

# U.S.-China Trade: From the Cold War to the Trade War

Alessandria, Khan, Khederlarian, Ruhl, and Steinberg

Devils and Wolves | March 22, 2024

A mix of two papers. . .

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

Alessandria, Khan, Khederlarian, Ruhl, Steinberg

Trade War and Peace: U.S.-China Trade and Tariff Risk from 2015–2050

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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
    - + Estimate probabilities of trade war ending, 2018–2023

## Brief history of U.S.-China trade

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**1950–1970:** Complete embargo

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

**1979:** U.S.-China diplomatic relations established

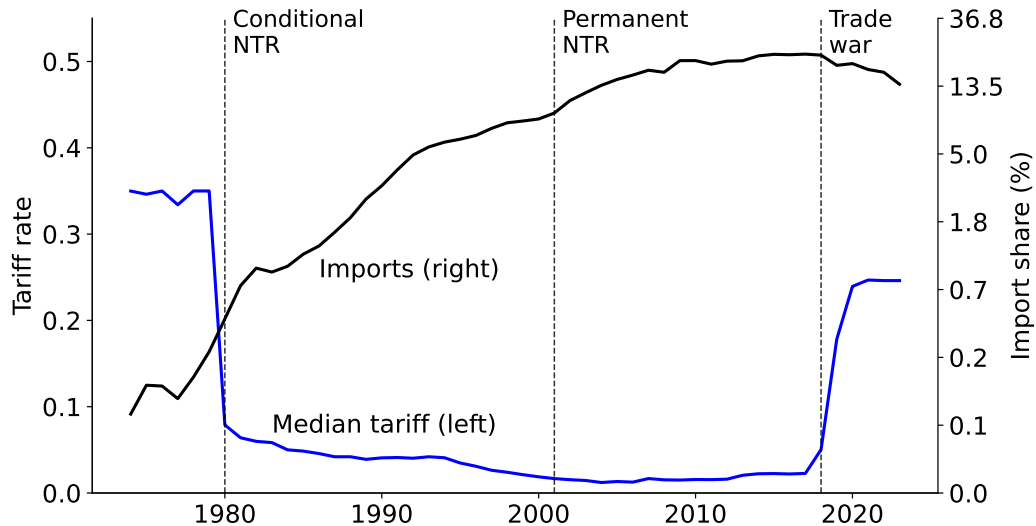
**1980–2000:** **Conditional** normal trade relations (NTR/MFN); Access to NTR tariffs granted on unilateral basis

- ▶ 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

## U.S.-China trade & policy dynamics



### Looking backward, 1971–2008

#### 1. Empirical features

- ▶ Slow adjustment to tariff changes:  $\sigma^{LR} \approx 8$ ,  $\sigma^{SR} \approx 2.3$
- ▶ Effects of uncertainty: 1970/80s  $\gg$  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

### Looking forward, 2014–2023

#### 1. Empirical features

- ▶ Growing substitution away from high tariff-risk goods

#### 2. Quantitative model: Same methodology

- ▶ Probability of trade peace initially high, but falling

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## 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

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- ▶ 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

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

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

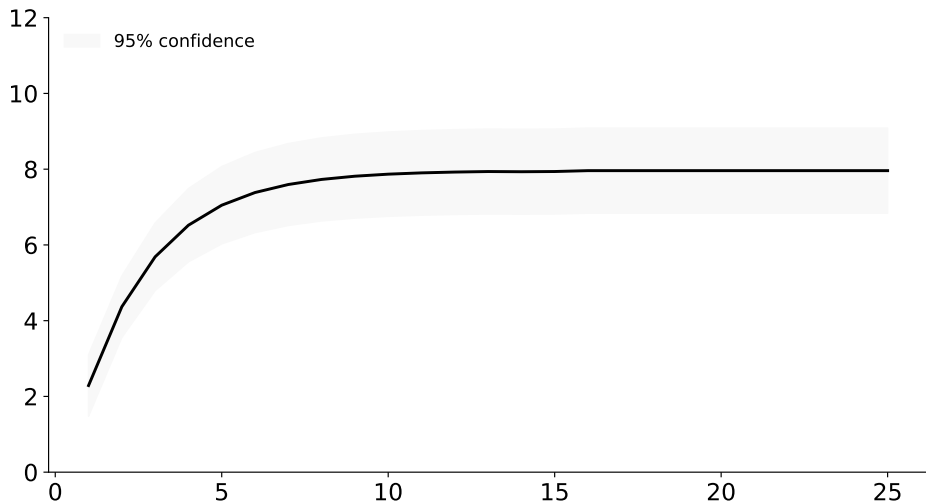
- ▶  $v_{jgt}$ : U.S. imports from source  $j$  of good  $g$
- ▶  $\tau_{jgt}$ : U.S. applied tariff on source  $j$  of good  $g$
- ▶ Control for the following (using fixed effects)
  - $jt$ : source-country aggregate shocks (exchange rates, structural changes, etc.)
  - $gt$ : good-level U.S. demand 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 $v_{jgt}$	ECM $\Delta v_{jgt}$
$\mathbb{1}\{j = \text{China}\}\tau_{jgt}$	-6.64 ***	
$\mathbb{1}\{j = \text{China}\}\Delta\tau_{jgt}$		-2.29 ***
$\mathbb{1}\{j = \text{China}\}v_{jg,t-1}$		-0.37 ***
$\mathbb{1}\{j = \text{China}\}\tau_{jg,t-1}$		-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  $\ll$  LR elasticity
- ▶ Calibrate to  $\sigma^{LR}$
- ▶ Local projections model similar (in paper)

## #2: The effect of future tariff risk

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- ▶ 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:

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

- ▶  $\beta > 0$ : 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:

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

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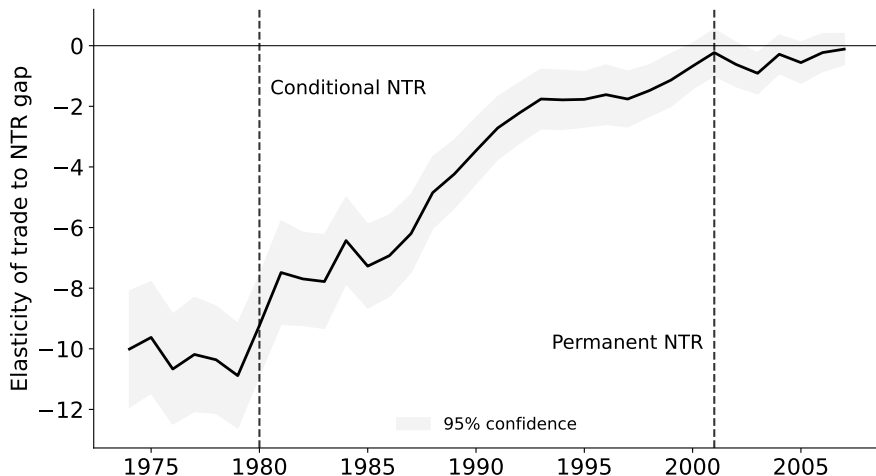
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## Time-varying NTR-gap elasticities



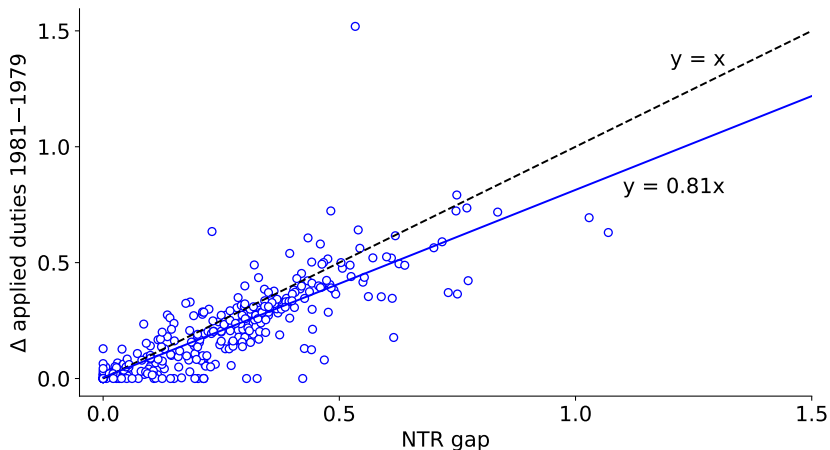
- ▶ Coefficients capture both initial reform and expectations (1970s vs. 1980s)
- ▶ Flat before 1980; Jumps in 1980 with NTR; stalls in early 1980s
- ▶ 1990s growth small share of overall growth
- ▶ [Calibrate to these elasticities](#)

## Interpreting $\beta_t$

- ▶ 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 $\beta_t$

- ▶ 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
- ▶  $\beta_t$  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 ( $\delta_{jgt}$ )
- ▶ 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<sup>2</sup>)

## The model

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- ▶ 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 ( $\xi$ )
  - ▶ New exporter  $\xi_H$ , with prob  $\rho_\xi$  transition to  $\xi_L$
- ▶ 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

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

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

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

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

- ▶ Given  $z, \xi, s$ , choose  $p, \ell$  to max flow profits

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

## Chinese producers: Exporter life cycle, dynamic optimization

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- ▶ Variable trade cost ( $\xi$ ) captures current export status
  - ▶  $\infty$ : non-exporter
  - ▶  $\xi_H$ : high-cost exporter
  - ▶  $\xi_L$ : 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 ( $\xi_H$ )
  - ▶ Continuing exporters: pay  $f_1$ , switch to higher/lower cost with prob.  $1 - \rho_\xi$
- ▶ Given  $z, \xi, s$ , 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,  $\hat{z}_t(\xi, s)$ , increases in current & future trade barriers



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## Aggregation, trade elasticities

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- ▶ 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 ( $\varphi$ ) depends on past and future tariffs
- ▶ Mapping to trade elasticities:
  - ▶ SR response to *unanticipated* reform:  $\theta$
  - ▶ LR response to *permanent* reform:  $> \theta$ , increasing in  $\xi_H/\xi_L$  and  $\rho_\xi$

## Calibration: Timing and beliefs

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- ▶ 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

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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
$\rho_z$	Persistence of productivity	0.65	Alessandria et al. (2021)
$\delta_0$	Corr. of survival with productivity	21.04	"
$\delta_1$	Minimum death probability	0.023	"
$\tau_{g,t}(2)$	NNTR tariff	Varies	Data
$\tau_{g,t}(1)$	NTR tariff	Varies	Data
$\theta_g$	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 ( $\xi$ ), prod. dispersion ( $\sigma_z$ ) 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

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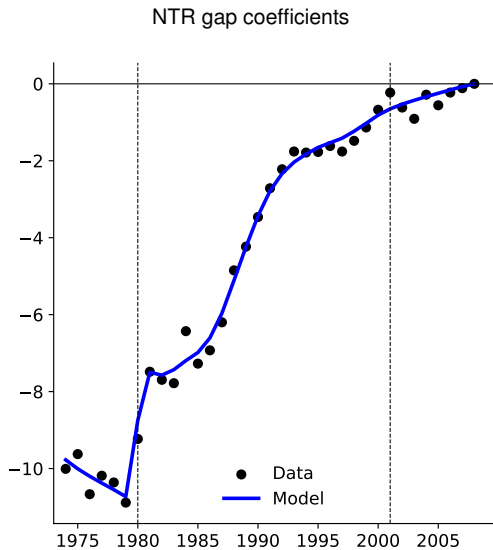
- ▶ Match estimates of
  1. Aggregate trade elasticity dynamics
  2. Annual NTR-gap coefficients
- ▶ Indirect inference approach
  1. Run ECM regressions in the model  $\rightarrow \sigma^{LR}$
  2. Run DiD regressions in the model  $\rightarrow$  **NTR gap coefficients 1974–2008**
- ▶ Note:  $\sigma_{LR}$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

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Parameter	Meaning	Value	Source/target
$\rho_{\xi}$	Prob. of keeping iceberg cost	0.87	ECM estimate of LR trade elasticity = 7.96
$\omega(2, 1)$	Prob. NNTR to NTR	0.25	Avg. NTR gap during 1974–1979
$\omega_t(1, 2)$	Prob. NTR to NNTR	Varies	NTR gap during 1980–2008

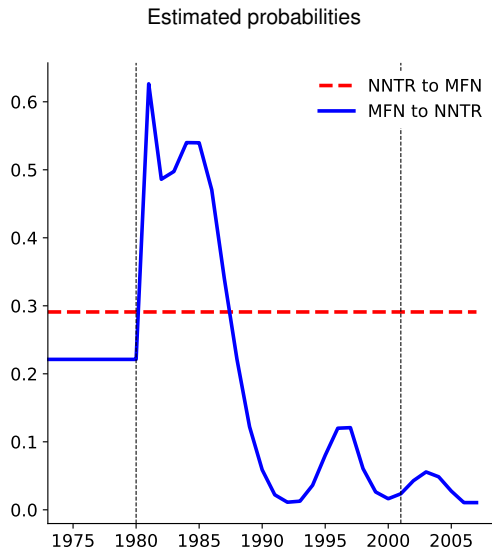
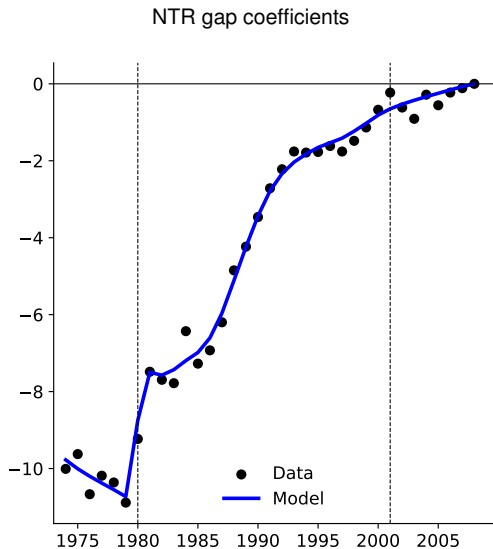
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# Model fit and estimated probabilities

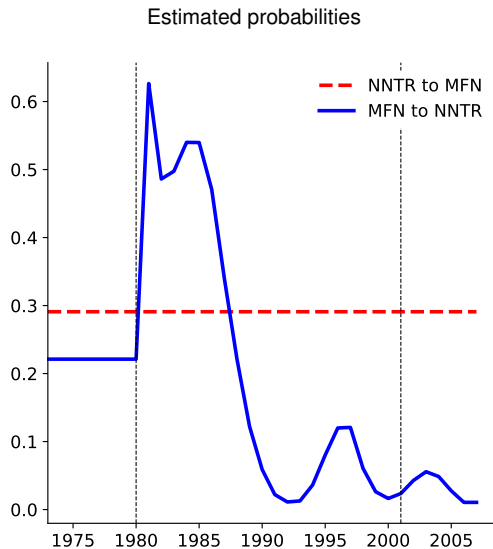
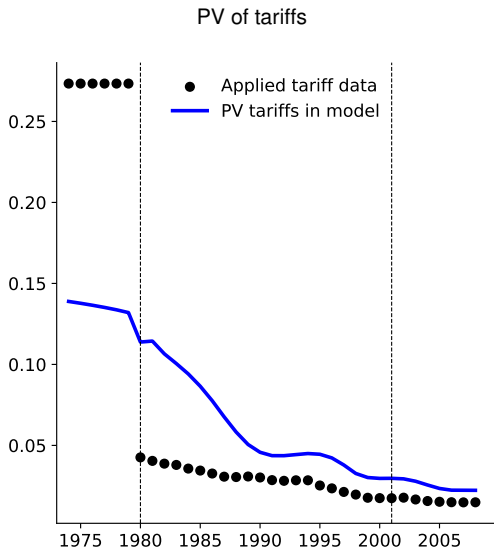




# Model fit and estimated probabilities



# 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

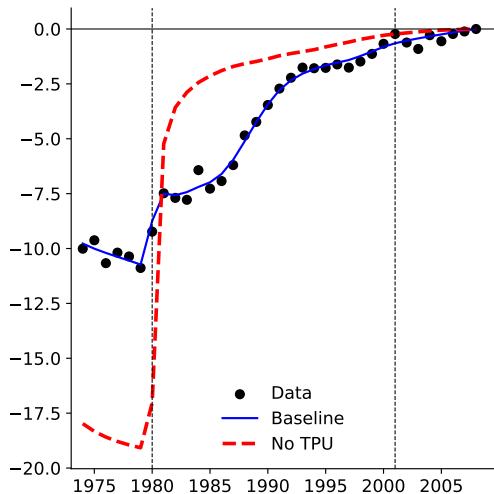
- 1979:** Carter normalizes relations with China; severs relations with Taiwan (keeps commercial & defense relations)
- ▶ Congress resoundingly passes Taiwan Relations Act
- 1980:** Carter makes China the 3rd non-market economy to receive a waiver through the Jackson-Vanik Amendment, following Romania (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

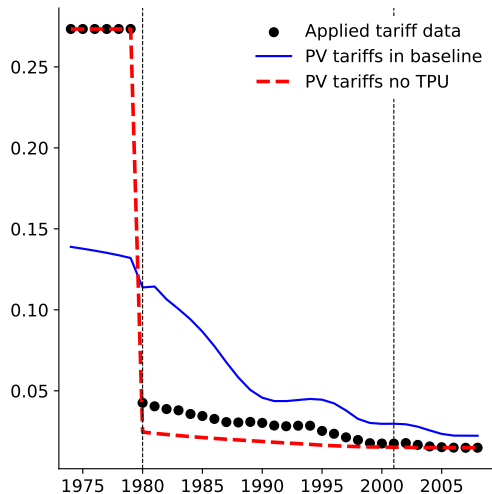
- ▶ Compare benchmark model to a model with no policy uncertainty
- ▶ Model begins in 1971; all firms are nonexporters
- ▶ Counterfactual model: “no TPU”
  - ▶ 1971: Learn that autarky is over, in NNTR regime
  - ▶ 1980: Learn that NTR status has been granted (unforeseen)
  - ▶ No uncertainty, perfect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

# The effects of policy uncertainty

## NTR-gap coefficients



## PV of tariffs



## Looking backward

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

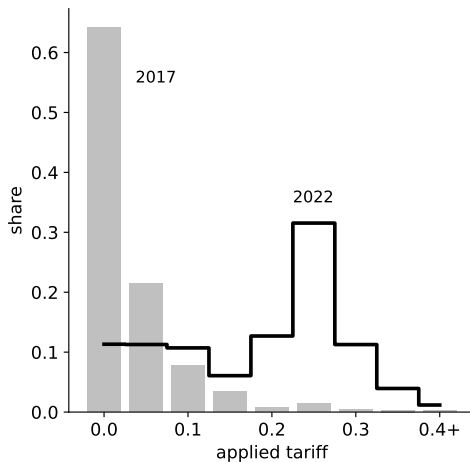
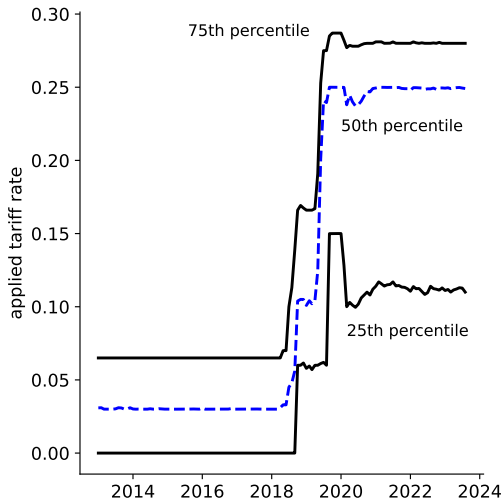
- ▶ In 1970s, possible future tariff cuts boosted trade in high tariff goods
- ▶ In early 1980s, lack of credibility reduced trade response to tariff cuts
- ▶ WTO ascension had a small impact, especially when compared to mid-1980s

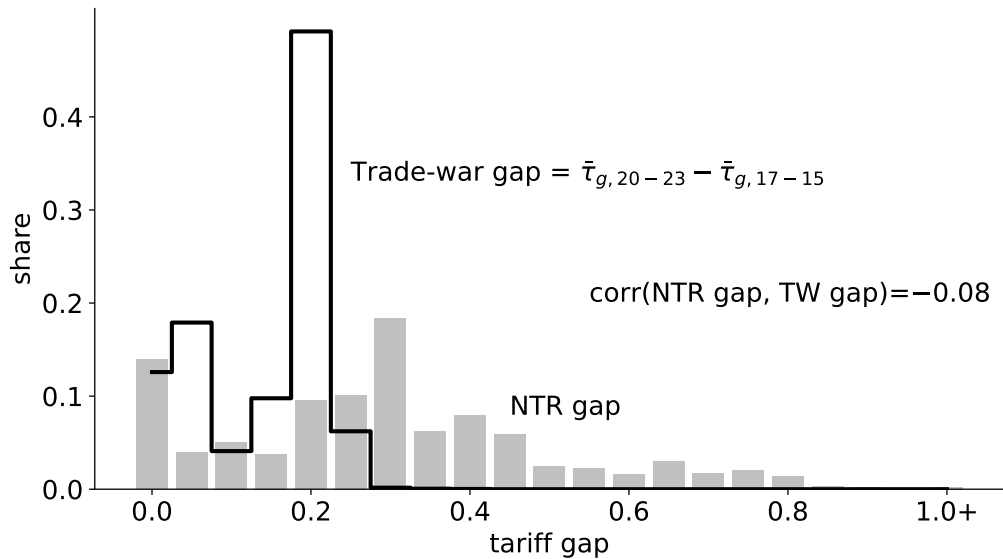
## Looking forward

How long will the U.S.-China trade war last?

- ▶ Use the same methodology
- ▶ Substitution away from high trade-war gap goods
- ▶ Probability of trade peace initially high, now low

# U.S. applied tariffs on Chinese goods







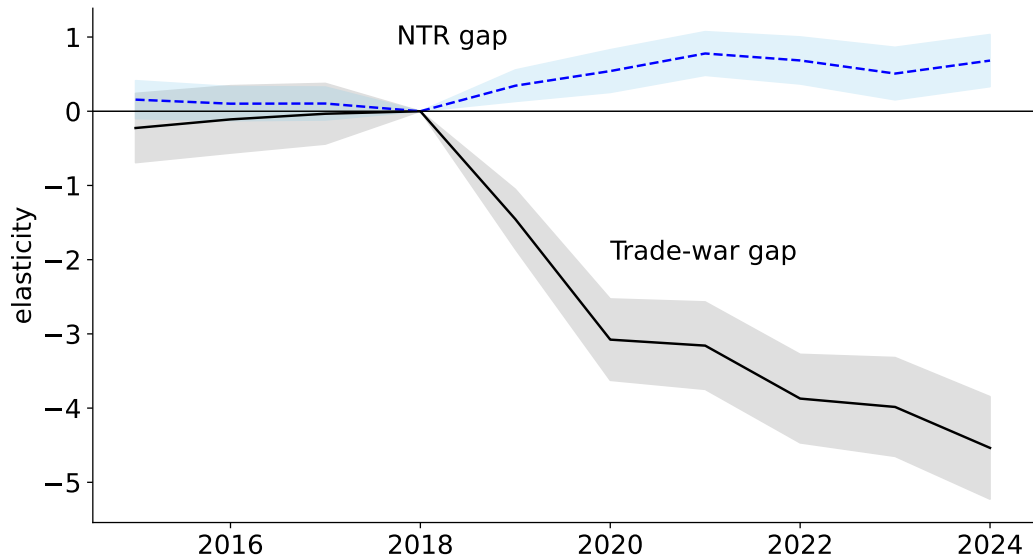
## Elasticity to the trade gaps

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- ▶ Same methodology

$$\log v_{igt} = \sum_{t'=2015}^{2023} \left( \beta_t^{NTR} X_g^{NTR} + \beta_t^{TW} X_g^{TW} \right) \mathbb{1}_{\{i=China \wedge t=t'\}} + \delta_{gt} + \delta_{ig} + \delta_{it} + \log c_{igt} + u_{igt}$$

# Gap elasticities



## Elasticity to the trade gap

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- ▶ Same methodology

$$\log v_{igt} = \sum_{t'=2015}^{2023} \left( \beta_t^{NTR} X_g^{NTR} + \beta_t^{TW} X_g^{TW} \right) \mathbb{1}_{\{i=China \wedge t=t'\}} \quad (1)$$
$$+ \delta_{gt} + \delta_{ig} + \delta_{it} + \log C_{igt} + u_{igt},$$

- ▶ Substitution
  - ▶ Modest initially, but growing
  - ▶ Path of substitution on par with dynamics of 1980 reform
  - ▶ Substitution to high NTR-gap goods
- ▶ Before 2018, no substitution away from
  - ▶ High tariff goods
  - ▶ High NTR-gap goods

## Structural model

- ▶ Same model structure as before: slow adjustment, time-varying uncertainty
- ▶ Begin in 2018, in “steady state” where NTR status has occurred for a very long time
- ▶ Trade war is a surprise, perfect foresight after
  - ▶ Will also consider perpetual surprises

**Goal:** Estimate probabilities of trade war ending

## Structural model

- ▶ Same model structure as before: slow adjustment, time-varying uncertainty
- ▶ Begin in 2018, in “steady state” where NTR status has occurred for a very long time
- ▶ Trade war is a surprise, perfect foresight after
  - ▶ Will also consider perpetual surprises

**Goal:** Estimate probabilities of trade war ending

## Tariff regimes

- ▶ Three tariff regimes, NNTR (N), NTR (M), TW (T)
- ▶ Regime-switching probabilities before the trade war
  - ▶ Trade war is a surprise
  - ▶ Downside risk is returning to NNTR

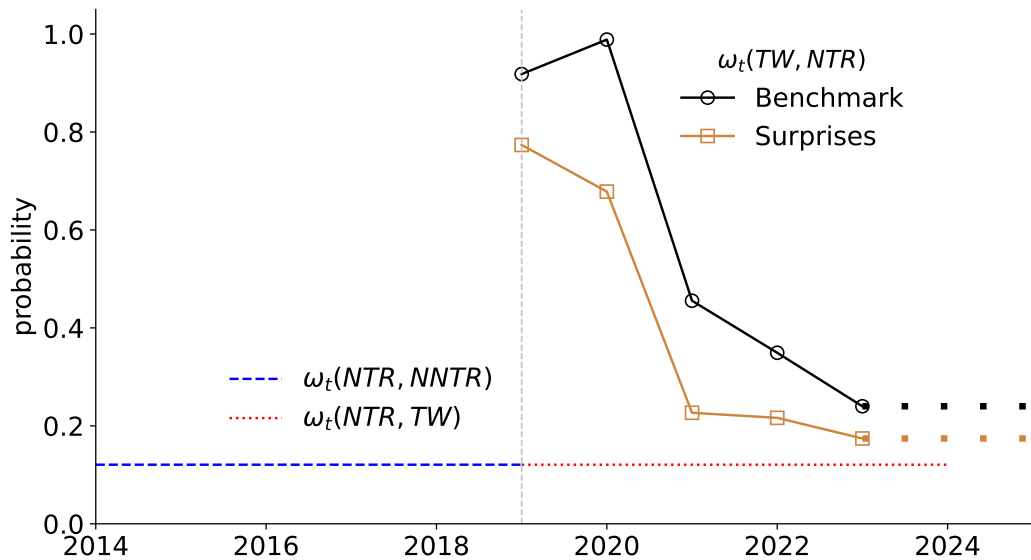
$$\Omega^M = \begin{bmatrix} \rho^M & 1 - \rho^M & 0 \\ 1 - \rho^N & \rho^N & 0 \\ 1 - \rho_{18}^T & 0 & \rho_{18}^T \end{bmatrix}$$

- ▶ Regime-switching probabilities after the trade war
  - ▶ Do not return to NNTR
  - ▶ Downside risk is the trade war

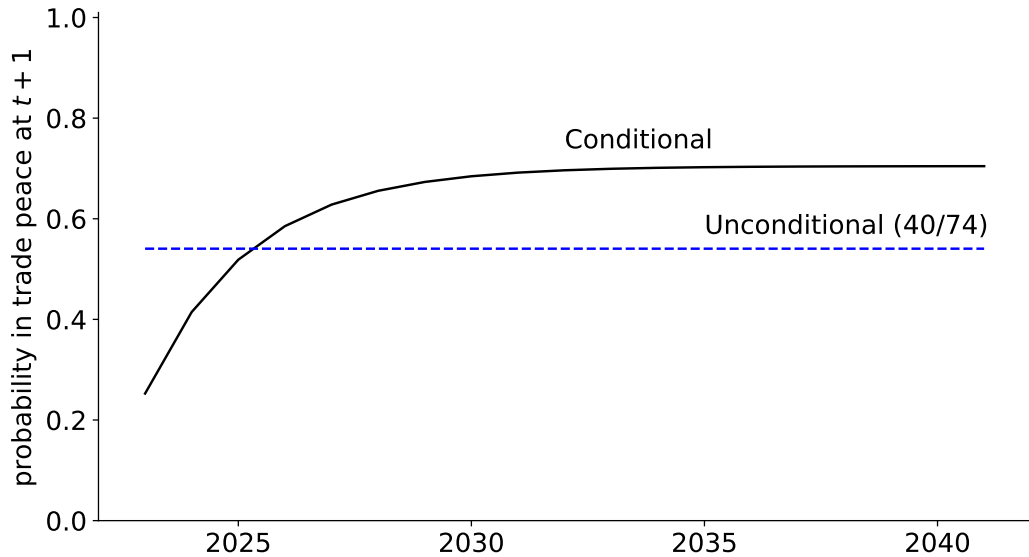
$$\Omega_t^T = \begin{bmatrix} \rho^M & 0 & 1 - \rho^M \\ 1 - \rho^N & \rho^N & 0 \\ 1 - \rho_t^T & 0 & \rho_t^T \end{bmatrix}$$

- ▶ Estimate  $\{\rho_t^T\}_{t=2019}^{2023}$  and  $\rho^M$  to match the TW-gap elasticities

## Regime probabilities



## Probability of trade peace (2023 estimate)





## Trade-policy innovations by administration

	Baseline		Surprises	
	Trump	Biden	Trump	Biden
Expected duration (years)	1.0	4.2	1.5	5.7
Change in mean discounted tariff (%)	-2.6	1.6	-4.7	5.1
Change in mean applied tariff (%)	17.2	0.0	17.2	0.0

**Trump:** Large change in tariffs, expected to be short-lived

**Biden:** No change in tariffs, low probability of trade peace

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