Asymmetric Trade Costs and Trade Balance Dynamics

Roman Merga and Brian Shin

January 30, 2024

Motivation

- Recent increases in both tariffs and non-tariff measures
- Some of these changes have been motivated to counteract trade balance deficits
- Revisit a classic question (Obstfeld et al., 2000 ; Boz et al. 2019):

  Do trade costs affect trade balance and exchange rate dynamics?

What we do

- Derive a new and model-consistent empirical measure for export and import costs
- Decompose the export and import cost measures:
  1. A common component
  2. A differential component
- Analyze the empirical relationship of these trade costs with:
  1. Trade openness
  2. Trade balance dynamics
  3. Real effective exchange rate (REER)
- Analyze trade policy episodes and their impact on these costs
- Model replicating the findings + different tariffs changes scenarios (To do - not today)

What we find

- Common trade cost shocks:
  1. Reduce trade openness (TO)
  2. No significant effect on trade balance over GDP (TBY)
  3. Important drivers of trade openness increased over the last two decades
- Differential trade cost shocks:
  1. Are asymmetric
  2. Present important dynamics
  3. Generate temporary reduction in TBY
  4. Generate temporary depreciation of REER
- Mapping to tariffs: A 1 p.p. increase in effective tariffs is associated with a 0.3 p.p. increase in TBY

Literature

1. Measuring trade costs: Alessandria et al. (2021), Boz et al. (2019), Eaton et al. (2002), Head et al. (2001), Jacks et al. (2011; 2008), Novy (2013), Waugh (2010), and Waugh et al. (2016)

   Contribution:

   - **New empirical measures for export and import costs separately**
   - **Differentiate between common and differential costs for these costs**

2. Trade costs shocks relevance for trade balance dynamics and REER: Alessandria et al. (2017), Alessandria et al. (2021), Alessandria et al. (2025), Barattieri et al. (2021), Bodenstein et al. (2024), Boz et al. (2019), Cuba-Borda et al. (2025), Cuñat et al. (2024), Fitzgerald (2012), Itshoki et al. (2021), Ju et al. (2021), Lindé et al. (2019), MacMullen et al. (2023), and Reyes-Heroles (2016)

   Contribution:

   - **Empirical relevance of these trade components for REER, and trade balance**
   - **Trade costs evolution and trade events**

Outline

Trade cost measure

Similar approach to Head et al. (2001). Define f's expenditure share on goods from d as:

$$\lambda^{d,f} = \frac{p_t^{d,f} x_t^{d,f}}{P_t^{f,C} C_t^f}$$

Export costs when d exports to f are given by:

$$\text{exp cost}_t^{d,f} = \left(\frac{\lambda_t^{d,f}}{\lambda^{d,d}} \right)^{\frac{1}{1-\theta}} \left(\frac{P_t^{f,C}}{P_t^{d,C}} \right) \tag{1}$$

Import costs when d imports from f are then given:

$$\text{imp cost}_t^{d,f} = \left(\frac{\lambda_t^{f,d}}{\lambda^{f,f}} \right)^{\frac{1}{1-\theta}} \left(\frac{P_t^{d,C}}{P_t^{f,C}} \right) \tag{2}$$

In what follows we treat country f as rest of the world (ROW)

Model details

Costs and benefits of the measure

- Benefits:
  1. Simple to compute
  2. Model-consistent: consistent with CES model of international trade (Novy 2013)
  3. Do not need to rule out export or import costs (Details on FE approach)
  4. By focusing on the origin country-ROW trade flows, it rules out aggregation problems
- Costs:
  1. The measures are indexes: They can't be mapped to tariffs equivalents in p.p.
  2. Too sensitive to price index changes or REER - (Ruhl 2008, Fitzgerald et al. 2024)
  3. Price data is different from "ideal price indexes"

Bringing trade cost measure to the data

$$\lambda^{n,z} = \frac{\overbrace{p_t^{n,z} x_t^{n,z}}^{\text{expt/impt/ tr. dom prod}}}{\underbrace{P_t^z C_t^z}_{\text{I-O total expenditure}}}$$

Export costs:

$$\text{exp cost}_t^{d,f} = \left(\frac{\lambda_t^{d,f}}{\lambda^{d,d}}\right)^{\frac{1}{1-\theta}} \underbrace{\left(\frac{P_t^{f,C}}{P_t^{d,C}}\right)^{(\frac{1-\alpha\theta}{1-\theta})}}_{\approx REER} \tag{3}$$

α : **Ad-hoc adjustment capturing trade flows' differential elasticity to REER**

Data & mapping

- OECD Input-Output tables: 1995-2020
- REER from Darvas 2012
- WEO for other aggregate variables
- Government revenues from imports and export tax: OECD

Trade costs' common and differential components

Decompose export and import costs into a common δ^{C} and differential δ_j^{D} component:

$$\ln\left(\text{exp costs}_{i,t}\right) = \ln \delta_{i,t}^{\mathrm{C}} + \ln \delta_{i,t}^{\mathrm{exp,D}}$$

$$\ln\left(\text{imp costs}_{i,t}\right) = \ln \delta_{i,t}^{\mathrm{C}} + \ln \delta_{i,t}^{\mathrm{imp,D}}$$

Hence, the export-import cost ratio becomes:

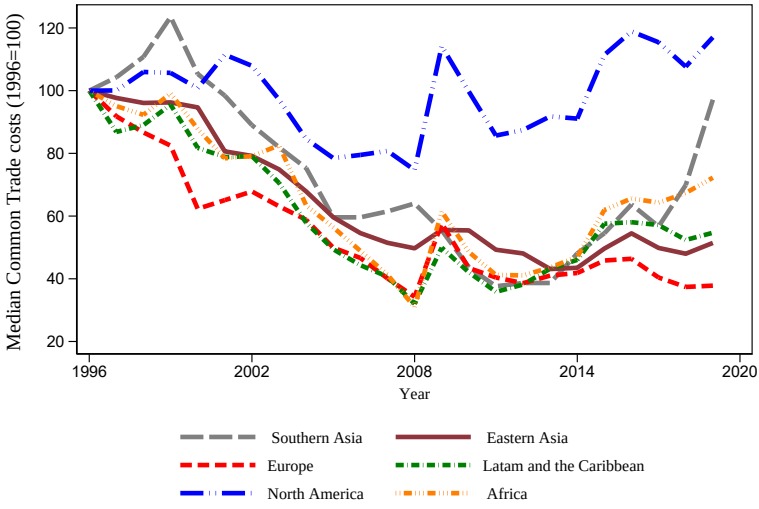
$$\ln\left(\frac{\text{exp costs}_{i,t}}{\text{imp costs}_{i,t}}\right) = \ln\left(\frac{\delta_{i,t}^{\mathrm{C}}\delta_{i,t}^{\mathrm{exp,D}}}{\delta_{i,t}^{\mathrm{C}}\delta_{i,t}^{\mathrm{imp,D}}}\right)$$

Takeaway: export-import cost ratio captures only the differential movements

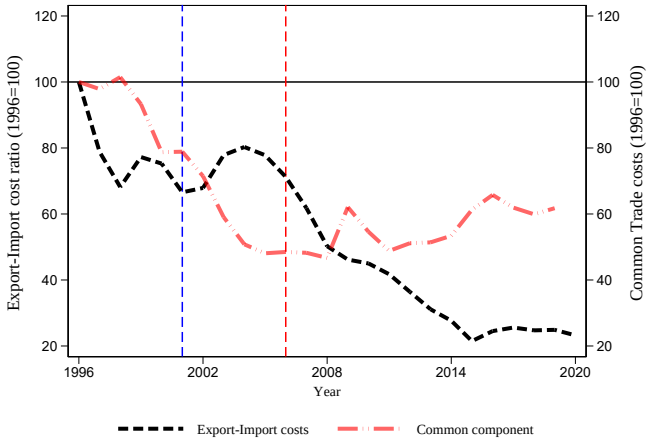
Next steps

- Example of measure over time
- Test common component's relevance for openness and TBY
  Compute common component using common factor analysis for each country
- Test exp-imp cost ratio relevance for TBY and REER
- Map their evolution to different events and tariff changes

Common trade costs evolution by region



Trade costs evolution China example



USA, Trade Cost Changes Distribution

Empirical specification

Estimate the following local projection:

$$\Delta_h Y_{i,t+h} = \beta^h \ln(\text{trade costs}) + \boldsymbol{\beta}_2 \boldsymbol{X}_{i,t} + \gamma_t + \epsilon_{i,t+h} \tag{4}$$

- $Y_{i,t+h} =$
  1. $\ln TO_{i,t} = \ln\left(\frac{\text{expt}_{i,t}+\text{impt}_{i,t}}{\text{GDP}_{i,t}}\right)$
  2. $TBY = \frac{\text{expt}_{i,t}-\text{impt}_{i,t}}{\text{GDP}_{i,t}}$
- β^h shows the cumulative elasticity h years after the change in trade cost occurs
- Trade costs:
  1. Common component
  2. Exp-imp cost ratio
- $\mathbf{X}_{i,t}$ includes: tot, RER, relative expenditure between country and ROW, up to 4 years lag for the dependent variable, and trade costs
- γ_t denotes year fixed effects

Common trade costs shocks decrease openness

Figure: TO response

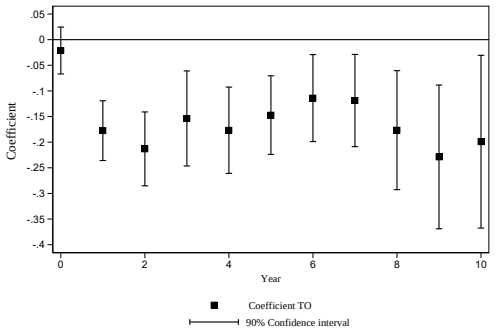
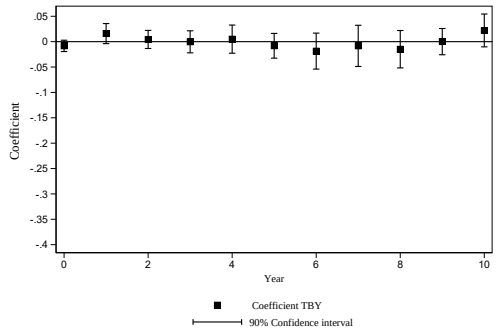


Figure: TBY response



Common trade costs shocks: Takeaways

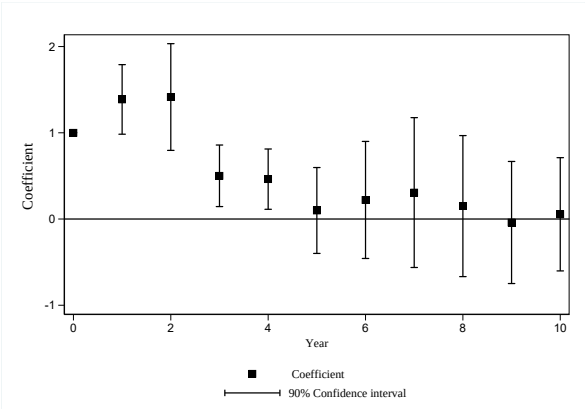
1. Increases in common trade costs decrease trade openness (TO)

2. Common trade costs have little impact on trade balance over GDP

3. Effective tariff changes are unlikely to affect TBY if ROW fully retaliates

Export-import cost shocks dynamics

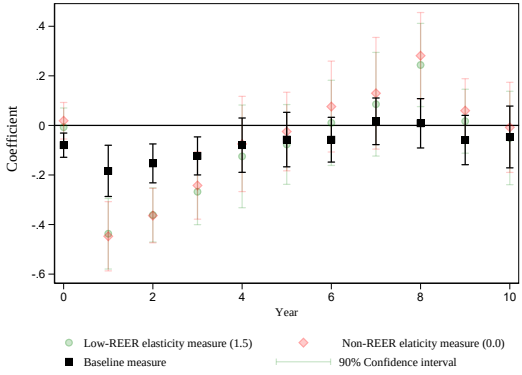
Figure: Exp-Imp cost ratio dynamics



The export-import cost ratio presents a hump-shape dynamic

Export-import cost shocks temporary reduce TBY

Figure: Trade balance over GDP response to changes in exp-imp cost ratio

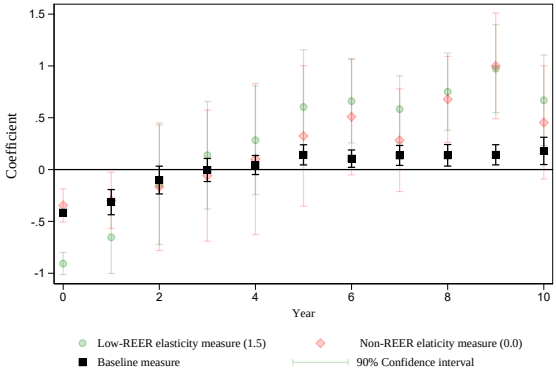


A 1% ↑ in the export-import cost ratio → ↓ TBY between 0.2 and 0.4 p.p.

Trade Cost Changes Distribution

Export-import cost shocks trigger temporary depreciation of REER

Figure: REER response to changes in exp-imp cost ratio



A 1% ↑ in the export-import cost ratio → ↓ (depreciates) REER between 0.5 and 1 %

Exp-Imp trade cost shocks: Takeaways

Export-import trade costs ratio:

1. Are asymmetric shocks by construction
2. Are dynamic (hump shape)
3. Temporarily reduce TBY
4. Temporarily depreciate REER

Trade events

- Define effective tariffs (export tax):

$$\text{effective tariffs}_{i,t} = \frac{\text{gov rev imports}_{i,t}}{\text{total imports}_{i,t}}$$

- Data: OECD
- Look for specific events and compare them with proposed measures:
  1. Argentina 2001: both export tax + import tariffs
  2. Examples of effective tariffs movements larger than 2.0 p.p. over 4 years
- Test empirical relationship between tariffs, import costs, and exp-imp trade cost ratio

Event 1: Argentina trade policy during 2001

Both trade policy and capital controls measures relate to trade cost measure

Import costs and tariffs

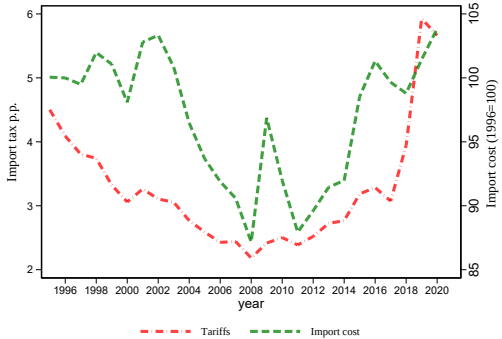


Figure: USA

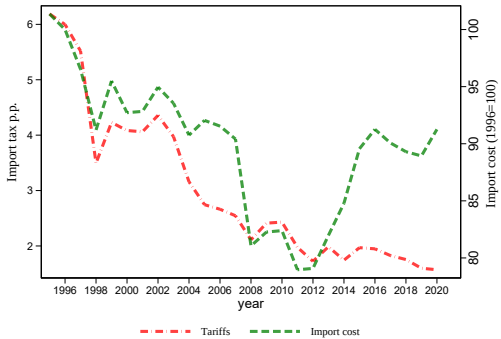


Figure: Korea

Import costs and tariffs

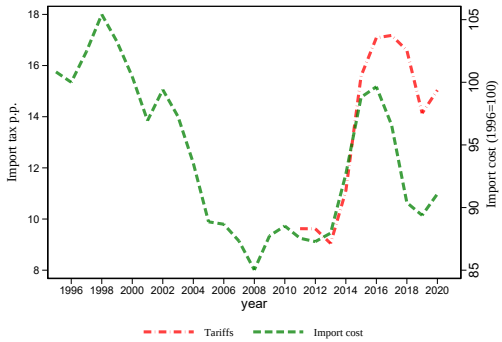


Figure: Pakistan

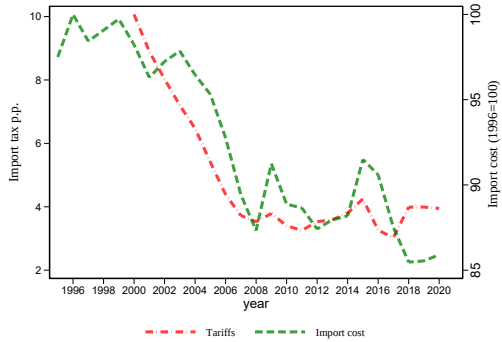


Figure: Peru

Other episodes

Tariffs and trade costs relationship

- Estimate the following regression:

$$ln(\text{Trade costs}_{i,t}) = \beta \text{Effective tariffs}_{i,t} + \beta^{\mathbf{2}} X_{i,t} + \gamma_i + \alpha_t + \epsilon_{i,t}$$

- $\mathbf{X}_{i,t}$ includes: tot, RER, relative expenditure between country and ROW, up to 4 years lag values for dependent variable, and effective tariffs

Tariffs and trade costs relationship

Panel 1: Import costs

	Δ Import costs	Δ Import costs	Δ Import costs
Δ Tariffs	2.917***	2.897***	1.034***
	(0.300)	(0.313)	(0.151)
N	1037	1037	649
R^2	0.084	0.111	0.941

Panel 2: Exp-Imp cost ratio

	Δ Exp-Imp cost	Δ Exp-Imp cost	Δ Exp-Imp cost
Δ Tariffs × $I_{\Delta\text{Tariffs}\leq 0}$	-5.020***	-5.375***	-1.837***
	(0.716)	(0.733)	(0.360)
Δ Tariffs × $I_{\Delta\text{Tariffs}>0}$	-1.643	-2.137	0.923
	(1.424)	(1.433)	(0.518)
N	1037	1037	649
R^2	0.052	0.085	0.942
Year FE	-	✓	✓
Controls	-	-	✓

Full Estimates

Takeaway

- Import costs increase 1.0% when tariffs increase one p.p.
- Export-import cost responses to tariffs appear driven by changes in import costs
- A 1 p.p. increase in effective tariffs is associated with:
  1. temporary increase TBY of 0.3 p.p.
     ($\approx$ 20% of TBY abs average yearly movement)
- A s.d change in effective tariffs is associated with a 0.28 p.p. increase in TBY
  ($\approx$ 10.7% of TBY s.d yearly change)

Tariffs change distribution

Conclusions

1. Developed a new - model-consistent- measure of asymmetric trade cost differential
2. Common trade shocks:
   - 2.1 Decrease trade openness
   - 2.2 little impact on TBY (usual intuition)
3. Differential Exp-imp cost measures:
   - 3.1 Are Asymmetric
   - 3.2 Are Dynamic - hump shape -
   - 3.3 Matter for TBY and REER dynamics
4. Tariffs can temporarily affect TBY, but:
   - 4.1 Not under full retaliation (if export costs fully offset import cost increase)
   - 4.2 Tariff dynamics might be relevant (assuming: same dynamics as for Exp-Imp cost ratio)
   - 4.3 Potential asymmetric response of exp-imp trade cost ratio to tariffs changes

Next steps

- More on trade costs and trade policies - GATT, and other multilateral agreements -
- Differentiate between developing and developed economies
- Estimate 2 country DSGE with exporters dynamics:
  - Match empirical findings and moments
  - Consequences of different tariffs policies
- Use dynamic model to understand the relevance of:
  - Permanent vs transitory tariffs changes
  - Retaliation through tariffs or non-tariffs
  - Consequences of switching to a regime where tariffs/NTMs respond more intensively to the trade balance or the state of the economy?

Appendix

Theoretical Framework

- Two countries - denote foreign country by *
- Endowments economies
- Two types of goods:
  1. Tradable from foreign to domestic ($x^{d,f}$)
  2. Non-tradable goods ($x_{nt}^{d,d}$)
- Two types of trade costs:
  - Iceberg costs to export from d (f) to domestic (foreign): τ_t (τ_t^*)
  - Trade wedge ξ_t: difference between consumption price relative to custom import prices

Intra-temporal problem

$$PC = \min p_t^{d,f} \zeta_t x_t^{d,f} + p_t^{d,d} x_t^{d,d} + p_{nt,t} x_{nt,t}$$

s.t.

$$C \leq [(\omega_1^{\frac{1}{\theta}} (x_t^{d,f})^{\frac{\theta-1}{\theta}} + \omega_2^{\frac{1}{\theta}} (x_t^{d,d})^{\frac{\theta-1}{\theta}} + \omega_3^{\frac{1}{\theta}} (x_{nt,t})^{\frac{\theta-1}{\theta}})]^{\frac{\theta}{\theta-1}} \tag{5}$$

ζ_t : **Difference between custom recorded price $p_t^{d,f}$ and consumer price**

$\tau_t^{d,f}$**: Affects custom prices relative to domestic prices** ($\tau_t^{d,f} = \frac{p_t^{d,f}}{p_t^{f,f}}$)

$\omega_i = 1 \ \forall i$ **for exposition simplicity**

Trade cost measure

FE method: Estimation of trade costs

Bilateral trade costs are estimated as follows:

1. Estimate using PPML:

$$\ln(X_{ni}/X_{nn}) = im_n + ex_i + Y_{ni} + \epsilon_{ni} \tag{6}$$

   Where $im_i; ex_n$ are FE. Y_{ni} is a vector of bilateral gravity controls

2. Set value for θ, and using equation (9) we get import and export costs are given by

$$ln(d_i^{exp}) + ln(d_i^{imp}) = \frac{im_i - ex_i}{\theta} \equiv \xi_i$$

3. Construct bilateral costs

$$\ln(\tilde{d}_{ni}) = Y_{ni} + \xi_n \tag{7}$$

4. Aggregated trade costs are:

$$d_n^{FE,exp} \equiv EXC_i = \sum_n w_{ni} d_{ni} \;\; ; \;\; d_n^{FE,imp} \equiv EMC_i = \sum_n w_{in} d_{in} \tag{8}$$

Back

Problem 1: FE approach might generate miss-specified trade cost

1. Under miss-specified assumption $d_i^{exp} = 1 \rightarrow e^{\xi_i} = d_i^{imp}$
2. Estimated trade cost becomes:

$$\tilde{d}_{ni} = e^{\xi_n} \hat{d}_{ni} = \underbrace{d_n^{imp} d_n{}^{exp}}_{=e_i^{\xi}} \hat{d}_{ni}$$

3. While true trade cost is:

$$d_{ni} = \underbrace{d_n^{imp} d_i{}^{exp}}_{\neq e_i^{\xi}} \hat{d}_{ni}$$

Identification only works if $d_i^{exp} = 1 \forall i$ or $d_i^{imp} = 1 \forall i$

The trade costs measures are likely to suffer from measurement error

Back

Problem 1: Consequence of miss-specified trade cost

Exports will be given - under the miss-specified assumption- by

$$Q_i = T_i(c_i)^{-\theta} \sum_m \frac{X_m}{\gamma p_m^{-\theta}} \left(d_m^{exp} d_m^{imp} \hat{d}_{mi} \right)^{-\theta}$$

vs the true equation:

$$Q_i = T_i(c_i d_i^{exp})^{-\theta} \sum_m \frac{X_m}{\gamma p_m^{-\theta}} \left(d_m^{imp} \hat{d}_{mi} \right)^{-\theta}$$

Estimates of exports reaction to trade costs are likely to suffer from measurement error

Measurement error $\rightarrow$ biases estimates towards zero

Back

Import costs and tariffs

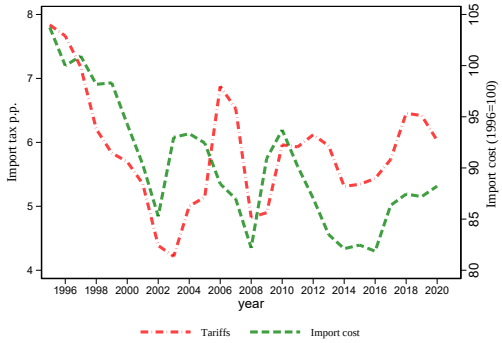


Figure: South Africa

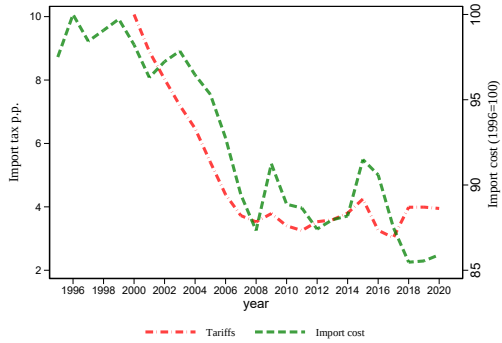


Figure: Tunisia

Back

Import costs and tariffs

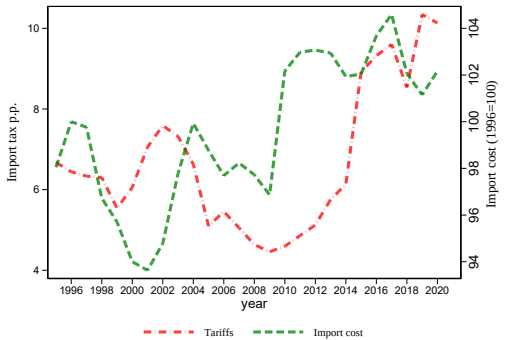


Figure: Australia

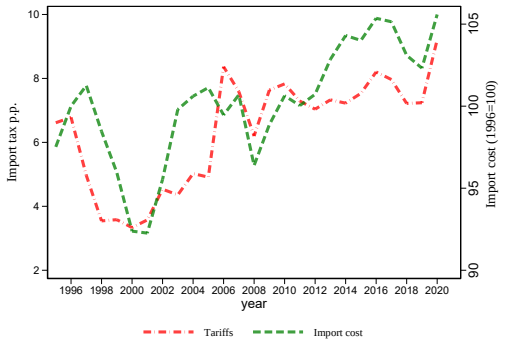


Figure: New Zealand

Back

Import costs and tariffs

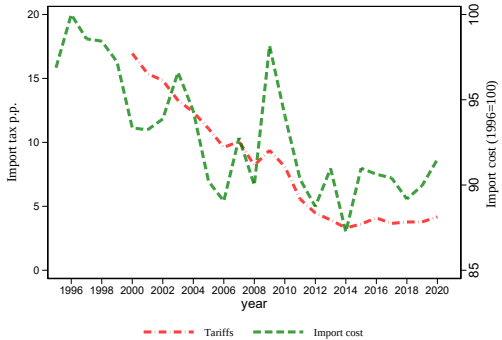


Figure: Morocco

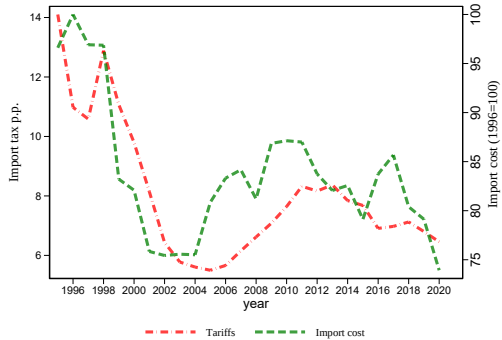


Figure: Brazil

Back

Import costs and tariffs

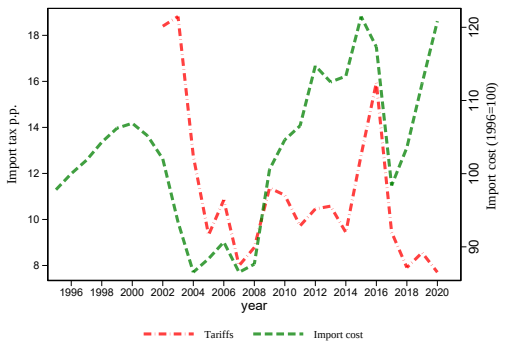


Figure: Egypt

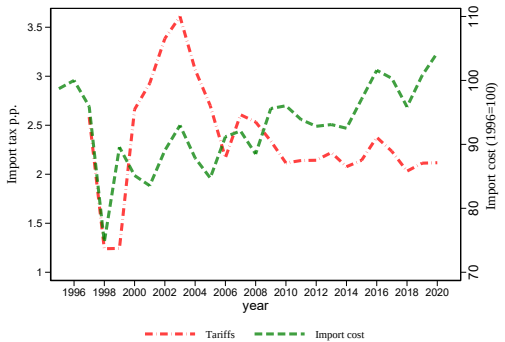


Figure: Indonesia

Back

Import costs and tariffs

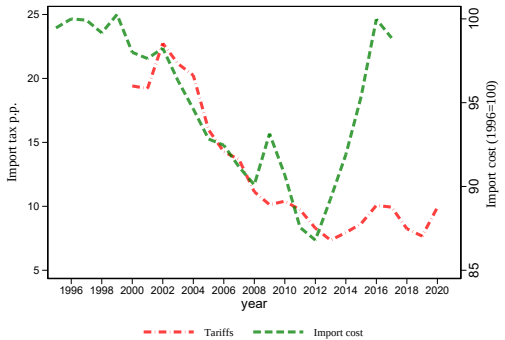


Figure: Bangladesh

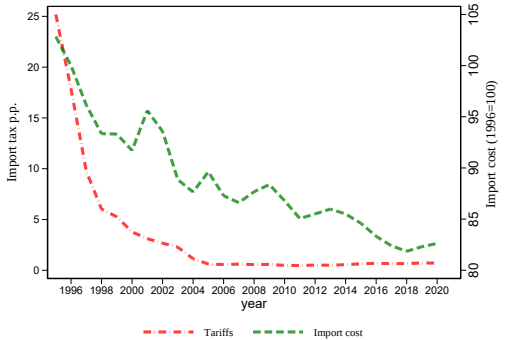
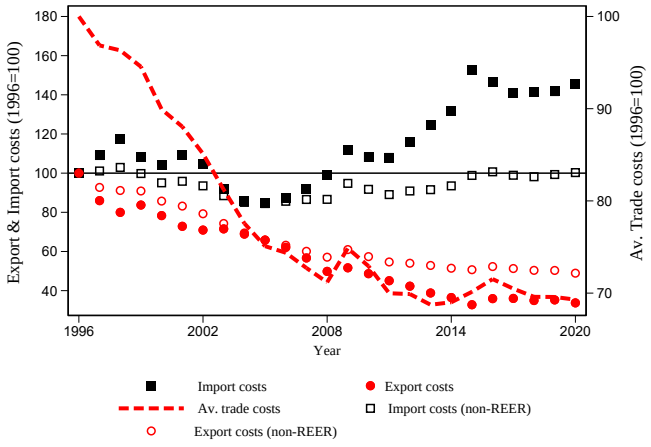


Figure: Poland

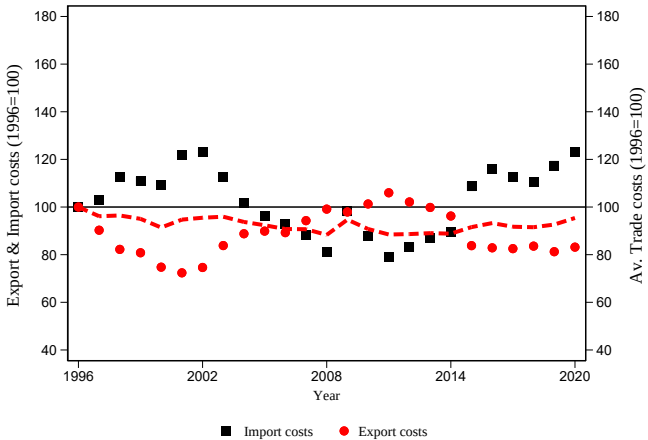
Back

Trade costs evolution: CHN



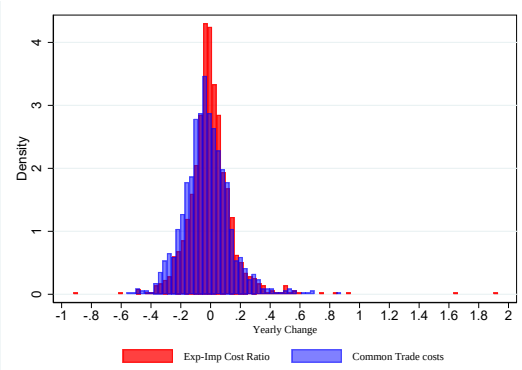
USA

Trade costs evolution: USA



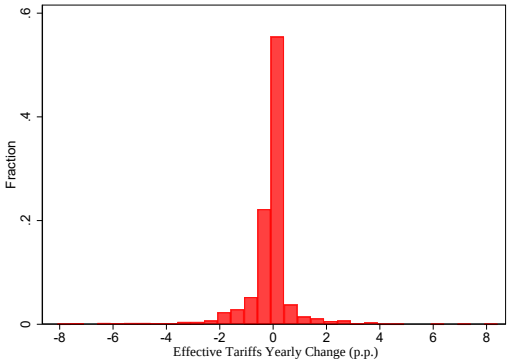
Back China

Trade cost changes distribution



Back to CHN example,Back to TBY results

Effective tariffs changes distribution



Back to tariffs estimates, Back to TBY results

Tariffs and trade costs relationship

Panel 1: Import costs

	Δ Import costs	Δ Import costs	Δ Import costs
Δ Tariffs	2.917***	2.897***	1.034***
	(0.300)	(0.313)	(0.151)
N	1037	1037	649
R^2	0.084	0.111	0.941

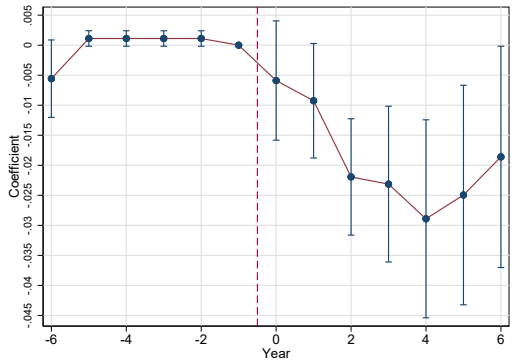
Panel 2: Exp-Imp cost ratio

	Δ Exp-Imp cost	Δ Exp-Imp cost	Δ Exp-Imp cost
Δ Tariffs × $I_{\Delta\text{Tariffs}\leq 0}$	-5.020***	-5.375***	-1.837***
	(0.716)	(0.733)	(0.360)
Δ Tariffs × $I_{\Delta\text{Tariffs}>0}$	-1.643	-2.137	0.923
	(1.424)	(1.433)	(0.518)
N	1037	1037	649
R^2	0.052	0.085	0.942
Year FE	-	✓	✓

Mapping trade cost ratio to trade policy: application to FTA - preliminary

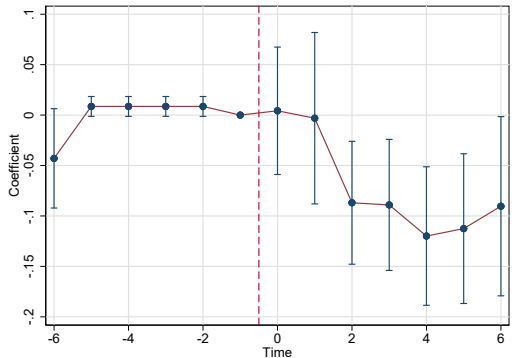
- Objective: look at trade cost in response to trade policy
- Look at bilateral and multilateral FTA with at least one of these partners: USA, CHN, DEU, ITA, CAN, JPN, GBR, FRA
- Only use FTA after 2001 and those with an applied tariff reduction of at least 25% 5 years after implementation needs to be updated
- Run a local projection DiD
- Included controls: anticipation period, domestic and row GDP, five lags of the dependent variable
- Add REER and ToT with up to 3 lags in some cases
- Compare changes relative to the 6 years of pre-treatment average

Average trade cost after a FTA



Average trade cost drops almost 3% afte FTA episodes

ratio drops after a FTA



Exp-imp trade cost ratio drops up to 10% after FTA episodes
See: Exports, Imports values, Exports, Imports costs