Global Networks, Risks and the U.S. Economy*

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Abstract

How sensitive is the U.S. economy to global risks? Conventional macro-open-economy frameworks imply limited exposure, given the United States' relatively low trade share and its dominant position in international finance. We reassess this assumption by modeling the transmission of external shocks through multilayer global trade, production, and financial networks that embed latent cross-country and cross-sector dependencies. We categorize global risks into real, financial, geopolitical, and policy uncertainty—originating both abroad and domestically—and estimate their impact on the U.S. economy using a network-augmented empirical framework. The results indicate that once indirect linkages and second-round spillovers are incorporated, U.S. insulation from global shocks in standard models is substantially overstated. Network amplification materially increases the pass-through of foreign risks to U.S. output, inflation, and financial conditions, challenging the benchmark view that low trade openness and dollar dominance provide strong protection against global volatility.

JEL Codes: E2, E3, E6, F1, F4

Keywords: global risks, geopolitics, supply chains, trade, macroeconomy

*This paper summarizes several recent papers of ours on global networks and macroeconomy, highlighting key themes and insights together with a presentation of new counterfactual exercises on the potential impact of global risks on the U.S. economy. We were fortunate enough to work jointly with Cem Cakmakli, Selva Demiralp, Julian di Giovanni, Alvaro Silva, Can Soylu, and Sevcan Yesiltas on these papers and we thank all. We thank David Baqaee and late Emmanuel Farhi, who were both instrumental, when we first started this research agenda in 2020. We also thank Pol Antras, Mark Gertler, Veronica Guerrieri, Guido Lorenzoni, and Elisa Rubbo for numerous discussions and helpful suggestions. All errors are our own.

1 Introduction

Emerging market and developing economies are widely understood to be highly exposed to external shocks. A large literature documents how real, financial, and policy disturbances originating abroad generate sizable macroeconomic fluctuations in these economies. Structural and institutional features—including shallow financial markets, fiscal dominance, limited monetary policy credibility, and heavy reliance on global value chains—amplify the transmission of external shocks. Export-led growth strategies often coexist with foreign-currency liabilities, constrained central-bank independence, and fragile investor confidence, creating recurrent episodes of macroeconomic instability.

In contrast, the conventional view holds that advanced economies are substantially less vulnerable to global shocks. Even relatively small open economies such as the United Kingdom or Canada are thought to be insulated by stronger institutions, more credible policy frameworks, and deeper financial markets. The United States is typically regarded as an extreme case of insulation. Its trade share is low relative to GDP—with exports and imports accounting for only about 10 and 14 percent, the dollar serves as the dominant international reserve currency, and U.S. financial markets provide the global supply of safe assets. Combined with the Federal Reserve's capacity to act as the world's lender of last resort, these features underpin the notion that global real or financial risks have only limited effects on the U.S. economy. Empirically, the United States has indeed fared comparatively well in episodes such as the 2008–09 global financial crisis, even-if originally this was home-grown, and the 2019–20 global COVID-19 pandemic, reinforcing this perception.

This paper revisits—and challenges—this conventional wisdom. We argue that in an era of dense global trade, production, and financial linkages, the U.S. economy is more exposed to global risk shocks than standard measures of openness imply. We develop a multilayer global network framework that embeds cross-country and cross-sector interdependencies and use it to study the propagation of global shocks to the United States. We construct measures of real, financial, geopolitical, and policy uncertainty, originating both abroad and domestically, and quantify their dynamic effects on U.S. macroeconomic outcomes. Once indirect exposures, second-round spillovers, and nonlinear propagation channels are incorporated, the traditional sources of U.S. insulation—low trade shares, favorable exchange rate adjustments, and dollar dominance—prove substantially weaker than commonly assumed. Global disturbances transmit through production networks, financial positions, and value-chain structures, feeding back into U.S. output, inflation, employment, and asset prices.

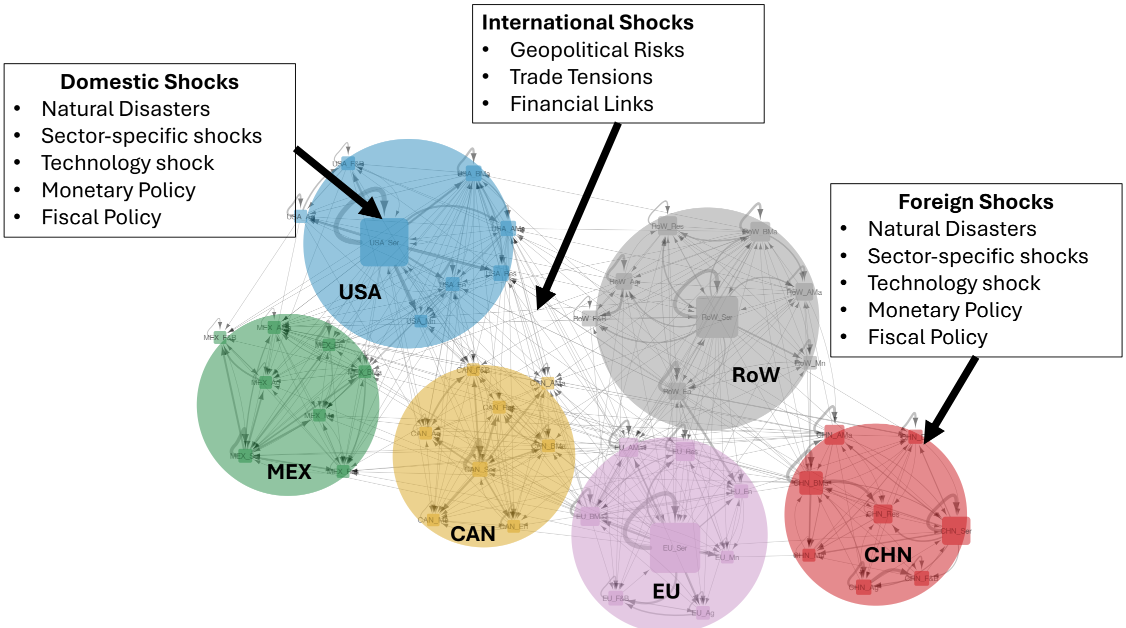


Figure 1. Global Risks and the U.S. Economy

Figure 1 illustrates the core structure of our framework. For expositional clarity, we aggregate the global economy into six regions with the deepest linkages to the United States: the U.S., Canada, Mexico, Europe, China, and the rest of the world (ROW). Cross-country and cross-sector trade and financial connections are represented as a multilayer network. The framework accommodates a broad set of disturbances, including domestic and external real shocks, financial shocks, sectoral disruptions, technology shifts, policy shocks, and fully global risk factors—most notably geopolitical and systemic risks. Unlike approaches that emphasize sectoral size (Domar weights) or aggregate trade elasticities alone, our network formulation highlights the role of granular intersectoral and cross-border elasticities, and interactions between, that govern how shocks propagate through production and financial channels.

Our key insights build on, but extend, the existing network macroeconomics literature. As in the existing literature, sectoral size, input complementarity, and concentration remain central determinants of propagation. However, once full network linkages and nonlinear interactions are taken into account, even economies with modest trade shares—such as the United States—can experience substantial amplification from large global shocks.

We motivate the analysis with three recent episodes that illustrate distinct forms of global risk: the COVID-19 pandemic (a globalized real health shock originating from China), the 2021 surge in global inflation (a heterogeneous but widespread real-financial shock), and the 2025 trade war (a U.S.-origin geopolitical shock with policy and international spillovers). These episodes underscore that both foreign and domestic risk events can propagate globally and feed back into the U.S. economy through the very network structures that traditional open-economy models tend to treat as peripheral. The next section outlines our framework and discusses how global interdependence shapes U.S. exposure to a broad class of risk shocks.

2 A New Framework

Our goal is to have a flexible framework that allows us to analyze the aggregate impact of *simultaneous sectoral* demand and supply shocks, with or without productivity shocks. We will start with the simplest set up, with no nominal rigidities and aggregate shocks and then illustrate cases with wage and price rigidities. The novelty in our framework is its flexibility in allowing many different types of shocks and elasticities at a granular level. Even without introducing any frictions, nominal or real, allowing all the price elasticities to impact market clearing and equilibrium goes beyond assuming a single Armington elasticity. Thus, equilibrium price changes for each sector, within global general equilibrium, as quantities, that is supply and demand of any factor of production, tradable or non-tradable in any sector-country changes.

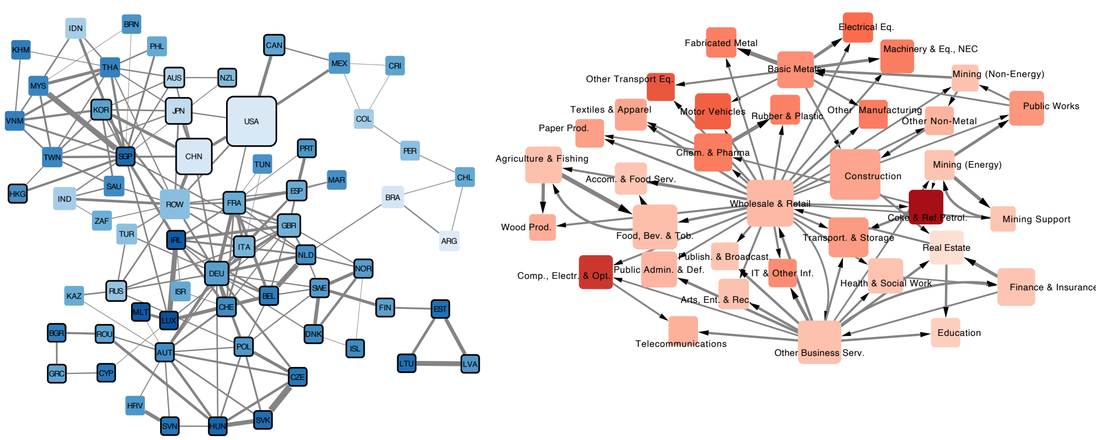


Figure 2. Global Trade (left) and Production Network (right)

Allowing for several granular elasticities leads to shock transmission within the global network that is not only pinned down by trade shares (expenditures shares) and sector sizes (Domar weights). These elasticities impact the degree of substitution/complementarity between factors of production and between consumption of goods produced with these factors, even the countries trade shares for those factors or goods are low. For typical small shocks our setup will deliver similar results to standard models, however, for large shocks, with non-linear impacts, there will be significant differences. Our framework can be visualized in the figure below where domestic I-O linkages on the right in red/pink, where red sectors are tradable, are fully incorporated into a typical trade network on the left in blue, where dark blue countries have higher exports and imports relative to GDP.

This baseline framework is detailed in Çakmaklı et al. (2025). There are no nominal rigidities in this two-period framework. In the general version we present below, the flex price analytical solution rests on using small perturbations/shocks that provide an exact hat-algebra solution, rather than solving the model via log-linearization around the steady state as typical for macro models. This solution method is similar to Baqaee and Farhi (2024) and will allow is to quantify a large impact of risk shocks, global or home-grown, in a non-linear framework.

Each country produces and consumes final and intermediate goods and services. We denote the set of countries with $\mathcal{C}$ and we index countries with c, v or m. The $\mathcal{N}$ denotes the set of industries or sectors (we use these terms interchangeably) that are indexed by i, j or k. A sector i in country c is denoted by ic and we denote the set of all such pairs with $\mathcal{CN}$. Production in ic can use inputs from sector j in country m, i.e., jm. For convenience, we also introduce the consumption as sector $0 \notin \mathcal{N}$, and consumption in country c is indexed by $0c$. The set of factors is represented by $\mathcal{F}$ and indexed by f or g. Because we work with more than 2 countries, more than 2 sectors, and more than 2 factors, this notation is essential. We denote the set of factors present and owned by country c with $\mathcal{F}_c$.

Prices, outputs and expenditures. The output of industry i in country c is denoted with y_{ic} and its price with p_{ic}. The country-sector pair ic uses inputs from other sectors from different countries in addition to labor. We show the inputs used from sector j in country m by sector i in country c with x^{ic}_{jm} and the price of this input is p_{jm}.[1] Recall that $i = 0$ denotes the consumption of households. We assume $y_{0c} = C_c$ is the total consumption in country c and the price index of consumption is denoted by p_{0c}. Let's denote the total nominal expenditure of country c with $E_c = p_{0c}y_{0c} = p_{0c}C_c$. The total world expenditure is $E \equiv \sum_c E_c$, which is also equal to the total world GDP. We assume that the factors are country and sector-specific. Since they are sector-specific, with an abuse of notation, we use industry indices to address them as well. For any factor used by industry i in country c, we denote the corresponding labor with L_{ic} and its wage with w_{ic}.

Input-Output Matrix. We use expenditure shares for both the consumption and the production sides of the economy to construct the input-output matrix. The input share of

[1] We solve the changes in the log prices and quantities to implement hat algebra used in the trade literature (Costinot and Rodríguez-Clare, 2014; Caliendo and Parro, 2015). In the model, we initialize the price of each good to be 1 in each country. Hence, when we solve for log-changes, price changes for a given variety are the same in each country.

sector j of country m in sector i in country c is defined by:

$$\Omega_{jm}^{ic} \equiv \frac{p_{jm} x_{jm}^{ic}}{p_{ic} y_{ic}}. \tag{1}$$

We denote the input share matrix with $\Omega^{\mathcal{N}}$. We express the expenditure share of industry jm in final good consumption in country c as:

$$\Omega_{jm}^{0c} \equiv \frac{p_{jm} x_{jm}^{0c}}{E_c}, \tag{2}$$

where x_{jm}^{0c} denotes the amount of industry jm's output consumed by the households in country c. The matrix corresponding to the final consumption is denoted by Ω^0. Finally, the value-added (or factor share) in country-sector pair ic is defined as:

$$\alpha_{ic} \equiv \Omega_{ic}^{\mathcal{F}} \equiv \frac{w_{ic} L_{ic}}{p_{ic} y_{ic}} = 1 - \sum_{jm \in \mathcal{CN}} \Omega_{jm}^{ic}. \tag{3}$$

Note that $\Omega^{\mathcal{F}}$– the matrix representing the factor shares– corresponds to a diagonal matrix whose elements are given by the value-added share.

2.1 Production

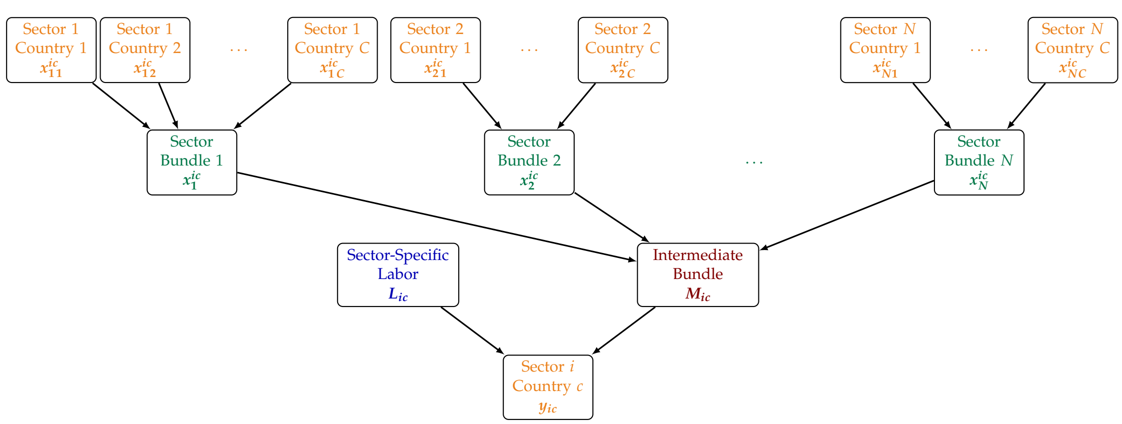


Figure 3. Production

Production structure depicted in the above figure. Production in each sector i in country c is achieved by combining sector-specific labor and a bundle of intermediate inputs. The assumption of sector-specific labor implies that labor is not mobile between sectors but can fluctuate within a sector over time. This assumption is later relaxed; the reason we start with this is to introduce the concept of factor supply shocks, including to labor, which is relevant for health and immigration related risks. The intermediate bundle for a sector-country pair ic consists of all the inputs from different sector bundles. These sector bundles, in turn, are formed by different sector-country varieties.

The production in country-sector pair ic is achieved by combining the sector-specific labor and the intermediate bundle. We denote the price of this bundle with p_M^{ic} and its quantity with M_{ic}. We assume that the production of the final good follows a constant elasticity of substitution (CES) technology with elasticity ϕ. The production function for the firms is given by:

$$y_{ic} = A_{ic}\left[\alpha_{ic}^{1/\phi} L_{ic}^{\frac{\phi-1}{\phi}} + (1-\alpha_{ic})^{1/\phi} M_{ic}^{\frac{\phi-1}{\phi}}\right]^{\frac{\phi}{\phi-1}}. \tag{4}$$

where A_{ic} is the productivity. The corresponding price index is:

$$p_{ic} = \frac{1}{A_{ic}}\left[\alpha_{ic}\left(w_{ic}\right)^{1-\phi} + (1-\alpha_{ic})\left(p_M^{ic}\right)^{1-\phi}\right]^{\frac{1}{1-\phi}}.$$

We assume $0 \leq \phi < 1$, i.e., labor and intermediate inputs are complements. As we show in the calibration section, this assumption is supported by the estimates we use from the empirical literature.

The intermediate bundle in ic is composed of inputs of sectoral bundles, denoted by x_j^{ic} for sector j. Assuming a CES aggregator with elasticity of substitution of ε, the intermediate bundle, M_{ic}, and its price index is given by:

$$\Omega s_j^{ic} \equiv \sum_{m\in\mathcal{C}} \Omega_{jm}^{ic}, \qquad M_{ic} = \left[\sum_{j\in\mathcal{N}}\left(\frac{\Omega s_j^{ic}}{1-\alpha_{ic}}\right)^{1/\varepsilon}\left(x_j^{ic}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \quad p_M^{ic} = \left[\sum_{j\in\mathcal{N}}\frac{\Omega s_j^{ic}}{1-\alpha_{ic}}\left(p_j^{ic}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}.$$

Ωs_j^{ic} captures the share of sector j in production of ic and is calculated by summing over the country varieties. p_j^{ic} is the sectoral price index. We assume that $0 \leq \varepsilon < 1$, i.e., all sectoral inputs for the intermediate bundle are complements. This assumption implies that plastic and steel cannot be easily substituted in auto production, which is backed by the estimates from the empirical literature, as we show in our calibration section.

Sector bundles are aggregates of varieties coming from different countries. We capture the share of bundle j for sector ic fulfilled by jm with the matrix $\Xi^{\mathcal{N}}$, and write the sectoral bundle input and the price index as:

$$\Xi_{jm}^{ic} \equiv \frac{\Omega_{jm}^{ic}}{\Omega s_j^{ic}}, \qquad x_j^{ic} = \left[\sum_{m\in\mathcal{C}}\left(\Xi_{jm}^{ic}\right)^{1/\xi_j}\left(x_{jm}^{ic}\right)^{\frac{\xi_j-1}{\xi_j}}\right]^{\frac{\xi_j}{\xi_j-1}}, \qquad p_j^{ic} = \left[\sum_{m\in\mathcal{C}}\Xi_{jm}^{ic}\left(p_{jm}\right)^{1-\xi_j}\right]^{\frac{1}{1-\xi_j}},$$

This uses a CES aggregator with a sector-specific elasticity of substitution ξ_j. This structure allows us to use empirically relevant sector-specific elasticities to allow substitutions between varieties coming from different countries in the long term (Costinot and Rodríguez-Clare, 2014; Caliendo and Parro, 2015) such that $\xi_j \geq 1$. But in the short term, we assume that it is hard to immediately substitute varieties from different countries to capture the difficulty in changing suppliers and re-wiring supply chains, as we have witnessed during the pandemic. The case of $\xi_j \leq 1$ is estimated by Boehm et al. (2019).

2.2 Consumption

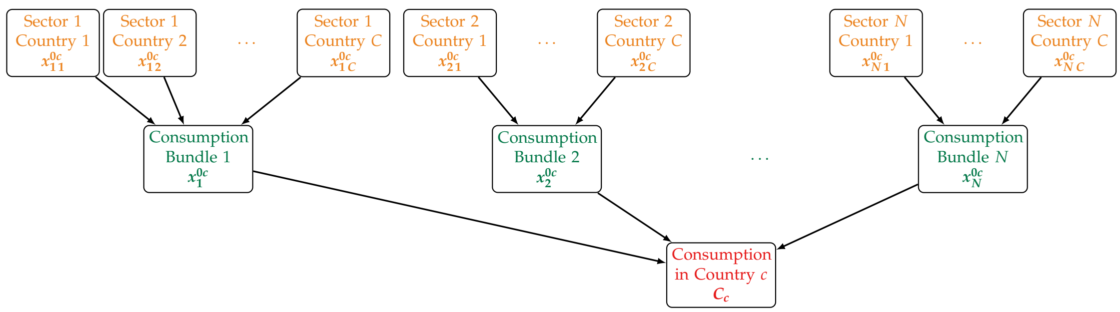


Figure 4. Consumption

Consumption structure is depicted in above figure. There is a representative agent in each country solving a two-period consumption optimization problem. The first period corresponds to the pre-shock stage and the second period corresponds to after the shock stage. The households collect their income through factor ownership. Each period, the national expenditure is equal to $E_{c,t}$. We normalize the world expenditure to 1 in both periods. In the absence of aggregate shocks and perfect foresight, the model effectively solved for each period. Hence, we drop the time subscript below to simplify the notation.

All the aggregations are done with functions exhibiting constant elasticity of substitution albeit with different elasticities. The consumption bundles are country-specific. Similar to our production structure, we also assume a nested structure in consumption. The representative agent optimization is given by:

$$C_c = \left[\sum_{j \in \mathcal{N}} \left(\Omega s_j^{0c} \right)^{1/\sigma} \left(x_j^{0c} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad \text{with} \quad \Omega s_j^{0c} \equiv \sum_{m \in \mathcal{C}} \Omega_{jm}^{0c}$$

where x_j^{0c} denotes the (normalized) sectoral consumption and Ωs_j^{0c}denotes the share of industry j in the final consumption of consumers in country c. We assume σ to be equal to 1 for Cobb-Douglas preferences. Similar to the production side, consumption bundles that are comprised of varieties from different countries. The corresponding consumption price index can be written as:

$$p_{0c} = \left[\sum_{j \in \mathcal{N}} \Omega s_j^{0c} \left(p_j^{0c} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \quad \text{for } (\sigma = 1) : \log p_{0c} = \sum_{j \in \mathcal{N}} \Omega s_j^{0c} \log p_j^{0c}, \tag{5}$$

where p_j^{0c} denotes the price of the consumption bundle j in country c, $\sigma = 1$ corresponds to the Cobb-Douglas case with constant expenditure shares.

We capture the share of bundle j for consumers in c fulfilled by jm with the matrix Ξ^0, and write the sectoral consumption bundle and its price index as:

$$\Xi_{jm}^{0c} \equiv \frac{\Omega_{jm}^{0c}}{\Omega s_j^{0c}}, \qquad x_j^{0c} = \left[\sum_{j \in \mathcal{N}} \left(\Xi_{jm}^{0c} \right)^{1/\xi_j^0} \left(x_{jm}^{0c} \right)^{\frac{\xi_j^0 - 1}{\xi_j^0}} \right]^{\frac{\xi_j^0}{\xi_j^0 - 1}}, \qquad p_j^{0c} = \left[\sum_{m \in \mathcal{C}} \Xi_{jm}^{0c} \left(p_{jm} \right)^{1-\xi_j^0} \right]^{\frac{1}{1-\xi_j^0}}.$$

As in the production side, ξ_i^0 is the trade elasticity for consumption. We use values both from Caliendo and Parro (2015) and from Boehm et al. (2023), so we study cases where these elasticities are greater and smaller than 1.

2.3 Equilibrium and Perturbation

Given the parameters, a general equilibrium consists of good prices, factor prices, outputs, intermediate inputs, factor inputs, and consumption levels such that producers minimize their costs, households maximize their utilities, and good and factor markets clear. The equilibrium is stable in the absence of any shocks. We perturb this equilibrium with sectoral demand and supply shocks. At each point in time, we assume that good markets clear such that for any industry ic:

$$y_{ic} = \sum_{m \in \mathcal{C}} \sum_{j \in \mathcal{N}} x_{ic}^{jm} + \sum_{m \in \mathcal{C}} x_{ic}^{0m}. \tag{6}$$

The first term corresponds to the intermediate input usage of ic by all country-industry pairs, indexed by jm. The second term captures to the final good usage of ic in all countries, indexed by m. We also assume labor markets clear such that all "potential" sector-specific workers are employed.

At the initial equilibrium, we set all prices to 1 and all output of country-sector pairs to their respective share in the total nominal world expenditure. After perturbing with shocks, the prices and outputs re-equilibriate.

2.4 Domar Weights, GDP and Country-Level Expenditures

Let's define the Domar weight of an industry ic to be: $\lambda_{ic} \equiv p_{ic}y_{ic}/E$ and for the factor employed in the same industry to be $\Lambda_{ic} \equiv w_{ic}L_{ic}/E$. We denote the expenditure share of country m with $\chi_m \equiv E_m/E$. Starting from market clearing condition in Equation (6), using the expenditures for each country, E_c, we can write the sector Domar weight for ic as:

$$\lambda_{ic} \equiv \frac{p_{ic}y_{ic}}{E} = \sum_{m\in\mathcal{C}} \frac{p_{ic}x_{ic}^{0m}}{E_m}\frac{E_m}{E} + \sum_{jm\in\mathcal{CN}} \frac{p_{ic}x_{ic}^{jm}}{E} = \sum_{m\in\mathcal{C}} \Omega_{jm}^{0c}\chi_m + \sum_{jm\in\mathcal{CN}} \Omega_{kc}^{jm}\lambda_{jm}. \tag{7}$$

Let λ and χ denote the row-vectors corresponding to the Domar weights of sectors and expenditure shares of countries, respectively. Then, Equation (7) can be written as:

$$\lambda = \chi\Omega^0 + \lambda\Omega^{\mathcal{N}} \Rightarrow \lambda = \chi\,\Omega^0\,\underbrace{(I-\Omega^{\mathcal{N}})^{-1}}_{\equiv\Psi^{\mathcal{N}}} = \chi\,\Omega^0\,\Psi^{\mathcal{N}}, \tag{8}$$

where $\Psi^{\mathcal{N}}$ is the Leontief Inverse. The row vector for factor Domar weights, denoted by Λ, captures the ratio of added value to the world GDP in each sector. We can write it as:

$$\Lambda = \lambda\,\Omega^{\mathcal{F}} = \chi\,\Omega^0\,\underbrace{\Psi^{\mathcal{N}}\,\Omega^{\mathcal{F}}}_{\equiv\Psi^{\mathcal{F}}} = \chi\,\Omega^0\,\Psi^{\mathcal{F}}. \tag{9}$$

The total world output (GDP) is the same as total world expenditure (GNE) and we normalize them to be equal to 1. For a country c, its output (GDP), denoted as Π_c, corresponds to the total value-added in the country. Hence, we can write this country's GDP in terms of its factor Domar weights as:

$$\Pi_c \equiv \sum_{f\in\mathcal{F}_c} \Lambda_f \qquad \Rightarrow \qquad \Pi = \Lambda\,\Phi^G. \tag{10}$$

where Φ^G is the matrix that assigns factors to countries with, Φ^G_{fc} equal to 1 if $f \in \mathcal{F}_c$ and 0 otherwise. Consistent with the real world, we allow countries to run trade surpluses or deficits, similar to Dekle et al. (2007); Costinot and Rodríguez-Clare (2014). First, we define the trade balance of country c with $\mathrm{TB}_c \equiv \Pi_c - \chi_c$, where χ_c denotes country's expenditure (GNE). TB could be positive for a trade surplus or negative for a trade deficit. Because there is no acquisition of assets in international capital markets by assumption, the current account deficit is financed only by "net factor income from abroad (NFIA)".

Using the definition of GDP in terms of factors and assuming that the GDP claims of each country on other countries is proportionally distributed to their factor income assignment, we can write country nominal expenditures as (GNE), χ:

$$\chi = \Pi + \mathbf{TB} = \Lambda\, \Phi^G + \mathbf{TB}. \tag{11}$$

The second equality follows from Equation (10).

We formulate sectoral factor shocks which later we relate to global risks we analyze. For each case, we calibrate **TB** vector to the pre-shock trade imbalances and the initial factor Domar weights from ICIO tables that are sector-country level. Once we shock this initial equilibrium, the factor Domar weights (Λ) are endogenously solved, hence the country-level expenditure, χ, endogenously adjust after the shocks. Hence, current accounts also endogenously adjust through factor income changes as factors assigned to countries change via Φ^G.

2.5 Sectoral Shocks

We frame global risk shocks as shocks to not abundant factors of production. These are sectoral in nature such as finance (dollar shortage) or rare earths or labor or oil.

Sectoral Supply (Factor) Shocks. Our key difference from the literature is to introduce 'quantity' or 'factor' shocks. These are different than a tax (tariff) or mark-up, or productivity, where we create a supply shock specific to a factor/sector. This can be pandemic or immigration related labor supply shocks, AI related electricity shortage shocks or geopolitics related rare earth/critical minerals shocks or earthquakes/wars destroying capital and oil refineries (e.g. Boehm et al. (2019).) If these shocks are negative, they will make the economy operate inside the production possibilities frontier, even this is temporary. The production in the given country-sector pair ic changes as a response to the supply shock specific to that pair, denoted by $\Delta^F_{ic}(FS_{c,t})$, which depends on the potential factor supply (FS) in country c at time t. Hence, Equation (4) changes to:

$$y_{ic,t} = A_{ic}\left[\alpha_{ic}^{1/\phi}\left(\Delta^F_{ic}(FS_{c,t})F_{ic}\right)^{\frac{\phi-1}{\phi}} + (1-\alpha_{ic})^{1/\phi}\, M_{ic}^{\frac{\phi-1}{\phi}}\right]^{\frac{\phi}{\phi-1}}. \tag{12}$$

Sectoral Demand Shocks. If production of certain goods are limited, so they become expansive, consumption will respond. We model this as a sectoral demand shifter. Thus, Equation (5) changes to:

$$p_{0c,t} = \left[\sum_{j\in\mathcal{N}}\left(\Delta^{0c}_j(F_{c,t})\right)^{\sigma}\Omega s^{0c}_j\left(p^{0c,t}_j\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \text{with } \sum_{j\in\mathcal{N}}\left(\Delta^{0c}_j(F_{c,t})\right)^{\sigma}\Omega s^{0c}_j = 1. \tag{13}$$

2.6 Solution

We solve our model in a similar way to Baqaee and Farhi (2024), where the higher-order terms are incorporated into the system via cross-factor and industry elasticities. By applying small perturbations to the system, and following the trajectory of the prices and wages, we arrive at a new equilibrium where the system re-optimizes around the old one. This methodology is akin to the Euler integration method to calculate the solutions of differential equations. Hence, we calculate differential exact hat-algebra to characterize the changes in the system by iterative means.

To compute the new equilibrium, we need to trace through the changes in prices and expenditure shares after we introduce sectoral shocks. We trace the sectoral shocks to the supply term $-\Delta_{ic}^{F}(FS_{c,t})$ in Equation (12)– and demand term $-\Delta_{j}^{0c}(F_{c,t})$ in Equation (13)– through inter-country input-output linkages. Any small perturbation to the system results in changes in the Domar weights and changes in prices. The relationship between changes in Domar weights and prices is governed by the shock, allowing us to solve the model.

On the cost side, with Shepard Lemma, we can write all the price changes in terms of wage changes. Formally, we can write the changes in prices as (in matrix notation):

$$d\log p_{ic} = \sum_{jm\in\mathcal{CN}} \Omega_{jm}^{ic} d\log p_{jm} + \Omega_{ic}^{\mathcal{F}} d\log w_{ic} \Rightarrow d\log p' = \Omega^{\mathcal{N}} d\log p' + \Omega^{\mathcal{F}} d\log w'.$$

Solving for changes in prices in terms of changes in wages, we arrive at:

$$d\log p' = \Omega^{\mathcal{F}} (I - \Omega^{\mathcal{N}})^{-1} d\log w' = \underbrace{\Omega^{\mathcal{F}}\, \Psi^{\mathcal{N}}}_{\equiv \Psi^{\mathcal{F}}} d\log w' = \Psi^{\mathcal{F}} d\log w'. \tag{14}$$

Focusing on the Domar weights of factors, we can also relate them to changes in prices and labor supply changes with:

$$d\Lambda_f = \Lambda_f\, d\log \Lambda_f = \Lambda_f (d\log w_f + d\log L_f) \Rightarrow d\log w = d\Lambda\, \hat{\Lambda}^{-1} - d\log L.$$

where $\hat{\Lambda}$ is the diagonal matrix whose diagonal elements are given by Λ. Hence, we can write the changes in log-wages in terms of changes in Factor Domar weights. Starting with

Equation (9), we can write changes in the Domar weights as:[2]

$$d\Lambda = (d\chi\,\Omega^0 + \chi\,d\Omega^0 + \lambda\,d\Omega^{\mathcal{N}})\Psi^{\mathcal{F}} + \lambda\,d\Omega^{\mathcal{F}}. \tag{15}$$

To solve the system, we will write all these terms in terms of $d\log\Lambda$ or equivalently $d\log w$. Note that the formulation is more general than the sector-specific labor case. If multiple factors are used, let's assume that these factors are combined with elasticity η. Consequently, we can pin down the changes in wages for any factor using the following proposition:

Proposition 1. *Given the sector supply/factor shock, the sectoral demand shock and the nested CES model explained in Sections 2.1 to 2.5, the changes in the wages satisfy:*

$$d\log w = d\log w\,A\,\hat{\Lambda}^{-1} + B\ \hat{\Lambda}^{-1} - d\log\Delta^F,$$

where $A = A_1 + A_{22} + A_{23} + A_{24} + A_{31} + A_{32} + A_{33} + A_{34} + A_{41} + A_{42} + A_{43}$, *and* $B = B_1 + B_{21}$ *such that:*

$$\begin{aligned}
&A_1 = \hat{\Lambda}\,\Phi^E\,\Omega^0\,\Psi^{\mathcal{F}} && B_1 = d\log\Delta^F\,\hat{\Lambda}\,\Phi^E\,\Omega^0\,\Psi^{\mathcal{F}}\\
&A_{22} = \Psi^{\mathcal{F}'}\,(1-\widehat{\xi^0})\,\widehat{\chi\Omega^0}\,\Psi^{\mathcal{F}} && A_{23} = \Psi^{\mathcal{F}'}\,(\widehat{\xi^0}-\sigma)\ \left[(1_{C\times C}\otimes I_N)\odot\left(\Xi^{0'}\,\hat{\chi}\,\Omega^0\right)\right]\ \Psi^{\mathcal{F}}\\
&A_{24} = (\sigma-1)\,\Psi^{\mathcal{F}'}\,\Omega^{0'}\,\hat{\chi}\,\Omega^0\,\Psi^{\mathcal{F}} && B_{21} = \sigma\,\chi\,(\Omega^0\odot d\log\Delta^0)\,\Psi^{\mathcal{F}}\\
&A_{31} = \Psi^{\mathcal{F}'}\,(1-\hat{\xi})\,\widehat{\lambda\Omega^{\mathcal{N}}}\,\Psi^{\mathcal{F}} && A_{32} = \Psi^{\mathcal{F}'}\,(\hat{\xi}-\varepsilon)\ \left[(1_{C\times C}\otimes I_N)\odot\left(\Xi^{\mathcal{N}'}\,\hat{\lambda}\,\Omega^{\mathcal{N}}\right)\right]\ \Psi^{\mathcal{F}}\\
&A_{33} = (\varepsilon-\phi)\,\Psi^{\mathcal{F}'}\,\Omega^{\mathcal{N}'}\,\hat{\lambda}\,(1-\hat{\alpha})^{-1}\,\Omega^{\mathcal{N}}\,\Psi^{\mathcal{F}} && A_{34} = (\phi-1)\,\Psi^{\mathcal{F}'}\,\hat{\lambda}\,\Omega^{\mathcal{N}}\,\Psi^{\mathcal{F}}\\
&A_{41} = (1-\eta)\widehat{\lambda\Omega^{\mathcal{F}}} && A_{42} = (\eta-\phi)\,\Omega^{\mathcal{F}'}\,\hat{\lambda}\,\hat{\alpha}^{-1}\,\Omega^{\mathcal{F}}\\
&A_{43} = (\phi-1)\,\Psi^{\mathcal{F}'}\,\hat{\lambda}\,\Omega^{\mathcal{F}}.
\end{aligned} \tag{16}$$

Here, Δ^L *represents the row-vector of labor supply shocks,* Δ^0 *represents* $C\times CN$ *matrix of sectoral demand shocks,* $\odot$ *(*$\otimes$*) represents Hadamard (Kronecker) product,* $1_{C\times C}$ *is the* $C\times C$ *matrix of ones,* I_N *is the identity matrix of size* N*,* ξ *and* ξ^0 *are the vector of sectoral elasticities matched to sector-industry combinations, hat (*$\hat{}$*) operator creates a diagonal matrix whose diagonal elements are given by the vector underneath it. To make the rank of* A *matrix full, we need to replace one equation with the fact that the total GDP of the world is*

[2] The second equality comes from the fact that $d\Psi^{\mathcal{N}} = \Psi^{\mathcal{N}}\,d\Omega^{\mathcal{N}}\,\Psi^{\mathcal{N}}$ (dropping superscripts):

$d(\Psi\,\Psi^{-1}) = 0 = d\Psi\,\Psi^{-1} + \Psi\,d\Psi^{-1} \Rightarrow d\Psi\,\Psi^{-1} = -\Psi\,d\Psi^{-1} \Rightarrow d\Psi = -\Psi\,d\Psi^{-1}\,\Psi = -\Psi\,d(I-\Omega)\,\Psi = \Psi\,d\Omega\,\Psi.$

not changing, i.e., $\sum_{f \in \mathcal{F}} d\Lambda_f = 0$. *Hence:*

$$A_{1,1} = 0, \quad A_{f>1,1} = -\Lambda_f$$

The proof of this proposition is provided in Çakmaklı et al. (2025). The intuition behind each matrix is as follows:

- $\Psi^{\mathcal{F}}$ connects the good price changes to factor prices.
- A_1 matrix captures the direct income effect of a change in factor wage on spending. This is the linear Leontief inverse channel.
- B_1 vector captures the income effect of the labor declines.
- B_{21} vector captures the direct effect of sectoral demand shocks.
- A_{22} matrix captures the direct effect of price change in an industry due to shocks. The first and the last $\Psi^{\mathcal{F}}$ terms maps these changes to the factor prices.
- A_{23} matrix captures the substitution between factors due to differential substitutability of country varieties within sectoral consumption bundles. The $(1_{C\times C} \otimes I_N)$ term selects for varieties within the same sectors. Note that if all sector elasticities are the same as σ, this term would drop.
- A_{24} matrix captures the overall substitution between any two industries in consumption through the consumption price index.
- A_{31} is similar to A_{22}, but operates through input shares.
- A_{32} is similar to A_{23}, but operates through input sectoral bundles.
- A_{33} is similar to A_{24}, but operates through input bundles.
- A_{34} matrix captures the direct effect of price changes.
- A_{41} matrix captures the wage changes induced by the factor input channel. Note that When the factors are sector-specific and only a single factor is used in each sector, then $\widehat{\lambda\Omega^{\mathcal{F}}} = \widehat{\lambda \odot \alpha}$, where α is the vector of value-added shares.
- A_{42} matrix captures the factor substitution within the same industry. With sector-specific labor as the only factor $\Omega^{\mathcal{F}'}\,\hat{\lambda}\,\hat{\alpha}^{-1}\,\Omega^{\mathcal{F}} = \widehat{\lambda\Omega^{\mathcal{F}}} = \widehat{\lambda \odot \alpha}$. Hence, in this case, the contribution of $A_{41} + A_{42}$ becomes $(1-\phi)\widehat{\lambda \odot \alpha}$.
- A_{43} matrix captures the substitution between industries and factors. With the sector specific labor assumption, this term becomes $A_{43} = (\phi - 1)\,\Psi^{\mathcal{F}'}\,\hat{\lambda}\,\Omega^{\mathcal{F}} = (\phi - 1)\,\Psi^{\mathcal{F}'}\,\hat{\Lambda}$.

Hence, given the supply and demand shocks, $d\log w$ term can be solved with:

$$d\log w = B\,\hat{\Lambda}^{-1}\,(I - A\,\hat{\Lambda}^{-1})^{-1}.$$

where A and B are matrices summarizing all linear relationships in Equation (16).

From the changes in wages, we can calculate all other changes including Domar weights, prices, Input-Output (Ω) matrix, Leontief-inverse (Ψ) matrix, GDP, country-level expenditures, real GDP, and real expenditures. Briefly, from changes in factor prices and changes in labor supply changes, we can calculate changes in factor Domar weights. From the changes in factor Domar weights, we can calculate the changes in each country's income share, χ vector. On the other hand, using Shepard Lemma, we can easily find the changes in good prices. From changes in good prices and changes in factor prices, we can calculate the changes in consumption shares, input-output shares, and value-added share for each industry using the underlying elasticities in our nested production and consumption functions. Once we have these changes as well, we can calculate the changes in Domar weights for goods using Equation (15). Given the price change and the Domar weight change, we can calculate the real production (GDP) change in each industry as:

$$d\log y_{ic} = d\log\lambda_{ic} - d\log p_{ic}.$$

Similarly, we can express the real expenditure (GNE) change of country c as:

$$d\log C_c = d\log\chi_c - d\log p_{0c}, \tag{17}$$

which is the nominal expenditure of country c divided by the consumption price index of country c, p_{0c}. Hence, the real "welfare" change linked to real expenditure change is endogenously determined. To make post shock real changes comparable with the pre-shock levels, we use a chained Törnqvist price index. This is a convenient tool to adapt for our framework because we chain small shocks to obtain a solution.

3 Global Risks and the U.S. Economy: Applications

We use the model to analyze the impact of three set of shocks in this section: real, geopolitical/financial and policy. For all these applications, we utilize the OECD Inter-Country Input-Output (ICIO) Tables from 2019, covering 65 countries and 35 sectors, to measure the trade and production linkages for the existing system—what we call globalization 1.0.

Although these linkages might be changing towards a system that can be thought as globalization 2.0, our field work and interviews with a large set of CEOs/CFOs and supply chain managers indicate that this will take many years if not decades given the complex web of the existing system and China's extreme cost-competitiveness. The OECD I-O tables detail the expenditure shares of each sector, illustrating the flow of funds to and from other sectors across countries, as of 2019. Of course, once we introduce the shocks, in the model, these shares will change.

As shown above, the model has a nested CES structure both on the production side and on the consumption side, that requires values for several elasticities. Producing "Good (Varieties)" requires combining labor and intermediate goods, which are complements. We set this elasticity to $\theta = 0.6$. The "intermediate bundle" captures the aggregation of alternative inputs such as steel and textiles, which are also complementary to each other. This elasticity is set to be $\varepsilon = 0.2$. This value is consistent with the estimates in the literature (Atalay, 2017) who find strong complementarities at this stage. On the consumption side, we set $\sigma = 1$ (Cobb–Douglas) as the elasticity of substitution between sectors, implying that a constant share of income is allocated across sectors according to their respective weights. We introduce our sectoral demand shocks through adjustments to these weights.

For the substitution among input varieties from different countries, such as Turkish steel, Chinese steel, and U.S. steel, from the perspective of a given U.S. industry (auto), we apply industry-specific trade elasticities as measured by Caliendo and Parro (2015), where all varieties are considered substitutes. Additionally, we incorporate elasticity estimates from Boehm et al. (2019), which treat the input varieties as complements. This multilayer CES structure enables us to capture both substitution and complementarity—e.g., between Turkish steel and Canadian lumber imported by the U.S. construction industry, as well as between Turkish and Chinese steel for the same U.S. auto sector. On the consumption side, the structure also allows us to distinguish between the consumption of Japanese cars versus German cars by U.S. consumers togehter with the supply of these.

3.1 COVID-19 Pandemic Application

How to measure sectoral real shocks that differ than sectoral productivity shocks, namely FS, factor supply shocks? Notice the nuance for labor for example—labor being more/less productive vs. labor being more/less abundant. We use COVID-19 pandemic, where we measure the sectoral labor supply shock based on infections. These are sector-specific and estimated in Çakmaklı et al. (2025) for 35 sectors and 65 countries using an epidemiological-economic model.

For sectoral demand shocks related to pandemic reallocation from closed to open sectors (services vs manufacturing; consume less of restaurant services and buy more of manufactured goods such as a new oven to cook for yourself), we use the monthly data, sourced from the Bureau of Economic Analysis, and do a non-parametric regression of U.S. sectoral personal consumption on U.S. sectoral infections using a second-order polynomial. From these estimates, we calculate the sector-specific consumption changes for other country-sectors based on their respective sectoral infections. These estimates further disciplined by sectoral credit card expenditures from few countries where we have the data available.

Below we show two scenarios, under low and high trade elasticities. Scenario I is a counterfactual where the U.S. population are vaccinated immediately upon vaccine discovery, while rest of the world receive vaccinations slowly. Scenario II is where only the U.S. gets the vaccinations. We report reductions in real expenditure for 2021, relative to 2019, in percentage terms and note the U.S. numbers on the map. Darker shades illustrate higher loss. Interestingly, the worst case scenario for the U.S. is one where the rest of the world does not get the vaccinations. And this result does not depend on how much trade U.S. has with the rest of the world directly and also how easy it is to substitute the lost trade from a country where U.S. has a large trade deficit to another country. As we move from high trade elasticity in panels (a) to relatively low trade elasticity in panels (b), the relative loss increases, everywhere, but not that much for the U.S., especially under Scenario II, making the hidden dependency of the U.S. to the ROW in a non-linear system crystal clear.

Figure 5. Model-Implied Real Expenditure Losses under Scenario I (percent)

(a) $\xi_i = 0.9$ **(b)** $\xi_i = 0.6$

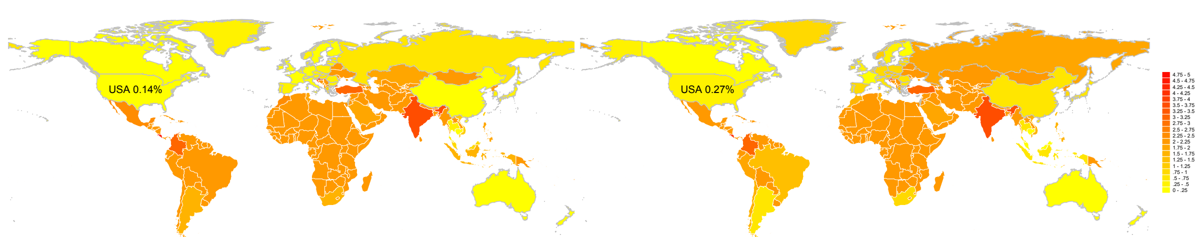
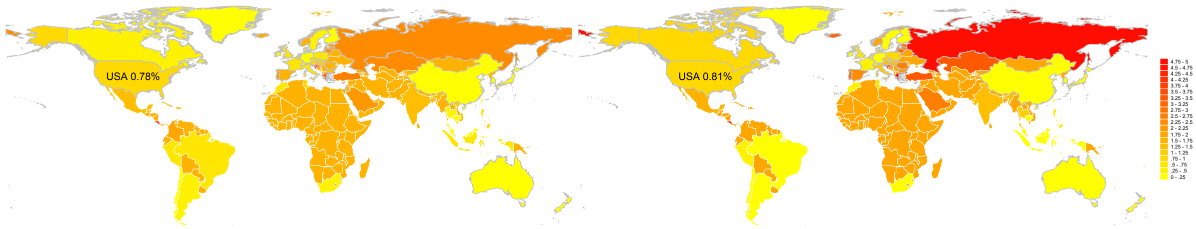


Figure 6. Model-Implied Real Expenditure Losses under Scenario II (percent)

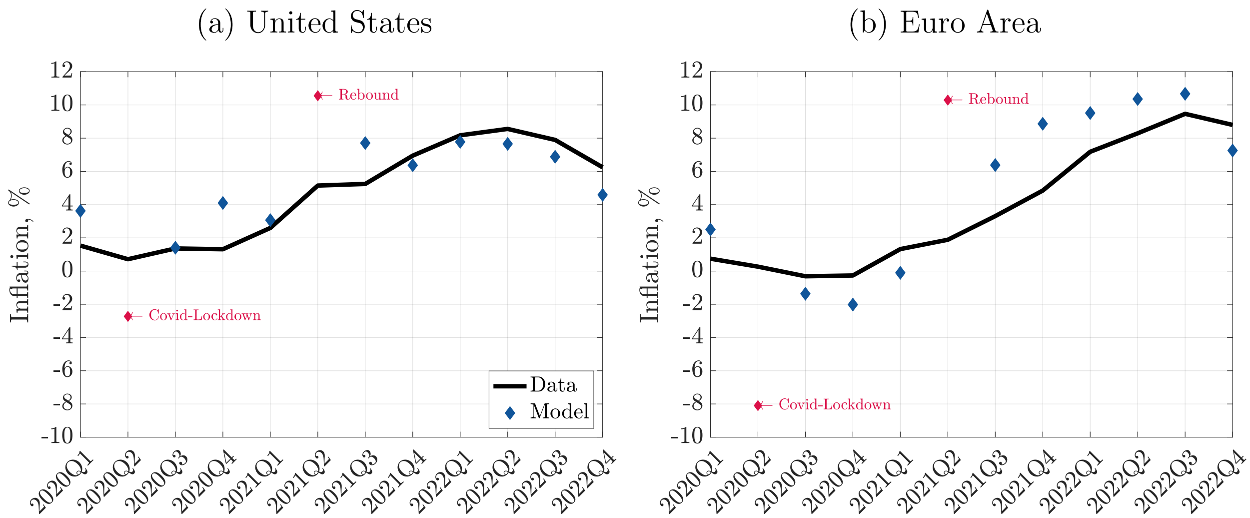
(a) $\xi_i = 0.9$ **(b)** $\xi_i = 0.6$



3.2 Geopolitical Shocks and Fragmentation Application

The world is going through a geopolitical fragmentation. Started as a race for dominance in technology space between the U.S. and China, with the backdrop of national security and supply chain resilience concerns, spilled into a full-blown global trade war as of 2025. Trade diversion and reallocation via connector countries, like Vietnam, are both visible (e.g., Alfaro and Chor, 2023; Gopinath et al., 2025). Researchers argue that similar patterns in FDI and bilateral portfolio flows, via financial centers a.k.a Luxembourg, started to emerge and geopolitical tensions influence cross-border allocation of investment (Catalan et al., 2024). Evidence of increased fragmentation and trade disruptions based on real time shipping and other AI-based data has also been shown (e.g., Fernández-Villaverde et al., 2024; Bai et al., 2024; Fetzer et al., 2024). Thus, fragmentation seems to be unfolding as a reconfiguration of trade and reshoring incentivized by geopolitics-led uncertainty, and reallocation—and misallocation—of global capital among friendly countries (e.g., Aiyar et al., 2024).

Should central banks care about geopolitical fragmentation in trade and finance? The long-run impact of reconfiguration of trade/capital flows on incomes and prices can be calculated using quantitative trade models, however, as we argue, short-run transitional dynamics is also important. The short-run inflationary impact of fragmentation could be particularly salient given relative price changes along the global trade and production networks—as evident during COVID-19 episode where policy makers caught off-guard. In fact, di Giovanni et al. (2023a) write down a version of the model depicted above with downward wage rigidity and aggregate demand shocks to study these issues. These authors are the first to study inflationary impact of the supply chain bottlenecks during the pandemic on a global scale, without introducing a fragmentation shock, but rather only sectoral supply and demand shocks, and aggregate demand shock without which it is hard to match the aggregate spend-



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

ing during recovery of 2021.[3] Their model can match pandemic-era inflation both in the U.S. and in the Euro Area, together with the cross-sectional patterns in consumption and nominal and real wages. Figures above show their exercise for aggregate inflation.

The intuition behind these figures, that are based on the non-linear solution of the model can be better understood with a first-order approximation to CPI inflation that these authors drive:

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

The term 'World Expenditure' ($\mathrm{d}\log E_W^{\$}$) picks up the impact of the U.S. interest rate and countries intertemporal shifters, whereas the term 'Exchange Rate' ($\mathrm{d}\log \mathcal{E}_c$) picks up country interest rate differential relative to the U.S., given the UIP condition. 'Productivity shock' term ($(\lambda^c)^T \mathrm{d}\log A$) is standard TFP changes weighted by the importance of sector in consumption basket of country c, and 'Factor Changes' ($(\Lambda^c)^T \mathrm{d}\log L$) are labor changes weighted by the importance of factor in providing for the consumption basket of country c, as labor is the only factor of production in this model. Finally, the term 'Local-Global D-S Imbalance' ($(\Lambda^c)^T \mathrm{d}\log \Lambda$) is new to the literature as it picks up relative changes in global and local factor shares. Hence, it is not the same mechanism in the trade literature where an increase in demand in country A can raise demand for some globally supplied input, thereby affecting inflation in another country B that uses the same input (e.g., Auer et al.,

[3]See also di Giovanni et al. (2022), di Giovanni et al. (2023b).

2019). But rather it is a specific mechanism about the mismatch between relative demand and Domar weights. Take chips, for example: it is a small sector in the U.S. in terms of production but big in Taiwan and big globally in terms of sales. Our term is capturing this idea that, chips are in high demand globally, but their supply is coming only from certain small countries and if the U.S. demand is bigger than say Brazil for chips (can be because a larger AI investment in the U.S.) then inflation in the U.S. will be higher than the one in Brazil even the source of inflation for both countries is high demand for a globally supplied input that is scarce to begin with or under monopoly of a country as in rare earths in China).

One can also introduce fragmentation shocks to this framework, in the form of higher trade barriers/trade costs (as oppose to sector-country specific tariffs or markups), then the first-order approximation to inflation becomes:

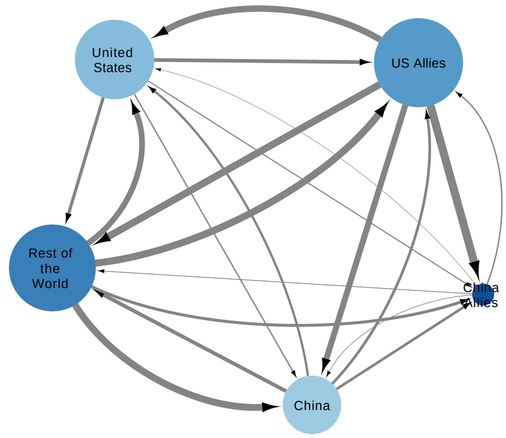
$$
\begin{aligned}
\mathrm{d}\log \mathrm{CPI}_c = {} & \mathrm{d}\log E_W^{\$} + \mathrm{d}\log \mathcal{E}_{c,US} - (\lambda^c)^T \mathrm{d}\log A - (\Lambda^c)^T \mathrm{d}\log L + (\Lambda^c)^T \mathrm{d}\log \Lambda \\
& + \underbrace{(\lambda^c)^T (\Omega^{\mathcal{N}} \odot \mathrm{d}\log \tau)\,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

where $(\Omega^{SS} \odot \mathrm{d}\log \tau)\, 1_{CN}$ term captures the direct inflationary impact of fragmentation (higher trade barriers). Note that with these barriers increasing trade costs ($\tau_{c,jm} \neq 1$), global factor shares are no longer the weighted average of local factor shares, as in many standard models:

$$
\Lambda \neq \sum_c \frac{E_c/\mathcal{E}_{c,US}}{E^W} \Lambda^c.
$$

To quantify the impact of such fragmentation, we divide the world into blocs. Note that this is totally exogenous, based on our reading of the literature that does this in more detail using classifications according to UN-voting, historical ties/partnerships, and other proxies. Our blocs shown in the figure above, where the node size is proportional to the expenditure of the bloc going from 1.4T USD to 24.5T USD. Node color shows the imported intermediate input share of the bloc (darker blue implies higher imported intermediate shares, ranging from 7.7% to 11.4%). Edge weights reflect the share of the intermediate input from the source country among all imported intermediates going from 1.4% to 56%.

Figure 7. Country-Country Input Linkages

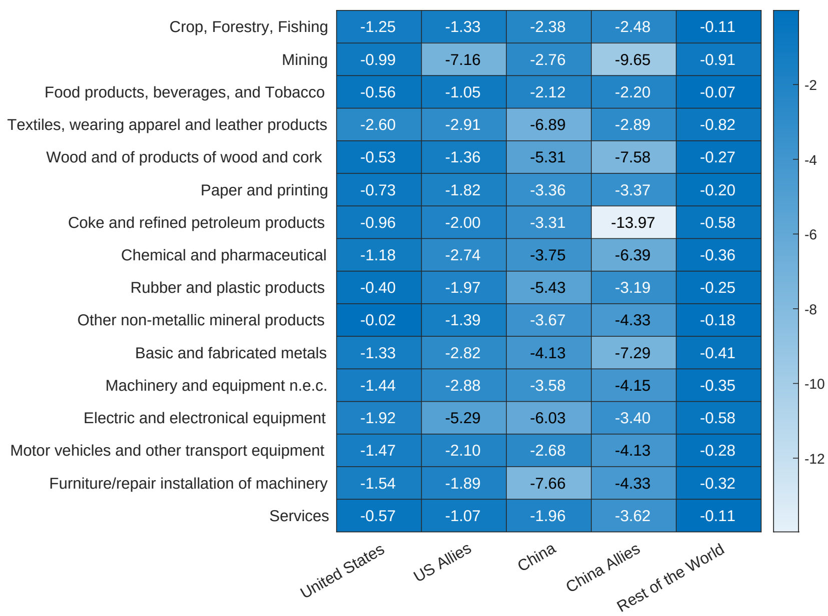


Using similar parameters before, and empirically relevant trade and production elasticities with intertemporal elasticity of substitution $\sigma^{-1}= 0.5$ as in (e.g., Auclert et al., 2021; Boehm et al., 2023), and Taylor-rule coefficient of $\phi = 1.5$, and calibrating sectoral demand shifters to match 1% interest rate at steady state, we work out the impact of empirically relevant fragmentation shocks. On purpose, we use these shocks from pre-Trump administration era, such as: Electric vehicles barriers going from 25% to 100% in 2024; semiconductor barriers going from 25% to 50% by 2024; steel and aluminium product barriers from 7.5% to 25% in 2024; lithium batteries and critical minerals barriers from 7.5% to 25% in 2024; solar cells barriers from 25% to 50% in 2024; shore cranes barriers from 0% to 25% in 2024, and rubber medical and surgical gloves barriers from 7.5% to 25%.

The impact of these sector-specific fragmentation shocks on sector specific unemployment is given in the Table below. We show the percent decline in employment, for each bloc, by sector. Aggregation of these asymmetric results show that, unemployment impact in the U.S. can be large, as the cost of stabilizing the inflationary impact of higher trade costs in a fragmented world is higher unemployment.

A big advantage of this framework is the ability to study spillovers of fragmentation between the U.S. and China to third country output-inflation. Our work is also complementary to other works studying fragmentation shocks, such as work focuses on income and output loss from friend-shoring (e.g., Javorcik et al., 2024; Bonadio et al., 2025) and Ambrosino et al. (2024) who study a two-sector (tradable and non-tradable) small open economy NK setting with constrained households. These authors model fragmentation as increase in import costs or decline in tradables' TFP, where a decline in productivity of tradables might be neutral for inflation. In our case, sectoral factor supply shocks combined with sectoral demand shocks can have a stagflationary impact. There are also papers that show possibility

Figure 8. Employment changes with downward rigidity



of higher real incomes, such as Bonadio et al. (2025), if terms of trade gains are powerful enough.

3.3 Trade Policy Application

Our final application focuses on 2025 global trade war, with a focus not only on tariffs but also on the general uncertainty surrounding the trade policies of 2025 U.S. administration. Kalemli-Özcan et al. (2025) studies the impact of these policies within multi-sector-country network model in global general equilibrium. They introduce full dynamics and price rigidities to the baseline model we have reviewed above, together with incomplete markets. The resulting NKOE framework combines the long-run flex price general equilibrium setup of trade models with short-run sticky price set up of NK open economy models within global networks. In this NKOE framework, shocks are propagated differentially, affected by the multi sector-country price rigidities and multi-country monetary policy responses. To make this intuition clear, these authors provide the following generalizations of the Leontief-inverse matrix:

- 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:

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

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

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

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

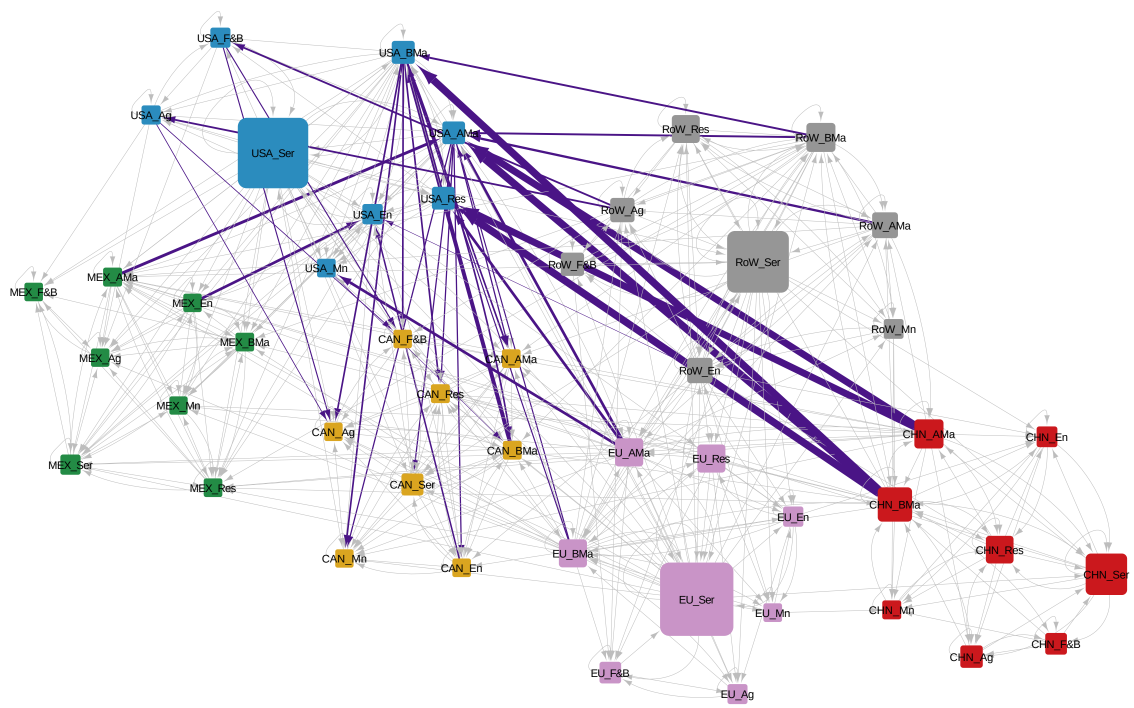


Figure 9. 2025 Tariffs as of August 7, 2025.

Kalemli-Özcan et al. (2025) shows that, this global network set-up can deliver *persistent inflation* in the U.S. compared both to a SOE representation of the U.S. economy, and two-country global GE. Full global I-O linkages, more than 1 sector, more than 2 countries are all important for this result. These theoretical effects are shown below for a given level of unilateral tariffs, applied to all trading partners of the U.S. mimicking the 2025 reality.

Figure 10. Model Comparison

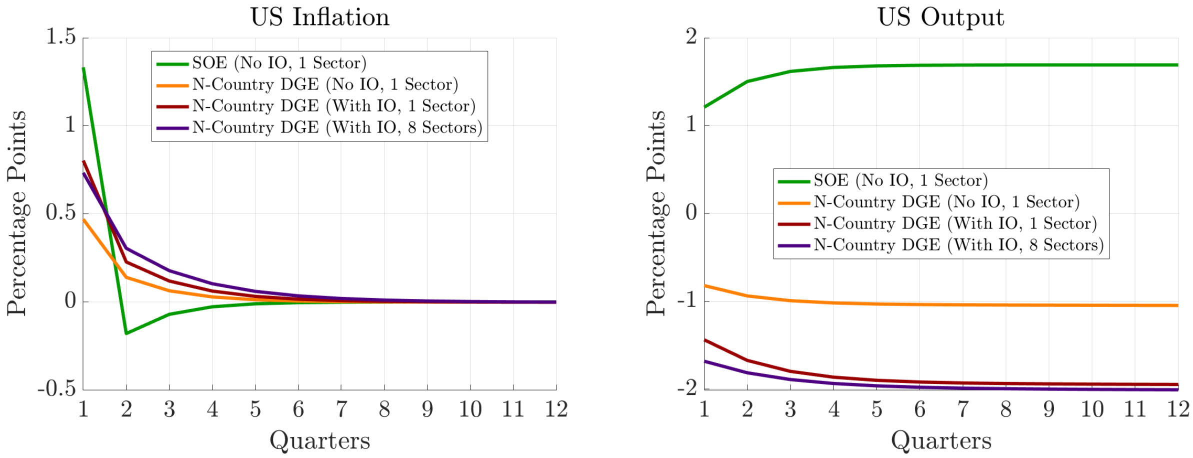
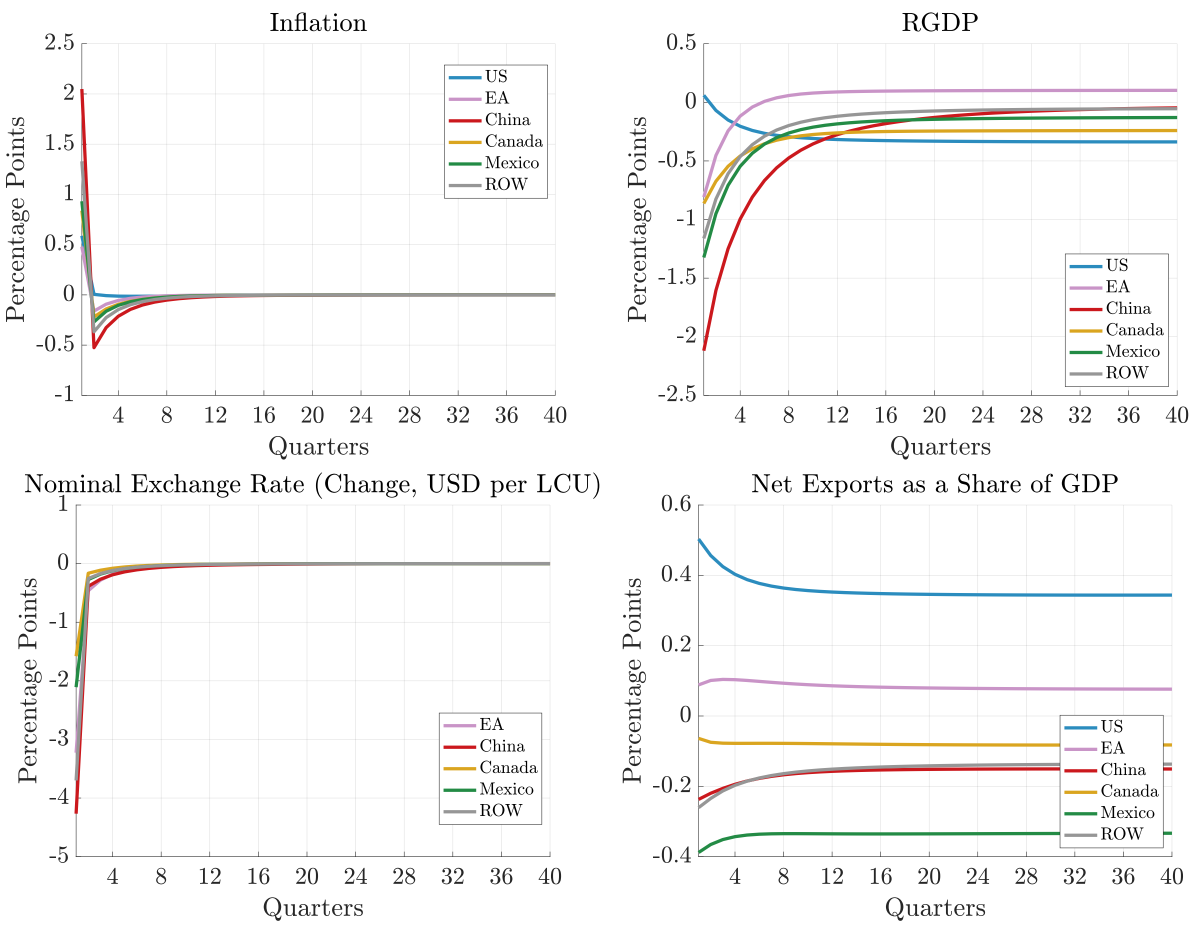


Figure 11 is a quantitative application taken from Kalemli-Özcan et al. (2025) showing the impact of implemented 2025 tariffs, as of August, on inflation, output, exchange rates and trade deficits for the U.S., EA, Canada, Mexico, China and a rest of the world aggregate.

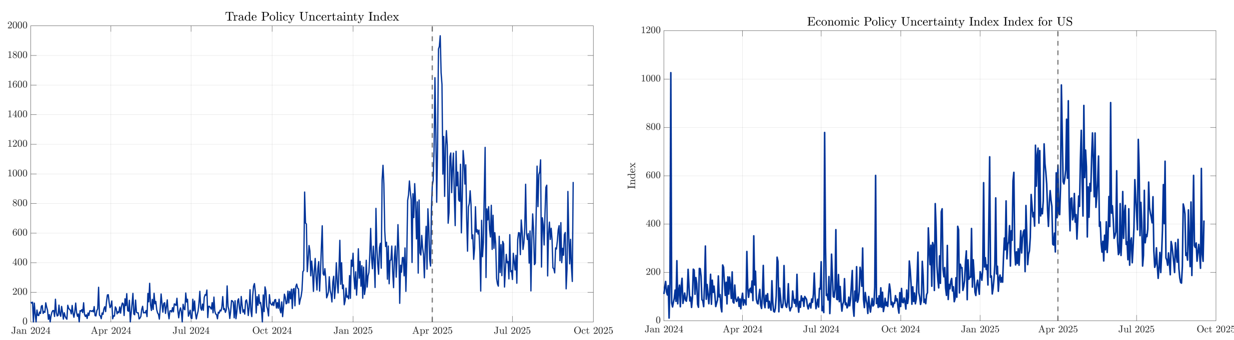
Figure 11. 2025 Tariffs



We estimate a 0.2-0.5 percentage point rise in the U.S. inflation, as a result of home-grown trade policy shock, in the short-run, with a drop in real GDP up to 1 percent in the long-run. Note that these exercise assumes monetary policy endogenously responds to inflationary impact of tariffs and in the absence of such policy responds, inflationary impact will be persistent.

Maybe the most interesting feature of the 2025 tariffs are not how high or low they are but the uncertainty surrounding the policy given its on and off nature. Below, in Figure 12, we plot the trade policy uncertainty index of Caldara et al. (2020) and general economic policy uncertainty index of Baker et al. (2016).

Figure 12. Policy Uncertainty

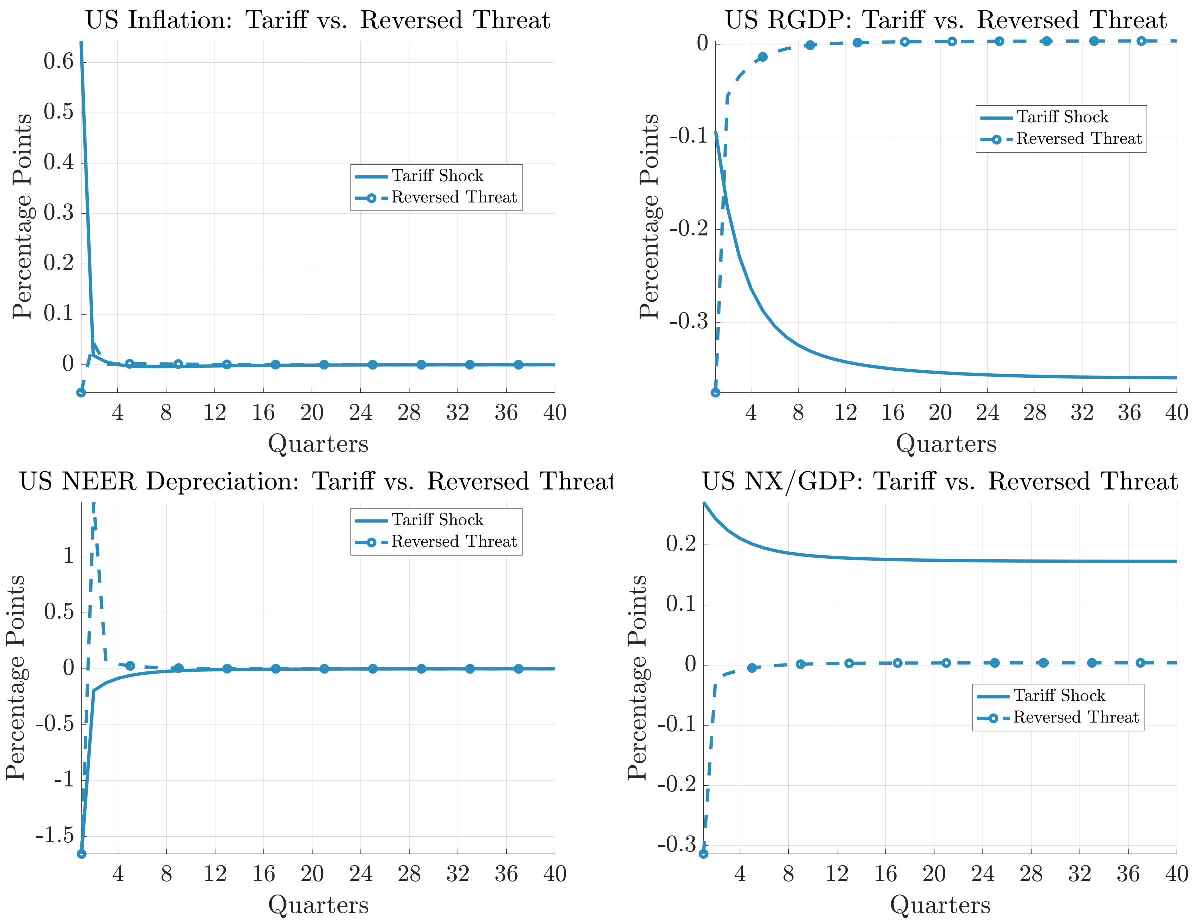


(a) Trade Policy Uncertainty (Caldara et al., 2020)

(b) Economic Policy Uncertainty (Baker et al., 2016)

Both indices spiked around the 'Liberation Day' event and stay elevated. Kalemli-Özcan et al. (2025) studies the impact of such policy uncertainty by feeding a reversed tariff threat shock into the model. The results are shown below in contrast to a regular tariff shock. A tariff threat not only leads to even a bigger drop in output in the short-run, but also is deflationary instead of being inflationary. It also leads to dollar depreciation, as observed in April 2025, and a deterioration in trade deficit, instead of improvement that would be the case via regular tariffs due to declining imports. The reason for these effects under tariff threats is agents' expectations about the future leading to not only slowing their domestic final demand but also front loading imports leading to higher trade deficit.

Figure 13. Reversed Tariff Threats



4 Conclusion

This paper develops a global framework that integrates trade, production, and financial networks to evaluate how rising global risks transmit to the U.S. economy. Even in its simplest form—an open-economy, two-period global general equilibrium model with full input–output linkages—the framework captures sectoral demand and supply shock spillovers across countries without relying on nominal rigidities, financial frictions, or a full dynamic structure. Its flexibility derives from its ability to incorporate granularity in the form of a rich set of cross-sector and cross-country elasticities, allowing aggregation at several different layers, offering a scalable tool for analyzing shock transmission in a highly interconnected global system. The three applications, centering on recent events all show a significant impact of global risks on the U.S. economy.

The real-life and policy relevance of such a framework is closely tied to the longstanding insight that global stability is a public good. Kindleberger (1941) argued that a leading economy cannot insulate itself from global turbulence and therefore must provide stabilizing functions—open markets, stable monetary arrangements, and lender-of-last-resort capacity—if it wishes to preserve international economic order. Hirschman's (1945) analysis of asymmetric dependencies similarly highlights how trade structures create geopolitical leverage, but also underscores that instability in the system ultimately feeding back onto the hegemon itself. Taken together, these perspectives imply that failing to maintain a stable international economic environment may undermine the very advantages associated with financial and geopolitical dominance for the U.S.

Our framework begins from the empirical reality of today's global production ecosystem, in which more than 70 percent of world trade flows through complex supply chains that span multiple countries and involve distinct producers, assemblers, financiers, and service providers. Products are routinely designed, sourced, manufactured, assembled, and tested across several jurisdictions, and financed by yet others. Such complexity means that global risks—real, financial, or geopolitical—propagate along pathways that conventional two-country or highly aggregated macro models cannot capture making the case for disaggregated models. Understanding U.S. vulnerability therefore requires acknowledging its dual role as both a geopolitical actor and a stabilizing anchor within this networked ecosystem.

To reflect this complexity, we introduce a broad set of elasticities governing trade, production, and financial linkages, moving beyond the limited substitution patterns implied by standard CES-based structures. Extending the framework toward a New Keynesian environment further enables the incorporation of time propagation combined with financial elasticities under incomplete markets and allows us to study how agents' expectations and perceptions of global risks shape macroeconomic outcomes, regardless of whether the shocks originate domestically or abroad and whether they are monetary, trade, or geopolitically driven.

The applications explored in this paper—from the COVID-19 pandemic to the 2021 inflation episode, supply-chain disruptions, geopolitical tensions, and the 2025 tariff shock—illustrate how a disaggregated network perspective alters the assessment of U.S. exposure to global risks. Despite low headline trade shares and dollar dominance, the United States is more deeply intertwined with global value chains than conventional measures suggest. As a result, global risks can generate meaningful effects on U.S. output, inflation, financial conditions, and labor markets. Our framework provides a structured way to analyze these exposures and underscores that safeguarding domestic stability increasingly requires understanding, and managing, the risks arise in global networks in which the U.S. economy is embedded.

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5 Appendix: Country Blocs (Exogenous)

Country	Bloc	Country	Bloc
Argentina	Rest of the World	Iceland	US Bloc
Australia	US Bloc	Israel	US Bloc
Austria	US Bloc	Italy	US Bloc
Belgium	US Bloc	Jordan	Rest of the World
Bangladesh	Rest of the World	Japan	Rest of the World
Bulgaria	US Bloc	Kazakhstan	Rest of the World
Belarus	China Bloc	Cambodia	Rest of the World
Brazil	Rest of the World	Korea	US Bloc
Brunei Darussalam	Rest of the World	Lao (People's Dem. Rep.)	China
Canada	US Bloc	Lithuania	US Bloc
Switzerland	US Bloc	Luxembourg	US Bloc
Chile	Rest of the World	Latvia	US Bloc
China (People's Rep.)	China	Morocco	Rest of the World
Côte d'Ivoire	Rest of the World	Mexico	Rest of the World
Cameroon	Rest of the World	Malta	US Bloc
Colombia	Rest of the World	Myanmar	Rest of the World
Costa Rica	Rest of the World	Malaysia	Rest of the World
Cyprus	US Bloc	Nigeria	Rest of the World
Czechia	US Bloc	Netherlands	US Bloc
Germany	US Bloc	Norway	US Bloc
Denmark	US Bloc	New Zealand	US Bloc
Egypt	Rest of the World	Pakistan	Rest of the World
Spain	US Bloc	Peru	Rest of the World
Estonia	US Bloc	Philippines	Rest of the World
Finland	US Bloc	Poland	US Bloc
France	US Bloc	Portugal	US Bloc
United Kingdom	US Bloc	Romania	US Bloc
Greece	US Bloc	Russian Federation	China Bloc
Hong Kong, China	China	Saudi Arabia	Rest of the World
Croatia	US Bloc	Senegal	Rest of the World
Hungary	US Bloc	Singapore	Rest of the World
Indonesia	Rest of the World	Slovakia	US Bloc
India	Rest of the World	Slovenia	US Bloc
Ireland	US Bloc	Sweden	US Bloc