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

Alessandria, Khan, Khederlarian, Ruhl, and Steinberg

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About Trade War and Peace

- Trade policy instruments: tariffs + credibility

- Important questions about trade policy changes:
  1. Size of policy change?
  2. How likely is it?
  3. How long will it last?

- Context: US-China Trade War — unprecedented scale of trade disintegration

- Today
  1. Size and timing of substitution away from China
  2. Estimate trade policy expectations

Brief history of U.S.-China trade

1949: PRC established, not recognized by US

1950–1970: Complete embargo

1971–1979: China exporting to US at Non-Normal Trade Relations (NNTR) rates

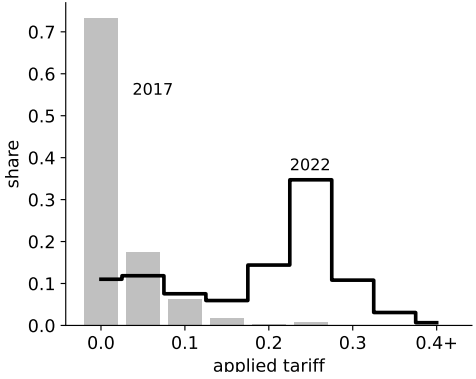
1980–2000: **Conditional** normal trade relations (NTR/MFN); Access to MFN tariffs granted on unilateral basis

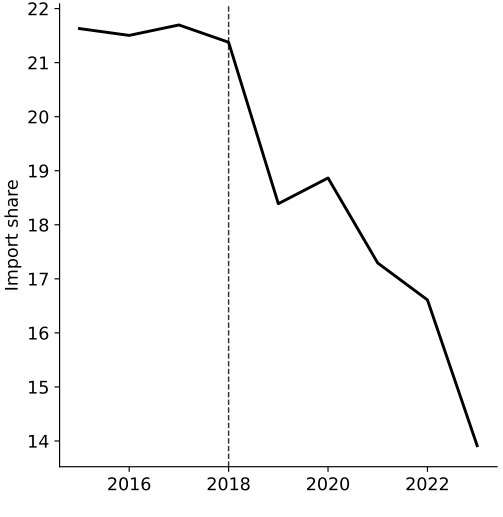
- Required annual President renewal
- Starting in 1990, Congress also voted on renewal

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

2018–????: Trump-Biden trade war: risk shifts from NNTR to Trade War (TW) tariffs

U.S.-China trade and policy dynamics





Empirical response to Trade War

1. Empirical features

- Change in risk from NNTR to TW tariffs
- Elasticity to NNTR and TW tariffs

2. Findings:

- Growth in high NNTR goods post-2018 (cond. on TW tariffs)
  identifies change in NNTR risk
- Gradual decline in high trade war tariff goods
  identifies persistence of TW over time

Quantifying Expectations

1. Quantitative model: slow adjustment + trade policy uncertainty

- Estimate model to match elasticity to NNTR and TW tariffs
- Recover agent beliefs over trade regime uncertainty
- Observed vs expected tariffs
- Future trade projections under different TW scenarios

2. Findings:

- Probability of trade peace initially high, now low
- Policy more restrictive post-2020
- TW + current expectations: trade decline continues
  Permanent MFN: trade rises above pre-war level

Related Literature

1. Trade dynamics: data

- 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)

2. 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)

3. Trade policy uncertainty (TPU)

- Ruhl (2011), Handley (2014), Handley and Limão (2015, 2017), Pierce and Schott (2016), Crowley et al. (2018), Steinberg (2019), Caldara et al. (2019), Handley et al. (2020), Bianconi et al. (2021), Alessandria et al. (2024b), Alessandria et al. (2024a)

Empirics: Introduction

- Goal: how trade responds to two measures of policy risk — NNTR and TW tariffs
- Data sources:
  - U.S. Customs trade data, includes import values and applied tariffs
  - Applied tariffs for NNTR, MFN and TW rates
- Unit of observation: source country (i) - good (g) - year (t)
  - 2014-2023, HS 6-digit level (3,500+ products)
  - Exclude goods with common tariff increase (steel, aluminum, etc)
  - Alternative year definition: July-June (TW started in July 18)
- Results are summarized as a set of elasticities
  - These are not structural elasticities

The effect of future tariff risk

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

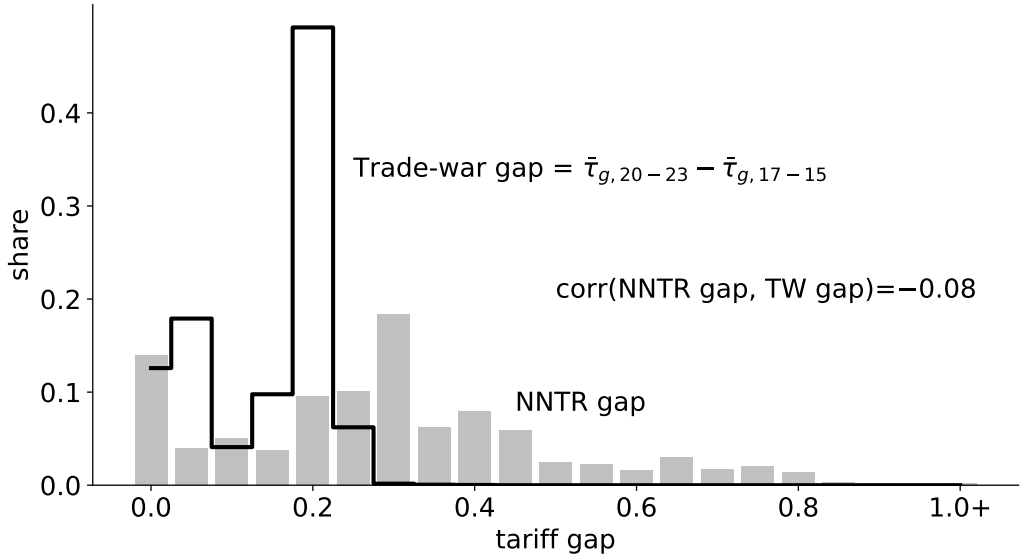
$$\text{NNTR gap}_g = \text{NNTR tariff}_g - \text{MFN tariff}_g$$

  - Tariff increase if China lost MFN status pre-WTO
  - Exogenous to U.S.-China relationship

- Introduce a measure of trade war risk:

$$\text{TW gap}_g = \text{TW tariff}_g - \text{MFN tariff}_g$$

  - Summarizes the pace of substitution away from China


0.4
0.3
0.2
0.1
0.0
share
Trade-war gap = $\bar{\tau}_{g,20-23} - \bar{\tau}_{g,17-15}$
corr(NNTR gap, TW gap)=−0.08
NNTR gap
0.0
0.2
0.4
0.6
0.8
1.0+
tariff gap

Elasticity to the trade gaps

- Extend AKKRS(2024a) to estimate year-by-year elasticity of trade to NNTR gap + TW gap:

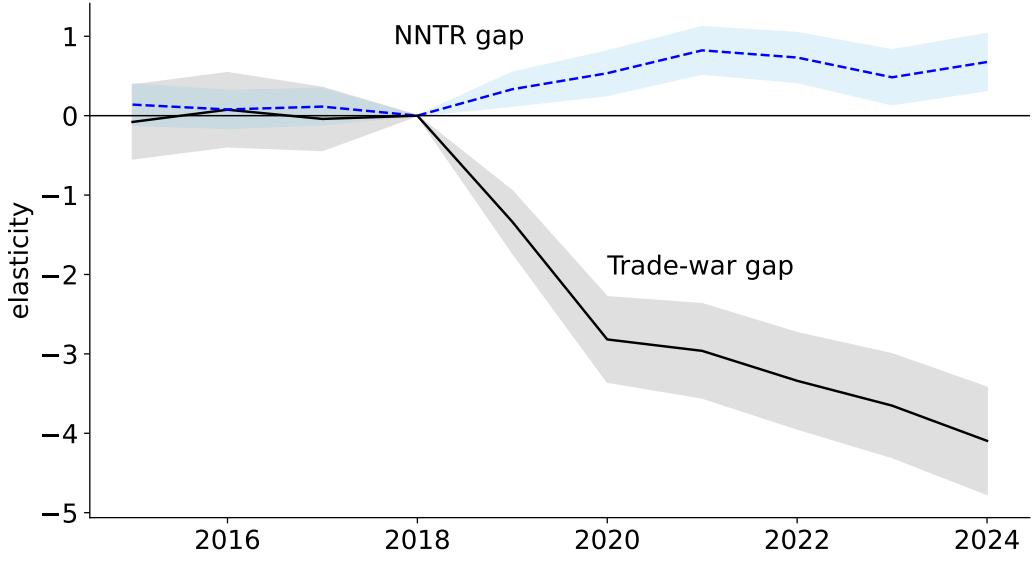
$$\log v_{igt} = \sum_{t'=2015}^{2023} \left(\beta_t^{NNTR} X_g^{NNTR} + \beta_t^{TW} X_g^{TW} \right) \mathbb{1}_{\{i=China \wedge t=t'\}} + \delta_{gt} + \delta_{ig} + \delta_{iht} + \log c_{igt} + u_{igt}$$

- v_{igt}: U.S. imports from source i of good g
- Control for the following (using fixed effects)
  - gt: good-level U.S. demand shocks, MFN trade policy
  - ig: imports of each good-country relative to a base period
  - iht: exporter-HS section level + exporter aggregate shocks (e.g. exchange rates)

β^{NNTR} captures response of high NNTR gap goods

β^{TW} captures response of high TW gap goods

Gap elasticities

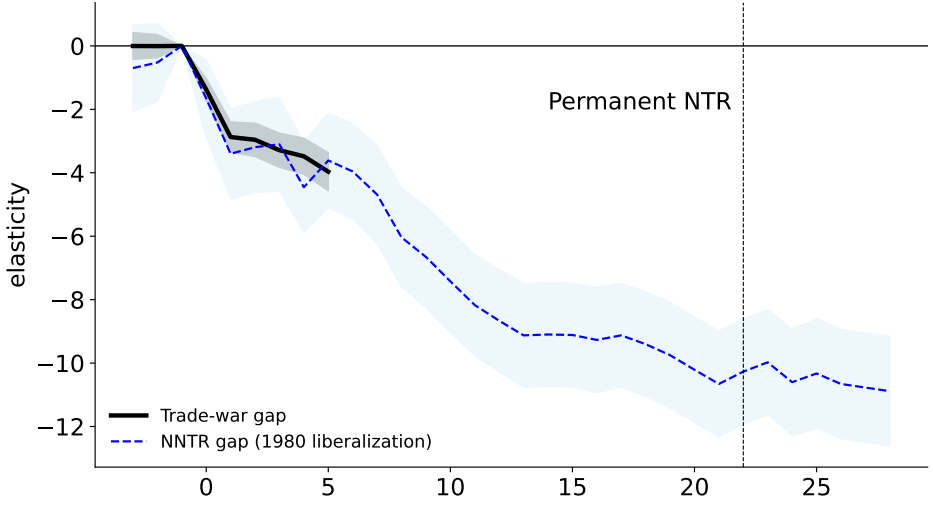


[China Only]

[MFN rate]

Adjustment not unprecendented

- Compare trade war tariff response with response to MFN in 1980



- Uncertainty much higher in 1980s than around WTO accession (AKKRS 2024a)

Empirical Results:

- Before 2018, no substitution away from
  - High TW tariff goods
  - High NNTR goods
- Substitution
  - Modest initially, but growing
  - Substitution to high NNTR goods
- Robust to:
  - Using cross-product variation only
  - Alternative fixed effects
  - Sample of goods (balanced/unbalanced)
  - Standard year definition
  - Level of aggregation (HS8/HS10)
  - China supply effects (δ_{jgt})

Back to the three questions

- Important questions about trade war:

1. How much could tariffs rise?
   NNTR rates and then observed TW tariffs

2. How likely is the policy change (exit from MFN)?
   MFN$\rightarrow$NNTR: Substitution to high NNTR tariff goods after TW
   MFN$\rightarrow$TW: (Lack of) substitution away from high TW tariff goods before TW

3. How long will it last?
   TW$\rightarrow$MFN: substitution away from high TW tariff goods after TW

The model

- Two key ingredients
  1. Slow adjustment (exporter life cycle, as in Alessandria, Choi, & Ruhl 2021)
  2. Time-varying uncertainty over future policy

- G goods, matched to HS 6-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 ($\xi \in \{\xi_H, \xi_L\}$)
  - New exporter ξ_H, with prob ρ_ξ transition to ξ_L

Tariff regimes

- Three tariff regimes, MFN (P), NNTR (N), TW (W)
- Regime-switching probabilities before the trade war
  - Trade war is a surprise
  - Downside risk is returning to NNTR

$$\Omega^P = \begin{bmatrix} \rho^P & 1-\rho^P & 0 \\ 1-\rho^N & \rho^N & 0 \\ 1-\rho^W_{18} & 0 & \rho^W_{18} \end{bmatrix}$$

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

$$\Omega^W_t = \begin{bmatrix} \rho^P & 0 & 1-\rho^P \\ 1-\rho^N & \rho^N & 0 \\ 1-\rho^W_t & 0 & \rho^W_t \end{bmatrix}$$

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

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)

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

- 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 ($\xi = \infty$); can 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: θ_g
  - LR response: $> \theta_g$, increasing in ξ_H/ξ_L and ρ_ξ

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

4. Estimate regime-switching probabilities to match our estimated trade dynamics

- Probability of exogenous exit

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

Calibration: Assigned parameters

Parameter	Meaning	Value	Source/target
r	Interest rate	4 pct.	Standard
ρ_z	Persistence of productivity	0.65	Alessandria et al. (2021)
δ_0	Corr.(survival,productivity)	21.04	Alessandria et al. (2021)
δ_1	Minimum death probability	0.023	Alessandria et al. (2021)
$\tau_g(N)$	NNTR tariff	Varies by good	Data
$\tau_g(P)$	MFN tariff	Varies by good	Data
$\tau_g(T)$	Trade-war tariff	Varies by good	Data
$\theta_{\gamma(g)}$	Demand elasticity	Varies by sector	Soderbery (2018)
ρ_ξ	Prob. of keeping iceberg cost	0.91	AKKRS 2024a
ρ^N	Prob. of staying in NNTR	0.71	AKKRS 2024a

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

	Export part. rate (%)	Exit rate (%)	Incumbent size prem.	Log CV exports
Base metal manufacturing	12	21	3.96	1.15
Calendered metal manufacturing	29	10	2.48	1.24
Computer, electronic and optica..	48	7	4.82	1.94
Electrical equipment manufactur..	32	10	3.35	1.55
Energy products and chemicals	19	15	3.23	1.48
Food, beverage and tobacco	19	16	2.71	0.91
Furniture and other manufacturing	59	7	1.76	0.95
Non-metallic mineral products	16	18	2.26	0.85
Other machinery and equipment	23	13	3.33	1.54
Paper and printing products	12	17	3.10	1.30
Rubber and plastic products	29	10	2.69	1.08
Textile, clothing, leather	45	10	1.99	1.06
Vehicle manufacturing	23	12	4.07	1.31
Wood and straw products	24	13	2.05	1.09

Calibrating to aggregate transition dynamics

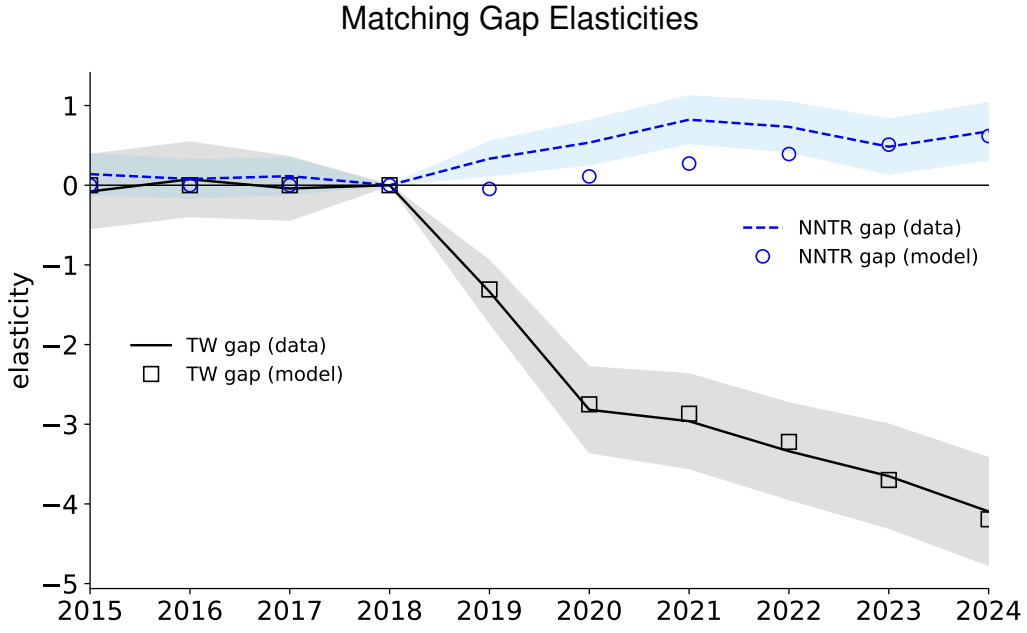
- Indirect inference approach: run DiD regressions in the model and match
  1. NNTR gap coefficients
  2. TW gap coefficients
- Note: β^{NNTR} and β^{TW} are
  - Reduced-form estimates, not structural parameters
  - Affected by presence of TPU

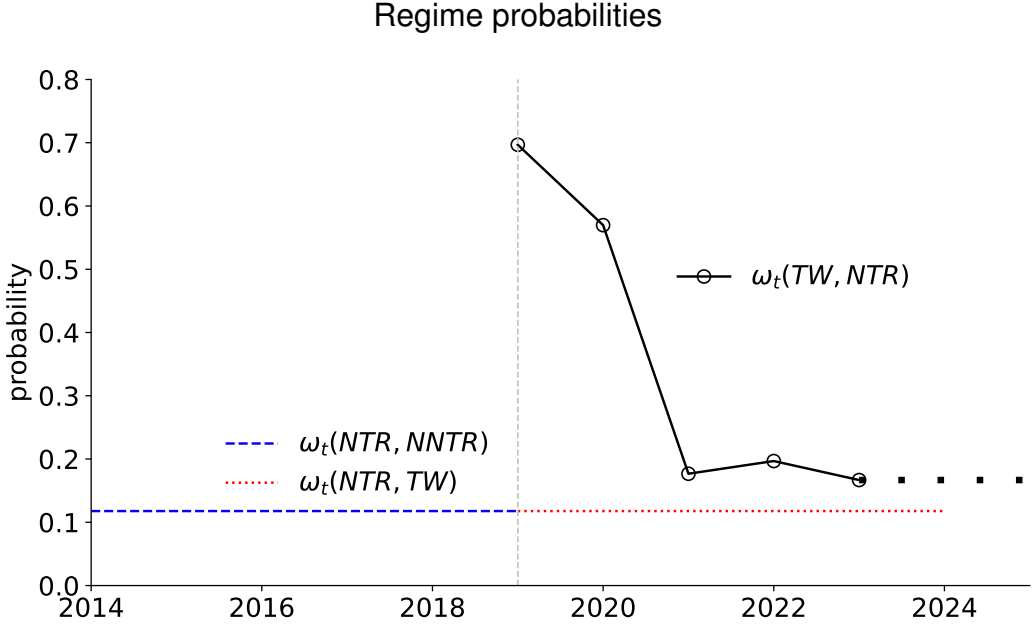
Parameter	Meaning	Value	Source/target
$1-\rho^{P}$	Prob. trade peace to NNTR	0.11	Δ NNTR-gap elasticity, 2019–2024
$\{1-\rho_t^{W}\}_{t=2018}^{2023}$	Prob. trade war to trade peace	Varies by year	Annual trade-war gap elasticities, 2019–2024

Timing and beliefs

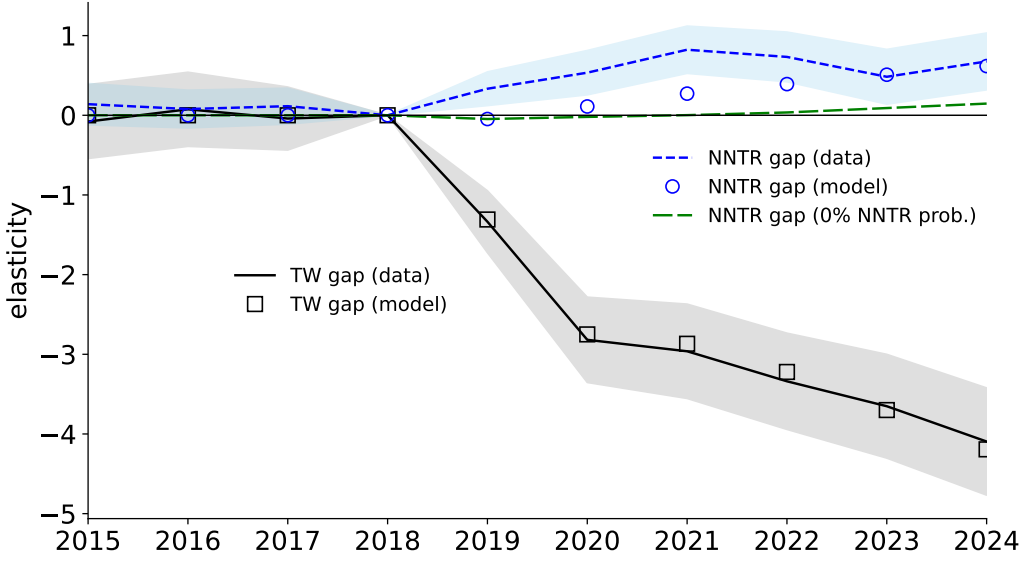
- Begin in 2018, in “steady state” where MFN status has occurred for a very long time
- Trade war & each change in probability are surprises

Goal: Estimate probabilities of trade war ending

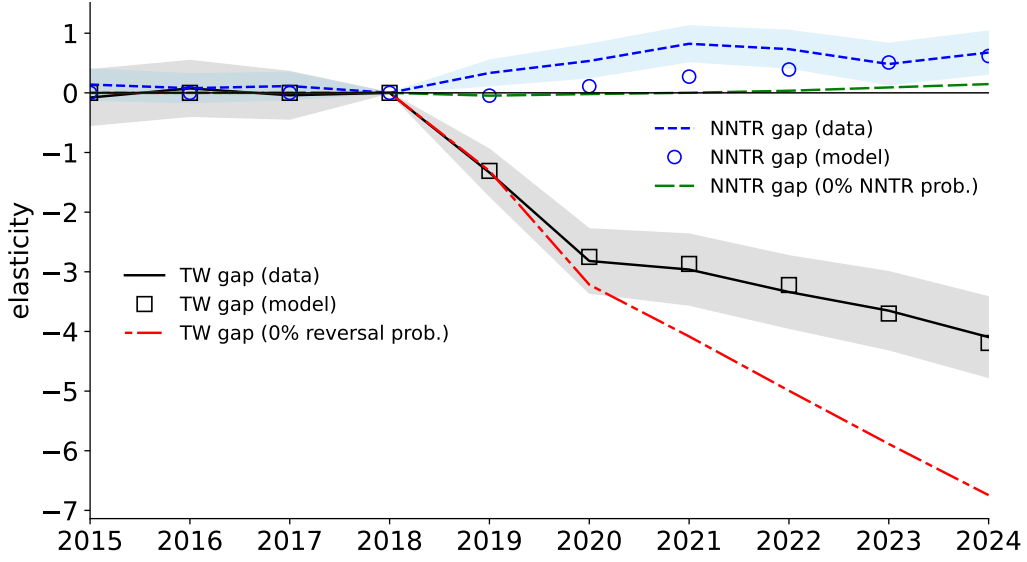

Matching Gap Elasticities
elasticity
1
0
−1
−2
−3
−4
−5
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
NNTR gap (data)
NNTR gap (model)
TW gap (data)
TW gap (model)


Regime probabilities
probability
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
2014
2016
2018
2020
2022
2024
$\omega_t(TW, NTR)$
$\omega_t(NTR, NNTR)$
$\omega_t(NTR, TW)$

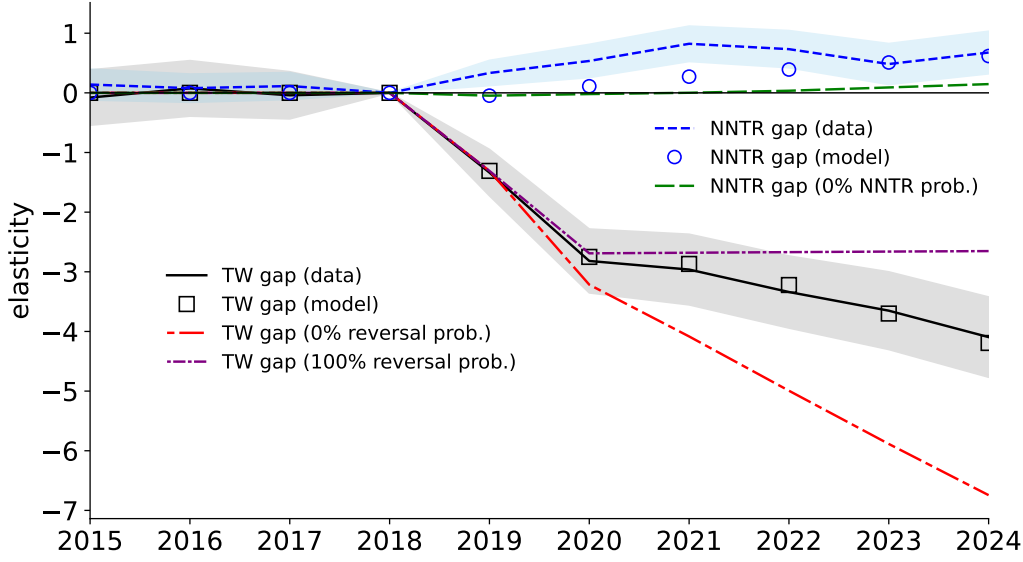
Identification intuition – 1

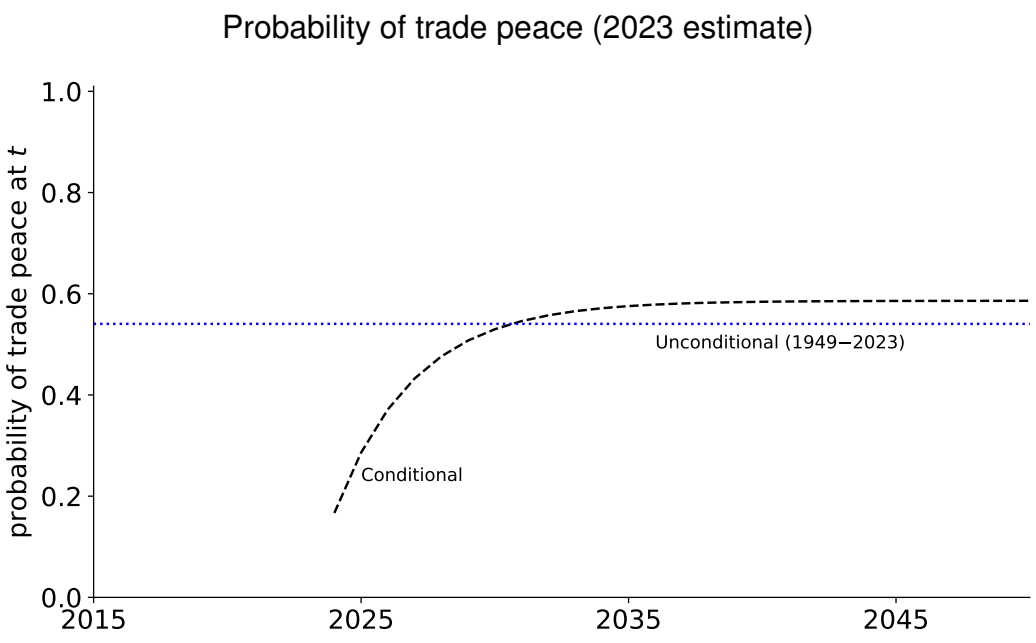


Identification intuition – 2



Identification intuition – 3




Probability of trade peace (2023 estimate)
probability of trade peace at t
1.0
0.8
0.6
0.4
0.2
0.0
2015
2025
2035
2045
Unconditional (1949–2023)
Conditional

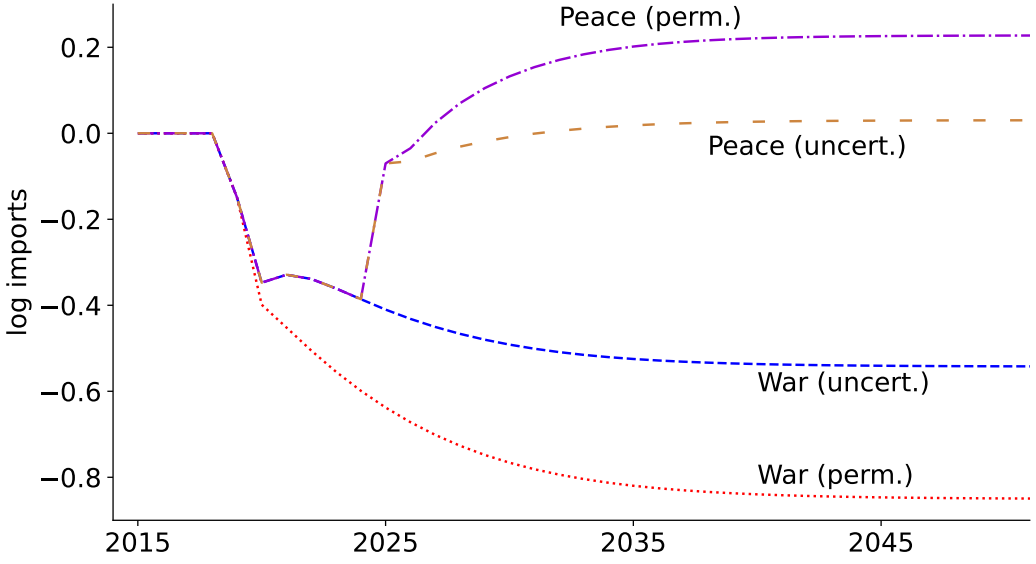
Trade-policy innovations by administration

	Trump	Biden
Change in mean applied tariff (%)	17.2	0.0
Expected duration (years)	1.8	6.0
Change in mean discounted tariff (%)	-4.1	4.7

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

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

Projections for the future



Alternative trade wars

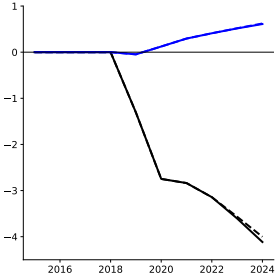
- We assumed a particular structure: Trade war or MFN
- Consider alternative potential policies
- Add other possible policies to the estimated model
  - Study how the gap elasticities change
  - If elasticities don't change much, our estimates of the probabilities of trade war ending are robust

Alternative policies

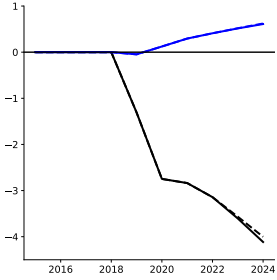
- In all scenarios, the trade war still occurs at it does in the data
- We allow for other policies to be possible
- Alternative policies possible **pre-trade war (2017–18)**
  - Possible regimes: (MFN, NNTR, TW, MFNA), $\sim$40% prob. MFN $\rightarrow$ MFNA
  1. MFNA surcharge: $\tau_{MFN} + 10$ pp. on all goods
  2. MFNA minimum tariff: new tariff is $\min(10\%, \tau_{MFN})$
- Alternative policies possible **during the trade war (2022–)**
  - Possible regimes: (MFN, NNTR, TW, TWA), $\sim$40% prob. TW $\rightarrow$ TWA
  3. TWA surcharge: $\tau_{TW} + 10$ pp. on all goods
  4. TWA minimum tariff: new tariff is $\min(10\%, \tau_{TW})$
- Consider each alternative separately

i

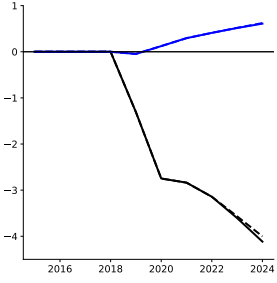
2017–18 surcharge



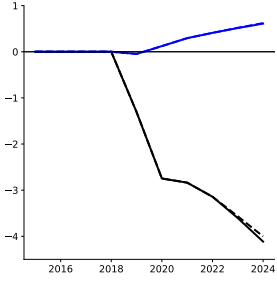
2017–18 minimum tariff



2022– surcharge



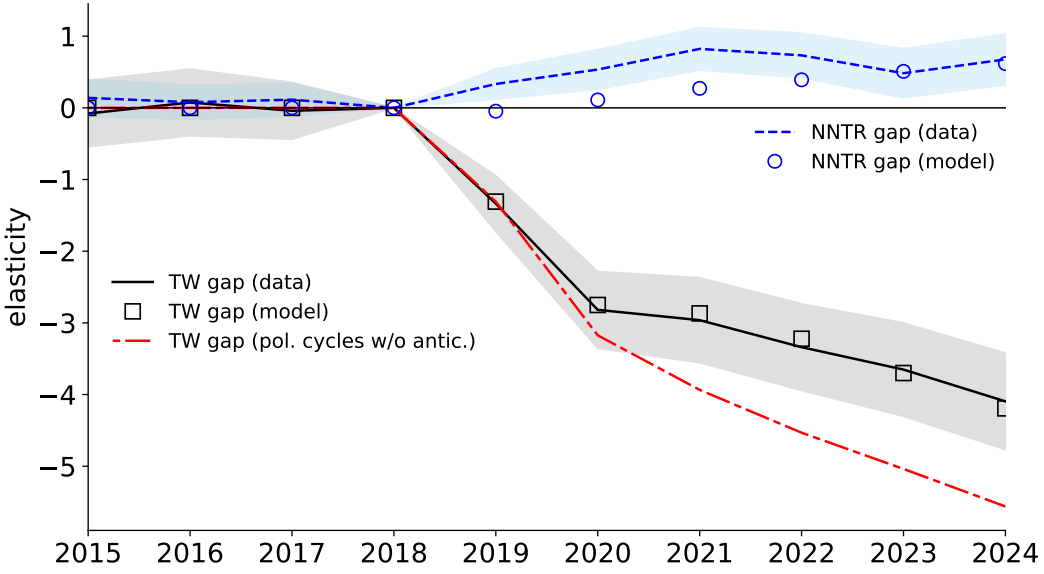
2022– minmum tariff



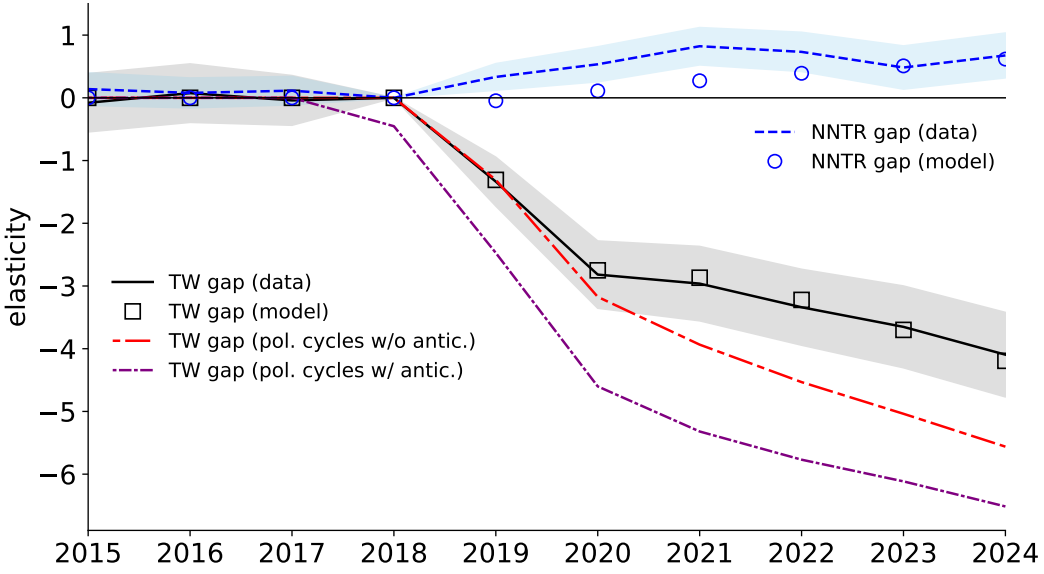
Exogenous political cycles

- We estimated the probability of switching policy regimes using the gap-elasticity dynamics
- Alternative is to posit a-priori process based on “political cycles”
- Two constant transition matrices, known ahead of time by firms
  - Trump: P(MFN to TW) = 0.75, P(TW to TW) = 1
  - Biden: P(MFN to TW) and P(TW to MFN) same as in 2015
  - Every 4 years, 50% chance to switch between matrices
  - Trump can have at most 2 terms during 2017–2029, after that Biden matrix forever
- Two versions:
  - Switch to Trump matrix in 2019 when trade war starts (no anticipation effects)
  - Switch to Trump matrix after he is elected in 2016 (trade falls in anticipation of possible trade war)

Political cycles – 1



Political cycles – 2



Summary

Trade policy follows a stochastic process
U.S.-China Trade War always a possibility (even after PNTR):

- Shift in risk from NNTR to TW tariffs boosted trade of high NNTR goods
- Increasing substitution away from China consistent with rising trade war persistence

More broadly:

- Trade flows informative about policy expectations
- Ignoring policy uncertainty substantially understates "trade elasticity" (AKKRS 2024c)
- Conventional trade risks make problem tractable.
  - Bit harder to recover unconventional trade risks.

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, Armen Khederlarian, Kim J. Ruhl, and Joseph B. Steinberg (2024a) 'Trade-policy dynamics: Evidence from 60 years of U.S.-China trade.' *Journal of Political Economy*

Alessandria, George, Shafaat Yar Khan, and Armen Khederlarian (2024b) 'Taking stock of trade policy uncertainty: Evidence from china's pre-wto accession.' *Journal of International Economics* 150, 103938

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

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 (2019) 'The economic effects of trade policy uncertainty'

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), 364–95

Fitzgerald, Doireann, Stefanie Haller, and Yaniv Yedid-Levi (2016) 'How exporters grow.' NBER Working Paper 21935

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

Handley, Kyle (2014) 'Exporting under trade policy uncertinaty: Theory and evidence.' *Journal of International Economics* 94, 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

References

_ (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

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

Pierce, Justin R., and Peter K. Schott (2016) ‘The surprisingly swift decline of US manufacturing employment.’ *American Economic Review* 106(7), 1632–1662

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

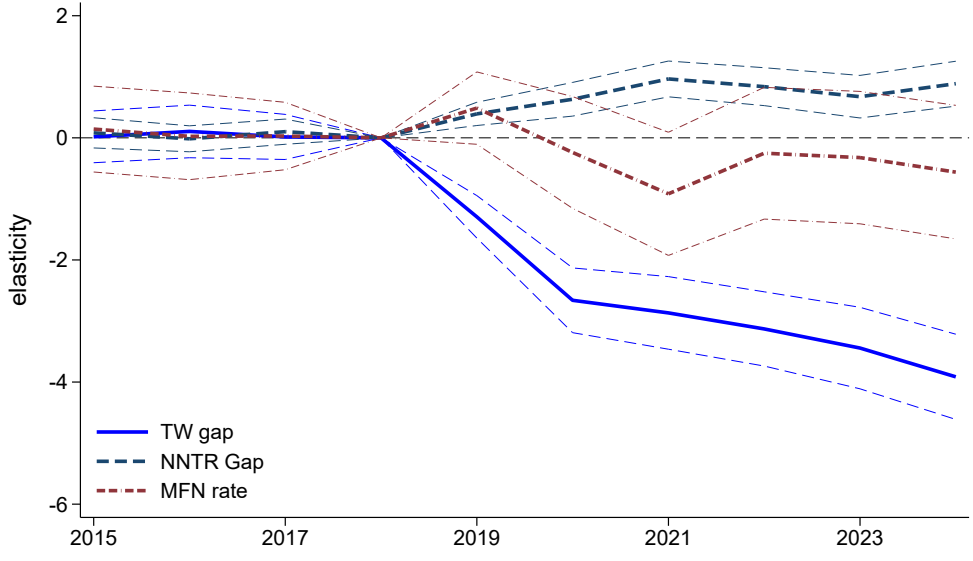
Simonovska, Ina, and Michael E. Waugh (2014) ‘The elasticity of trade: Estimates and evidence.’ *Journal of International Economics* 92(1), 34–50

References

Soderbery, Anson (2018) 'Trade elasticities, heterogeneity, and optimal tariffs.' *Journal of International Economics* 114, 44–62

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

Alternative Tariff Threat



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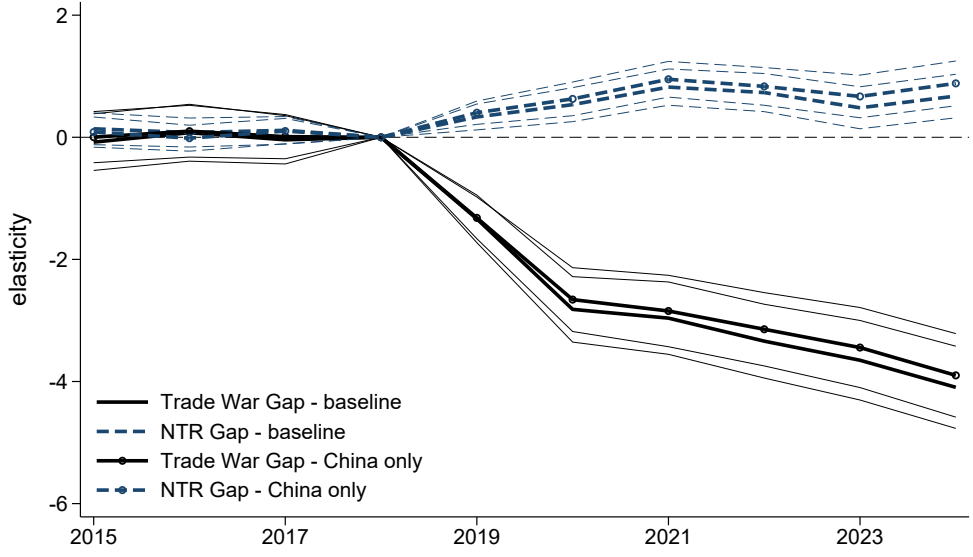
Identification using China only



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Pre-trade war alternative

- Four tariff regimes, MFN (P), NNTR (N), TW (W), MFNA (A)
- 2015–2016 probabilities same as baseline
- Regime-switching probabilities in 2017–18

$$\Omega^P = \begin{bmatrix} \rho^P/2 & 1-\rho^P & 0 & \rho^P/2 \\ 1-\rho^N & \rho^N & 0 & 0 \\ 1-\rho^W_{18} & 0 & \rho^W_{18} & 0 \\ 0 & 1-\rho^P & 0 & \rho^P \end{bmatrix}$$

- 2019– probabilities as in the baseline

Post-trade war alternative

- Four tariff regimes, MFN (P), NNTR (N), TW (W), TWA (A)
- Probabilities 2015–2021 as in baseline
- Regime-switching probabilities 2022–

$$\Omega_t^W = \begin{bmatrix} \rho^P & 0 & 1-\rho^P & 0 \\ 1-\rho^N & \rho^N & 0 & 0 \\ 1-\rho_t^W & 0 & \rho_t^W/2 & \rho_t^W/2 \\ 1-\rho_t^W & 0 & 0 & \rho_t^W \end{bmatrix}$$