World Financial Cycles and Global Trade

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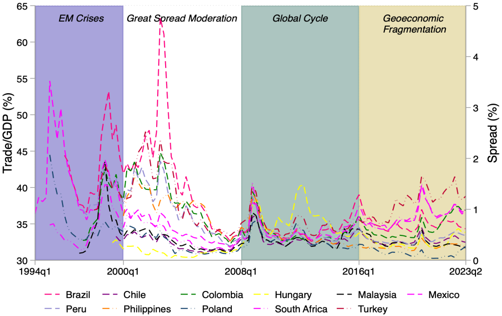
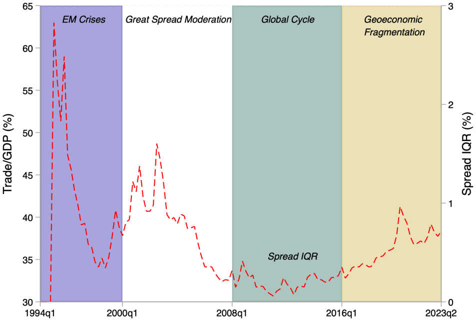
Motivation

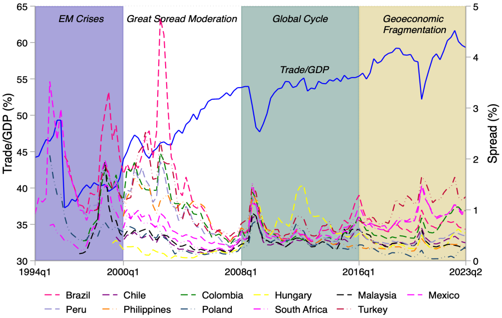
- Global cycle: common trend and divergence of sovereign spread (Bai-Kehoe-Lopez-Perri 2025)

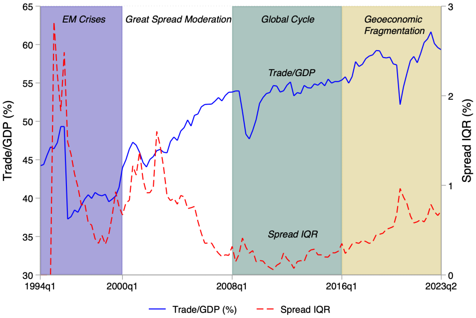




Motivation

- **Global trade shock**: potential driver of **trend** and **divergence** of sovereign spreads
  - 2000-2007: mean & divergence spread ↓ + trade integration
  - After 2016: mean & divergence spread ↑ + trade barriers ↑





What We Do

- A **world GE model** with SOEs' sovereign default risk
  - Rep. advanced economy (AE) and unit mass of emerging markets (SOE)
  - Gross trade flows: all import final goods from all, use as intermediates
  - Global iceberg trade cost
  - Sovereign default setting for SOEs: incomplete markets, default, haircuts
- **Mechanism**: Global trade cost shock $\uparrow$
  - Import cost $\uparrow \Rightarrow$ output $\downarrow \Rightarrow$ sovereign default risk $\uparrow$ (**same across countries**)
  - Domestic price $\uparrow \Rightarrow$ real borrowing $\downarrow \Rightarrow$ larger borrowers lower imports and output by more $\Rightarrow$ sovereign default risk $\uparrow$ more (**heterogeneous across countries**)

Plan for Today

- **Numerically** show heterogeneous impacts of global trade shock
  - Exogenous country distribution in productivity and trade balance
- **Empirically**, when trade costs $\uparrow$, greater trade deficits $\Rightarrow$ greater output $\downarrow$
  - Panel local projection with heterogeneous effects
  - Alternative measures of trade cost, sample selection, etc.
- **Dynamic world equilibrium (ongoing)**
  - Endogenize government default and borrowing decisions
  - Clear all financial and goods' markets
  - Quantify impact of trade shock on trend & dispersion of spreads

Literature

- **Sovereign default**

  Eaton and Gersovitz (1981); Aguiar and Gopinath (2006); Arellano (2008); Cuadra et al.(2010); Yue (2010); Hatchondo et al.(2016); Na et al. (2018), Aguiar et al. (2016), Aguiar and Amador (2023), etc.

  Introduce trade frictions as a key driver of dynamics of sovereign spreads

- **Global financial cycles**

  Longstaff et al. (2011); Miranda-Agrippino and Rey (2020, 2022); Morelli et al. (2022); Gilchrist et al. (2022); Bai et al. (2024), etc.

  Aggregate trade shocks explain trend and time-varying divergence in spreads

- **World general equilibrium models with international financial markets**

  Bai and Zhang (2012); Morelli et al. (2022); Alessandria et al. (2024), etc

  World GE models with interaction between gross trade and limited enforcement

- **Trade costs consequences of sovereign defaults**

  Rose (2005); Borensztein and Panizza (2010); Martinez and Sandleris (2011); Mendoza and Yue (2012); Zymek (2012); Serfaty (2021); Andreasen et al. (2024); Alessandria et al. (2024), etc.

  Impact of sovereign defaults on trade, through global equilibrium effects

A Model of Gross Trade Flows and Default

Model

- World general equilibrium model: a continuum of small open economies (SOE) and a stand-in advanced economy (AE)
- Countries
  - Produce using labor and a composite intermediate good
  - Import intermediates from all countries, export final goods
  - Iceberg trade costs
- Imperfect international financial markets
  - Centralized borrowing and default decision
  - Sovereign default $\Rightarrow$ haircut + productivity loss (no market exclusion)
- Idiosyncratic productivity shock + global trade cost shock τ

Individual country: Production

- Each country i produces a tradable differentiated good with labor, domestic intermediate H, imported intermediate M

$$Q_{it} = z_{it} L_{it}^{\alpha} G_{it}^{\theta},$$

where

$$G_{it} = \left(\omega H_{it}^{\frac{\gamma-1}{\gamma}} + (1-\omega) M_{it}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}$$

- Firms take prices as given and solve

$$\pi_{it} = \max_{L_{it}, H_{it}, M_{it}} \{ p_{it} Q_{it} - w_{it} L_{it} - p_{it} H_{it} - p_t^M \tau_t M_{it} \},$$

Individual Country: Households

- A representative household's optimization problem

$$\max_{\{C_{it},L_{it}\}} \mathbb{E}\sum_{t=0}^{\infty}\beta^t \frac{\left(C_{it}-\chi\frac{L_{it}^{1+1/\nu}}{1+1/\nu}\right)^{1-\sigma}}{1-\sigma}$$

$$\text{s.t.} \quad p_{it}C_{it} = w_{it}L_{it} + T_{it} + \pi_{it},$$

  - T_{it}: lump sum tax or transfer from government
  - π_{it}: profits of the representative firm

- Optimal GHH labor supply: $\chi L_{it}^{1/\nu} = \frac{w_{it}}{p_{it}}$

Individual Country: The Sovereign

- Country i issues claims to b_{it+1} units of long-term defaultable bonds at t
  - Sequence of payments starting from $t+1$: κ, $\kappa(1-\delta)$, $\kappa(1-\delta)^2$,...
  - δ: controls bond duration
- The sovereign decides whether to default and future bond position b_{it+1}
  - Default ($d_{it}=1$) $\Rightarrow$ *immediate* debt reduction, $b_{it} \to \phi b_{it}$, with $\phi < 1$
  - Cost: utility cost (ζ) + productivity loss ($\tilde{z}_{it} = h(z_{it}, d_{it}) \leq z_{it}$)
- Budget constraint

$$T_{it} = -\kappa\phi^{d_{it}} b_{it} + q_t(z_{it}, b_{it+1}) \left[b_{it+1} - (1-\delta)\phi^{d_{it}} b_{it} \right]$$

Global Intermediate Producer

- Competitive global intermediaries assemble goods from all countries:

$$Y_t = \left(X_{\mathrm{AE},t}^{\frac{\eta-1}{\eta}} + \int_0^1 X_{it}^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}}$$

- Optimization

$$\max_{X_{\mathrm{AE},t}, \{X_{it}\}} \; p_t^M Y_t - \int_0^1 p_{it} \tau_t X_{it} di - \underbrace{p_{\mathrm{AE},t}}_{\to 1} \tau_t X_{\mathrm{AE},t}$$

$\Rightarrow$ demand function and price index for global intermediate

$$X_{it} = \left(\frac{\tau_t p_{it}}{p_t^M} \right)^{-\frac{1}{\eta}} Y_t, \qquad p_t^M = \tau_t \left(p_{\mathrm{AE},t} + \int_0^1 p_{it}^{1-\eta} di \right)^{\frac{1}{1-\eta}}$$

Bond Pricing

- Intl' lenders: risk neutral and competitive, fully committed
  - $b_{it+1} \leq 0$: Country i holds long-term bonds issued by international lenders
  - $b_{it+1} > 0$: Lenders hold long-term risky bonds issued by country i
- Introduce short-term, gross risk-free rate R_t
- Equilibrium bond prices:

$$q_{it} = \begin{cases} q_{it}^{rf}, & \text{if } b_{it+1} \leq 0 \\ \frac{1}{R_t}\mathbb{E}_t\left[\phi^{d_{it+1}}\left(\kappa + (1-\delta)q_{it+1}\right)\right], & \text{otherwise} \end{cases}$$

with

$$q_t^{rf} = \frac{1}{R_t}\left(\kappa + (1-\delta)q_{t+1}^{rf}\right)$$

Static Private Trade Equilibrium

Given the trade cost τ_t and distribution $\Omega_t(\tilde{z}_{it}, T_{it})$, the static-private equilibrium allocations $\{C_{it}, L_{it}, Q_{it}, X_{it}, M_{it}\}$, prices $\{w_{it}, p_{it}, p_t^M\}$ satisfy the following

- Firms' optimization conditions on labor and intermediate goods, for each i
- Households optimizes, for each i
- Global intermediate producers optimize
- Goods market clearing and balance of payment, for each i

$$Q_{it} = C_{it} + H_{it} + \tau_t X_{it}, \qquad T_{it} + \underbrace{p_{it}\tau_t X_{it}}_{\text{Exports}} = \underbrace{p_t^M \tau_t M_{it}}_{\text{Imports}}$$

- Global intermediate goods clearing, $Y_t = \tau_t \left(M_{\mathrm{AE},t} + \int_0^1 M_{it} di \right)$

Dynamic World Equilibrium

- Given aggregate state variable $S_t = (\tau_t, \Omega_t(z_{jt}, b_{jt}))$, government i solves

$$
\begin{aligned}
V_{it}(z_{it}, b_{it}, S_t) &= \max_{d_{it} \in \{0,1\}} \left\{ d_{it} \left[W_{it}(\tilde{z}_{it}, \phi b_{it}, S_t) - \zeta \right] + (1 - d_{it}) W_{it}(z_{it}, b_{it}, S_t) \right\} \\
W_{it}(z_{it}, b_{it}, S_t) &= \max_{b_{it+1}} \left\{ u(C_{it}, L_{it}) + \beta \mathbb{E}_t V(z_{it+1}, b_{it+1}, S_{t+1}) \right\} \\
\text{s.t. } T_{it} &= -\kappa b_{it} + q_t(z_{it}, b_{it+1}) \left[b_{it+1} - (1-\delta) b_{it} \right], \\
C_{it} &= \mathcal{C}_{it}(z_{it}, T_{it}, \Omega_t, \tau_t), \quad L_{it} = \mathcal{L}_{it}(z_{it}, T_{it}, \Omega_t, \tau_t), \\
\Omega_{t+1} &= H_{\Omega}(\Omega_t, \tau_t)
\end{aligned}
$$

- Bonds market clearing, determining R_t: $\int_0^1 q_{it} b_{it+1} di + q_{\mathrm{AE},t} b_{\mathrm{AE},t+1} = 0$

Differential Impacts of Global Trade Shocks

Static Private Equilibrium

Given $\{\tau, Y, p^M\}$, (z, T) for each country, $\{C, L, H, M, X, Q, p\}$ solve

$$X = \left(\frac{\tau p}{p^M}\right)^{-\eta} Y \qquad \text{(export demand)}$$

$$\alpha \frac{Q}{L} = \chi L^{1/\nu} \qquad \text{(labor market)}$$

$$\frac{\tau p^M}{p} = \theta(1-\omega) Q G^{\frac{1}{\gamma}-1} M^{-\frac{1}{\gamma}} \qquad \text{(M demand)}$$

$$1 = \theta \omega Q G^{\frac{1}{\gamma}-1} H^{-\frac{1}{\gamma}} \qquad \text{(H demand)}$$

$$Q = z L^{\alpha} G(H, M)^{\theta} \qquad \text{(gross output)}$$

$$C = Q - H - \tau X \qquad \text{(domestic resources)}$$

$$T + \tau p X = \tau p^M M \qquad \text{(BoP)}$$

Mechanism: Effects of Trade Cost Shocks

Following a trade cost shock, $\tau \uparrow$,

- Intermediate price p^M increase (same across countries)
  $\Rightarrow$ import cost $\uparrow \Rightarrow$ output $\downarrow$, price $p \uparrow$
- Heterogeneous effects
  Higher T, transfer in domestic goods $T/p \downarrow$ (since $p \uparrow$)
  $\Rightarrow$ either lower imports or increase export
  $\Rightarrow$ larger fall in Q or smaller increase in p

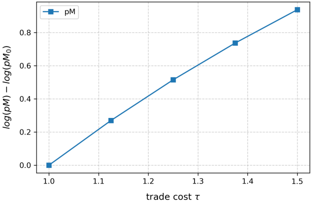
$$\underbrace{\frac{T}{p}}_{\text{in domestic}} + \underbrace{\tau \left(\frac{\tau p}{p^M}\right)^{-\eta} Y}_{\text{Exports}} = \underbrace{(1-\theta)Q}_{\text{Imports}},$$

- Higher T (countries with large deficit) has a larger fall in output

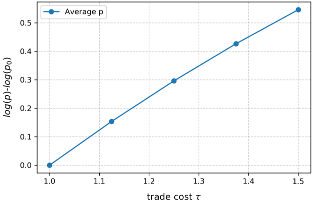
Simple Numerical Illustration

- Fix standard parameter values:
  $\alpha = 0.4$, $\theta = 0.42$, $\chi = 1.0$, $\nu = 0.72$, $\eta = \gamma = 3$, $\omega = 0.6$
- Equilibria with $\tau \in [1.1, 1.2, 1.3, 1.4, 1.5]$
  - Assume T_i are exogenous, (z_i, T_i) jointly normally distributed
  - Positive T_i: a net borrower (net importer)

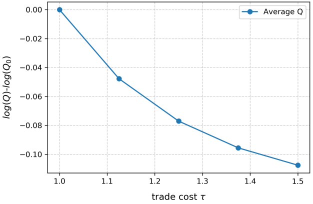
Global trade shock: Average effects



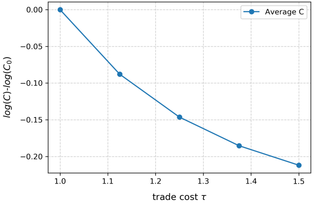
(a) P^M



(b) Average domestic price p



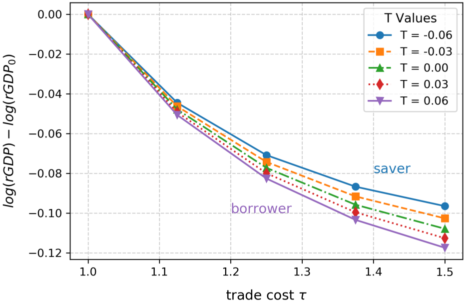
(c) GDP



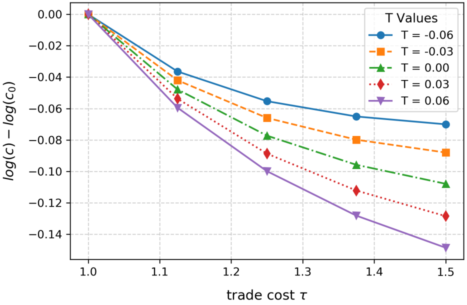
(d) Consumption C

- Higher trade cost $\Rightarrow$ increase in price, fall in GDP and consumption

Differential effects across countries: GDP and consumption



(a) GDP



(b) Consumption

- Positive T $\Rightarrow$ a country is a net borrower
- Higher trade cost hurt borrowers' output and consumption by more

Evidence on Differential Effect of Trade Shocks

Testing the Differential Effect of τ

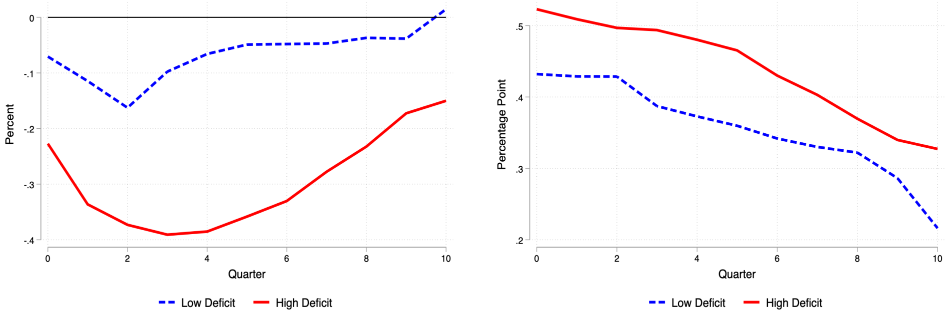
- 12 Emerging markets, 2000Q1–2023Q3
  - Argentina, Brazil, Chile, Colombia, Hungary, Malaysia, Mexico, Peru, the Philippines, Poland, South Africa, and Turkey
  - EMBI spreads (working on CDS)
- Panel Local Projection, Jorda (2005)
  - Heterogeneous effects, Cloyne-Jorda-Taylor (2023)
- Alternative measures of trade cost shock

Heterogeneous Local Projection

$$Y_{i,t+h} = \alpha^h_{low} \left(TC_{t-1} \times \mathcal{I}^{low}_{t-1} \right) + \alpha^h_{high} \left(TC_{t-1} \times \mathcal{I}^{high}_{t-1} \right) + \sum_{j=1}^{P} \gamma^h_j W_{j,t-1} + \delta^h_i + u_{i,t+h}, \quad h = 0, \ldots, H$$

- Y_{it}: outocome, HP-cycle of GDP or spreads, for country i at time t
- TC_t: trade cost measure
  - The Geopolitical Fragmentation Index of Fernandez-Villaverde, Mineyama, Song
  - First principal component of gross trade-to-GDP ratio (different samples)
- $\mathcal{I}^{low}_{t-1}$ ($\mathcal{I}^{high}_{t-1}$): dummy, 1 if trade deficit (M-X)/GDP lower (higher) than mean value
- $W_{j,t-1}$: other controls, including lags of outcome variable
- δ^h_i: country fixed effect

Results (L: GDP, R: spread)



Consistent with theory:

- Significantly greater GDP drop in higher deficit countries
- Significantly higher spread increases in higher deficit countries

Summary

- We build a world GE model with gross trade and sovereign default
- Effects of trade cost shock
  - On average, output decrease due to higher import cost
  - Countries with large deficit have greater fall in output, consistent with empirics
- Quantitative analysis of dynamic world equilibrium (ongoing)
  - IRFs to unexpected trade cost shocks: WTO, Trump trade war
  - Feed dynamics of trade cost:
    how much spread variance explained by global trade shock?