Global Networks, Risks and the U.S. Economy

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Boston Fed 2025: The U.S. Economy in a Changing Global Landscape

Motivation

- Conventional macro-open-economy view:
  - U.S. is relatively closed in trade: exports $\approx 10\%$ of GDP, imports $\approx 14\%$.
  - Dollar dominance and deep financial markets.
  - Federal Reserve as global lender of last resort.

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  - 2008–09 global financial crisis.
  - 2019–20 COVID-19 pandemic.

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  - 2019–20 COVID-19 pandemic.
- Question: **How sensitive is the U.S. economy to global risks once we account for full global trade, production and finance networks?**

A New Global Network Framework

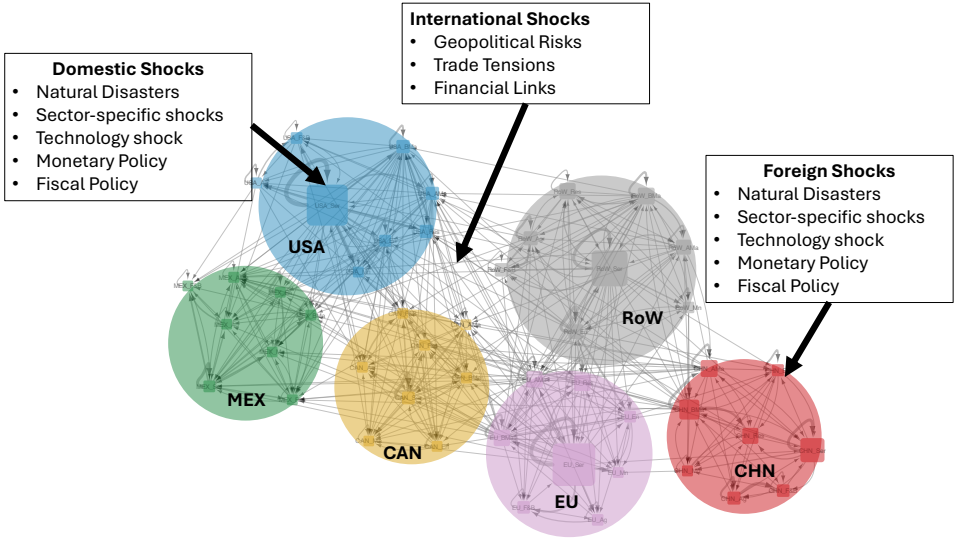


Figure: Global Risks and the U.S. Economy

Research Question and Contribution

How do real, financial, geopolitical, and policy risks transmit to the U.S. economy through global trade, production, and financial networks?

- Develop a **multilayer global network** framework:
  - Trade, production, and finance linkages across countries and sectors.
  - Rich set of cross-sector and cross-country elasticities.
- Embed a variety of **global risks/shocks**:
  - Real, financial, geopolitical, and policy uncertainty.
  - Shocks can be external or U.S. home-grown.
- Quantify the impact of these risks on U.S. output, inflation, employment, and financial conditions.

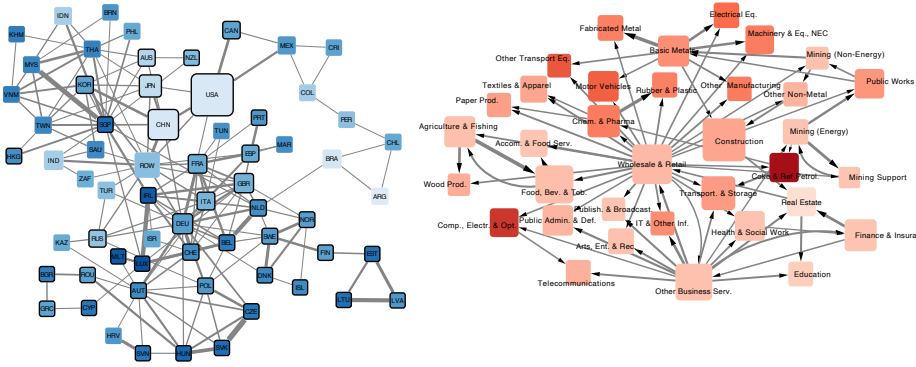
Why matters?

- Kindleberger (1941):
  - Global stability is a **public good**.
  - A leading economy *cannot* fully insulate itself from global turbulence.
  - Hegemon must supply:
    - Open markets.
    - Stable monetary arrangements.
    - Lender-of-last-resort capacity.
- Hirschman (1945):
  - Asymmetric trade dependencies create **geopolitical leverage**.
  - But instability generated by these dependencies and leverage feeds back to hegemon.
- Our framework: makes this logic **quantitative** in a world of complex supply chains and multilayer networks.

Overview of the Framework

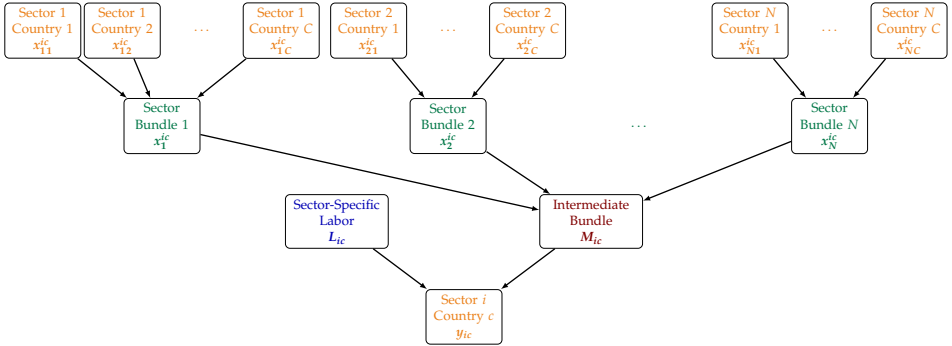
- Open-economy global general equilibrium with:
  - Multiple countries (C) and sectors (N).
  - Nested CES production and consumption.
  - Full input–output linkages (domestic and international).
- Baseline: two-period, flexible-price environment:
  - No nominal rigidities or financial frictions needed to study sectoral global propagation.
  - Extended versions with wage/price rigidities, dynamics and monetary policy.
- Key novelty:
  - Rich matrix of **granular elasticities** (across sectors, factors, varieties, countries).
  - Allows for non-linear amplification and asymmetric global propagation of large shocks.

Global Trade and Production Networks



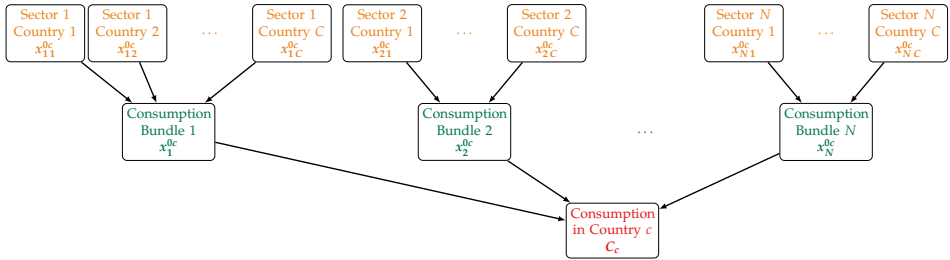
- Blue country network—nodes sized by GDP, color by openness, edges by trade.
- Red sector network—nodes sized by intermediate use, color by import intensity.
- Globalization 1.0: highly interconnected system prior to 2019 and after shocks.

Production Structure



- Sector i in country c uses:
  - Sector-specific labor L_{ic}.
  - Intermediate bundle M_{ic}, aggregating inputs from many sectors and countries.
- Labor and intermediates are (empirically) **complements**.
- Within M_{ic}:
  - Sector bundles (e.g., steel, plastics) are complements.
  - Country varieties within a sector allow for substitution or complementarity depending on elasticities.

Consumption Structure



- Representative household in each country:
  - Cobb–Douglas aggregation across sectors.
  - Sectoral bundles combine varieties from different countries with sector-specific elasticities.
- Allows differentiation between, e.g., German vs. Japanese cars, while respecting expenditure shares and trade imbalances.

Network Propagation and Domar Weights

- Input–output structure summarized by matrices:
  - $\Omega^{\mathcal{N}}$: intermediate input shares.
  - Ω^{0}: final consumption shares.
- Leontief inverse maps sector-level shocks into global output effects.
- With nonlinear propagation,
  small trade shares *do not* guarantee small macro effects when shocks are large and/or concentrated.

Global Risk Shocks in the Model

- We model global risks as **sectoral shocks to non-abundant factors**:
  - Labor (pandemic, immigration).
  - Energy (oil, electricity constraints-AI investment).
  - Critical minerals / rare earths.
  - Finance (dollar shortages).
- Supply (factor) shocks:

$$\Delta_{ic}^{F}(FS_{c,t}) \quad \Rightarrow \quad \text{sector-specific effective factor supply}$$

- Demand shocks: shifts in consumption weights across sectors
- Solution uses **exact hat algebra** and perturbation methods in the spirit of Baqaee–Farhi.

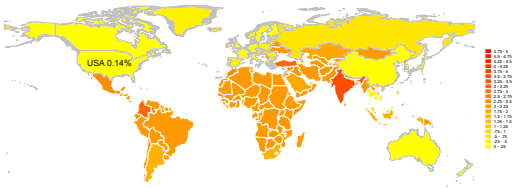
Empirical Applications

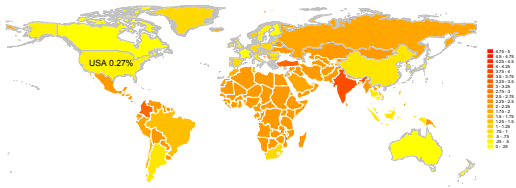
- We apply the framework to three recent global risk episodes:
  1. COVID-19 pandemic (real health risks).
  2. Geopolitical fragmentation and inflation (real/financial risks).
  3. 2025 trade war and trade policy uncertainty (geopolitical/policy risks).
- All three highlight:
  - Strong transmission of global risks to the U.S.
  - Importance of indirect linkages, second-round spillovers and non-linearity.

COVID-19: Measuring Factor Supply Shocks

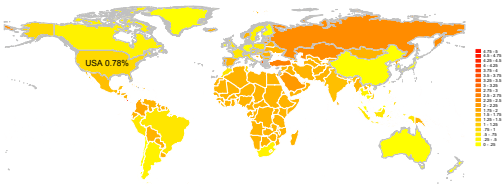
- Sectoral **labor supply** shocks:
  - Estimated from infections by sector and country.
  - Captures lost effective labor input.
- Sectoral **demand** reallocation:
  - Non-parametric regressions of U.S. sectoral consumption on infections.
  - Cross-checked with credit card data where available.
- Feed these shocks through the model disciplined by data on global production network using ICIO tables (65 countries, 35 sectors).

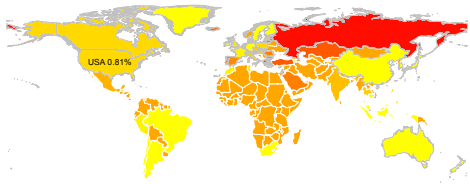
COVID-19: U.S. vaccinated fast, rest slow





COVID-19: Only U.S. vaccinated





- Worst outcome for the U.S.
- Hidden dependencies on RoW supply chains are revealed by network propagation, regardless of trade of elasticity.

Geopolitical Fragmentation and Inflation

- Fragmentation: higher trade costs or barriers along geopolitical lines.
- First-order approximation to CPI inflation in country c (with d-sticky wages):

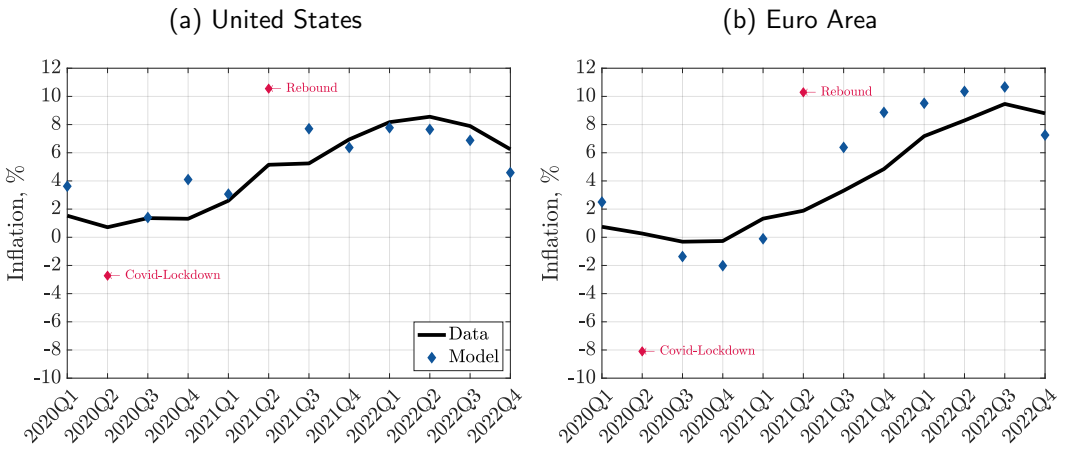
$$\mathrm{d}\log \mathrm{CPI}_c = \underbrace{\mathrm{d}\log E_W^{\$}}_{\text{World Expenditure}} + \underbrace{\mathrm{d}\log \mathcal{E}_c}_{\text{Exchange Rate}} - \underbrace{(\lambda^c)^T \mathrm{d}\log A}_{\text{Productivity Shocks}} - \underbrace{(\Lambda^c)^T \mathrm{d}\log L}_{\text{Factor Changes}} + \underbrace{(\Lambda^c)^T \mathrm{d}\log \Lambda}_{\substack{\text{Local-Global} \\ \text{D-S Imbalance}}}$$

- Under fragmentation:

$$\mathrm{d}\log \mathrm{CPI}_c = \mathrm{d}\log E_W^{\$} + \mathrm{d}\log \mathcal{E}_{c,US} - (\lambda^c)^T \mathrm{d}\log A - (\Lambda^c)^T \mathrm{d}\log L + (\Lambda^c)^T \mathrm{d}\log \Lambda + \underbrace{(\lambda^c)^T (\Omega^{\mathcal{N}} \odot \mathrm{d}\log \tau)\, 1_{CN}}_{\text{Trade cost effects}}.$$

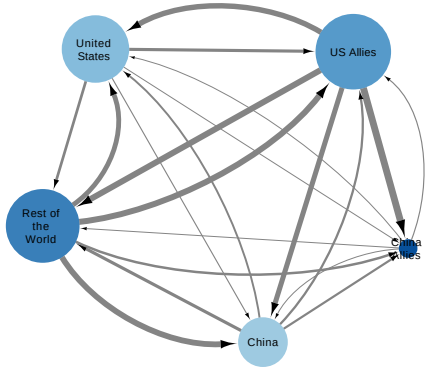
- New mechanism: **local-global demand–Domar weight mismatch** (e.g., chips, rare earths).

2021 Inflation



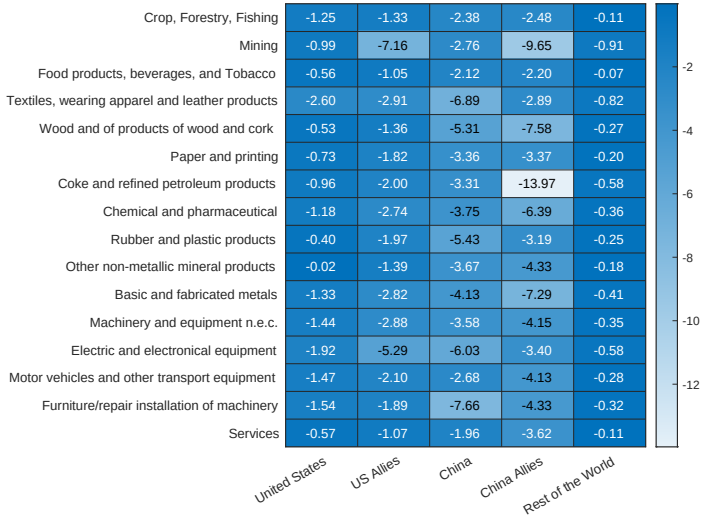
Source: di Giovanni, Kalemli-Özcan, Silva and Yıldırım (2023)

Counterfactual Fragmentation



- Blocs: U.S., U.S. allies, China, China allies, Rest of World.
- Node size: expenditure; color: imported intermediate share; edge thickness: share of imported intermediates.

Fragmentation: Employment Effects



- The U.S. is not immune, despite modest direct trade shares.

2025 Trade War and Inflation Persistence

- Extend baseline to a **New Keynesian Open Economy (NKOE)** framework:
  - Sticky prices.
  - Dynamics.
  - Incomplete markets and monetary policy rules.
- Propagation object generalizes the NKOE Leontief inverse:
- Applied to 2025 U.S. tariffs (broad-based, home-grown trade policy shock in levels and volatility).

NKOE Leontief-Inverse

- Under flexible prices, the Standard Leontief Inverse governs the propagation:

$$\boldsymbol{\Psi} = \boldsymbol{I} + \underbrace{\boldsymbol{\Omega}^{\mathcal{N}}}_{\text{IO Matrix}} + \left(\boldsymbol{\Omega}^{\mathcal{N}}\right)^2 + \left(\boldsymbol{\Omega}^{\mathcal{N}}\right)^3 + \cdots = \left[\, \boldsymbol{I} - \boldsymbol{\Omega}^{\mathcal{N}} \,\right]^{-1}$$

- Under fixed nominal demand and price rigidities, where the central banks target a nominal expenditure level, the key propagation object becomes:

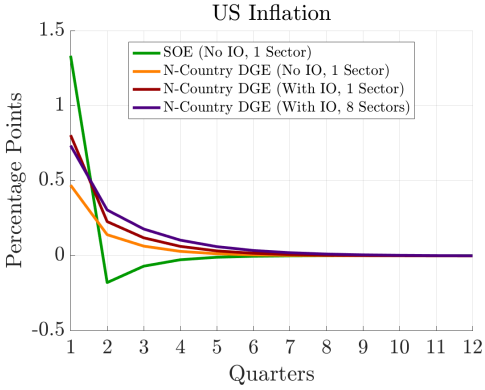
$$\boldsymbol{\Psi}_{\Lambda} = \left[\boldsymbol{I} \left(1 + \underbrace{\beta}_{\text{Discount F.}} \right) + \underbrace{\kappa}_{\text{Stickiness}} \left(\boldsymbol{I} - \boldsymbol{\Omega}^{\mathcal{N}} \right) \right]^{-1}.$$

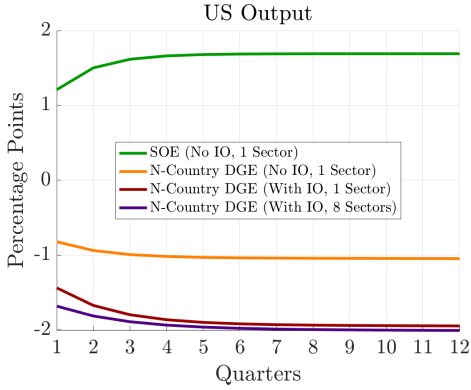
- Under differential Taylor rules to curb inflation, the propagation matrix becomes:

$$\boldsymbol{\Psi}_{\phi} = \left[\boldsymbol{I}(1+\beta) + \boldsymbol{\Lambda} \left[\boldsymbol{I} - \boldsymbol{\Omega}^{\mathcal{N}} + \underbrace{\boldsymbol{\alpha}}_{\substack{\text{Labor} \\ \text{Shares}}} \left(\underbrace{\boldsymbol{\Phi}}_{\substack{\text{Central Bank} \\ \text{Sensitivity}}} - \boldsymbol{I} \right) \underbrace{\boldsymbol{\Omega}^{0}}_{\substack{\text{Consumption} \\ \text{Shares}}} \right] \right]^{-1}.$$

Solving for the dynamic general equilibrium with the last matrix propagation matrix yields: $\boldsymbol{\Psi}_{\phi} \Rightarrow \boldsymbol{\Psi}_{\phi}^{NKOE}$

Figure: U.S. Inflation-Output Trade-Off





2025 Tariffs (as of August)

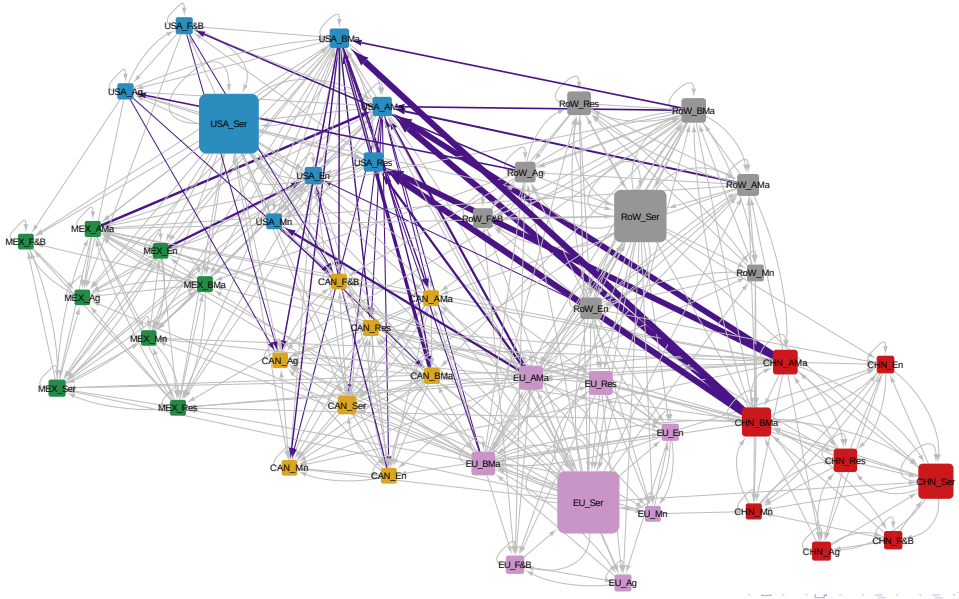
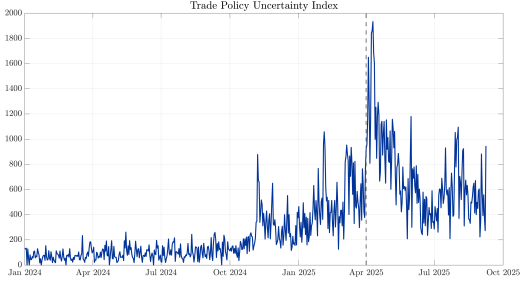
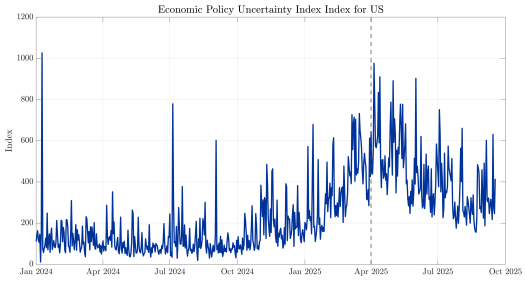


Figure: U.S. Policy Uncertainty

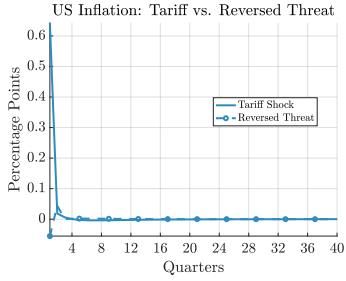


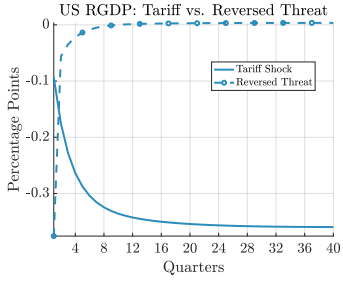
(a) Trade Policy Uncertainty

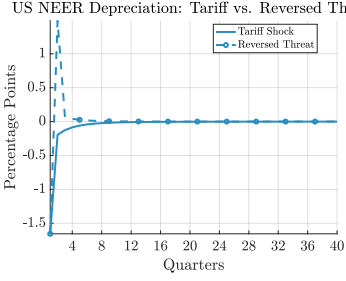


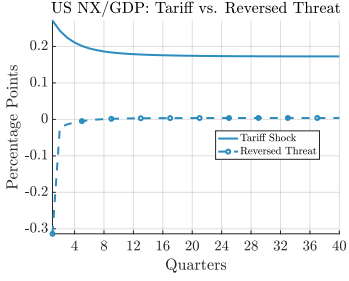
(b) Economic Policy Uncertainty

Tariff Threats vs. Tariffs

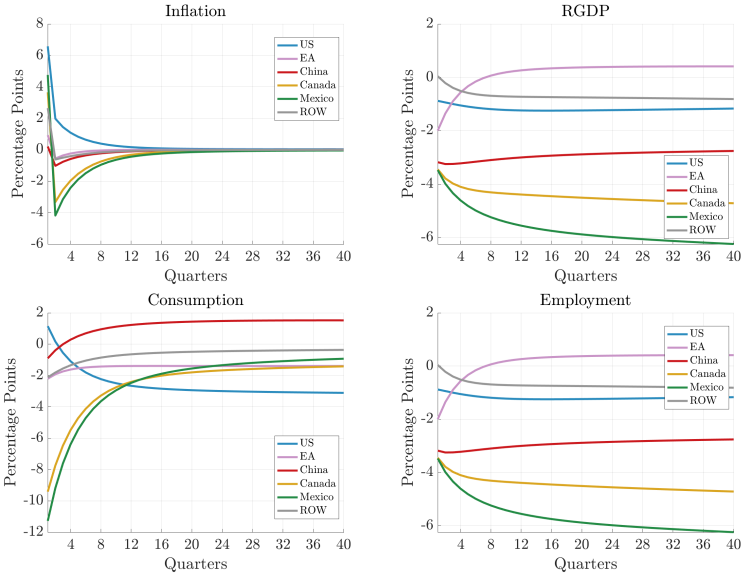








Counterfactual w/Large Tariffs and No Policy Response



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- Once non-linear, indirect and second-round linkages are accounted for, U.S. exposure is **much larger** than standard models suggest.
  - 2025 tariffs: 0.2-0.5 pp inflation; 1% drop in output.
  - Inflation can be as high as 6% w/persistence up to 12 quarters with tariffs over 50%.

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  - Inflation can be as high as 6% w/persistence up to 12 quarters with tariffs over 50%.
- Policy implication:
  - Preserving a financially stable, open to trade international eco-system is the best **self-insurance** for the U.S.