Trade Policy Dynamics: Evidence from 50 years of China-U.S. trade
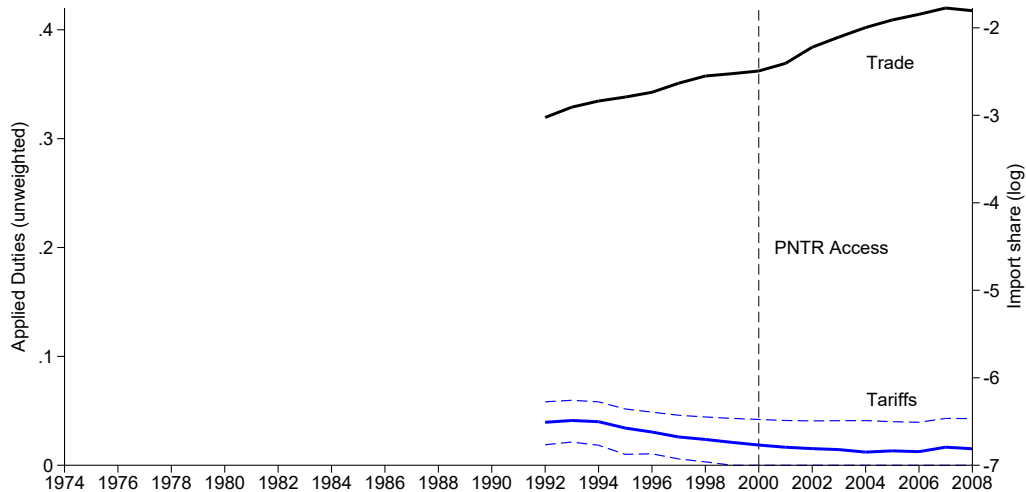
Alessandria, Khan, Khederlarian, Ruhl, and Steinberg

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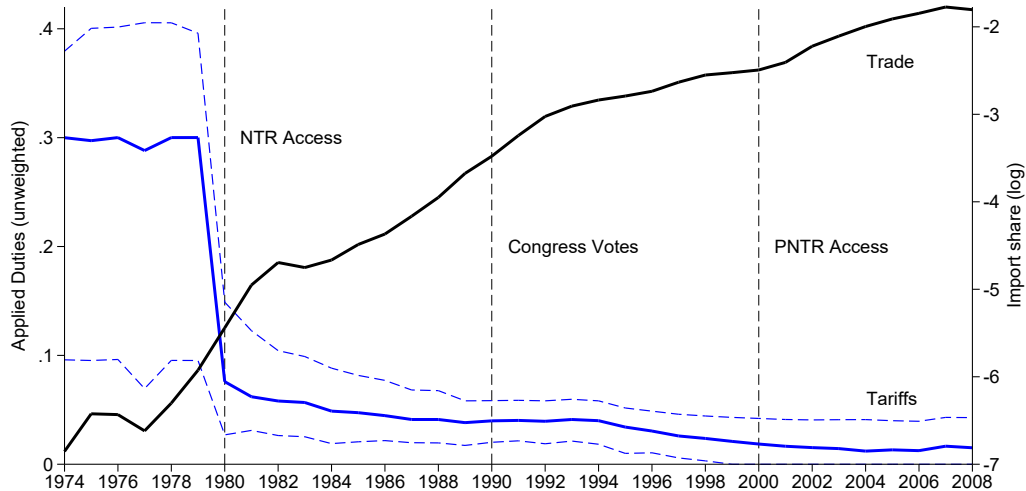
Aggregate trade

- Aggregate trade is a function of
  - Individual firm choices
  - Distribution over firms
- These are functions of past, present, and future policy

- Large literature studies the effects of past policy

- Growing literature focuses on uncertain future policy

China's import share and tariff rates

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▶ Our goal: Methodology for disentangling the past from the future

▶ Today: Use China-U.S. trade as a case study
  ▶ Begin from autarky
  ▶ No phase-ins of tariffs (as in NAFTA)

U.S. trade policy towards China: $(1 + \tau_t^{NTR})/(1 + \tau_t^{CH})$
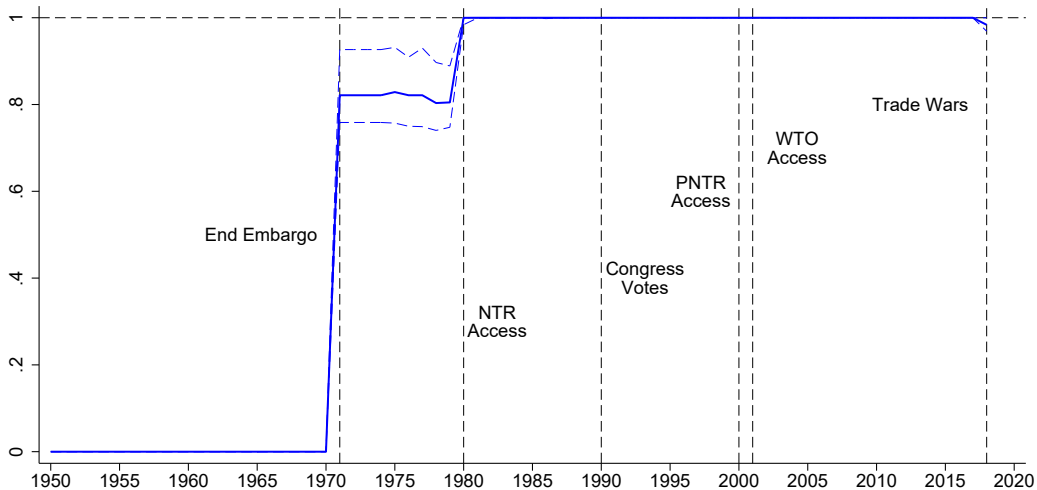
▶ The 1970s liberalizations were huge, adjustment takes decades

Roadmap

1. Summarize the slow nature of adjustment (long/short elasticities)

2. Difference in differences approach
  ▶ Revisit Pierce and Schott (2016); Handley and Limão (2017)

  ▶ Estimate year-by-year NNTR-gap coefficients on longer sample

  ▶ Adjust for effects of past policy

3. Quantitative model
  ▶ Partial equilibrium model with extensive and intensive margins

  ▶ Time-varying uncertainty over trade policy regime

  ▶ Estimate model to match NNTR-gap coefficients

  ▶ Recover agent beliefs over trade regime uncertainty

Our findings

1. Slow adjustment: $\sigma^{LR} \approx 8$, $\sigma^{SR} \approx 2.3$

2. Empirical
  - ▶ NNTR gap coefficients: 1970s $>>$ 1990s
  - ▶ NNTR gap coefficients shrink when adding lagged trade

3. Structural model
  - ▶ Policy uncertainty: 1980s $>>$ 1990s
  - ▶ Policy uncertainty before/after 2000 similar
  - ▶ Post-1980 uncertainty estimates quite stable
  - ▶ High initial policy uncertainty delayed transition from early liberalizations

Trade elasticities

- $j =$ country, $g =$ good (SITC 5-digit)

- $v =$ trade value, $\tau =$ applied duties, $\delta =$ fixed effect

- Error correction model (restricted) $\sigma^{LR} = \sigma^{SR}/(1 - \alpha)$

$$v_{jgt} = \sigma^{SR} \mathbb{1}\{j = \text{China}\}\tau_{jgt} + \sigma^{SR} \mathbb{1}\{j \neq \text{China}\}\tau_{jgt}$$
$$+ \alpha \mathbb{1}\{j = \text{China}\}v_{jg,t-1} + \alpha \mathbb{1}\{j \neq \text{China}\}v_{jg,t-1} + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt},$$

- Error correction model (unrestricted) $\sigma^{LR} = -\alpha_2/\alpha_1$

$$\Delta v_{jgt} = \sigma^{SR} \mathbb{1}\{j = \text{China}\}\Delta\tau_{jgt} + \sigma^{SR} \mathbb{1}\{j \neq \text{China}\}\Delta\tau_{jgt}$$
$$+ \alpha_2 \mathbb{1}\{j = \text{China}\}\tau_{jg,t-1} + \alpha_2 \mathbb{1}\{j \neq \text{China}\}\tau_{jg,t-1}$$
$$+ \alpha_1 \mathbb{1}\{j = \text{China}\}v_{jg,t-1} + \alpha_1 \mathbb{1}\{j \neq \text{China}\}v_{jg,t-1} + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}.$$

Aggregate elasticity estimates

	Cross-section	ECM rest.	ECM unrest.
	v_{jgt}	v_{jgt}	Δv_{jgt}
$\mathbb{1}\{j = China\}\tau_{jgt}$	-6.69 ***	-2.84 ***	
$\mathbb{1}\{j = China\}\Delta\tau_{jgt}$			-2.30 ***
$\mathbb{1}\{j = China\}v_{jg,t-1}$		0.63***	-0.37 ***
$\mathbb{1}\{j = China\}\tau_{jg,t-1}$			-2.96 ***
Long-Run China		-7.78 ***	-8.07 ***
Long-/Short-Run China		2.74	3.51
FE	gt, jt, gj	gt, jt, gj	gt, jt, gj
Observations	1,184,722	934,249	934,249
Adjusted R^2	0.79	0.86	0.27

Difference in differences approach

- Follow Pierce and Schott (2016)

- $X_g =$ NNTR Gap (Column two tariff minus MFN tariff)

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

Tariff gap estimates

|	PS (2016)	1974–2008	NTR countries	Excl. tariffs	NNTR	Applied NNTR
$\mathbb{1}_{\substack{t>2000 \\ j=China}} NNTRGap_g$	0.9***	2.5***	3.3***	3.6***		
$\mathbb{1}_{\substack{t>2000 \\ j=China}} NNTR_g$					3.0***	
$\mathbb{1}_{\substack{t>2000 \\ j=China}} AppNNTR_g$						4.1***
τ_{jgt}	-3.3***	-3.2***	-2.8***			
Period	'92-'07	'74-'08	'74-'08	'74-'08	'74-'08	'74-'08
Countries	All	All	NTR	NTR	NTR	NTR
Life-Cycle controls					✓	
FE	gt, jt, gj	gt, jt, gj	gt, jt, gj	gt, jt, gj	gt, jt, gj	gt, jt, gj
R^2	0.86	0.81	0.80	0.80	0.80	0.82

Difference in differences approach

▶ Follow Pierce and Schott (2016)

▶ $X_g = $ NNTR Gap (Column two tariff minus MFN tariff)

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

▶ The dynamics of the NNTR-gap effects

$$v_{jgt} = \sum_{t'=1974}^{2007} \beta_t \mathbb{1}\{t = t'\} \mathbb{1}\{j = China\} X_g + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$

Elasticity of U.S. imports from China to NNTR gap
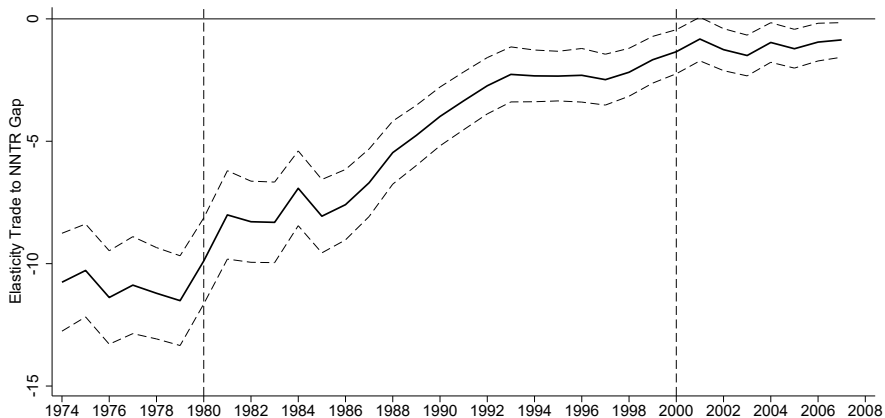
- ▶ Coefficients capture initial reform and expectations (1970s vs. 1980s)
- ▶ Flat before 1980
- ▶ Jumps in 1980 with NTR liberalization; Stalls in early 1980s
- ▶ 1990s growth small share of overall growth

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Difference in differences approach (Pierce and Schott 2016)

▶ X_g = NNTR Gap (Column two tariff minus MFN tariff)

$$v_{jgt} = \beta \mathbb{1}\{t > 2000\} \mathbb{1}\{j = China\} X_g + \sigma \tau_{jgt} + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$
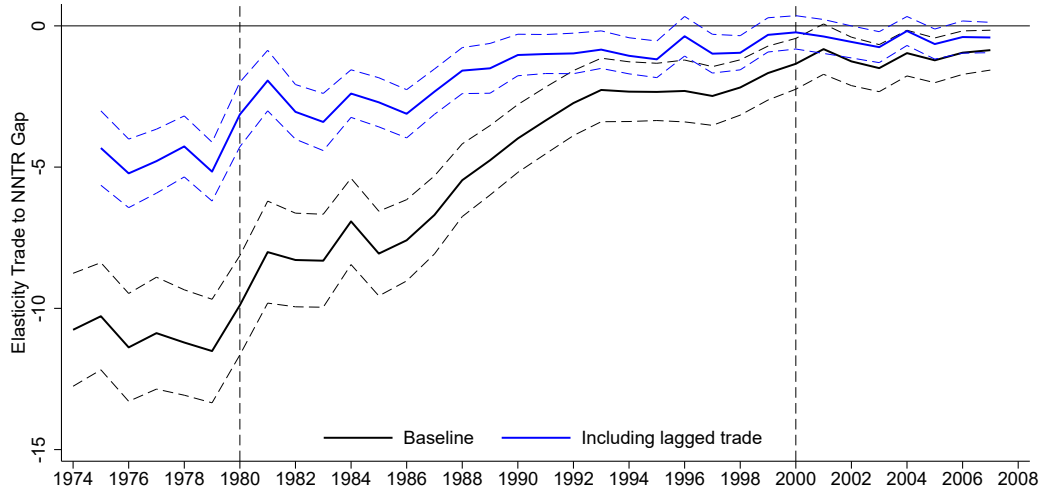
▶ The dynamics of the NNTR-gap effects

$$v_{jgt} = \sum_{t'=1974}^{2007} \beta_t \mathbb{1}\{t = t'\} \mathbb{1}\{j = China\} X_g + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$

▶ A crude way to control for the pervious liberalizations

$$v_{jgt} = \sum_{t'=1974}^{2007} \beta_t \mathbb{1}\{t = t'\} \mathbb{1}\{j = China\} X_g + \gamma v_{jg,t-1} + \delta_{jt} + \delta_{jg} + \delta_{gt} + u_{jgt}$$

Elasticity of U.S. imports from China to NNTR gap

Findings robust to:

- Level of aggregation (TSUSA8/HS8)
- Sample of countries (NTR countries/all countries)
- Alternative gap measures (NNTR statutory, NNTR applied)
- Sample of goods (balanced/unbalanced)
- Trade costs (applied tariffs, shipping costs)
- Life cycle controls (entry/exit dummies, age, age^2)

The model

▶ Ingredients
  ▶ Time-varying uncertainty over policy
  ▶ Exporter life cycle (slow adjustment)

▶ Partial equilibrium version of ACR(2021)

▶ G goods, matched to SITC 5-digit tariffs

▶ In each g, fixed mass of producers (no entry)
  ▶ Heterogenous in productivity (z), variable trade cost (ξ)
  ▶ Firms exit with probability $1 - \delta(z)$, replaced by new firm

▶ Two policy regimes: NNTR and MFN
  ▶ At each t, probability of moving to the other regime

Producers in China

▶ Production (z = productivity; ℓ = labor)

$$y_t = z_t \ell_t$$

▶ Firm-level demand (τ = tariff; ξ = trade cost; D^* = aggregate shifter)

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

▶ Variable export costs
   ▶ $\xi_L < \xi_H < \infty$
   ▶ New exporters are ξ_H, then Markov process over ξ

▶ Fixed export costs
   ▶ f_0 to enter, f_1 to continue
   ▶ One period "time to export"

Static optimization

► Firms are monopolistic competitors

► Export status is predetermined

$$\pi(z_t, \xi_t, \tau_{gt}) = \max_{p, \ell} p_t d_t(p_t, \xi_t, \tau_{gt}) - w_t \ell_t$$

$$\text{s.t. } z_t \ell_t \geq d_t(p_t, \xi_t, \tau_{gt}) \xi_t$$

Dynamic optimization

▶ A firm that chooses to export at $t+1$

$$V_{gt}^1 \left(z_t, \xi_t, \tau_{gt}\right) = -f(\xi_t) + \frac{\delta(z_t)}{1+r} \mathop{\mathbb{E}}_{\substack{t \\ z,\xi,\tau}} V_{t+1} \left(z_{t+1}, \xi_{t+1}, \tau_{g,t+1}\right)$$

▶ A firm that choose not to export at $t+1$

$$V_{gt}^0 \left(z_t, \xi_t, \tau_{gt}\right) = \frac{\delta(z_t)}{1+r} \mathop{\mathbb{E}}_{\substack{t \\ z,\xi,\tau}} V_{t+1} \left(z_{t+1}, \infty, \tau_{g,t+1}\right)$$

▶ Firm value

$$V_{gt} \left(z_t, \xi_t, \tau_{gt}\right) = \pi(z_t, \xi_t, \tau_{gt}) + \max \left\{ V_{gt}^1 \left(z_t, \xi_t, \tau_{gt}\right), V_{gt}^0 \left(z_t, \xi_t, \tau_{gt}\right) \right\}$$

Dynamic optimization

▶ The break-even exporter has

$$V_{gt}^0 \left(z_t, \xi_t, \tau_{gt}\right) = V_{gt}^1 \left(z_t, \xi_t, \tau_{gt}\right)$$

▶ Equating the cost of exporting to the benefit

$$f(\xi_t) = \frac{\delta(z_t)}{1 + r} \mathop{\mathbb{E}_t}_{z,\xi,\tau} \left[V_{t+1}(z_{t+1}, \xi_{t+1}, \tau_{t+1}) - V_{t+1}(z_{t+1}, \infty, \tau_{t+1})\right]$$

Aggregate exports

▶ Measures of exporters $\varphi_{gt}^1(z, \xi)$

$$EX_{gt} = \sum_{\xi \in \{\xi_L, \xi_H\}} \int_z p(z, \xi, \tau_{gt}) \, y(z, \xi, \tau_{gt}) \, \varphi_{gt}^1(z, \xi) \, dz.$$

▶ *py* depends on current tariff rates (jump variables)

▶ φ depends on past and future tariff rates (state variables)

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 two tariff paths (NNTR, MFN)
   - 1971: Observe time-varying Markov probs. of switching regimes

Estimation: Basics

Parameter	Meaning	Value	Source/target
Assigned			
w	Wage	1	Normalization
r	Interest rate	4 pct.	Standard
σ_z	Variance of productivity	1.32	Alessandria et al. (2021)
ρ_z	Persistence of productivity	0.65	"
δ_0	Corr. of survival with productivity	21.04	"
δ_1	Minimum death probability	0.023	"
τ_{g1}	NNTR tariff	Varies	Data
τ_{g2}	MFN tariff	Varies	Data
Calibrated to match terminal steady state			
f_0	Entry cost	0.60	Export part. rate = 22 pct.
f_1	Continuation cost	0.32	Exit rate = 17 pct.
ξ_H/ξ_L	High iceberg cost	2.40	$\frac{\text{mean ent. sales}}{\text{mean inc. sales}} = 0.5$

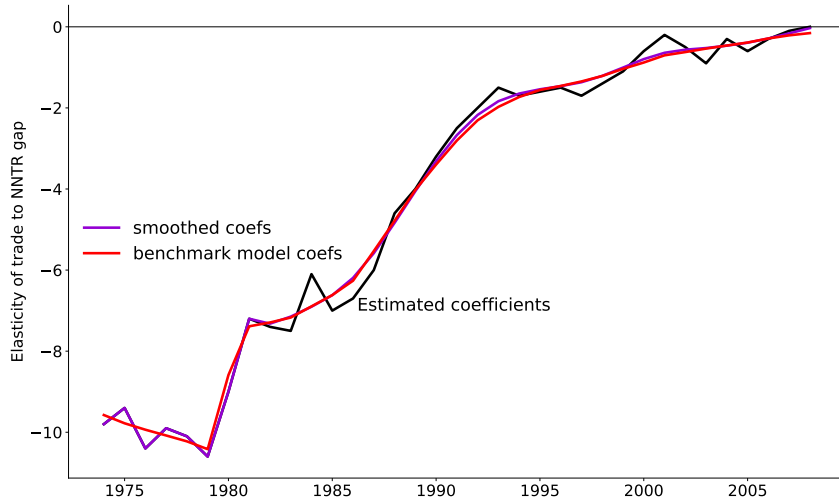## Calibrating to transition dynamics

- ▶ Indirect inference approach
    - ▶ Run DiD regressions in the model
    - ▶ Run ECM regressions in the model
- ▶ Match aggregate trade adjustment and industry differences

- ▶ Probability of NNTR $\rightarrow$ MFN: ω_{21}
    - ▶ Match average NNTR gap coefficients 1974–1979
- ▶ Probability of MFN $\rightarrow$ NNTR: $\{\omega_{12,t}\}_{t=1980}^{2008}$
    - ▶ Match NNTR gap coefficients 1980–2008

- ▶ Demand elasticity: $\theta = 3.55$ to match ECM $\sigma^{SR} = 2.3$
- ▶ Iceberg cost persistence: $\rho_\xi = 0.85$ to match ECM $\sigma^{LR} = 8.07$
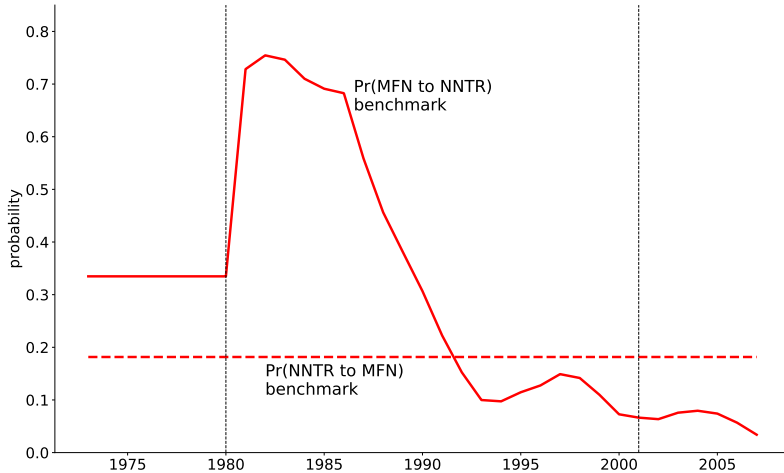
Smooth the coefficients from 1981–2008

Estimated coefficients
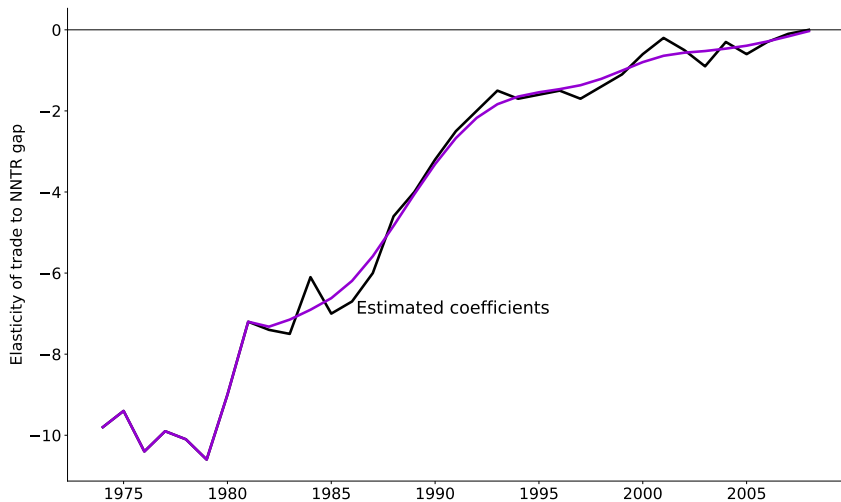
► Do not smooth jump at 1980, it identifies σ^{SR}

Model fit

Estimated coefficients

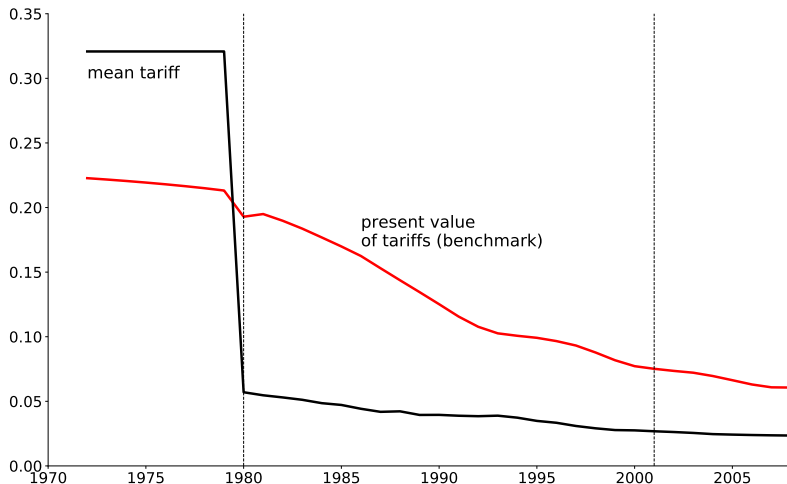- smoothed coefs
- benchmark model coefs

Estimated probabilities

- ► Lots of uncertainty in the early 1980s
- ► Falls rapidly post-1986
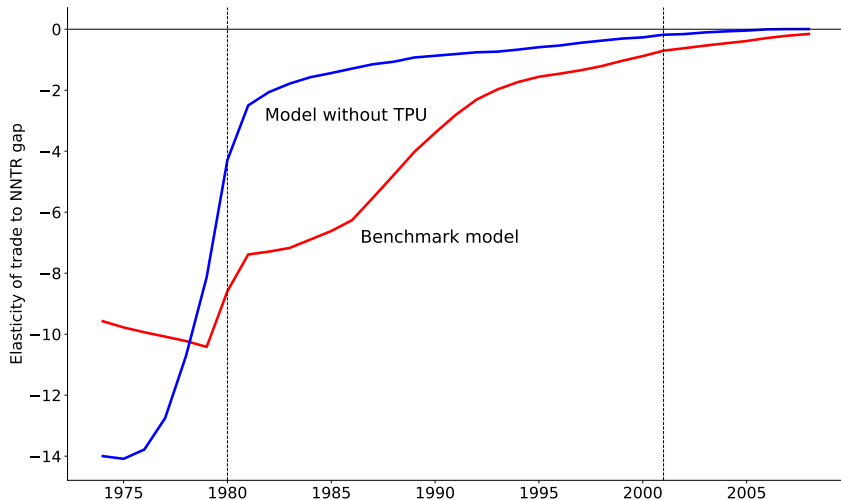- ► Much lower in the late 1990s and 2000s

Present value of tariffs

- $\tau_t^{pv} = (1 - \beta) \sum_{s=t}^{\infty} \beta^{s-t} \mathbb{E}_t[\tau_s]$
- Expected tariffs stay high, suppressing entry
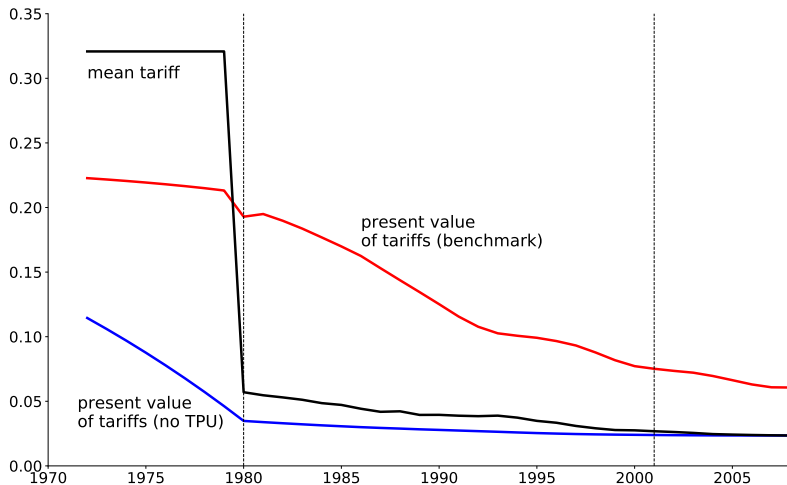
Uncertainty effects

- ▶ Model begins in 1971; all firms are nonexporters

- ▶ Benchmark model ("with TPU")
    - ▶ 1971: Learn that autarky is over, in NNTR regime
    - ▶ 1971: Observe two tariff paths (NNTR, MFN)
    - ▶ 1971: Observe time-varying Markov probs. of switching regimes

- ▶ Counterfactual model ("no TPU")
    - ▶ 1971: Learn that autarky is over, in NNTR regime
    - ▶ 1971: Learn that NNTR until 1980, MFN afterwards
    - ▶ No uncertainty. Perfect foresight.

The effects of policy uncertainty

- ▶ TPU slows down trade growth significantly
- ▶ Largest effects are in the 1980s
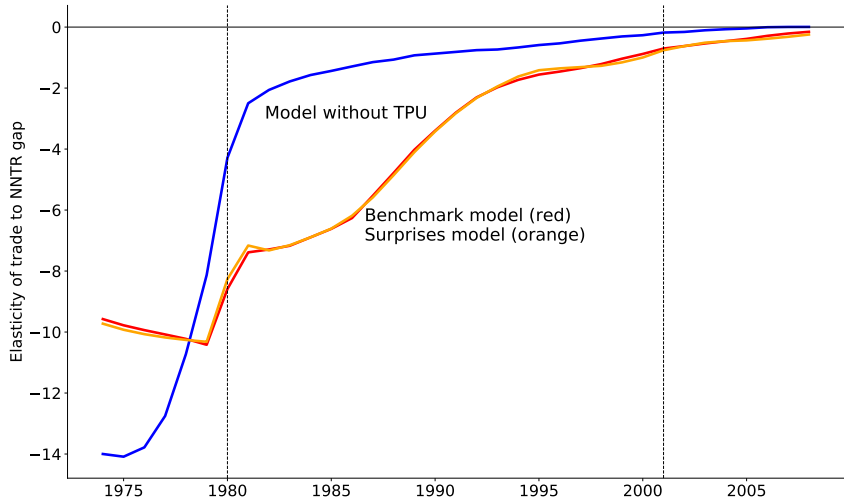- ▶ Trade is more depressed in early period

Present value of tariffs

- ▶ (TPU) Expected tariffs stay high, suppressing entry
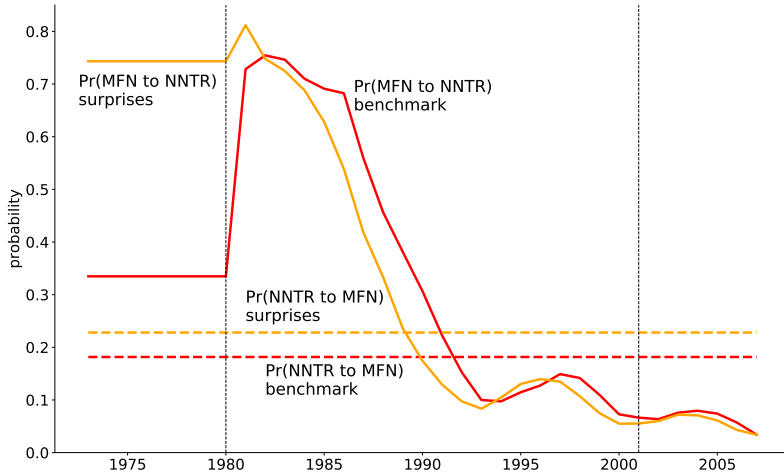- ▶ (no TPU) Expected tariffs fall quickly, change little

Sensitivity to expectations assumptions

▶ Model begins in 1971; all firms are nonexporters

▶ Benchmark model ("with TPU")
  ▶ 1971: Learn that autarky is over, in NNTR regime
  ▶ 1971: Observe two tariff paths (NNTR, MFN)
  ▶ 1971: Observe time-varying Markov probs. of switching regimes

▶ Counterfactual model ("no TPU")
  ▶ 1971: Learn that autarky is over, in NNTR regime
  ▶ 1971: Learn that NNTR until 1980, MFN afterwards
  ▶ No uncertainty. Perfect foresight.

▶ Counterfactual model ("surprises")
  ▶ 1971: Learn that autarky is over, in NNTR regime
  ▶ 1971–2008: Surprised by a new transition matrix, believe it is permanent

Expectation assumptions

- Model without TPU
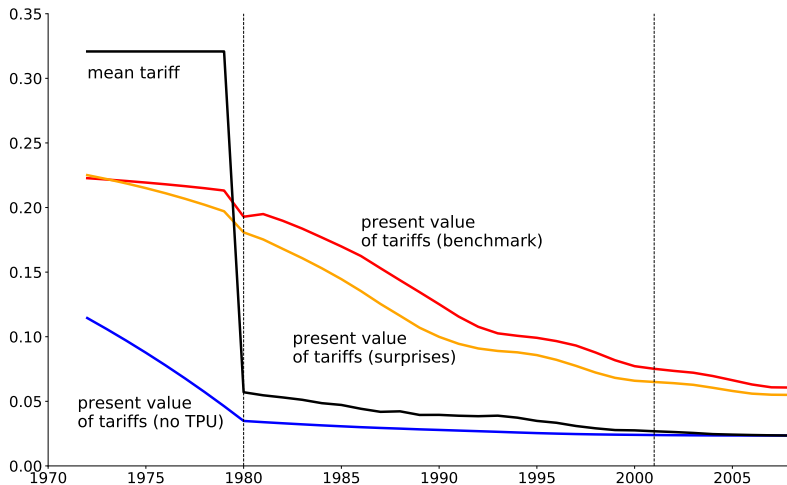- Benchmark model (red)
- Surprises model (orange)

Estimated probabilities

- ▶ Post-1980 estimates relatively unchanged
- ▶ Pre-1980: if benchmark estimate was believed permanent, would get too much entry

Present value of tariffs

- ▶ (TPU) Expected tariffs stay high, suppressing entry
- ▶ (no TPU) Expected tariffs fall quickly, change little
- ▶ (surprises) Tariff PV pre-1980 very similar to benchmark

Conclusions

1. Slow adjustment: $\sigma^{LR} \approx 8$, $\sigma^{SR} \approx 2.3$

2. Empirical
- ▶ NNTR gap coefficients: 1970s $>>$ 1990s
- ▶ NNTR gap coefficients shrink when adding lagged trade

3. Structural model
- ▶ Policy uncertainty: 1980s $>>$ 1990s
- ▶ Policy uncertainty before/after 2000 similar
- ▶ Post-1980 uncertainty estimates quite stable
- ▶ Policy uncertainty slowed down transition from early liberalizations

References

Alessandria, George, Horag Choi, and Kim J. Ruhl, "Trade adjustment dynamics and the welfare gains from trade," *Journal of International Economics*, 2021, *131*, 1034–58.

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