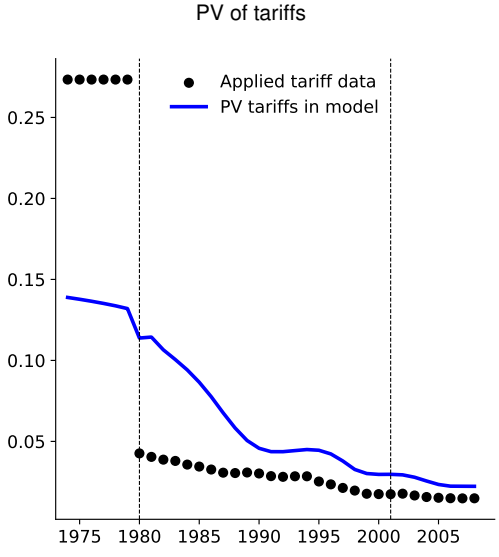
Parameter	Meaning	Value	Source/target
ρ_ξ	Prob. of keeping iceberg cost	0.87	ECM estimate of LR trade elasticity = 8.07
$\omega(1,0)$	Prob. NNTR to MFN	0.25	Avg. NNTR gap during 1974–1979
$\omega_t(0,1)$	Prob. MFN to NNTR	Varies	NNTR gap during 1980–2008

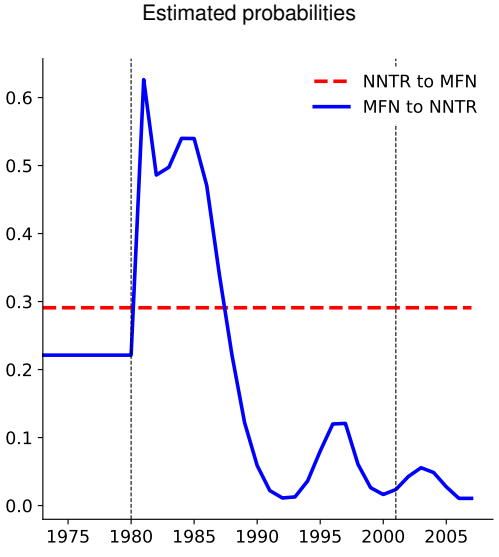
Model fit & estimated probabilities





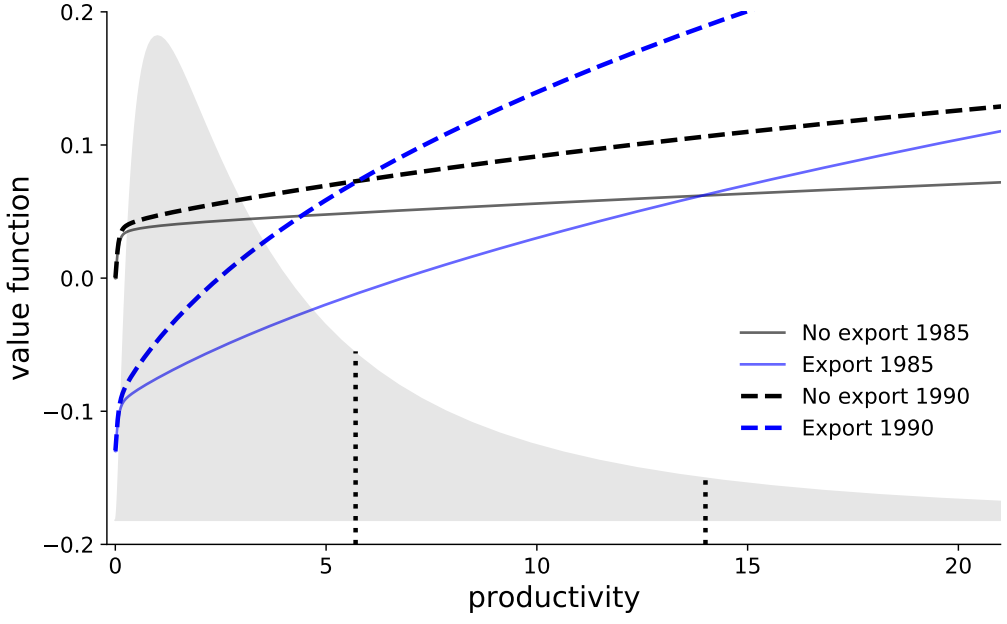
Present value of tariffs





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

Lower uncertainty shifts export entry threshold



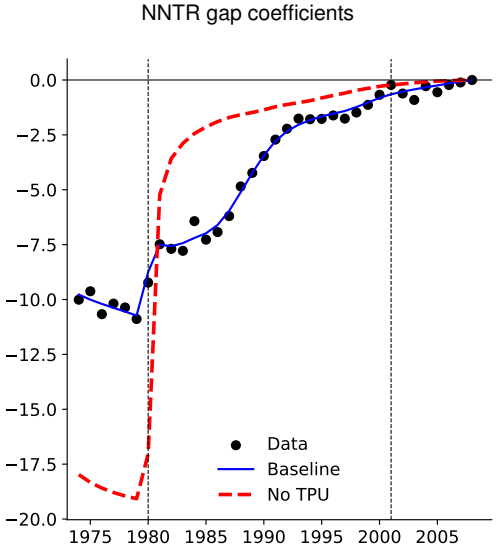
Large uncertainty in 1980s: Background

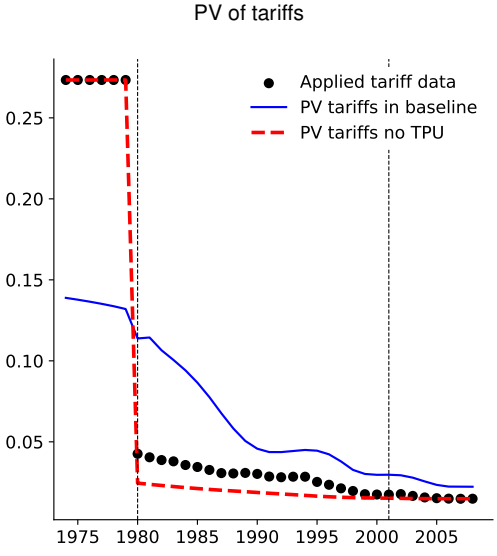
- 1979: Carter normalizes relations with China; severs relations with Taiwan (keeps commercial & defense relations)
  - Congress resoundingly passes Taiwan Relations Act (signed by Carter)
- 1980: Carter makes China the 3rd non-market economy to receive a waiver through the Jackson-Vanik Amendment, following Romania (1975) and Hungary (1978)
  - For 10 years, no other country gains access and Romania lost it in 1988.
  - Poland loses MFN in 1982 (granted in 1962)
- 1981: Reagan elected; campaigned on restoring relations with Taiwan.
- 1982/83: China gains observer status at GATT and joins the Multi-fibre agreement
- 1985: China undertakes major market-oriented reforms following key agricultural reforms.
  - Deng is Time Man of the Year for 85 (also in 79)
- 1986: China applies for membership in GATT, negotiations expected to last a few years

The effects of 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

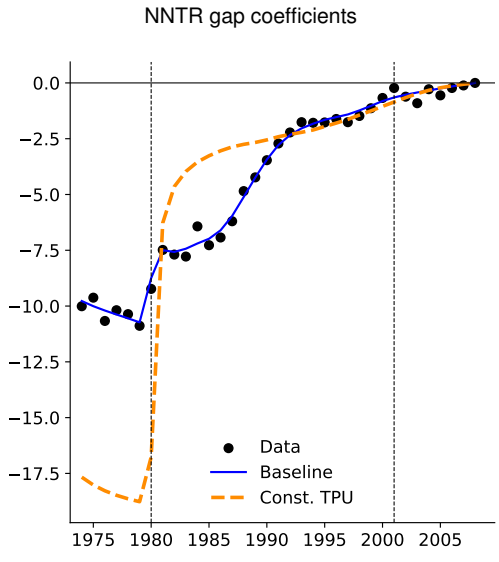
Key features of the model: time-varying uncertainty & slow adjustment

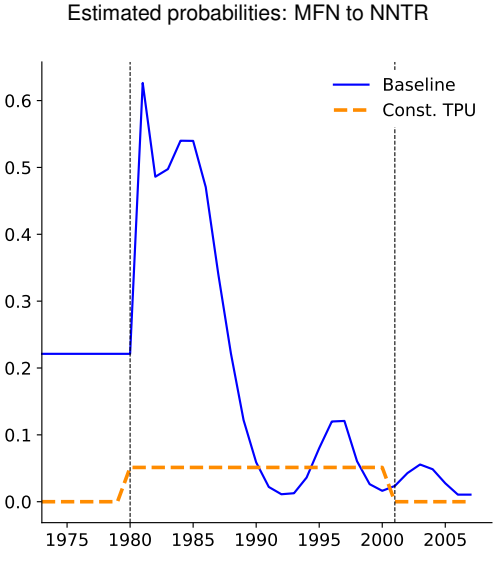
1. The role of time-varying uncertainty
   - Consider alternative uncertainty structures
     - *Constant*: Probabilities only change in 1980 and 2000
     - *Consensus*: No uncertainty until 1990
2. The role of slow adjustment
   - Remove exporter life cycle $\rightarrow$ standard sunk-cost structure

The role of time-varying policy uncertainty

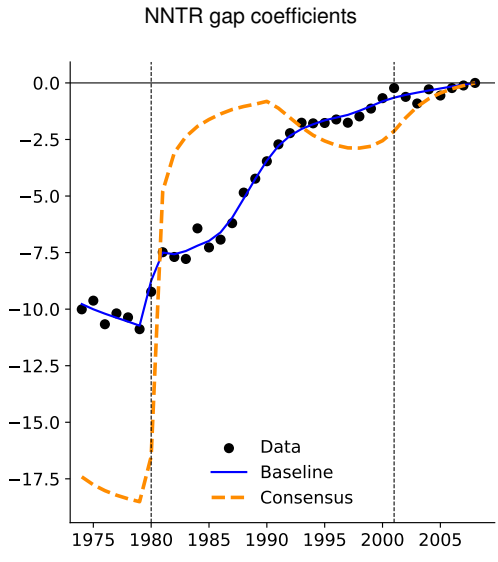
- Model begins in 1971; all firms are nonexporters
- 1971: Learn that autarky is over, in NNTR regime
- 1980: Learn that NTR status has been granted (unforeseen)
- Counterfactual models
  - Constant probability from 1980–2000
  - No TPU until 1990, constant probability between 1990–2000
- Calibrate $\omega(0, 1)$

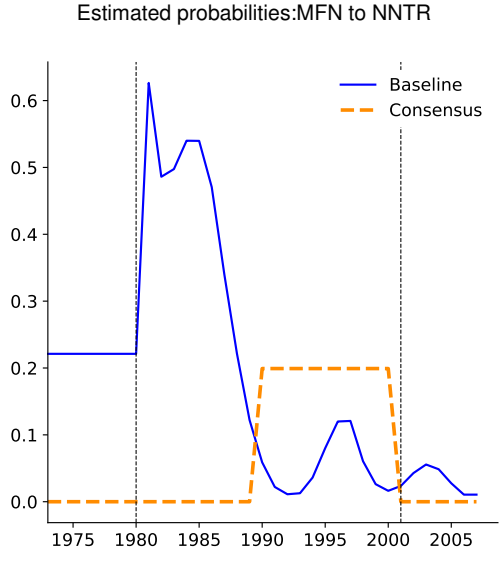
The role of time-varying policy uncertainty





The role of time-varying policy uncertainty

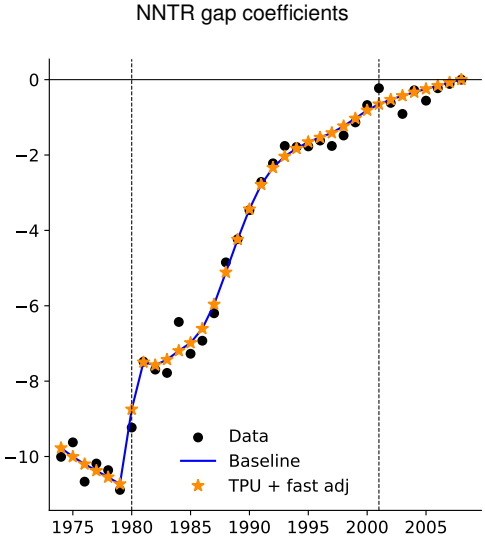


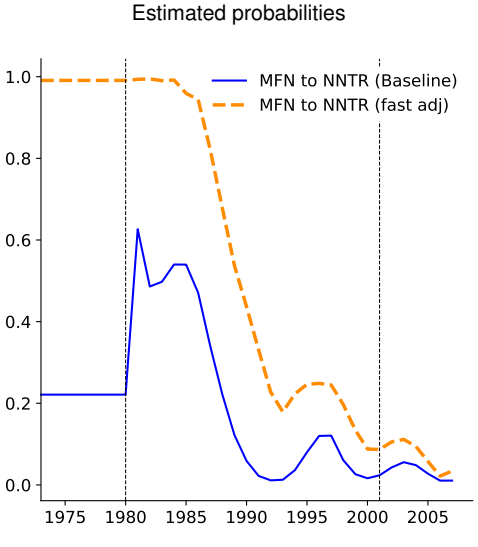


The role of slow adjustment

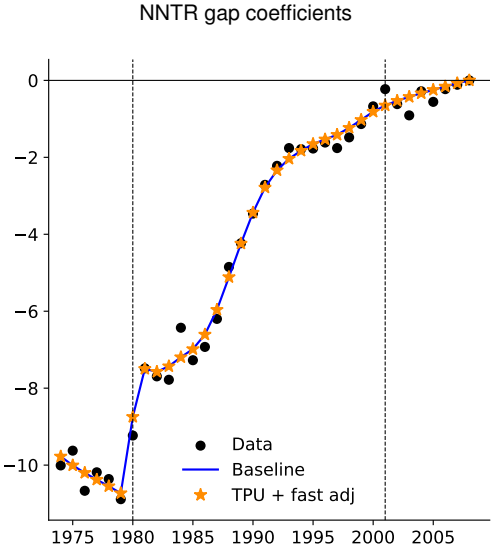
- Model begins in 1971; all firms are nonexporters
- Counterfactual models: “fast adjustment”
  - Timing is the same as in the benchmark model
  - No exporter life cycle, no endogenous exit (Calvo exporting)
  - Sunk-cost model; similar to Handley and Limão (2017) model

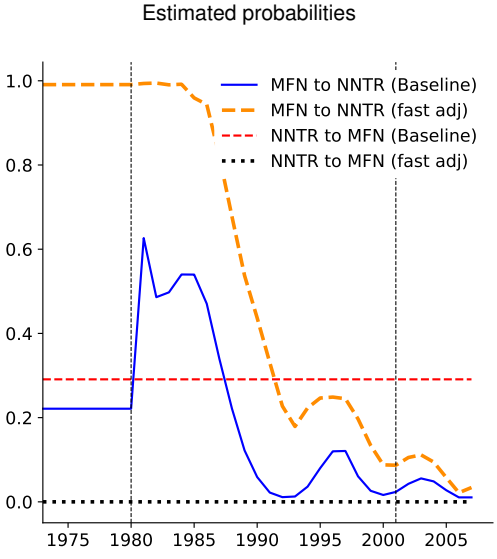
The role of slow adjustment



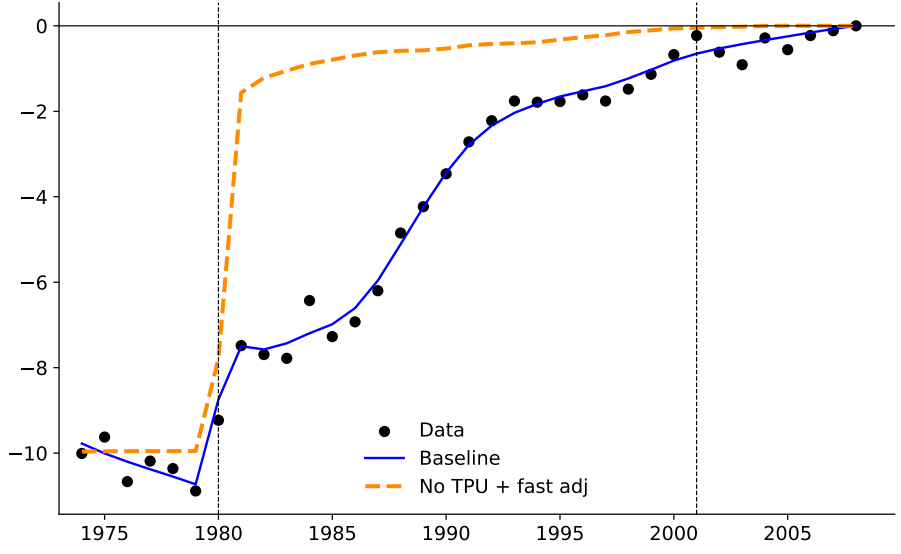


The role of slow adjustment





The role of slow adjustment



- No TPU and fast adjustment

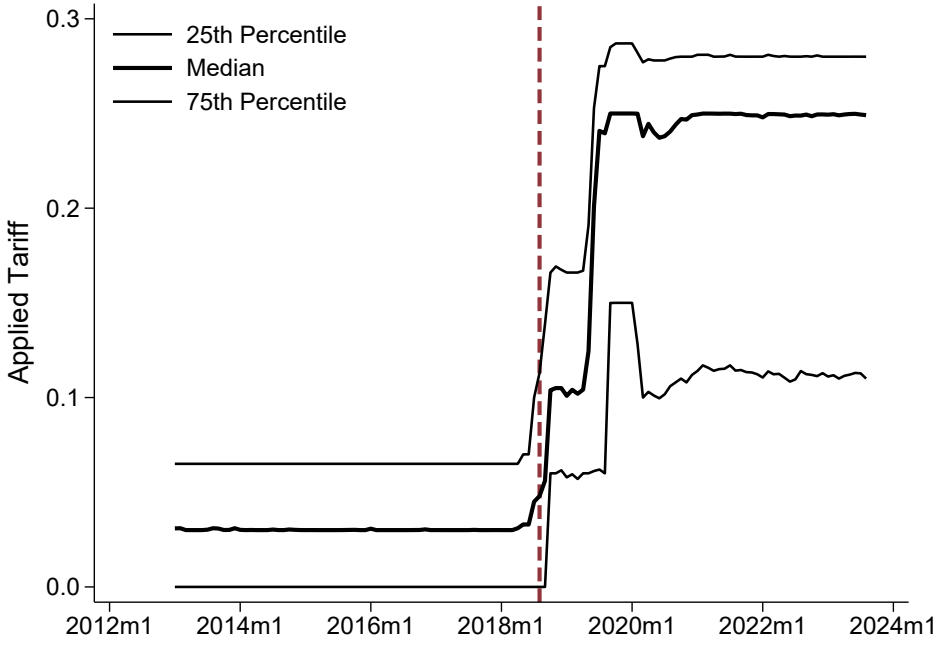
Conclusions

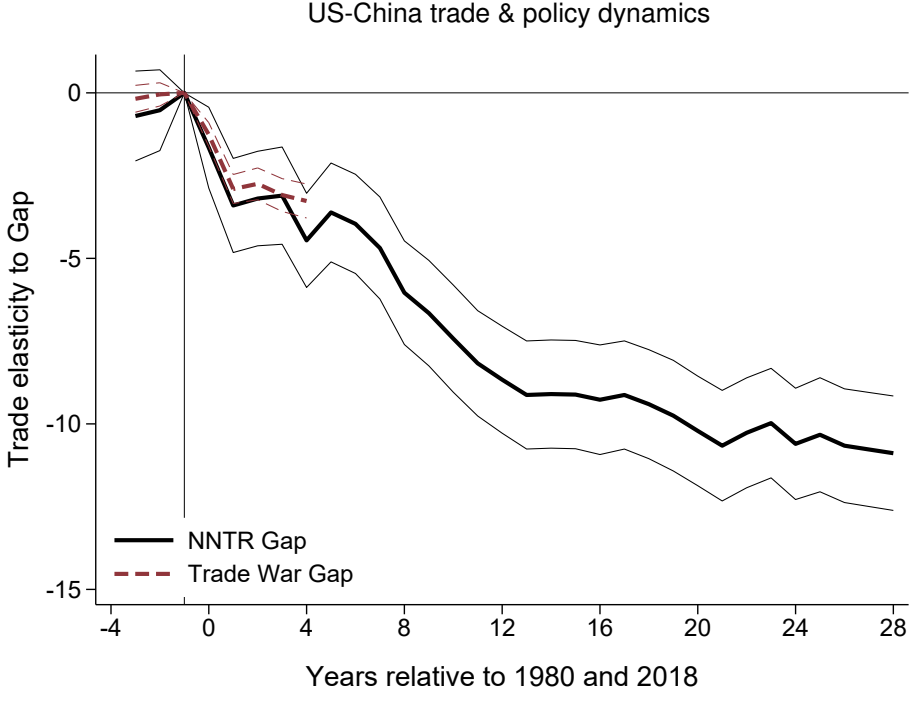
1. Trade policy and trade are dynamic
2. Changes in the credibility of reform can be recovered from trade dynamics.
3. Conventional narrative on US trade policy on China needs amending.
   - In 70s, possible future tariff cuts boosted trade in high tariff goods.
   - In early 1980s, lack of credibility reduced trade response to tariff cuts.
   - WTO ascension had small impact on tariff outlook, especially compared to mid-80s.
4. With Trade Policy Uncertainty conventional estimates of trade elasticities aimed at recovering LR response to **once-and-for-all permanent** reforms biased downwards.
5. Applicable to Trump-Biden tariffs.
   - Persistence of Trade War not that credible, yet.

Trump-Biden Tariffs

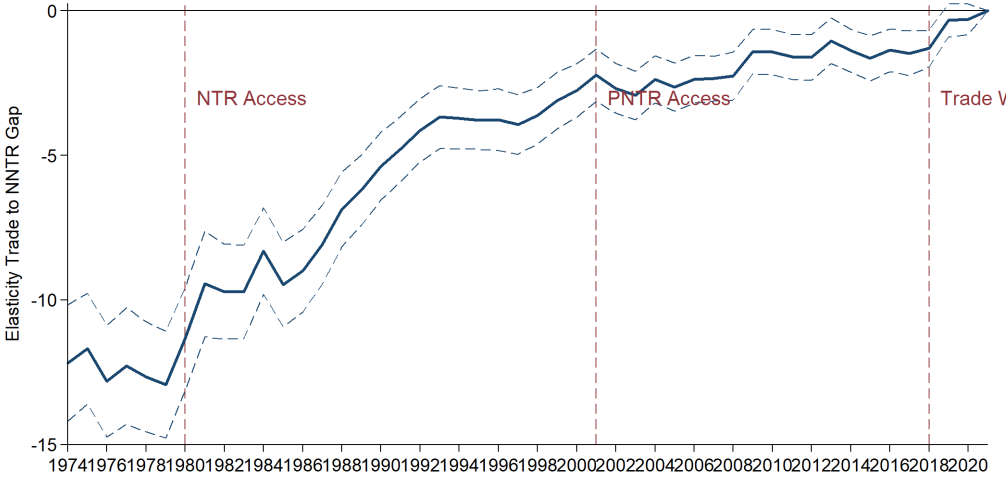
1. Import Tariffs rose sharply on Chinese imports mid 2018 (median + 20%)
2. Substitution:
   - Modest initially but is growing
   - Path of substitution on par with dynamics of 1980 reform
   - Substitution to high NNTR-MFN gap goods
3. Pre-TW, no substitution away from either:
   - High tariff goods.
   - High NNTR gap goods.

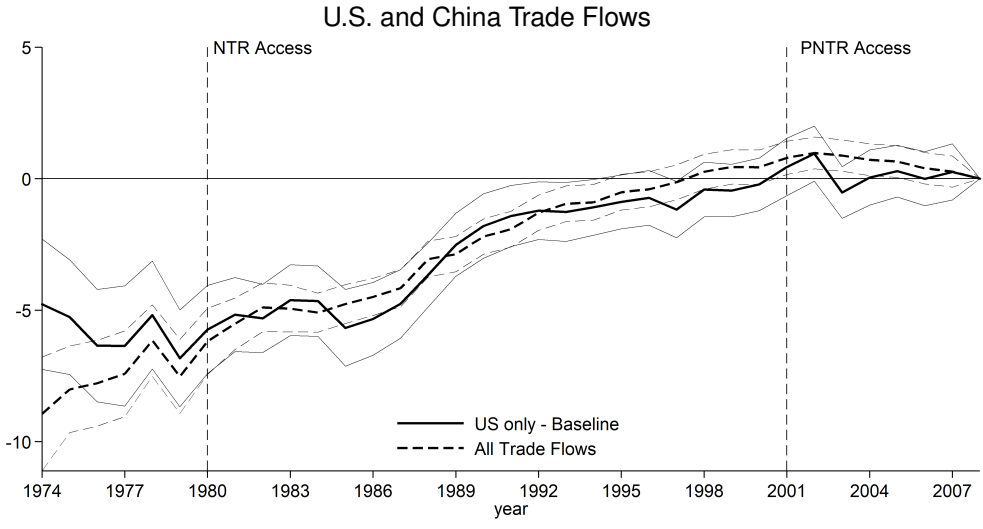
1. Slide 1: Path of Tariffs
2. Slide 2: Path of Trade and GDP
3. Slide 3: Gap elasticity
4. Slide 4: Pre-trends to Gap and Tariffs.


US-China trade & policy dynamics
25th Percentile
Median
75th Percentile
Applied Tariff
0.3
0.2
0.1
0.0
2012m1
2014m1
2016m1
2018m1
2020m1
2022m1
2024m1


US-China trade & policy dynamics
Trade elasticity to Gap
0
-5
-10
-15
NNTR Gap
Trade War Gap
-4
0
4
8
12
16
20
24
28
Years relative to 1980 and 2018

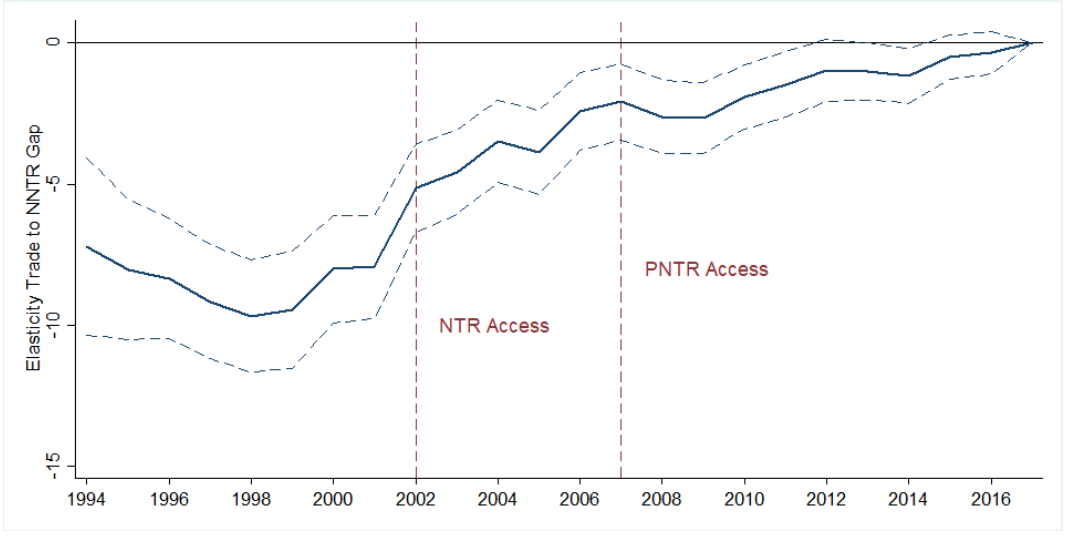
Annual Gap Elasticities - Extended




U.S. and China Trade Flows
NTR Access
PNTR Access
5
0
-5
-10
US only - Baseline
All Trade Flows
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
year

[Back]

NNTR Elasticities — Vietnam



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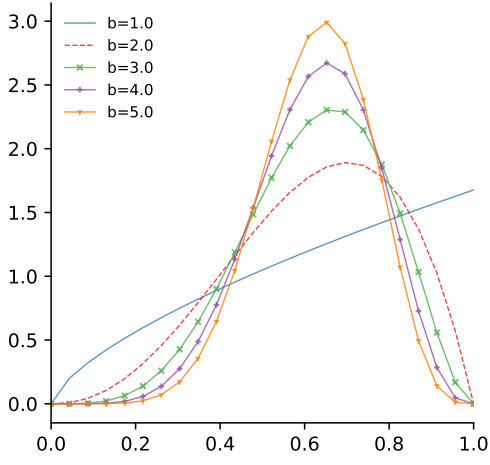
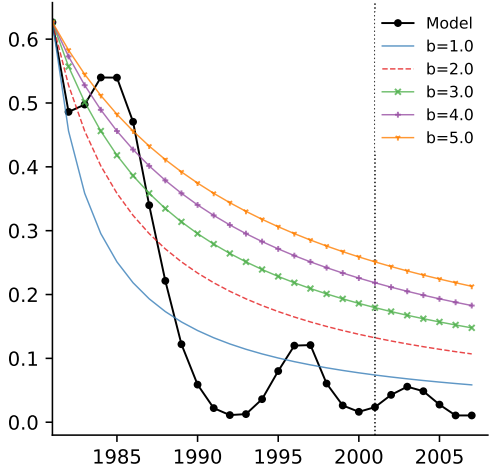
Model-free Bayesian approach

(a) Prior PDF



(b) Posterior mean



Panel (a): Prior belief density functions. Panel (b): Mean posteriors (colors) and benchmark probability of reverting to NNTR regime.