The Propagation of Tariff Shocks via Production Networks*

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March 24, 2026

Abstract

Import tariffs have offsetting macroeconomic effects: they shift expenditure toward domestic production while raising the cost of imported intermediates. We show that their aggregate impact depends on the propagation via the domestic production network. In a New Keynesian small open economy model with input–output linkages, tariff shocks transmit both upstream and downstream, shaping output and inflation. Using U.S. sectoral time-series data, we document patterns consistent with the model's predictions. Calibrating the model to match these sectoral moments, we find that a uniform tariff reduces aggregate output through production networks. A heterogeneous "Liberation Day" tariff package generates a 2 percent decline in output and an 80 basis point increase in inflation.

Keywords: Tariffs shocks, business cycle, upstream sectors, downstream sector, input-output network, monetary policy, inflation
JEL-Codes: F41, E32

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1 Introduction

How do import tariffs affect business-cycle dynamics, in particular output and inflation? Addressing this question is challenging because tariffs do not affect the economy uniformly. They are typically imposed on specific goods or trading partners, and even when applied uniformly across all imports, their effects differ across sectors due to heterogeneity in import intensity. This heterogeneity reflects both differences in the use of imported inputs and in exposure to import competition in output markets. More broadly, tariffs propagate through domestic production networks, generating spillover effects that extend beyond the directly targeted sectors.

This paper studies the propagation of tariff shocks and their aggregate effects in a New Keynesian multi-sector small open economy. The model features an input–output network with imported goods used at all stages of production. We show analytically that sectoral import tariffs propagate through the production network both downstream and upstream. Upstream tariffs reduce downstream output by raising input costs, whereas downstream tariffs can increase upstream output by shielding domestic producers from foreign competition. To assess these mechanisms empirically, we construct a measure of effective sectoral tariffs using U.S. customs data. Consistent with the model, tariffs reduce downstream output and increase upstream output. We further document a statistically significant rise in downstream prices, with no corresponding effect upstream.

The aggregate effects of import tariffs depend on their sectoral distribution and the structure of the domestic production network. Tariffs can be expansionary or contractionary, depending on whether upstream or downstream propagation dominates and on the ease of substituting imported goods with domestic inputs along the value chain. For a quantitative assessment, we calibrate key model parameters to match evidence on sectoral tariff transmission and simulate tariff shocks. Under a uniform tariff, the model predicts a sharp output contraction and a prolonged inflation response; absent production networks, the same tariff raises output and generates only transitory inflation. We then simulate the "Liberation Day" tariffs proposed by the Trump administration. While their output effects are similar to those of a uniform tariff, their inflationary impact is stronger because they disproportionately affect upstream sectors. In this case, U.S. GDP falls by about 2%, and consumer price inflation rises by approximately 0.8 percentage points.

Our results—that the aggregate impact of tariff shocks depends on its sector of origin—have important implications for monetary policy because the fundamental effect of the shock changes with the sector of origin. Tariffs imposed on upstream sectors producing intermediate goods represent a negative supply shock and are highly stagflationary: they reduce output and raise inflation due to downstream propagation of production costs throughout the network. This creates a monetary policy tradeoff—stimulating the economy to mitigate the recessionary impact raises inflation further, while tightening to control inflation deepens the recession. In contrast, as the tariff shock originates further down the supply chain, the role of downstream propagation diminishes, and the stagflationary impact weakens. When tariffs target sectors closer to final use, they act as positive domestic demand shocks, raising both domestic output and prices. Their impact can be contained more easily by monetary policy.

Our model extends the New Keynesian small open economy workhorse model à la Gali and Monacelli (2005) to a multi-sector environment with a fully specified input-output network. It differs from the related framework by Qiu et al. (2025) in that we consider a fully dynamic model. Goods used for intermediate inputs and final consumption are bundles of domestically produced and imported sectoral goods, allowing imported inputs to matter at all stages of production and to be partially substituted by domestic counterparts. Sectors differ in their use of intermediate inputs, trade openness, and importance in household consumption. We allow for time-varying, sector-specific import tariffs and study their short-run effects, notably how they propagate through the network. For our model simulation, we assume feedback rule for monetary policy that adjusts interest rate in response to domestic inflation.

To establish the determinants of sectoral tariff propagation, we analytically solve the model under assumptions that yield tractability—flexible prices and linear disutility of labor. We show that tariffs imposed on upstream sectors reduce output and raise prices in downstream sectors. Conversely, tariffs in downstream sectors increase output in upstream sectors, provided domestic and imported goods are sufficiently substitutable. We illustrate these results using a numerical three-sector example with a vertical production chain: A tariff in the middle sector raises output in the upstream and middle sectors while reducing it in the downstream sector. In larger and more realistic production networks, any given sector can be simultaneously upstream and downstream relative to any other sector, resulting in a more complex tariff propagation in both directions.

We then turn to US data to assess whether there is empirical support for the patterns of sectoral tariff propagation predicted by our model. We begin by constructing a quarterly sector-level effective tariff measure for the period 2002Q1–2024Q4 using US Census Bureau data on imports and estimated duties. Then we estimate tariff propagation patterns following the approach of Acemoglu et al. (2016). Specifically, we calibrate the input-output matrix based on the Use Tables of the Bureau of Economic Analysis to measure the upstream and downstream proximity between pairs of sectors and construct a sector-specific time series of upstream and downstream tariff exposures for all sectors in the sample. Based on local projections, we estimate the response of sectoral output to changes in upstream and downstream tariff rates. As predicted by the model, output increases in sectors upstream and decreases in sectors downstream after an increase in tariffs. Estimating the response of domestic sectoral prices, we find an increase in prices downstream, but no significant response for other directions of propagation.

Having established evidence that supports the model predictions on tariff propagation, we use the model to analyze the aggregate effects of tariffs. We calibrate the model to the US production network at the disaggregated level allowing for 63 sectors, incorporating sector-specific input-output linkages, labor shares, consumption shares, trade openness, and price stickiness. This allows us to generate quantitative predictions for the effects of actual or hypothetical tariff packages, accounting for the structure of the US economy. We examine two policy scenarios and compare their effects in the calibrated model with what would happen in the absence of an input-output network. First, we consider a 10 percent import tariff uniformly imposed on all imports. This scenario allows us to isolate the role of the production network for the propagation of tariffs: Any difference in the overall effect relative to what we find in the absence of a network is caused by input-output linkages. And the difference turns out to be fundamental. In the baseline, GDP, measured in terms of value added, falls by more than 1.5 percent, while it rises mildly in the absence of the network; inflation increases persistently in the baseline while undershooting quickly after an initial increase in the absence of the network.

Second, we simulate the effect of the "Liberation Day" tariffs, announced by the US government in April 2025. In this case, tariffs are not uniform. While these tariffs prima facie vary primarily across trading partners, they effectively vary across sectors, too. Intuitively, a high tariff on imports from a country that mostly exports textiles to the US and a low tariff on imports from a country that

mainly exports machinery to the US results in a higher effective tariff rate on textiles than on machinery. We compute the sector-specific tariff rates implied by the "Liberation Day" tariffs, using sectoral import shares from all US trading partners, and find that they vary substantially across sectors. Yet their impact on GDP is similar to that of the uniform tariff scenario—testifying to the importance of network propagation for the aggregate effects of tariffs. However, the "Liberation Day" tariffs induce a stronger inflation response because in this case tariffs increase disproportionately in upstream sectors.

The paper is organized as follows. In the remainder of the introduction, we place the paper in the context of the literature and outline its contribution. Section 2 presents the structural model used to study tariff propagation across sectors. Section 3 outlines the theoretical patterns of tariff propagation and documents corresponding evidence in US data. Section 4 provides a quantitative analysis of tariff scenarios. Section 5 concludes.

Related literature. First and foremost, our paper contributes to recent work on the short-run impact of tariffs in economies with imported intermediate inputs. Bergin and Corsetti (2023, 2025) and Auclert et al. (2025) show that tariffs are generally recessionary. Auray et al. (2024); Ambrosino et al. (2024); Bianchi and Coulibaly (2025); Monacelli (2025); Werning et al. (2025) study the implications of tariffs for monetary policy. Kalemli-Özcan et al. (2025) find that in a production network economy, tariffs, while contractionary, can be deflationary or inflationary, depending on the strength of demand effects. We contribute to this literature by analyzing tariff propagation through the domestic production network using both a structural model and US data. We show that downstream linkages cause recessionary effects, while upstream propagation can be expansionary.

Second, in this way, our paper complements the empirical literature on how import tariffs propagate through domestic production chains. Blonigen (2016); Cox (2021) document that steel-related trade protection harms downstream sectors, while Flaaen and Pierce (2019) show that manufacturing tariffs reduce employment due to higher input costs. Barattieri and Cacciatore (2023) find large negative effects of tariffs on downstream employment but minimal short-term benefits for protected sectors. Bown et al. (2024) provide evidence of negative downstream employment effects alongside positive long-run gains for protected sectors. Rodríguez-Clare et al. (2025) show that tariffs can stimulate domestic manufacturing.

Third, there is a large empirical literature on the effects of tariffs on sectoral and aggregate economic activity. Tariffs have been found to reduce output, productivity, consumption, and exports in the medium run (Furceri et al., 2018; Waugh, 2019; Handley et al., 2020), with retaliation often amplifying these effects (Fajgelbaum et al., 2020; Autor et al., 2024). While some studies find benefits for protected sectors, these are typically outweighed by broader welfare losses (Fajgelbaum et al., 2020; Autor et al., 2024). Protectionism has also been shown to act as a negative supply shock, lowering output and raising inflation across countries (Barattieri et al., 2021), and harming economic activity globally (Chor and Li, 2024). We complement this evidence by emphasizing the role of production networks in the propagation of tariff shocks.

Fourth, we contribute to the literature on the effects of tariffs on prices. While some argue tariffs have not historically been inflationary in the US (Batra, 2001), recent evidence suggests mixed price effects—often offset by trade diversion (Flaaen et al., 2020)—with import prices rising and export prices falling (Cavallo et al., 2021). We add to this by analyzing how tariffs propagate through production networks to influence domestic prices.

Fifth, there is related but distinct work on the objectives and effectiveness of trade protection (e.g., Hume, 1742; Lerner, 1936; Krugman, 1985; Marris, 1987). More recent work has explored the political economy rationale for trade protection (Ossa, 2014) and how optimal tariffs are influenced by production and trade network structures (Erbahar and Zi, 2017; Antràs et al., 2024; Blanchard et al., 2025). Another line of research considers trade protection as a tool for business cycle stabilization through fiscal devaluations, though its practical effectiveness is debated (Farhi et al., 2014; Erceg et al., 2023). Obstfeld (2025) reviews common fallacies in tariff policy aimed at reducing the US trade deficit, and Itskhoki and Mukhin (2025) examine optimal tariffs when policy goals include supporting manufacturing jobs and improving the trade balance.

Lastly, we relate to the broad literature on shock propagation trough production networks. Acemoglu et al. (2012, 2016); Carvalho (2014); Barrot and Sauvagnat (2016) study how the transmission of microeconomic shocks matters for macroeconomic outcomes. Baqaee and Farhi (2019, 2020); Bigio and La'o (2020) develop methodologies to assess the effects of sectoral shocks on the misallocation and productivity. Carvalho et al. (2021) explores the effects of the 2011 Japan earthquake on production networks. Pasten et al. (2020); Ghassibe (2021) analyze the propagation of monetary policy shocks within input-output network economies.

2 Model

To study the propagation of sector-specific import tariffs, we set up a dynamic New Keynesian model of a small open economy featuring a production network and sectoral imports and exports. The model allows for sector-specific import tariffs, along with an arbitrary degree of substitutability between imported and domestic varieties at each stage of production and in final consumption. Goods produced in each sector can serve as intermediate inputs for other sectors or as final consumption goods. Domestic prices are subject to a Calvo-type nominal rigidity.

2.1 Structure

Households. A representative domestic household consumes a bundle of domestic and imported sectoral goods and supplies labor to the N domestic sectors. International financial markets are complete, allowing the household to trade a full set of state-contingent assets across countries. The household maximizes expected lifetime utility

$$\max_{\{C_t, L_t\}} E_t \sum_{t=0}^{\infty} \delta^t \{\log C_t - \sum_{i=1}^{N} \frac{L_{t,i}^{1+\phi}}{1+\phi}\},$$

where C_t is the final consumption good and $L_{t,i}$ is the labor supplied to domestic sector i. The parameter $\delta < 1$ is the discount factor, and $\varphi > 0$ is the inverse of the Frisch elasticity. The household's nominal budget constraint is given by

$$P_t^c C_t + E_t\{Q_{t,t+1}, B_{t+1}\} \leq B_t + \sum_{i=1}^{N} W_{t,i} L_{t,i} + D_t + T_t,$$

where P_t^c is the consumer price index (CPI), B_t is the nominal payoff in period t from a portfolio purchased in period $t-1$, $Q_{t,t+1}$ is the one-period-ahead stochastic discount factor for nominal payoffs, $W_{t,i}$ is the nominal wage paid in sector i, D_t are aggregate firm profits, and T_t is a lump-sum transfer. The (inverse of the) riskless nominal interest rate is given by $R_t^{-1} \equiv E_t Q_{t,t+1}$.

The final consumption good C_t is a bundle of sector-specific goods:

$$C_t = \prod_{i=1}^{N} \left(\frac{C_{t,i}}{\beta_i}\right)^{\beta_i},$$

where $\sum \beta_i = 1$. The sector-specific consumption good, in turn, is a composite of domestic and imported (foreign) varieties:

$$C_{t,i} = \left((1-\gamma_i)(C^D_{t,i})^{\frac{\eta_i - 1}{\eta_i}} + \gamma_i (\phi_{t,i} C^F_{t,i})^{\frac{\eta_i - 1}{\eta_i}} \right)^{\frac{\eta_i}{\eta_i - 1}} \tag{1}$$

where $0 \leq \gamma_i \leq 1$ is the sector-specific importance of imports in consumption (trade openness), and $\eta_i > 0$ is the sector-specific long-run elasticity of substitution between domestic and imported varieties. $C^F_{t,i}$ denotes the sector-i imports used for final consumption, while $C^D_{t,i}$ denotes the consumption of sector-i goods produced domestically. Following Gornemann et al. (2025) we assume that the mix of foreign and domestic goods is subject to adjustment cost governed by $\phi_{t,i}$ such that

$$\phi_{t,i} = 1 - \frac{\iota}{2} \left(\frac{(C^F_{t,i}/C^D_{t,i})}{(C^F_{t-1,i}/C^D_{t-1,i})} - 1 \right)^2 .$$

These adjustment costs allow the model to capture a dynamic elasticity of substitution that is lower in the short run as documented by Boehm et al. (2023) and others. The parameter ι hence governs the stickiness of the sectoral import vs. domestic goods ratio after relative price changes.

The expenditure-minimizing choice between domestic and foreign sector-i goods follows a dynamic optimization problem:

$$\max_{C_{t,i}, C^D_{t,i}, C^F_{t,i}} \quad \sum_{s=t}^{\infty} Q_{t,s} \Big(P^c_{t,i} C_{t,i} - P_{t,i} C^D_{t,i} - (1+\tau_{t,i}) \mathcal{E}_t P^*_{t,i} C^F_{t,i} \Big), \tag{2}$$

subject to constraint given by Eq. (1).

Note that the imported good trades at world-market price $P^\star_{t,i}$, denoted in foreign currency. $\mathcal{E}_t$ is the nominal exchange rate, and $\tau_{t,i}$ is an import tariff in sector i. As a result, $(1+\tau_{t,i})\mathcal{E}_t P^\star_{t,i}$ is the domestic-currency price of imports in sector i.

In the special case without the adjustment cost ($\iota = 0$), the problem (2) becomes static, and we obtain the familiar constant-elasticity demand functions:

$$C^D_{t,i} = (1-\gamma_i) \left(\frac{P_{t,i}}{P^c_{t,i}} \right)^{-\eta_i} C_{t,i} \tag{3}$$

for the domestically produced sector-i aggregate which trades at price $P_{t,i}$, and

$$C_{t,i}^F = \gamma_i \left(\frac{(1+\tau_{t,i})\mathcal{E}_t P_{t,i}^\star}{P_{t,i}^c} \right)^{-\eta_i} C_{t,i} \tag{4}$$

for the imported good. This implies a consumer price for sector-i of

$$P_{t,i}^c = \left((1-\gamma_i) \cdot [P_{t,i}]^{1-\eta_i} + \gamma_i \cdot [(1+\tau_{t,i})\mathcal{E}_t P_{t,i}^\star]^{1-\eta_i} \right)^{\frac{1}{\eta_i - 1}}. \tag{5}$$

The price of the final consumption good (CPI) is given by

$$P_t^c = \prod_i \left[P_{t,i}^c \right]^{\beta_i}. \tag{6}$$

Because international financial markets are complete, there is full risk sharing with the rest of the world. Letting C_t^* denote consumption in the rest of the world and P_t^* its price, this implies:

$$\frac{C_t}{C_t^*} = \frac{\mathcal{E}_t P_t^*}{P_t^c}, \tag{7}$$

assuming a symmetric steady state and identical initial conditions in Home and the rest of the world. Moreover, domestic interest rates R_t and their foreign counterpart $R_t^\star$ are linked via the UIP condition:

$$E_t \left\{ Q_{t,t+1} \left(R_t - \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} R_t^* \right) \right\} = 0. \tag{8}$$

Firms. In each sector i, there is a continuum of monopolistic competitive firms, indexed by $k \in [0,1]$. Each firm produces with a constant-returns-to-scale technology, combining sectoral labor with intermediate inputs:

$$Y_{t,i,k} = A_{t,i} \left(\frac{L_{t,i,k}}{\alpha_i} \right)^{\alpha_i} \prod_{j=1}^{N} \left(\frac{X_{t,i,j,k}}{\omega_{i,j}} \right)^{\omega_{i,j}(1-\alpha_i)},$$

where $Y_{t,i,k}$ denotes the output of firm k in sector i, $L_{t,i,k}$ is the amount of labor employed by the firm, $A_{t,i}$ is sector-specific total factor productivity, and $X_{t,i,j,k}$ is the quantity of good j used as an intermediate input. The parameter α_i is the sectoral labor share in total costs, and $\omega_{i,j}$ is the share of input j in the total intermediate input cost of sector i. The factors of production can be adjusted

flexibly so that marginal costs in a sector, $MC_{t,i}$, are the same for all firms in sector i:

$$MC_{t,i} = \frac{\overline{A_i}}{A_{t,i}} W_{t,i}^{\alpha_i} \prod_{j=1} (P_{t,j}^x)^{(1-\alpha_i)\omega_{i,j}} , \tag{9}$$

with $\bar{A}_i$ as a normalizing constant and $P_{t,j}^x$ is the price of intermediate good j.

The aggregate of inputs sourced by sector-i firms from sector j is defined analogously to the sectoral consumption bundle in Eq. (1) above:

$$X_{t,i,j} = \left((1-\gamma_j) \cdot [X_{t,i,j}^D]^{\frac{\eta_j - 1}{\eta_j}} + \gamma_j \cdot [\phi_{t,j} X_{t,i,j}^F]^{\frac{\eta_j - 1}{\eta_j}} \right)^{\frac{\eta_j}{\eta_j - 1}} , \tag{10}$$

where $X_{t,i,j}^D$ and $X_{t,i,j}^F$ denote the quantities of domestically produced and imported sector-j goods used in sector-i production, respectively. Hence, $P_{t,i}^c = P_{t,i}^x$. Similar to the consumption bundle, the adjustment cost is

$$\phi_{t,j} = 1 - \frac{\iota}{2} \left(\frac{(X_{t,i,j}^F / X_{t,i,j}^D)}{(X_{t-1,i,j}^F / X_{t-1,i,j}^D)} - 1 \right)^2 ,$$

and the optimal mix of intermediate inputs obtains from the cost-minimization:

$$\max_{X_{t,i,j}, X_{t,i,j}^D, X_{t,i,j}^F} \sum_{s=t}^{\infty} Q_{t,s} \Big(P_{t,j}^x X_{t,i,j} - P_{t,j} X_{t,i,j}^D - (1+\tau_{t,j}) \mathcal{E}_t P_{t,j}^* X_{t,i,j}^F \Big), \tag{11}$$

subject to constraint given by Eq. (10); the special case of $\iota = 0$ yields the familiar constant-elasticity demand functions:

$$X_{t,i,j}^D = (1-\gamma_j) \left(\frac{P_{t,j}}{P_{t,j}^x} \right)^{-\eta_j} X_{t,i,j} \quad \text{and} \quad X_{t,i,j}^F = \gamma_j \left(\frac{(1+\tau_{t,j}) \mathcal{E}_t P_{t,j}^\star}{P_{t,j}^x} \right)^{-\eta_j} X_{t,i,j} \, . \tag{12}$$

Sectoral output, used for consumption and domestic production as well as abroad, is a CES aggregate of sector specific varieties:

$$Y_{t,i} = \left(\int_0^1 Y_{t,i,k}^{\frac{\epsilon-1}{\epsilon}} dk, \right)^{\frac{\epsilon}{1-\epsilon}} , \tag{13}$$

where $\epsilon > 1$ denotes the elasticity of substitution between varieties. Cost-minimization of aggregating firms implies that the domestic *producer* price in

sector i is given by

$$P_{t,i} = \left(\int_0^1 P_{t,i,k}^{1-\epsilon} \, dk \right)^{\frac{1}{1-\epsilon}} . \tag{14}$$

Price setting is subject to a Calvo friction: in any given period, only a fraction $1 - \lambda_i$ of firms in sector i may reset their prices. Thus, λ_i captures sector-specific price stickiness. Firms that reset their prices choose a new price to maximize the expected discounted stream of future profits generated while the price remains in effect:

$$\max_{\{P_{t,i}^f\}} E_t \sum_{s=t}^{\infty} Q_{t,s} \lambda_i^{s-t} (P_{t,i}^f Y_{s,i,k} - (1 - \overline{\tau}) MC_{s,i} Y_{s,i,k})$$

where $P_{t,i}^f$ is the new price chosen by firms that reset their prices in period t, and $\bar{\tau}$ is a subsidy that offsets distortions from monopolistic markups. The above maximization is subject to the constraint that the demand faced by each firm is given by $Y_{t,i,k} = (P_{t,i,k}/P_{t,i})^{-\varepsilon} Y_{t,i}$.

The sectoral price index evolves as a weighted average of unchanged and newly set prices: $P_{t,i}^{1-\varepsilon} = \lambda_i (P_{t-1,i})^{1-\varepsilon} + (1 - \lambda_i)(P_{t,i}^f)^{1-\varepsilon}$.

Foreign demand and trade. Letting $Y_{t,i}^*$ denote the total world demand for good i, we assume an ad-hoc export demand function for domestically produced good i:

$$E_{t,i} = \left(\frac{P_{t,i}(1 + \tau_{t,i}^e)}{\mathcal{E}_t P_{t,i}^*} \right)^{-\eta^*} \cdot Y_{t,i}^* , \tag{15}$$

where $E_{t,i}$ is the quantity of good i exported, $P_{t,i}^*$ is the price of good i in foreign currency, η^* is the elasticity of demand for exports and $\tau_{t,i}^e$ is a sector-specific export tax. Total exports are given by $EX_t = \sum_{i=1}^N (1 - \tau_{t,i}^e) P_{t,i} E_{t,i}$, while total imports are given by $IM_t = \mathcal{E}_t \sum_{i=1}^N (1 + \tau_{t,i}) P_{t,i}^* (C_{t,i}^F + \sum_{j=1}^N X_{t,j,i}^F)$. Below we also refer the terms of trade of sector i which we define as the price of its imports relative to the price of its exports

$$\mathcal{S}_{t,i} = \left(\frac{(1 + \tau_{t,i}) \mathcal{E}_t P_{t,i}^*}{P_{t,i}} \right) . \tag{16}$$

Policy and equilibrium. Monetary policy controls the domestic nominal interest rate and sets it in response to observable economic conditions:

$$R_t = f(\pi_t, y_t ...). \tag{17}$$

Fiscal policy pays a constant production subsidy $\bar{\tau}$ to firms and collects revenues from import tariffs and export taxes. The net balance is then returned to or extracted from households via lump-sum transfers such that the government budget is balanced at all times:

$$T_t = \sum_{i=1}^{N} \tau_{t,i} \mathcal{E}_t P^*_{t,i} (C^F_{t,i} + \sum_{j=1}^{N} X^F_{t,j,i}) + \tau^e_{t,i} P_{t,i} E_{t,i} - \bar{\tau} Y_{t,i} MC_{t,i} \, . \tag{18}$$

In equilibrium, all markets clear. Specifically, at the sectoral level we aggregate labor input $L_{t,i} = \int_k L_{t,i,k}$ and intermediate goods input $X_{t,i,j} = \int_k X_{t,i,j,k}$. Output in each sector is either consumed domestically, exported, or used as an intermediate input:

$$Y_{t,i} = C^D_{t,i} + \sum_{j=1}^{N} X^D_{t,j,i} + E_{t,i} \, . \tag{19}$$

Exogenous processes. We assume that total factor productivity, as well as import and export tariffs in each sector follow AR(1) processes in logs:

$$\begin{aligned} \log(A_{t,i}) = a_{t,i} &= \rho_a a_{t-1,i} + \varepsilon^a_{t,i}, \\ \tau_{t,i} &= \rho_\tau \tau_{t-1,i} + \varepsilon^\tau_{t,i}, \\ \tau^e_{t,i} &= \rho_{\tau^e} \tau^e_{t-1,i} + \varepsilon^{\tau^e}_{t,i}. \end{aligned}$$

2.2 Steady state, definitions, log-linearization

We log-linearize the model around a steady state in which all import and export tariffs are zero, trade is balanced in the aggregate but not at the sectoral level, and all prices and the exchange rate are normalized to one.

Notation. In what follows we use bold-faced letters to denote column vectors, that is, $\boldsymbol{X} \equiv [X_1, ..., X_N]'$ and lower-case letters to denote the deviation of a variable from its steady state level, $x_t = \log(X_t) - \log(X)$, where variables without a time subscript refers to the steady-state value. Matrix I_X is a diagonal matrix with elements $\boldsymbol{X}$ on the diagonal, and $\mathbf{1}$ denotes a column vector of ones.

Steady-state shares. Several steady-state shares are used throughout our analysis and in the calibration. The input-output matrix Ω, or "use matrix," collects the intermediate input shares in sectoral output, such that $\Omega_{ij} = (1 - \alpha_i)\omega_{ij} = X_{ij}/Y_i$. We define the Leontief inverse of the use matrix as $\hat{L} = (I - \Omega)^{-1}$.

$\tilde{\Omega} = (I - I_\gamma)\Omega'$ is the domestic sales matrix, such that $\tilde{\Omega}_{ij} = X^D_{ji}/Y_j$ is the share of domestic output i sold to sector j. We define the Leontief inverse of the sales matrix as $\tilde{L} = (I - \tilde{\Omega})^{-1}$.

The domestic product share in intermediate and consumption goods from any sector i is given by $C^D_i/C_i = X^D_{ji}/X_{ji} = 1 - \gamma_i$. The ratio of sectoral domestic consumption to aggregate consumption is $C^D_i/C = (1 - \gamma_i)\beta_i$, while the ratio of sectoral imported consumption to aggregate consumption is $C^F_i/C = \gamma_i\beta_i$. We denote the ratio of sectoral exports to aggregate consumption by $d_i \equiv E_{/}C$.

Let us also define sectoral sales shares in aggregate consumption as $\xi_i = Y_i/C$, often referred to as Domar weights. Using the sectoral market-clearing condition, we can derive the vector of sales shares as:

$$\boldsymbol{\xi} = \tilde{L} \cdot [(I - I_\gamma) \cdot \boldsymbol{\beta} + \boldsymbol{d}], \tag{20}$$

We log-linearize the model around the steady state and solve the resulting system of linear rational expectation equations using the QZ decomposition method (Klein, 2000).

3 The sectoral propagation of tariffs

In this section, we first provide a theoretical characterization of how tariff shocks propagate through the domestic production network in our model. We then present new empirical evidence based on US data that is consistent with the model's predictions about the sectoral pattern of tariff propagation.

3.1 Theory

In this section, we simplify the model to enhance analytical tractability. Specifically, we assume: (i) flexible prices (such that markups are constant), (ii) linear leisure utility ($\phi = 0$), (iii) a unit export elasticity ($\eta^* = 1$), (iv) monetary policy controls the money supply, and (v) a common import elasticity η across all sectors, (vi) no adjustment cost ($\iota = 0$). Under these assumptions, we obtain several results summarized below, with derivations provided in Appendix A. The following proposition characterizes the propagation of sectoral tariffs to sectoral output.

Proposition 1 (Sectoral tariff propagation)**.** The effect of sectoral tariffs on sectoral output consists of the upstream and downstream propagation links such

that:

$$\boldsymbol{y_t} = (\eta - 1) \cdot (U + O) \cdot Z\boldsymbol{\tau_t} - D \cdot Z\boldsymbol{\tau_t} \,, \tag{21}$$

where $U = I_{\tilde{\xi}}^{-1} \cdot [\tilde{L} - I] \cdot (I_{1-\gamma} I_{\beta} + I_{\tilde{\xi}}) I_{\gamma}$ captures *upstream propagation* through the non-diagonal matrix $\tilde{L} - I$. The diagonal matrix $O = I_{\tilde{\xi}}^{-1} I_{1-\gamma} I_{\beta} I_{\gamma}$ captures the impact of tariff changes in the *own sector*. $D = [\hat{L} - I] \cdot I_{\gamma}$ captures *downstream propagation* of tariffs changes through the non-diagonal matrix $\hat{L} - I$. Finally, $Z = I - o(\Omega)$ where $\|o(\Omega)\| < 1$ captures higher order network links between sectoral tariffs and the terms of trade.

The matrices U, O, and D are positive transformations of the input–output network and therefore contain only positive entries or zeros. Against this background, the result in Proposition 1 is intuitive: sectoral tariffs propagate downstream by reducing output in sectors further along the production chain—through the links captured by matrix D. Because intermediate inputs include imported goods, which become more expensive when tariffs rise, production costs increase in these downstream sectors and output declines.

At time same time, as long as $\eta \neq 1$, tariffs propagate not only downstream but also affect the sector itself through O and propagate upstream through U. If imported and domestic varieties are sufficiently substitutable (that is, if $\eta > 1$), higher tariffs in a sector shift expenditure toward domestically produced varieties. This increases production not only in the tariffed sector but also in upstream sectors, because the demand for inputs used in producing that good rises. Instead, if imports and domestically produced goods are complements ($\eta < 1$) the own-sector impact and the upstream propagation are negative.

A closer examination of Proposition 1 reveals that tariff propagation consists of two underlying stages. First, tariffs shape sectoral terms of trade, as captured by the matrix Z, that is $\boldsymbol{s_t} = Z\boldsymbol{\tau_t}$; second, changes in the terms of trade propagate through the domestic network, captured by U, O, and D. The matrix $Z = I - D + D^2 - \cdots = I - o(\Omega)$ includes a direct effect, I, mapping tariffs to terms of trade via import prices, and higher-order network effects $o(\Omega)$, which arise because tariffs also influence domestic prices indirectly through downstream propagation; if the network is absent, the sectoral terms of trade simplifies to $\boldsymbol{s_t} = \boldsymbol{\tau_t}$, as the higher-order effects vanish, $o(0) = 0$. While terms-of-trade propagation admits an exact additive decomposition into upstream, own-sector, and downstream components, the decomposition for tariffs is only approximate, since higher-order linkages between tariffs and terms of trade prevent a fully additive breakdown.

Note also that a sector i can simultaneously have both upstream and downstream links with another sector j, and the total effect of a sector-i tariff on sector-j output is the sum of these upstream and downstream effects.

Next we establish how sectoral tariffs propagate onto sectoral domestic prices.

Corollary 1 (Tariff effect on domestic prices)**.** Tariff shocks affect domestic prices via downstream propagation links such that:

$$\boldsymbol{p}_t = D \cdot Z\boldsymbol{\tau_t}. \tag{22}$$

Hence, under assumptions (i)–(v) sectoral tariffs propagate to domestic prices only downstream, through the increased costs of imported inputs used to produce domestic goods. Note that sectoral consumer prices can be expressed as $\boldsymbol{p_t^c} = (I - I_\gamma)\boldsymbol{p_t} + I_\gamma\boldsymbol{\tau_t}$: consumer prices are influenced by tariffs both directly—through more expensive imports—and indirectly—through higher domestic prices resulting from increased production costs.

A pertinent question in policy debates about tariffs is whether they lead to an expansion or a recession in the short run. To analyze this question, we define GDP as aggregate real value added— that is, nominal value added deflated by the GDP deflator. The following corollary establishes the effect of tariff shocks on GDP:

Corollary 2 (Tariff propagation on GDP)**.** The link between sectoral terms of trade and aggregate final output is

$$y_t^{GDP} = (\eta - 1) \cdot \hat{\boldsymbol{\xi}}' \cdot (U + O) \cdot Z\boldsymbol{\tau_t} - \hat{\boldsymbol{\xi}}' \cdot D \cdot Z\boldsymbol{\tau_t}\ , \tag{23}$$

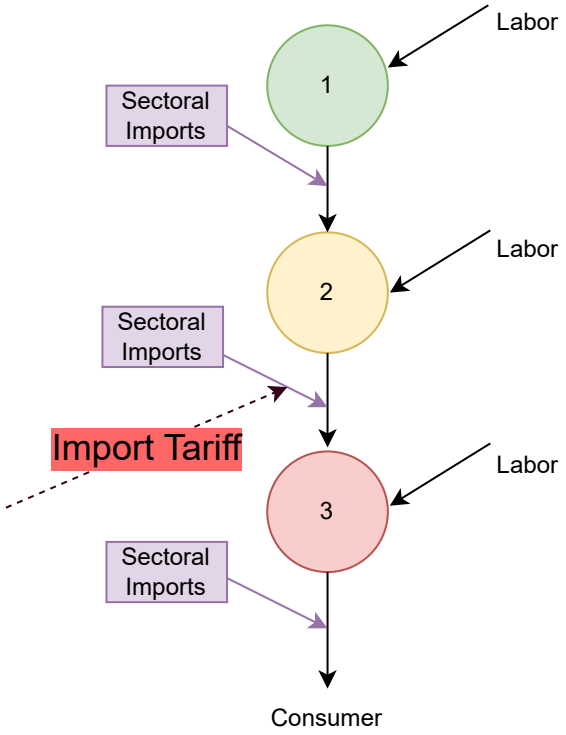
where $\hat{\xi}_i = \frac{VA_i}{VA}$.

The effect of sectoral tariffs on GDP reflects two channels: downstream propagation, which is recessionary all else equal, and upstream propagation, which is expansionary all else equal. Which effect dominates is ultimately a quantitative question, depending on the specific structure of the production network.

3.2 Example

To illustrate the propagation of sectoral tariffs, we consider an economy, shown in Figure 1. This example represents a three-sector economy with a vertically

Figure 1: Example economy w/ vertical supply chain

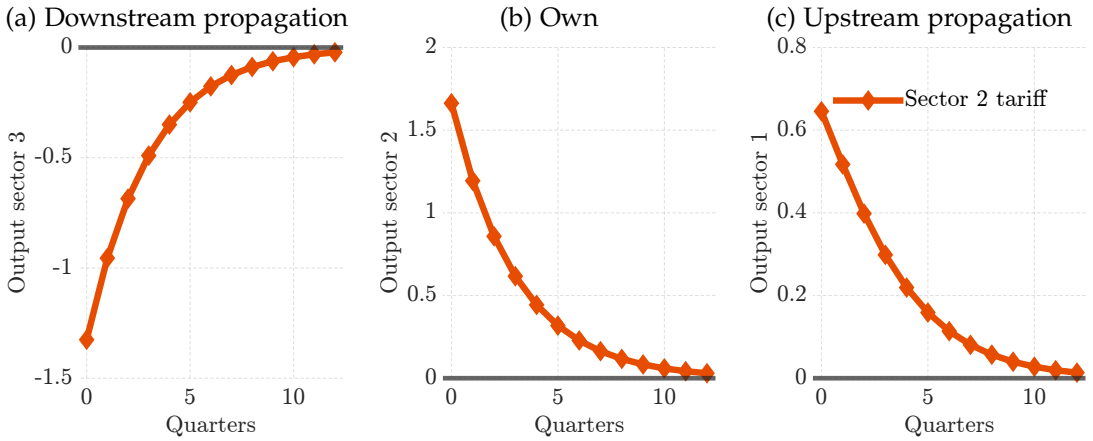


Notes: This figure depicts a three-sector vertical chain economy, in which sector-specific imported inputs are used at all stages of production. An import tariff is imposed on Sector 2.

integrated supply chain in which both imported and domestic inputs are used in production. The domestic inputs are sourced from sectors located upstream in the supply chain. This vertical production network is sufficiently deep for our purposes, as it captures both upstream and downstream propagation of tariffs. To demonstrate the propagation mechanism, we consider an import tariff imposed on Sector 2. In this case, downstream propagation affects Sector 3, while upstream propagation influences Sector 1. Sector 2 is referred to as the "own sector" in this example.

We also consider numerical simulations, which allow us to relax the simplifying assumptions made above. Figure 2 illustrates the response of sectoral output to a tariff shock in Sector 2. The results are consistent with our analytical findings. The middle panel shows the own-sector effect in Sector 2: output increases as the tariff shields the domestic industry from foreign competition. The left panel shows downstream propagation: output in Sector 3 falls as the

Figure 2: Propagation of a tariff shock in a three-sector vertical chain economy



Notes: This figure shows sectoral output responses to a tariff shock in Sector 2 in a three-sector vertical chain economy. Trade openness is set to 0.4 in each sector. Sectoral labor shares are (1,0.6,0.6). Price stickiness is set to 0.75. All remaining parameters follow those reported in Table 1. All responses are expressed as percentage deviations from the steady state.

imported input from Sector 2 becomes more expensive due to the tariff, raising production costs. The right panel captures upstream propagation: output in Sector 1 rises because the tariff in Sector 2 shifts production toward the domestic supply chain, boosting demand for Sector 1's output.

3.3 Evidence

We now turn to the data to empirically establish the patterns of tariff propagation through the domestic production network in the US. To do this, we construct a panel of sector-level import tariff measures and apply the approach of Acemoglu et al. (2016) to trace tariff effects across the network. Specifically, we compute each sector's upstream, own-sector, and downstream tariff exposure using its input–output linkages to sectors facing tariff changes. We then estimate how these different forms of exposure affect domestic sectoral output and prices.

Methodology and data. We first construct upstream and downstream propagation matrices to capture the intensity of direct and indirect input–output linkages across sectors. This enables us to quantify each sector's exposure to tariff changes originating elsewhere in the economy. Using the 2023 BEA *Use Table* and *Import Matrix* for 73 industries, we build the use matrix Ω and the

sales matrix $\tilde{\Omega}$ and compute their Leontief inverses, $\hat{L}$ and $\tilde{L}$, which characterize downstream and upstream shock propagation (see again Proposition 1). Based on these matrices, we construct measures of tariff exposure. Let $\Delta\tau_{t,j}$ be tariff shock in sector j. Then the exposure of sector i to tariffs through the downstream links is given by $X^D_{t,i} = \sum_j (\hat{L}_{ij} - 1_{i=j}) \cdot \Delta\tau_{t,j}$, where $1_{i=j}$ is an indicator function equal to 1 if $i = j$, and 0 otherwise. Similarly, the exposure to tariffs through the upstream links is captured by $X^U_{t,i} = \sum_j (\tilde{L}_{ij} - 1_{i=j}) \cdot \Delta\tau_{t,j}$. Finally, the exposure to the own-sector tariff is simply given by $X^O_{t,i} = \Delta\tau_{t,i}$.

Second, based on these measures we estimate how tariffs propagate to sectoral domestic output. Proposition 1 establishes how tariffs propagate upstream, downstream, and into the own sector within the model. Guided by this result, we estimate an empirical specification aiming to capture all three aspects of propagation. To estimate the dynamic responses, we employ a local projection methodology and estimate the following specification:

$$Y_{t+h,i} - Y_{t-1,i} = \beta^h_O X^O_{t,i} + \beta^h_D X^D_{t,i} + \beta^h_U X^U_{t,i} + \gamma_i + \gamma_t + X_{t,ij} + \epsilon^h_{t,ij} \tag{24}$$

for $0 \leq h \leq H$. Here, $Y_{t+h,i}$ is output in sector i in period h after tariffs are imposed. The first three terms on the right hand side are defined above and capture the *direction* of propagation (not the origin of the tariff change). Accordingly, coefficients $\{\beta^h_D\}_{h=1}^H$ capture the downstream propagation of tariffs, $\{\beta^h_U\}_{h=1}^H$ the upstream propagation, and $\{\beta^h_O\}_{h=1}^H$ the effect of tariffs within the sector itself. The terms γ_t and γ_i denote time and sector fixed effects, and $X_{t,ij}$ is a vector of other controls (including lagged output and tariff exposures).

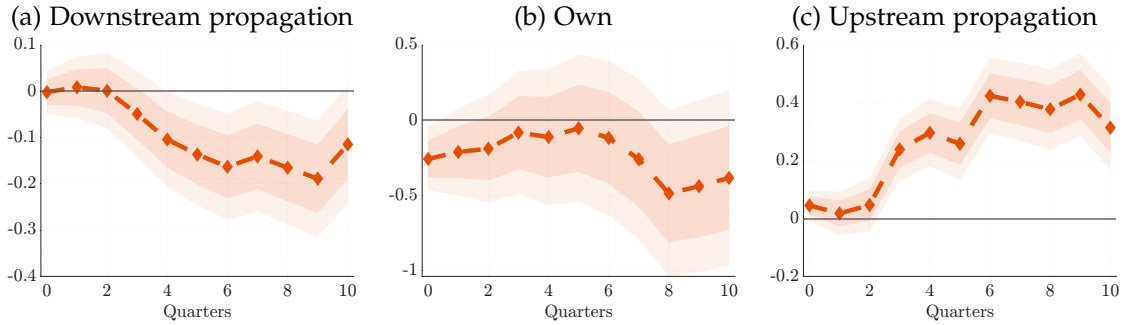
Additionally, we estimate the propagation of tariffs on sectoral domestic prices using the specification implied by Corollary 1:

$$P_{t+h,i} - P_{t-1,i} = \beta^h_D X^D_{t,i} + \gamma_i + \gamma_t + X_{t,ij} + \epsilon^h_{t,ij} \tag{25}$$

where $P_{t+h,i}$ denotes the price level in sector i at horizon h. Note that, unlike the estimates of the output response, the baseline specification for prices excludes upstream and own-sector tariff propagation, in accordance with our theoretical result. We do consider an augmented specification, however, which also features the other directions of propagation—own, upstream, and downstream—to mirror the specification used for output.

Our estimates rely on a measure of sectoral import tariffs constructed using USA Trade Online data on customs import values and duties from the U.S. Census Bureau. Specifically, we retrieve monthly *Customs Value (Gen)* and *Calculated*

Figure 3: Propagation of tariffs on domestic sectoral output



The dark shaded area represents the 68% confidence interval; the light shaded area is the 90% confidence interval.

Duty at the HS-10 code level for all countries of origin from January 2002 to December 2024 and aggregate these data to quarterly frequency. We map HS codes to BEA 2-digit industries, yielding data for 23 sectors. For each sector, we construct a sector-level tariff as the ratio of calculated duty to customs value, following Poilly and Tripier (2025).[1]

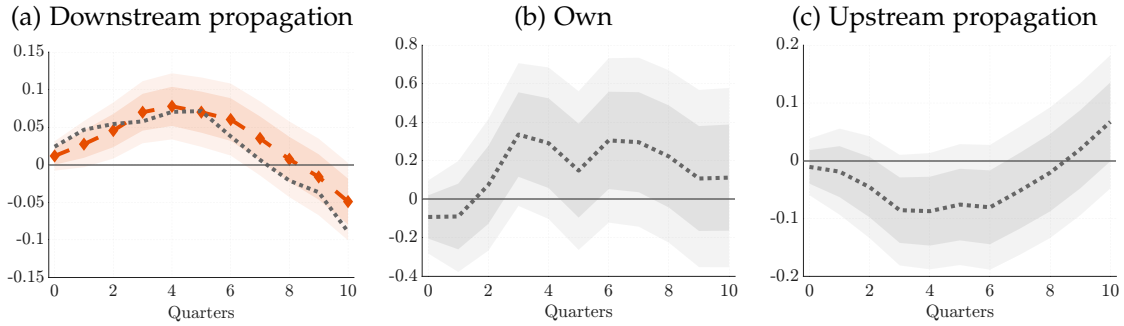
Sectoral output is measured using the BEA's *Real Gross Output by Industry*, while prices are taken from the BEA's *Chain-Type Price Indexes for Gross Output by Industry*, both available quarterly from 2005Q1 to 2024Q3 for 66 industries (excluding government). All series are log-transformed.[2]

Results. Figure 3 presents the results, showing how tariffs propagate to sectoral output through the domestic production network according to U.S. data. Panel (a) shows the estimate for downstream propagation: a one–percentage point increase in the effective tariff generates a gradual decline in downstream output, with a maximum effect of roughly 0.2% after 6 to 8 quarters. Such a negative response is consistent with the theoretical prediction derived above. Panel (c), in turn, reports the estimate for upstream propagation: a one–percentage point increase in tariffs leads to a gradual rise in sectoral output upstream, peaking at approximately 0.4% after six quarters. This positive response, too is consistent with theory. Finally, Panel (b) shows the effect of tariffs within the sector itself. In this case, we do not obtain a statistically significant response. One possible explanation is that the sectoral classification is not sufficiently disaggregated; as a result, the "own" sector may contain both upstream and down-

[1]Details on the data are provided in Appendix B. Table B.3 lists the sectors for which tariffs are computed, and Figure B.10 plots the time series of sectoral tariffs.

[2]Table B.4 provides the resulting list of sectors.

Figure 4: Propagation of tariffs on domestic sectoral prices



Notes: Dashed red line with diamonds in Panel (a) shows estimate of downstream propagation on prices using the specification that includes only downstream propagation. The confidence bands in Panel (a) correspond to this baseline specification. The dotted black lines depict the estimated price responses in the alternative specification that includes all directions of propagation. Confidence bands in Panels (b) and (c) correspond to this alternative specification. The dark shaded area represents the 68% confidence interval, while the light shaded area indicates the 90% confidence interval.

stream industries, making it difficult to isolate the own-sector effect in the data.

We now turn to the estimates for producer price response to an import tariff in downstream sectors, as specified in Equation (25). The dashed line with diamonds in Panel (a) of Figure 4 shows the result: An increase in tariffs leads to higher prices in sectors downstream. A one percentage point increase in the effective tariff measure results in nearly a 0.05 percent rise in downstream prices, and this effect is statistically significant. This finding is consistent with the theoretical mechanism: imported inputs become more expensive, raising the cost of domestic production and, in turn, pushing domestic prices upward.

We also consider an alternative specification that includes upstream and own-sector propagation, even though these are not implied by our theoretical results. This specification mirrors the approach used in our output analysis. The dotted lines in Panels (a)–(c) of Figure 4 show the corresponding results. We do not find statistically significant effects for these additional directions.

4 The macroeconomic impact of tariffs

We now study the macroeconomic impact of tariffs based on the full model put forward in Section 2. In a first step we calibrate the model in such a way that it captures the key aspects of the data as far as the sectoral transmission of tariffs are concerned. Using a calibrated version of this model, we quantitatively examine the effects of tariffs. We consider two quantitative experiments: (1) a 10%

uniform tariff applied across all sectors, and (2) a set of sectoral tariffs reflecting the distribution proposed under the "Liberation Day" scenario announced by the U.S. government in April 2025 (and subsequently retracted).

Next, we describe the calibration of the model parameters and the tariff distribution.

4.1 Model calibration

Model parameters. To calibrate the sectoral structure of the model, we use the Bureau of Economic Analysis Input-Output Accounts Data. For the intermediate input shares $\omega_{i,j}$, labor shares α_i, and consumption shares β_i, we rely on the 2023 "Use Table", which covers 71 industries. Following Baqaee and Farhi (2020), we exclude the government, scrap, and noncomparable imports sectors and assume that each industry produces exactly one commodity. We drop sectors whose output is neither used in final consumption nor as intermediate inputs by any other industry, leaving us with 63 sectors. For each of the remaining sectors, we compute the input share of each commodity, yielding $\omega_{i,j}$. We then use the field "Compensation of employees" for each industry to calibrate sectoral labor shares α_i as the share of compensation of employees in total costs (defined as compensation plus the expenditure on all intermediate inputs). Next, we calibrate the consumption shares β_i using each sector's share of "Personal consumption expenditure" in the total value of personal consumption across all sectors. To calibrate sectoral import share γ_i, we divide the "Imports of goods and services" from the 2023 import matrix (before redefinition) by the total domestic use of products – that is, the difference between "Total use of products" and "Exports of goods and services", as reported in the Use Table for each commodity. We calibrate the shares of sectoral exports in total consumption $d_i = \frac{EX_i}{C}$ so that the relative size of exports across sectors is given by the data while the aggregate trade balance is zero in steady state. To this end, we choose a scalar Θ which scales all exports such that

$$\frac{\sum_{i=1}^{N} IM_i}{C} \stackrel{!}{=} \frac{\sum_{i=1}^{N} EX_i}{C} = \sum_{i=1}^{N} d_i = \sum_{i=1}^{N} EX_i^* \Theta \,, \tag{26}$$

Table 1: Parametrization of three-sector vertical economy

Parameter	Description	Value
η^*	Export elasticity	2
δ	Discount factor	0.96
φ	Inverse Frisch elasticity	2
ρ_τ	Tariff shock persistence	0.7
ϕ_π	Inflation feedback Taylor rule	1.5
λ	Calvo parameter	0.75

where EX_i^* are the sector i "Exports of goods and services" from the Use Table. Total imports are given by

$$\frac{\sum_{i=1}^N IM_i}{C} = \sum_{i=1}^N \left(\frac{C_i^F}{C} + \sum_{i=1}^N \frac{X_{j,i}^F}{C} \right) = \sum_{i=1}^N \gamma_i \left(\beta_i + \sum_{j=1}^N (1-\alpha_j)\omega_{j,i}\xi_j \right)$$

and feature the Domar weights ξ_i, which themselves are a function of d_i and thus Θ. Hence, there is no closed-form solution for Θ in 26 and we resort to numerical methods to find the Θ which solves 26 subject to the definition of Domar weights in 20.

For the sectoral import demand elasticities $\{\eta_i\}$, we use the "hybrid estimates" by Soderbery (2015), which are reported on a 10-digit HTS level. We aggregate these values to the 2-digit HTS level via weighted sums that weigh 10-digit sectors with their respective share of imports within their 2-digit sector and subsequently harmonize them with the BEA2 codes in the same way as for the tariff time series above. For the HTS sectors for which we do not have a mapping to BEA2, we assign the value of 2. This is fairly inconsequential to results, since the sectors where the mapping is missing are mostly services or other sectors with import shares close to zero and hence no significant effect of tariffs. When simply using (weighted) averages of highly disaggregated varieties, one can expect an upward bias in the elasticities of the aggregated values. After all, it may be fairly easy to substitute away from imports of a given variety at the 10-digit level, but much harder to substitute away from all imports of a 2-digit sector at once. To alleviate concerns about this bias, we winsorize the elasticities of the 10-digit level at 5 before aggregation. Table B.4 lists the calibrated elasticities for sectors where the mapping to BEA2 is available.

We base our calibration of sectoral price stickiness λ_i on the estimates for monthly price adjustment frequencies from Pasten et al. (2024). See Appendix for details on how we aggregate these frequencies to the level of 2-digit BEA

codes. We convert the monthly adjustment probabilities θ_i into quarterly price stickiness λ_i by setting $\lambda_i = (1 - \theta_i)^3$. The remaining model parameters are calibrated as shown in Table 1.

For the remaining parameters, we set the $\varphi = 2$, implying a Frisch elasticity of $1/2$, the discount factor $\delta = 0.96$, and the export elasticity $\eta^* = 1$. For the results presented in Section 4, we use a persistence of $\rho_\tau = 0.9$ for the exogenous tariff processes.

Monetary policy. As the baseline monetary policy, we assume that the central bank follows a Taylor rule, which, after log-linearization, takes the form

$$i_t = \phi_\pi \pi_t^{PPI} + \phi_y (y_t^{GDP} - y_{t-1}^{GDP}),$$

where π_t^{PPI} is producer price inflation. We define π_t^{PPI} as the linear combination of sectoral domestic inflations, computed using Domar weights. In line with the US estimates by Bayer et al. (2024), we set the inflation feedback to $\phi_\pi = 2.1$ and the coefficient on output growth to $\phi_y = 0.25$.

Tariff package calibration. We compute the sectoral tariff rates implied by the tariff package announced by the US government on April 2, 2025. Although the package has since been revised and largely withdrawn, it illustrates how tariffs that are uniform at a country level can still result in heterogeneous effective sectoral tariff rates.

To compute the sectoral imports structure across US trading partners, we use Harmonized System (HS) District-level Data from the US Census Bureau. We consider imports (`"Customs Value (Cons)($US)"`) from all countries of origin in 2024 at the 10-digit level. For each of the 32,583 commodities, we compute the share of each country of origin in the overall imports of that commodity. We then multiply these shares by the country-specific tariff rates reflecting the "Liberation day" policy. The list of these rates is provided in Table C.6 in the Appendix. For all countries not listed in Table C.6 (except Belarus, Cuba, North Korea, and Russia), we apply a baseline tariff of 10%. For all exempted commodities listed in Appendix II of Executive Order 14257[3], we subsequently set the tariff rate to zero. This yields effective tariff rates for all commodities at the 10-digit level. Finally, we use the mapping from 10-digit HTS codes to 23 BEA2 industry codes, as described in Section 3.3. When aggregating multiple units to a higher level, we weigh them by their import shares. As shown in Table 2,

[3] Accessed via https://www.whitehouse.gov/wp-content/uploads/2025/04/Annex-II.pdf

Table 2: Effective sectoral tariffs implied by the "Liberation Day" package

BEA2 sector	Description	Tariff rate
315AL	Apparel and leather and allied products	31.72%
337	Furniture and related products	30.45%
313TT	Textile mills and textile product mills	27.28%
334	Computer and electronic products	25.88%
339	Miscellaneous manufacturing	24.54%
335	Electrical equipment, appliances, & components	24.54%
326	Plastics and rubber products	24.32%
332	Fabricated metal products	22.54%
327	Nonmetallic mineral products	21.46%
333	Machinery	21.01%
3364OT	Other transportation equipment	17.80%
322	Paper products	17.62%
113FF	Forestry, fishing, and related activities	17.14%
3361MV	Motor vehicles, bodies and trailers, and parts	16.48%
311FT	Food and beverage and tobacco products	16.19%
111CA	Farms	13.13%
331	Primary metals	12.15%
323	Printing and related support activities	11.62%
212	Mining, except oil and gas	7.20%
321	Wood products	6.78%
325	Chemical products	5.92%
324	Petroleum and coal products	0.73%
211	Oil and gas extraction	0.00%

the resulting effective tariff rates exhibit significant variation across the 23 BEA2 sectors.

The trade adjustment cost parameter ι governs the elasticity of substitution in the short run and is critical for the adjustment dynamics. There is, however, little evidence based on which we can pin down this parameter. Hence, we estimate it based on impulse response matching. Since the empirical measures for sector-specific "downstream" and "upstream" tariff exposure have no clear counterparts in the model, we use an indirect-inference approach and replicate our empirical approach on model-generated data. More in detail, we first simulate the path of all model variables by feeding the time series of observed sectoral tariffs used in Section 3.3 into the model.[4] As we assume the tariff rates to follow AR(1)-processes, we impose a persistence of 1 only for this exercise and set the residuals to the observed changes in the tariffs. This implies that the

[4]We add ten periods without tariff changes in the end, which is fairly inconsequential for the results.

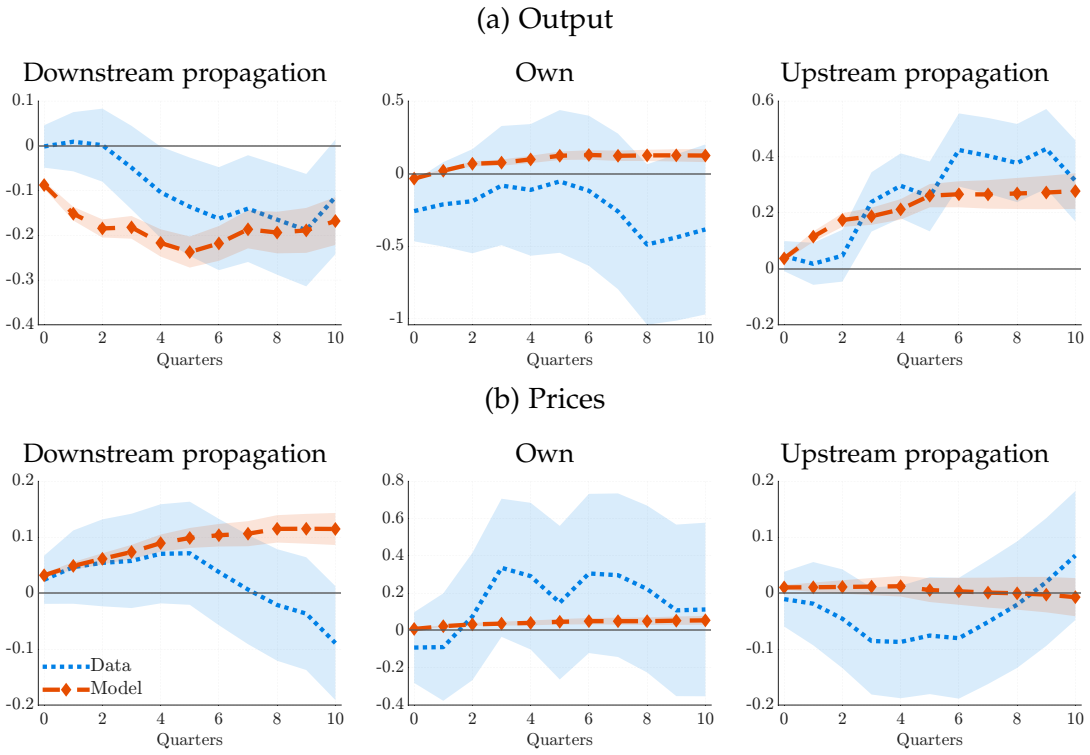
tariff rates in the model follow those in the data, while only their first difference surprises agents in each period. We then compute the Leontief inverses $\hat{L}$ and $\tilde{L}$, which characterize downstream and upstream shock propagation, for the network in our model and compute the time series of upstream, downstream, and own-sector tariff exposure analogous to Section 3.3. This allows us to estimate the regressions in Equations (24) and (25) using the constructed series of tariff exposure and the simulated series of sectoral output and prices. Finally, we estimate ι as the value for which this procedure generates the closest fit between empirical and model-implied impulse response. Formally, the estimate $\hat{\iota}$ is given by

$$\hat{\iota} = \underset{\theta}{\operatorname{argmin}} \left(\Psi^M(\iota) - \Psi^E\right)' W^{-1} \left(\Psi^M(\iota) - \Psi^E\right) . \tag{27}$$

Here, Ψ^E is a column vector that stacks selected empirical impulse responses shown in Figures 3 and 4 and Ψ^M contains the corresponding impulse responses that we obtain when estimating the local projections on model-generated data. W is a diagonal weighting matrix that contains the standard errors of the empirical estimates on its main diagonal. We include those (parts of the) impulse responses in Ψ^E and Ψ^M for which the empirical evidence qualitatively aligns with our theoretical predictions. That is, we include the output responses to upstream and downstream tariffs (panels (a) and (c) of Figure 3, respectively) up to period 10 after the change in the tariff rate and price response to upstream tariffs (panel (a) of Figure 4) up to period 5 after the tariff change. Hence, we do not seek to capture the insignificant responses in the remaining panels as well as the eventual decline in prices in the second and third year after a tariff change. Figure 5 displays the empirical and model-implied impulse responses at the estimate parameter value of $\iota = 2.04$. This implies that the effective elasticity in the quarter of the shock is on average 20% of the calibrated long-run elasticity, in line with the estimate by Boehm et al. (2023) that the elasticity in the first *year* is roughly 35% of the long-run elasticity after ten years.

Overall, the impulse responses generated by the model (red dashed lines with markers) match their empirical counterparts (blue dotted lines) quite well, both qualitatively and quantitatively. Owing to the adjustment parameter, the substitution toward domestically produced goods that drives the responses of upstream and own-sector output materializes only gradually over time. In line with the predictions of the simplified version of the model in Section 3.1, output increases in response to an own-sector tariff also in the rich quantitative model, whereas prices react almost exclusively to upstream tariffs. Note that, in

Figure 5: Model fit



Notes: Local projections impulse responses to upstream (left column) own-sector (middle column) and downstream (right column) tariff exposure. The first row contains the effect on sectoral output, the second row contains the effect on sectoral producer prices (all in percent). Blue dotted line, reproduced from Figures 3 and 4: IRFs from LPs estimated on actual time series; red dashed line with markers: LPs based on simulated data. Shaded areas denote 90% HPDIs.

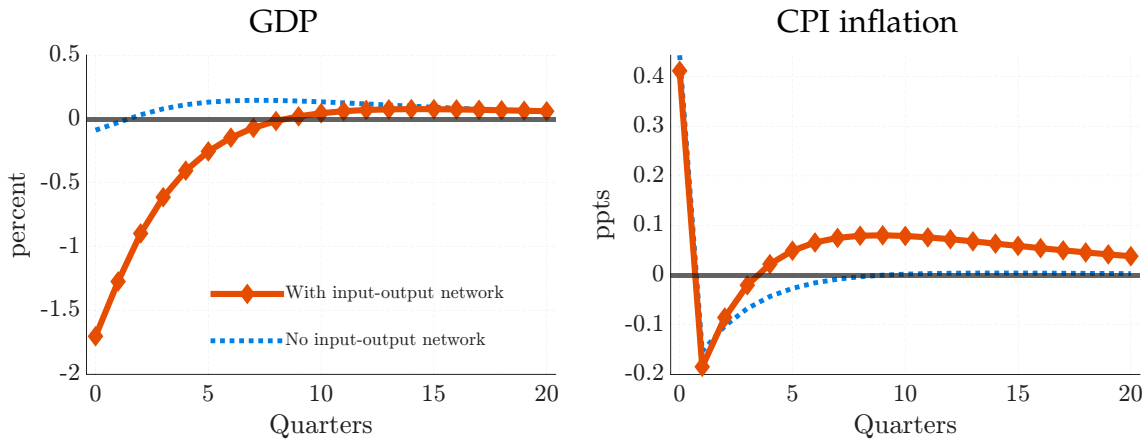
general, estimates based on simulated data are much more precise than those based on actual data, since the simulations do not include non-tariff shocks that would otherwise add noise.

4.2 Quantitative results

We begin by examining the model prediction for the responses of domestic output (GDP) and inflation (CPI) to a uniform tariff shock.[5] As shown in Figure 6 (red line), GDP falls while inflation rises on impact and in the medium and long term, indicating that the uniform tariff shock is overall *stagflationary*. The decline in domestic output primarily reflects the downstream propagation of

[5]GDP is computed as aggregate real value added, calculated by summing sectoral nominal value added and deflating the result by the GDP deflator. CPI inflation is computed as the change in the price of the aggregate consumption good.

Figure 6: Aggregate effects of a uniform 10% import tariff



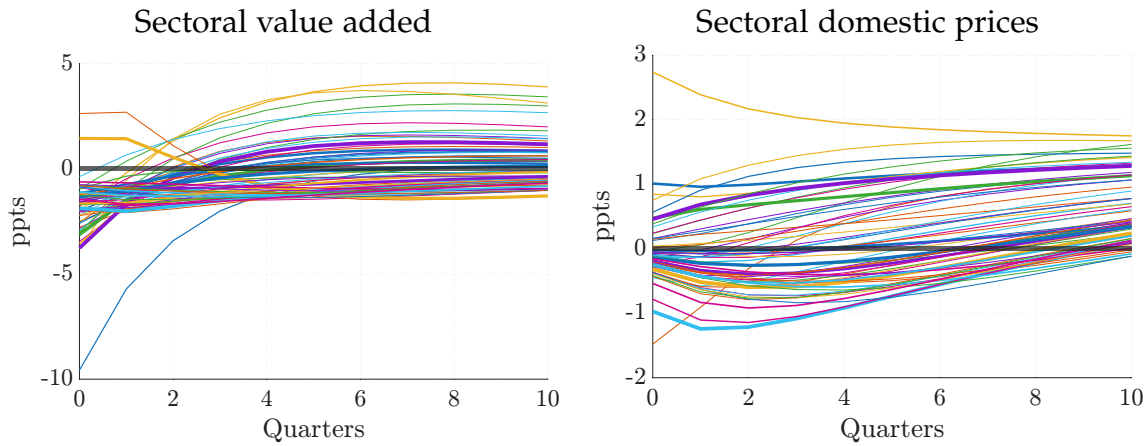
Notes: This figure shows the aggregate impulse responses to the imposition of a 10% import tariff on all sectors in the quantitative model. Red solid lines with markers denote responses under the full production network; blue dashed lines are responses when no intermediate inputs are used in production. Responses are in percent/ppts deviations from the steady state.

tariffs through the domestic production network: higher import tariffs in upstream sectors raise input costs for downstream producers, driving up domestic prices and reducing output. The sign flips in the response of CPI inflation are due to the trade adjustment costs: After the initial price increase when the tariffs are imposed, consumer prices decrease in the three subsequent quarters as retailers substitute towards the relatively cheaper domestic good. After the first year when most of the trade adjustments have been made, consumer inflation is again positive, this time due to the persistent effects on *producer* inflation.[6]

To illustrate the role of production network linkages in shaping the economy's response to tariffs, we consider a counterfactual version of the economy in which the domestic production network is suppressed by setting the input–output matrix to zero. We then repeat the same quantitative experiment—imposing a 10% uniform tariff—on the counterfactual version of the economy.As shown in Figure 6 (blue line), in the absence of a production network, domestic output increases in response to a uniform tariff after the first two periods in which the trade adjustment costs significantly limit the expenditure switching towards domestic goods. Without the production network, the economy effectively becomes a multi-sector horizontal system in which domestic production costs are not directly affected by tariffs. As a result, the tariff stimulates domestic production by shielding the domestic economy from foreign compe-

[6]This is consistent with the notion that production networks in sticky-price economies amplify the persistence of inflation response to shocks, see Afrouzi and Bhattarai (2023).

Figure 7: Sectoral effects of uniform 10% tariff



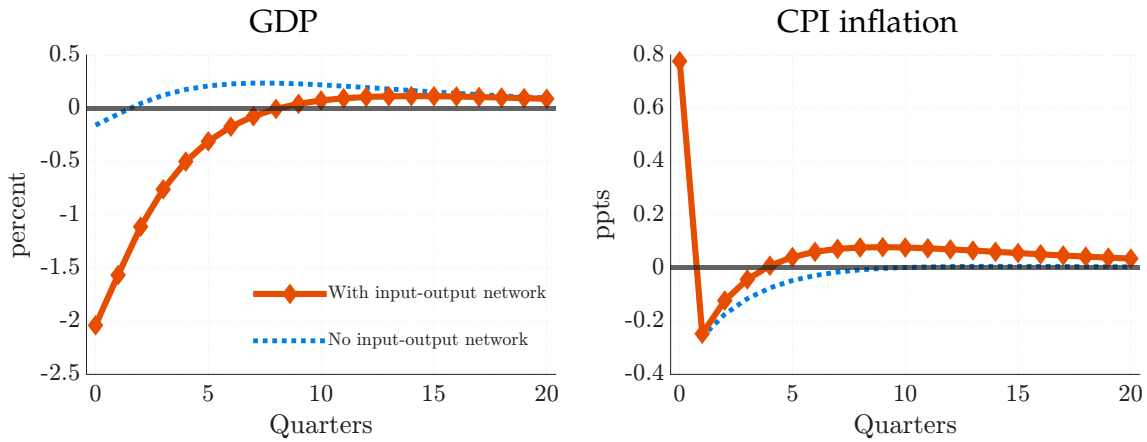
Notes: This figure shows the sectoral impulse responses to the imposition of a 10% import tariff on all sectors in the quantitative model. Left panel: real value added (nominal VA deflated by the GDP deflator) for each sector. Right panel: domestic sectoral prices. Each line represents one sector; line width is proportional to the sector's Domar weight.

tition. Note also that in the absence of a production network, the price level only increases on impact. After this initial inflation, the price level decreases as retailers switch to the cheaper domestic goods and the tariff rate itself declines towards its pre-shock level.

Figure 7 illustrates the sectoral heterogeneity in responses to a tariff shock. In line with the theory, value added (left panel) increases in some sectors, in which the upstream propagation effect from higher demand for domestic varieties outweighs the downstream propagation effect of rising input costs. In most sectors, however, the downstream propagation dominates, resulting in negative sectoral responses and ultimately driving the aggregate recession shown in Figure 6. Note that the small aggregate effect after the first six quarters shown in 7 does not tell the full story, as it is merely a weighted average of much larger effects on the sectoral level. Sectoral domestic prices (right panel of Figure 7), on the other hand, increase across the majority of sectors.

In addition to the uniform tariff, we also construct the model response to the "Liberation Day" tariff scenario. Unlike the uniform tariff, the "Liberation Day" policy implies a non-uniform distribution of effective tariffs across sectors (see Table 2). As shown in Figure 8, the "Liberation Day" tariff shock leads to a decline in domestic output and a rise in inflation on impact and after one year. Similar to the uniform tariff, the recessionary impact on output is primarily driven by the downstream transmission of tariffs through the production network, as confirmed by the counterfactual without production linkages.

Figure 8: Aggregate effects of "Liberation Day" tariffs



Notes: This figure shows the aggregate impulse responses to the imposition of "Liberation Day" tariff policy, as detailed in Table 2 in the quantitative model. Red solid lines with markers denote responses under the full production network; blue dashed lines are responses when no intermediate inputs are used in production. Responses are in percent/ppts relative to steady state.

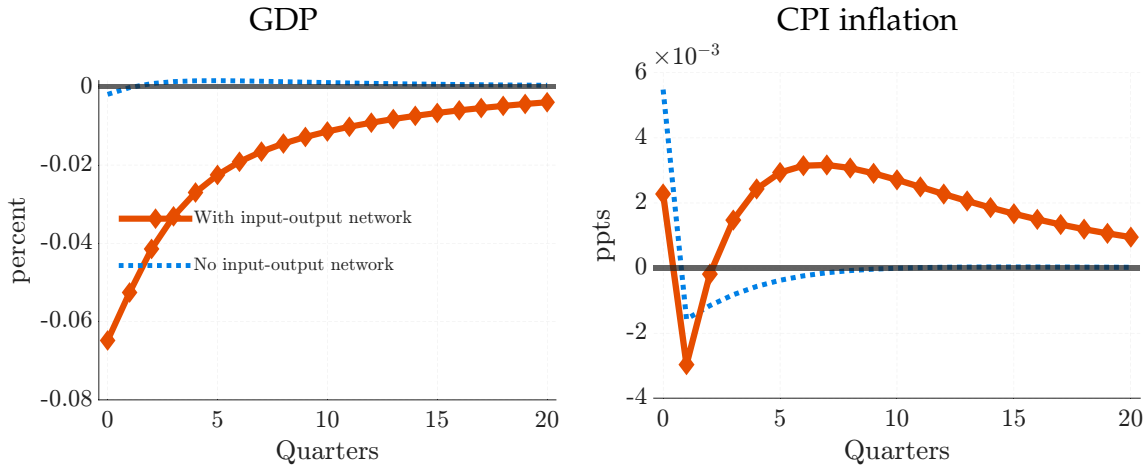
While the qualitative effects of the uniform and "Liberation Day" tariff scenarios are broadly similar, there is a notable quantitative difference. The "Liberation Day" tariffs are approximately twice as inflationary as the uniform tariffs for an only slightly larger reduction in domestic output. This suggests that the "Liberation Day" tariffs are more stagflationary – an outcome driven by their non-uniform application across sectors, which amplifies relative price distortions.

Having shown that tariffs can increase output in individual sectors, we now ask whether sector-specific tariffs can cause an aggregate expansion, despite the presence of the production network. In our quantitative model, for nearly all sectors with a significant import share, a sector-specific tariff results in an aggregate recession. This implies that almost all tradable sectors play a large enough role as (direct or indirect) suppliers to other sectors in the domestic economy, such that downstream propagation through higher input prices dominates the upstream propagation through higher demand. To illustrate this, the upper panels of Figure 9 show the aggregate effects of a 10% tariff in the "Chemical products" sector. This tariff is highly recessionary, with the downturn primarily driven by the downstream propagation of the tariff through the domestic supply network. Moreover, the downstream propagation through the network amplifies the price response.

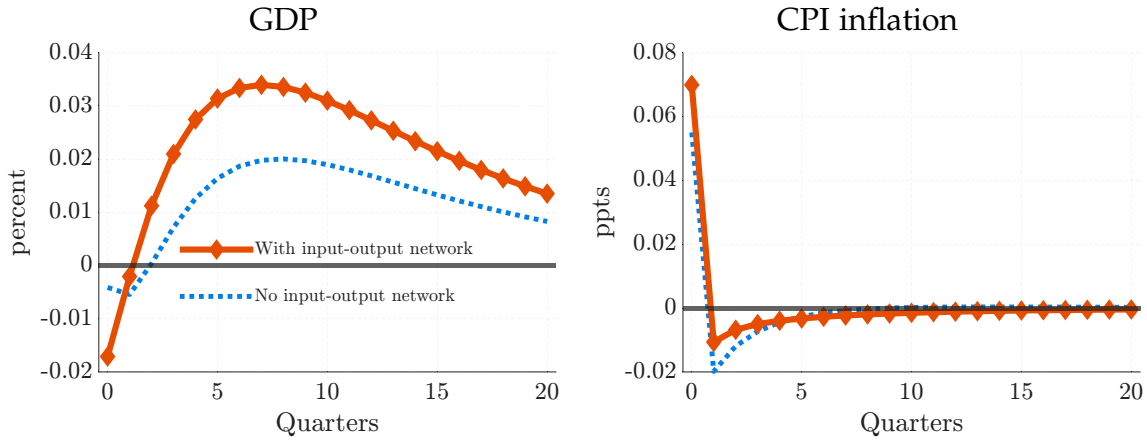
However, not all sector-specific tariffs lead to an aggregate recession —imposing

Figure 9: Aggregate effects of sector-specific tariffs

(a) 10% Tariff in "Chemical products" sector



(b) 10% Tariff in "Apparel, leather, and allied products" sector



Notes: This figure shows the aggregate impulse responses to the sector-specific import tariff of 10% in the quantitative model. Panel (a) presents the response to a tariff imposed on the "Chemical products" sector (BEA2 code 325). Panel (b) shows the response to a tariff on the "Apparel and leather and allied products" sector (BEA2 code 315AL). Red solid lines with markers denote responses under the full production network; blue dashed lines are responses when no intermediate inputs are used in production. Responses are in percent/ppts deviations from the steady state.

tariffs on certain sectors can result in aggregate expansion. An illustration of this possibility is the "Apparel and leather and allied products" sector. As shown in the bottom panels of Figure 9, imposing a tariff on this sector is expansionary after the first two quarters in which the trade adjustment costs limit expenditure switching, with input-output linkages amplifying the boom. This indicates that although the sector likely transmits shocks in both directions, its role as a

demander of inputs contributes more to propagation than its role as a supplier, leading to dominant upstream effects. Note that in this case, the inflation dynamic is only marginally influenced by the presence of a production network, as downstream propagation – which primarily shapes the price response – is particularly weak.

5 Conclusion

What are the short-run effects of an import tariff shock, notably on output and inflation? We address this question with a focus on the propagation of tariffs through the domestic production network—both analytically and by presenting new evidence. The network is also key to the aggregate effect of the shock: we find that it can even alter the sign of the effect of a tariff on GDP and inflation—even when it is imposed uniformly across all sectors.

Our quantitative results show that the aggregate consequences of tariffs are sensitive to their distribution across sectors and the structure of the production network. As we simulate the "Liberation Day" tariffs, we find output effects that are similar to the uniform tariff but the inflationary effect is stronger still—underscoring the importance of accounting for production linkages in trade policy evaluation.

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Appendix

A Model derivations and proofs

A.1 Optimality conditions

Households. The Euler equation is given by

$$\delta R_t \mathbb{E}_t \frac{C_t P_t^c}{C_{t+1} P_{t+1}^c} = 1 \ . \tag{A1}$$

Sectoral labor is supplied according to

$$L_{t,i}^{\phi} C_t = \frac{W_{t,i}}{P_t^C} \tag{A2}$$

and expenditure minimization for the final consumption good implies that consumption demand for sector-i goods satisfies

$$\frac{P_{t,i}^c C_{t,i}}{P_t^c C_t} = \beta_i \ , \tag{A3}$$

where $P_{t,i}^c$ is the price of the sector-i good defined in (1). Hence, β_i is the share of expenditure on the sector-i good in total consumption expenditure.

Firms. The optimal choice of inputs yields the demand functions for sectoral labor and for intermediate inputs produced by sector j:

$$W_{t,i} L_{t,i,k} = \alpha_i MC_{t,i} Y_{t,i,k} \tag{A4}$$

$$P_{t,j}^x X_{t,i,j,k} = (1-\alpha_i)\omega_{i,j} MC_{t,i} Y_{t,i,k} \ , \tag{A5}$$

where $P_{t,j}^x$ is the price of intermediate good j.

The optimal price chosen by firms that reset their prices is given by

$$P_{t,i}^f = \frac{E_t \sum_{s=t}^{\infty} Q_{t,s} \lambda_i^{s-t} P_{s,i} Y_{s,i} MC_{s,i}}{E_t \sum_{s=t}^{\infty} Q_{t,s} \lambda_i^{s-t} P_{s,i} Y_{s,i}} \tag{A6}$$

A.2 Steady-state domestic sales shares

Consider the steady state sectoral market clearing condition: $Y_i = C_i^D + \sum_j X_{ji}^D + E_i$. Rewrite it in terms of shares: $\frac{Y_i}{C} = \frac{C_i^D}{C} + \sum_j \frac{X_{ji}^D}{C} + \frac{E_i}{C}$. The corresponding shares are $\frac{C_i^D}{C} = \frac{C_i^D}{C_i} \cdot \frac{C_i}{C} = (1-\gamma_i)\beta$, $\frac{X_{ji}^D}{C} = \frac{X_{ji}^D}{X_{ji}} \cdot \frac{X_{ji}}{Y_j} \cdot \frac{Y_j}{C} = (1-\gamma_i) \cdot (1-\alpha_j)\omega_{ji} \cdot \frac{Y_j}{C}$, $\frac{E_i}{C} = d_i$. Let us denote the domestic sales share $\frac{Y_i}{C} = \xi_i$. Then, we can write $\xi_i = (1-\gamma_i)\beta_i + (1-\gamma_i)\sum_j (1-\alpha_j)\omega_{ji}\xi_j + d_i$, which in matrix form gives $\boldsymbol{\xi} = (I - I_\gamma)\boldsymbol{\beta} + \boldsymbol{d} + (I - I_\gamma)\Omega'\boldsymbol{\xi}$, from where the expression for vector of sales shares follows:

$$\boldsymbol{\xi} = L' \cdot [(I - I_\gamma) \cdot \boldsymbol{\beta} + \boldsymbol{d}] \tag{A7}$$

where $L = [I - \Omega(I - I_\gamma)]^{-1}$ is the Leontieff inverse matrix, relevant in this context.

A.3 Proof of Proposition 1

Sectoral market clearing. We log-linearize the sectoral market clearing condition. First, we multiply by sectoral good price: $P_{t,i}Y_{t,i} = P_{t,i}C_i^D + \sum_j P_{t,i}X_{t,ji}^D + P_{t,i}E_{t,i}$. Then we have,

$$\xi_i(p_{t,i} + y_{t,i}) = (1-\gamma_i)\beta_i(p_{t,i} + c_{t,i}^d) + I_d(e_t + d_{t,i}) + (1-\gamma_i)\sum_j (1-\alpha_j)\omega_{ji}\xi_j(p_{t,i} + x_{t,ji}^d)$$

where e_t is exchange rate, $d_{t,i}$ is export demand shock in sector i.

We can express $p_{t,i} + x_{t,ji}^d = x_{t,ji} + \eta(p_{t,i}^x - p_{t,i}) + p_{t,i} = x_{t,ji} + p_{t,i}^x + (\eta - 1)\gamma_i s_{t,i}$, where $s_{t,i} = (e_t + \tau_{t,i} + p_{t,i}^\star) - p_{t,i}$ is terms of trade. And $x_{t,ji} + p_{t,i}^x = y_{t,j} + p_{t,j} - \mu_{t,j}$ follows from intermediate input demand equation, where $\mu_{t,i}$ is sectoral markup.

Then, in matrix form, upon rearranging the terms, we can write

$$\boldsymbol{p_t} + \boldsymbol{y_t} - \boldsymbol{\mu_t} = I_\xi^{-1}L'(I - I_\gamma)I_\beta \cdot (\boldsymbol{p_t} + \boldsymbol{c_t^d}) + I_\xi^{-1}L'I_d \cdot (\mathbf{1}e_t + \boldsymbol{d_t}) - I_\xi^{-1}L'I_\xi \cdot \boldsymbol{\mu_t} + \\ + (\eta - 1)I_\xi^{-1}L'(I - I_\gamma)\Omega'I_\xi I_\gamma \boldsymbol{s_t}$$

Similarly, we can express $p_{t,i} + c_{t,i}^d = (\eta - 1)\gamma_i s_{t,i} + (p_t^c + c_t) = (\eta - 1)\gamma_i s_{t,i} + m_t$, where $m_t = p_t^c + c_t$ is the money supply, controlling the nominal spending in the economy. Note also, that under this assumption, combined with risk

sharing, we have $m_t = e_t$. Then we have

$$\begin{aligned}\boldsymbol{p_t} + \boldsymbol{y_t} - \boldsymbol{\mu_t} = I_{\tilde{\xi}}^{-1} L'(I - I_\gamma) I_\beta \cdot [(\eta - 1) I_\gamma \boldsymbol{s_t} + \mathbf{1} m_t] + \\ I_{\tilde{\xi}}^{-1} L' I_d \cdot (\mathbf{1} e_t + \boldsymbol{d_t}) - I_{\tilde{\xi}}^{-1} L' I_{\tilde{\xi}} \cdot \boldsymbol{\mu_t} + \\ + (\eta - 1) I_{\tilde{\xi}}^{-1} L'(I - I_\gamma) \Omega' I_{\tilde{\xi}} I_\gamma \boldsymbol{s_t}\end{aligned}$$

Rearranging the terms we obtain the expression for sectoral outputs:

$$\boldsymbol{y_t} = -\boldsymbol{p_t} + \mathbf{1} m_t + (I - I_{\tilde{\xi}}^{-1} L' I_{\tilde{\xi}}) \cdot \boldsymbol{\mu_t} + I_{\tilde{\xi}}^{-1} L' I_d \cdot \boldsymbol{d_t} + (\eta - 1) I_{\tilde{\xi}}^{-1} L'(I - I_\gamma)[I_\beta + \Omega' I_{\tilde{\xi}}] I_\gamma \cdot \boldsymbol{s_t}$$

Marginal costs and prices. Now, from the marginal cost expression we can write:

$$\boldsymbol{p_t} = \boldsymbol{\mu_t} - \boldsymbol{a_t} + \Omega \boldsymbol{p_t^x} + I_\alpha \mathbf{1} m_t$$

Given that $\boldsymbol{p_t^x} = I_\gamma \boldsymbol{s_t} + \boldsymbol{p_t}$, we can rearrange the terms and rewrite:

$$\boldsymbol{p_t} = \hat{L} \boldsymbol{\mu_t} - \hat{L} \boldsymbol{a_t} + \hat{L} \Omega I_\gamma \boldsymbol{s_t} + \mathbf{1} m_t$$

where $\hat{L} = (I - \Omega)^{-1}$ is the Leontieff inverse relevant in this context. Substituting this price expression back into output, we obtain:

$$\begin{aligned}\boldsymbol{y_t} = -(\hat{L} - I + I_{\tilde{\xi}}^{-1} L' I_{\tilde{\xi}}) \cdot \boldsymbol{\mu_t} + \hat{L} \boldsymbol{a_t} + I_{\tilde{\xi}}^{-1} L' I_d \cdot \boldsymbol{d_t} + \\ + (\eta - 1) I_{\tilde{\xi}}^{-1} L'(I - I_\gamma)[I_\beta + \Omega' I_{\tilde{\xi}}] I_\gamma \cdot \boldsymbol{s_t} - \hat{L} \Omega I_\gamma \cdot \boldsymbol{s_t}\end{aligned}$$

The downstream propagation matrix follows from the last term of the above expression. The upstream and own-sector matrices follow from noting that $I_{\tilde{\xi}}^{-1} L'(I - I_\gamma)[I_\beta + \Omega' I_{\tilde{\xi}}] I_\gamma = I_{\tilde{\xi}}^{-1} L'(I - I_\gamma)[I_\beta + \Omega' I_{\tilde{\xi}} + \Omega' I_{1-\gamma} I_\beta - \Omega' I_{1-\gamma} I_\beta] I_\gamma$. Then, $U = I_{\tilde{\xi}}^{-1} L'(I - I_\gamma)[\Omega' I_{\tilde{\xi}} + \Omega' I_{1-\gamma} I_\beta] I_\gamma$, and $O = I_{\tilde{\xi}}^{-1} L'(I - I_\gamma)[I - \Omega' I_{1-\gamma}] I_\beta I_\gamma = I_{\tilde{\xi}}^{-1} I_{1-\gamma} I_\beta I_\gamma$ (using the fact that $L'(I - I_\gamma)\Omega' = L' - I$).

Propagation of tariffs.

We assume that there are no markups (flex. price economy), money supply is constant, and there are no other shocks, except for tariff shocks. Using the notation of the main text, we can rewrite output as:

$$\boldsymbol{y}_t = -\boldsymbol{p}_t + (\eta - 1)(U + O)\boldsymbol{s}_t$$

and prices as

$$\boldsymbol{p}_t = D\boldsymbol{s}_t$$

Hence, terms of trade propagate on output as:

$$\boldsymbol{y}_t = -D\boldsymbol{s}_t + (\eta - 1)(U + O)\boldsymbol{s}_t$$

Noting that tariffs and terms of trade are related as $\boldsymbol{s}_t = \boldsymbol{\tau}_t - \boldsymbol{p}_t$ in the absence of other shocks, we can express output as and prices as the functions of (slightly adjusted) upstream, downstream, and own-sector propagation of tariffs:

$$\boldsymbol{p}_t = Z^p D\boldsymbol{\tau}_t$$

where $Z^p = (I + D)^{-1}$, and

$$\boldsymbol{y_t} = -Z^y D\boldsymbol{\tau}_t + (\eta - 1)(U + O)\boldsymbol{\tau}_t$$

where $Z^y = [I + (\eta - 1)(U + O)]Z^p$.

Remark. Since terms of trade contain both domestic prices and tariffs, the propagation of tariffs in general depends on how prices react. Let $s_{t,i} = \tau_{t,i} - p_{t,i}$. If no production network, domestic prices do not change in response to tariffs, and we have $\boldsymbol{s_t} = \boldsymbol{\tau_t}$. In the presence of a network, the effect of tariffs on prices is $\boldsymbol{p_t} = [I + \hat{L}\Omega I_\gamma]^{-1}\hat{L}\Omega I_\gamma \boldsymbol{\tau_t}$ which is also fully driven by the downstream matrix. Then, ToT themselves $\boldsymbol{s_t} = (I - [I + \hat{L}\Omega I_\gamma]^{-1}\hat{L}\Omega I_\gamma) \cdot \boldsymbol{\tau_t}$. The second term is generally smaller than the first one as it captures higher-order propagation as opposed to direct effect.

Final output weights. We compute GDP as value added. Real GDP (in log-deviations) is given by:

$$va_t^R = va_t^N - p_t^{GDP}$$

where v_t^N is nominal GDP and p_t^{GDP} is GDP deflator. Nominal value added (in levels) is: $VA_t = \sum_i VA_{t,i}$. Sectoral value added euqals labor income $VA_{t,i} = W_{t,i}L_{t,i} = \alpha_i P_{t,i} Y_{t,i}$. Then, aggregate nominal value added is:

$$va_t^N = \sum_i \alpha_i \xi_i (p_{t,i} + y_{t,i}) = \mathbf{1}' I_\alpha I_\xi \cdot (\boldsymbol{p_t} + \boldsymbol{y_t})$$

GDP deflator is and index of domestic prices $p_t^{GDP} = \sum_i \tilde{\xi}_i \cdot p_{t,i} = \mathbf{1}' I_{\tilde{\xi}} \cdot \boldsymbol{p_t}$. Then,

real value added is:

$$va_t^R = \mathbf{1}' I_\alpha I_\xi \cdot (\boldsymbol{p_t} + \boldsymbol{y_t}) - \mathbf{1}' I_{\tilde{\xi}} \cdot \boldsymbol{p_t}$$

where $\alpha_i \xi_i = \frac{VA_i}{VA} = \frac{\alpha_i \xi_i}{\sum_i \alpha_i \xi_i}$ are value added weights. Here we have used the fact that around steady state with balanced trade we have: $\sum_i \alpha_i \xi_i = 1$. The GDP deflator can be constructed with value added weights, yielding $\tilde{\xi}_i = \alpha_i \xi_i$.

Given the link between $\boldsymbol{s_t}$ and sectoral output and prices, we have the result of Corollary 2.

B Data

Import tariffs. We extract data on US imports and duties from the US Census Bureau using USA Trade Online. Using Harmonized System (HS) data, we collect (i) "Customs Value (Gen)" – the value of imported goods as reported by US Customs and Border Protection, expressed in US dollars; and (ii) "Calculated Duty" – the estimated import duties, also expressed in US dollars. Both series are extracted at the 10-digit disaggregation level for all countries of origin. The data is collected at a monthly frequency and then aggregated to quarterly values. The time span covers January 2002 (the earliest available period for monthly data) to December 2024.

Harmonizing data. As no correspondence between HS10 and BEA2 codes is currently available, we harmonize sectoral import and tariff data with output and price data through a two-step procedure. First, using the USITC DataWeb mapping, we map imports and tariffs from 10-digit HTS codes to North American Industry Classification System (NAICS) codes and then convert NAICS codes into the BEA system. We focus on BEA2 industry codes, the highest available level of disaggregation for output. As a result, we obtain non-zero import tariff data for 23 sectors, along with sectoral output and price data for 66 sectors.

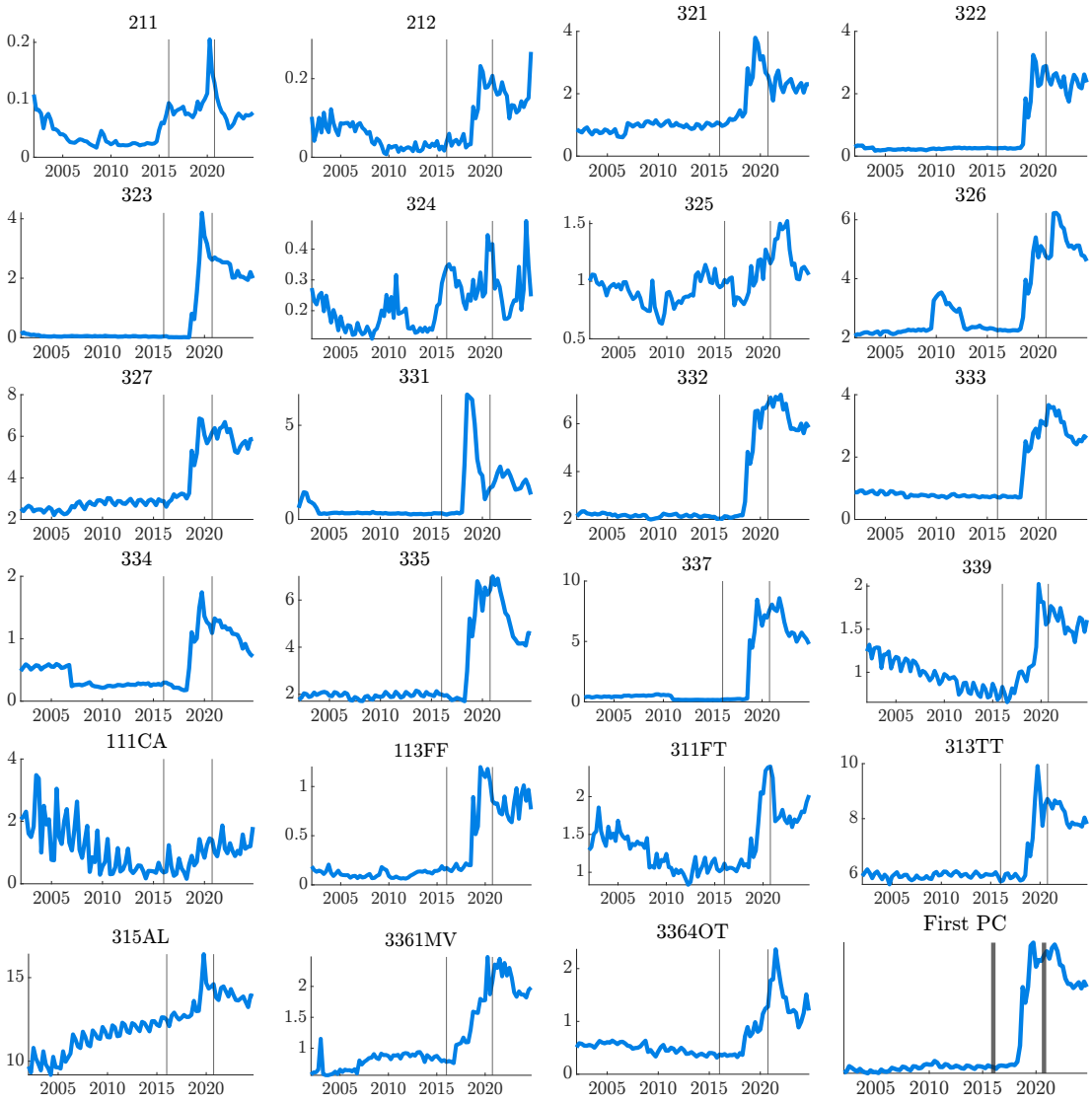
Table B.3: Tariff Sectors

Index	BEA 2-digit code	Sector description
1	111CA	Farms
2	113FF	Forestry, fishing, and related activities
3	211	Oil and gas extraction
4	212	Mining, except oil and gas
5	311FT	Food and beverage and tobacco products
6	313TT	Textile mills and textile product mills
7	315AL	Apparel and leather and allied products
8	321	Wood products
9	322	Paper products
10	323	Printing and related support activities
11	324	Petroleum and coal products
12	325	Chemical products
13	326	Plastics and rubber products
14	327	Nonmetallic mineral products
15	331	Primary metals
16	332	Fabricated metal products
17	333	Machinery
18	334	Computer and electronic products
19	335	Electrical equipment, appliances, and components
20	3361MV	Motor vehicles, bodies and trailers, and parts
21	3364OT	Other transportation equipment
22	337	Furniture and related products
23	339	Miscellaneous manufacturing

Table B.4: Output and Price Sectors

Index	BEA 2-digit code	Sector description
1	111CA	Farms
2	113FF	Forestry, fishing, and related activities
3	211	Oil and gas extraction
4	212	Mining, except oil and gas
5	213	Support activities for mining
6	22	Utilities
7	23	Construction
8	311FT	Food and beverage and tobacco products
9	313TT	Textile mills and textile product mills
10	315AL	Apparel and leather and allied products
11	321	Wood products
12	322	Paper products
13	323	Printing and related support activities
14	324	Petroleum and coal products
15	325	Chemical products
16	326	Plastics and rubber products
17	327	Nonmetallic mineral products
18	331	Primary metals
19	332	Fabricated metal products
20	333	Machinery
21	334	Computer and electronic products
22	335	Electrical equipment, appliances, and components
23	3361MV	Motor vehicles, bodies and trailers, and parts
24	3364OT	Other transportation equipment
25	337	Furniture and related products
26	339	Miscellaneous manufacturing
27	42	Wholesale trade
28	441	Motor vehicle and parts dealers
29	445	Food and beverage stores
30	452	General merchandise stores
31	481	Air transportation
32	482	Rail transportation
33	483	Water transportation
34	484	Truck transportation
35	485	Transit and ground passenger transportation
36	486	Pipeline transportation
37	487OS	Other transportation and support activities
38	493	Warehousing and storage
39	4A0	Other retail
40	511	Publishing industries, except internet (includes software)
41	512	Motion picture and sound recording industries
42	513	Broadcasting and telecommunications
43	514	Data processing, internet publishing, and other information services
44	521CI	Federal Reserve banks, credit intermediation, and related activities
45	523	Securities, commodity contracts, and investments
46	524	Insurance carriers and related activities
47	525	Funds, trusts, and other financial vehicles
48	532RL	Rental and leasing services and lessors of intangible assets
49	5411	Legal services
50	5412OP	Miscellaneous professional, scientific, and technical services
51	5415	Computer systems design and related services
52	55	Management of companies and enterprises
53	561	Administrative and support services
54	562	Waste management and remediation services
55	61	Educational services
56	621	Ambulatory health care services
57	622	Hospitals
58	623	Nursing and residential care facilities
59	624	Social assistance
60	711AS	Performing arts, spectator sports, museums, and related activities
61	713	Amusements, gambling, and recreation industries
62	721	Accommodation
63	722	Food services and drinking places
64	81	Other services, except government
65	HS	Housing
66	ORE	Other real estate

Figure B.10: Tariff time series



Notes: Time series of tariffs (in levels) for all sectors with nonzero tariffs during the sample. Grey vertical lines indicate the first Trump presidency. The last panel shows the first principal component, which explains 88% of the variation.

C Quantitative appendix

Table C.5: Calibrated Import Elasticities

BEA2	sector	import elasticity
111CA	Farms	4.3887
113FF	Forestry, fishing, and related activities	2.5184
211	Oil and gas extraction	11.130
212	Mining, except oil and gas	4.7882
311FT	Food and beverage and tobacco products	7.6323
313TT	Textile mills and textile product mills	4.5169
315AL	Apparel and leather and allied products	6.2019
321	Wood products	3.8118
322	Paper products	3.5291
323	Printing and related support activities	2.1023
324	Petroleum and coal products	2.0410
325	Chemical products	3.1400
326	Plastics and rubber products	16.722
327	Nonmetallic mineral products	3.9828
331	Primary metals	4.9888
332	Fabricated metal products	2.9186
333	Machinery	6.6417
334	Computer and electronic products	3.9155
335	Electrical equipment, appliances, and components	3.1257
3361MV	Motor vehicles, bodies and trailers, and parts	2.4435
3364OT	Other transportation equipment	2.7643
337	Furniture and related products	1.5839
339	Miscellaneous manufacturing	3.8517

Notes: Elasticities based on Soderbery (2015), see main text for details. Elasticities in sectors not listed are set to 2.

Aggregation of Pasten et al. (2024) price adjustment frequencies. Since the data provided by Pasten et al. (2024) is mostly on the level of 6-digit BEA code, we aggregate it to two digits using Domar weights. We compute the latter based on the "Use" table for 402 industries from 2017. To do so, we again exclude the government, scrap, and noncomparable imports sectors and then compute intermediate input shares, final consumption shares and labor shares among the remaining sectors as above, as well as shares of imports and exports in total consumption.[7] For the matching of 6-digit to 2-digit BEA codes, we make use of the BEA's levels of aggregation: Sector (most aggregated), summary, underlying summary, and detail (least aggregated). There is also a fifth level of further disaggregation, on which some of the Pasten et al. (2024) price adjustment frequencies are reported. We will refer to these levels as first to fifth level, starting with the sector level. We want to aggregate to the second level and preceed as follows:

In general for each industry on the second level, we use the Domar-weighted

[7] For this step, we ignore the assumption made above that the aggregate trade balance is zero in steady state and use the observed share of sectoral exports in total consumption for d_i in the computation of Domar weights.

(normalized so that the weights sum up to one) average of all available Pasten et al. (2024) frequencies at the fourth level. If the frequency is missing for at least one, but not all industries on the fourth level within one industry on the third level, we replace it with the Domar weighted average of the other fourth-level industries in the same third-level industry.[8] In the same fashion, we use Domar-weighted averages to aggregate the industries of the third level within one industry to the second level. If the (average) frequency is missing for at least one, but not all third-level industries, we replace the missing ones with the weighted average of the other industries of the third level within the same second-level industries. This procedure gives us a frequency for most of our 63 second-level industries. For the other ones, we proceed as follows:

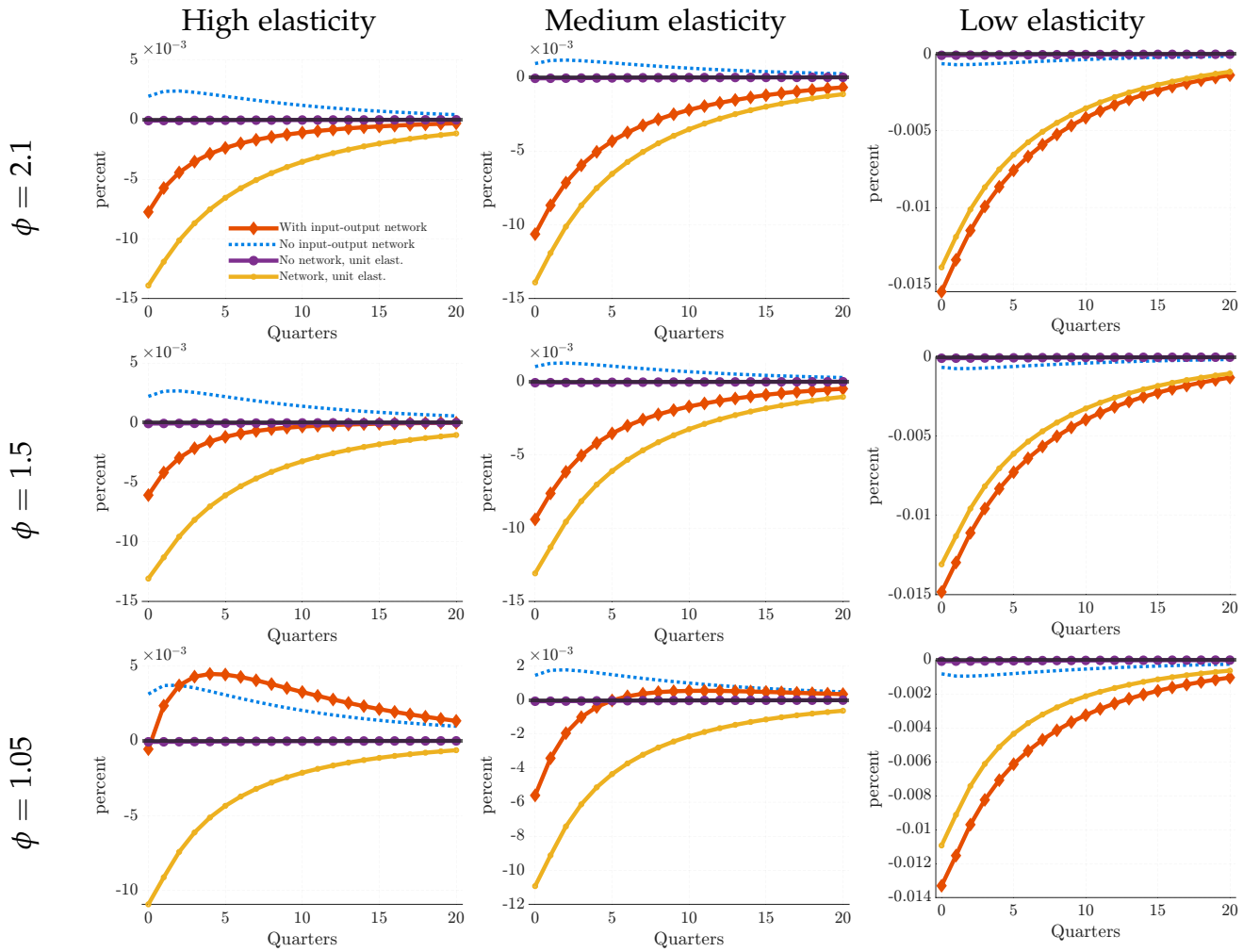
- For industries 42, 4A0, HS, ORE, 623, 721, and 713, there is precisely one frequency available that is already reported by Pasten et al. (2024) at either a higher or lower level of aggregation than the fourth, so we use this one.
- For industries 113FF, 315AL, 485, 512, 523, 525, 5415, 55, 61, 624, 711AS, and 722, we use the Domar-weighted average of the other second-level industries within the same first-level sector.
- For the remaining industries 23 and 81, we use the domar-weighted average of all other second-level industries.

[8]When there is no frequency available at the fourth level (for which we can compute Domar weights, but multiple ones on the fifth level, for which we can not, we treat these frequencies as missing.

Table C.6: Country-specific tariff rates

Country	Tariff rate (%)	Country	Tariff rate (%)	Country	Tariff rate (%)
Algeria	30	Malawi	17	Austria (EU)	20
Angola	32	Malaysia	24	Belgium (EU)	20
Bangladesh	37	Mauritius	40	Bulgaria (EU)	20
Bosnia & Herzegovina	35	Moldova	31	Croatia (EU)	20
Botswana	37	Mozambique	16	Cyprus (EU)	20
Brunei	24	Myanmar	44	Czech Rep. (EU)	20
Cambodia	49	Namibia	21	Denmark (EU)	20
Cameroon	11	Nauru	30	Estonia (EU)	20
Chad	13	Nicaragua	18	Finland (EU)	20
China	34	Nigeria	14	France (EU)	20
Côte d'Ivoire	21	Macedonia	33	Germany (EU)	20
Congo (Kinshasa)	11	Norway	15	Greece (EU)	20
Equatorial Guinea	13	Pakistan	29	Hungary (EU)	20
Falkland Islands	41	Philippines	17	Ireland (EU)	20
Fiji	32	Serbia	37	Italy (EU)	20
Guyana	38	South Africa	30	Latvia (EU)	20
India	26	Sri Lanka	44	Lithuania (EU)	20
Indonesia	32	South Korea	25	Luxembourg (EU)	20
Iraq	39	Switzerland	31	Malta (EU)	20
Israel	17	Syria	41	Netherlands (EU)	20
Japan	24	Taiwan	32	Poland (EU)	20
Jordan	20	Thailand	36	Portugal (EU)	20
Kazakhstan	27	Tunisia	28	Romania (EU)	20
Laos	48	Vanuatu	22	Slovakia (EU)	20
Lesotho	50	Venezuela	15	Slovenia (EU)	20
Libya	31	Vietnam	46	Spain (EU)	20
Liechtenstein	37	Zambia	17	Sweden (EU)	20
Madagascar	47	Zimbabwe	18	**All other countries**	**10**

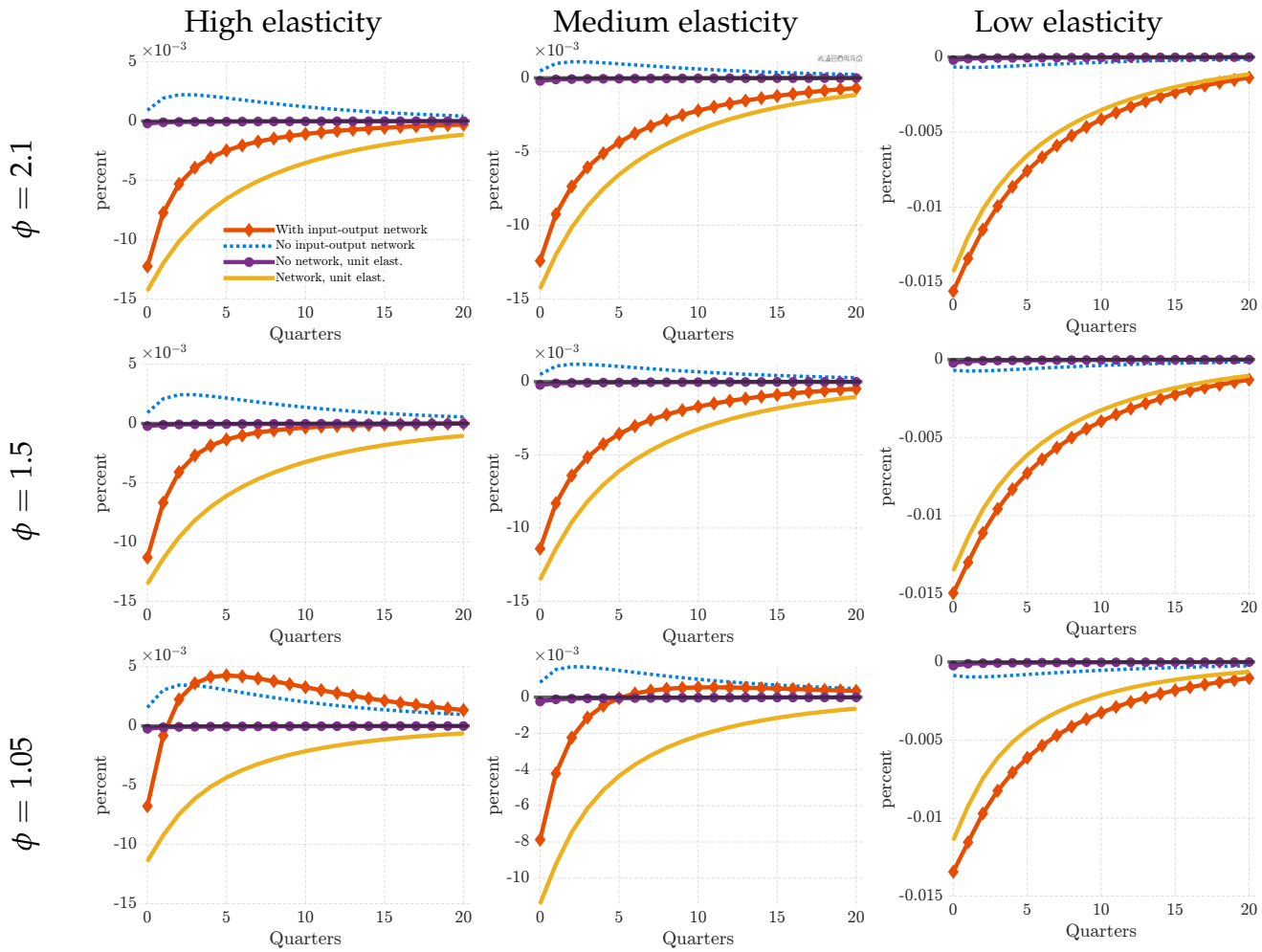
Figure C.11: GDP responses without trade adjustment costs ($\iota = 0$)



High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

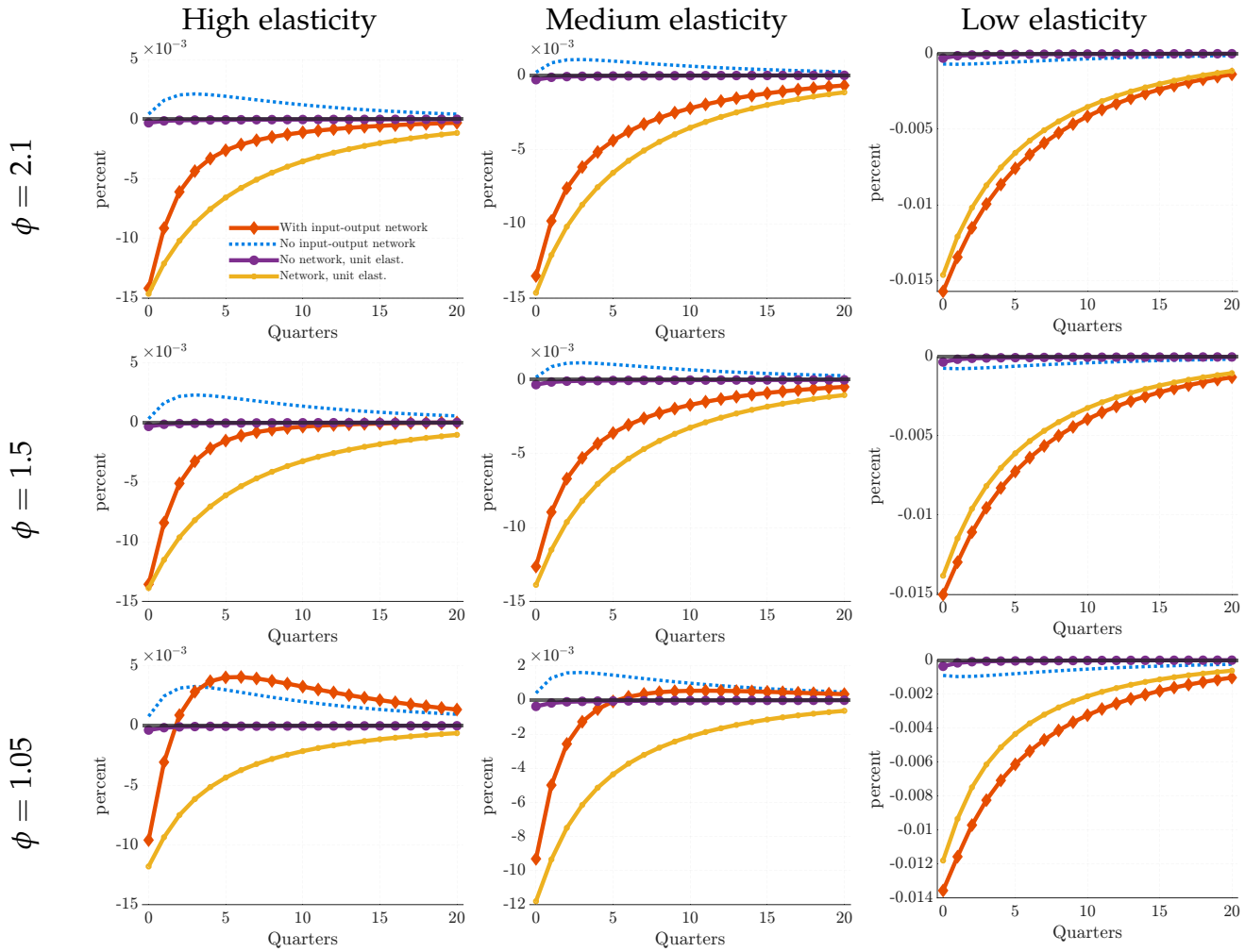
C.1 Cumulated responses

Figure C.12: GDP responses with trade adjustment costs ($\iota = 0.05$)



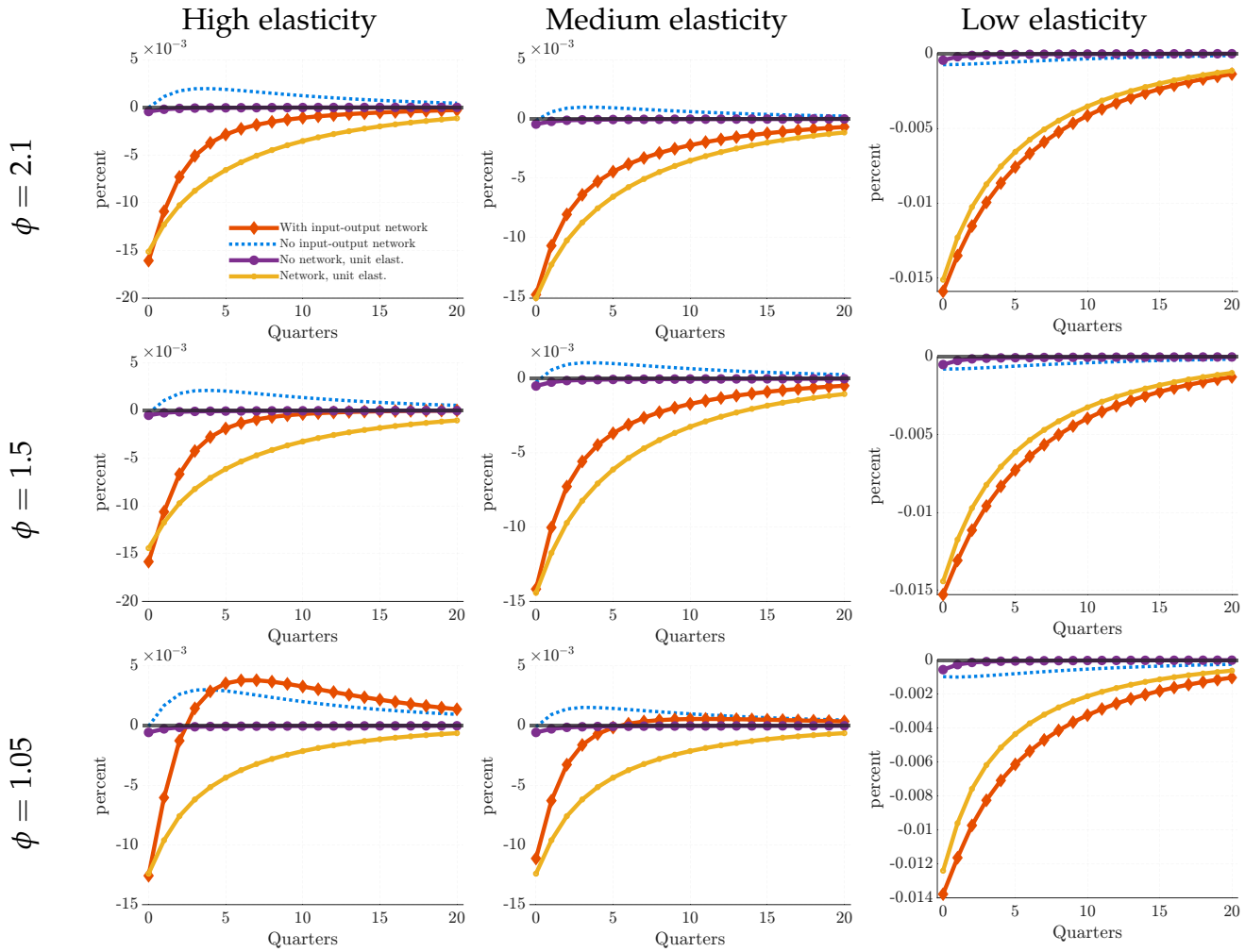
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.13: GDP responses with trade adjustment costs ($\iota = 0.1$)



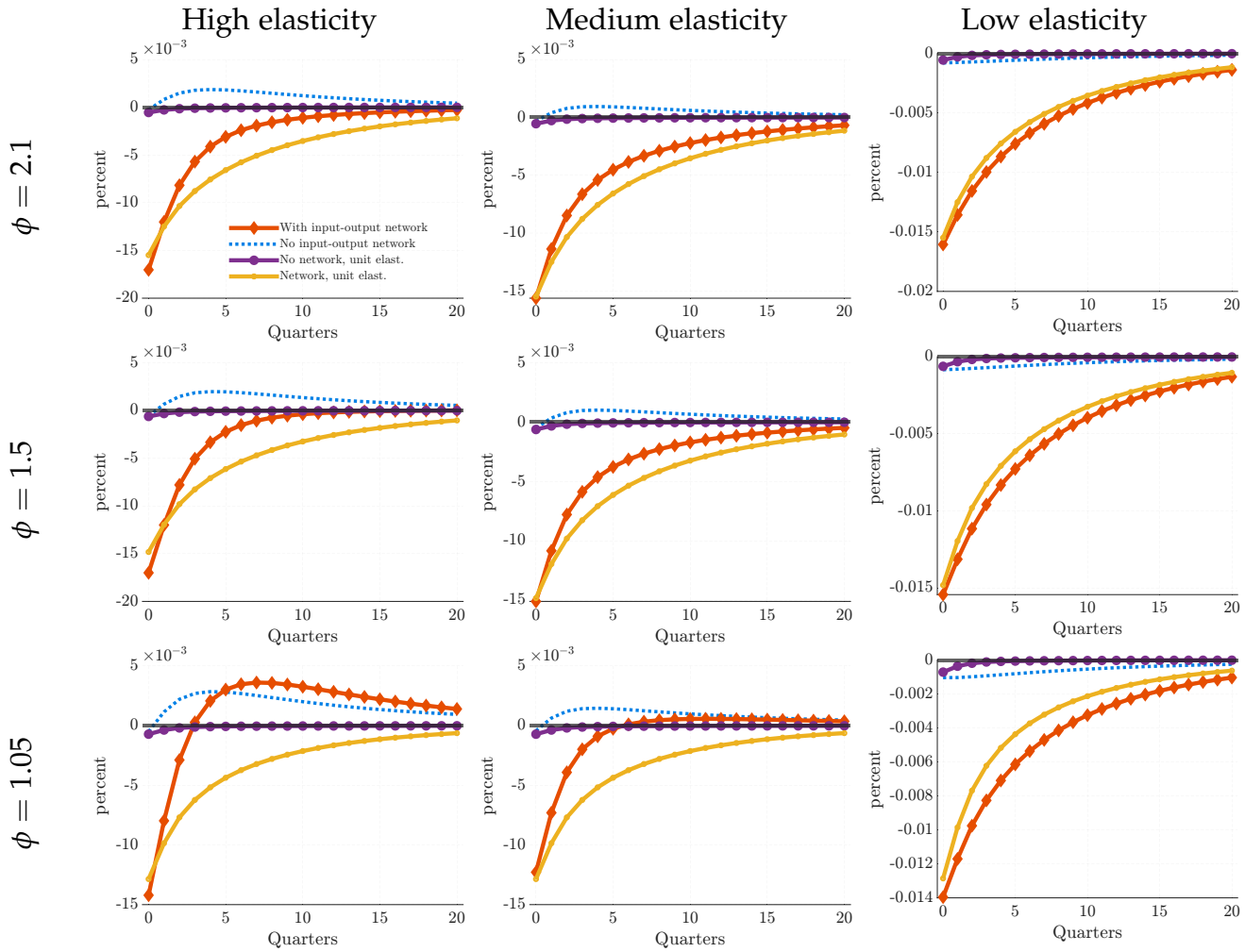
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.14: GDP responses with trade adjustment costs ($\iota = 0.2$)



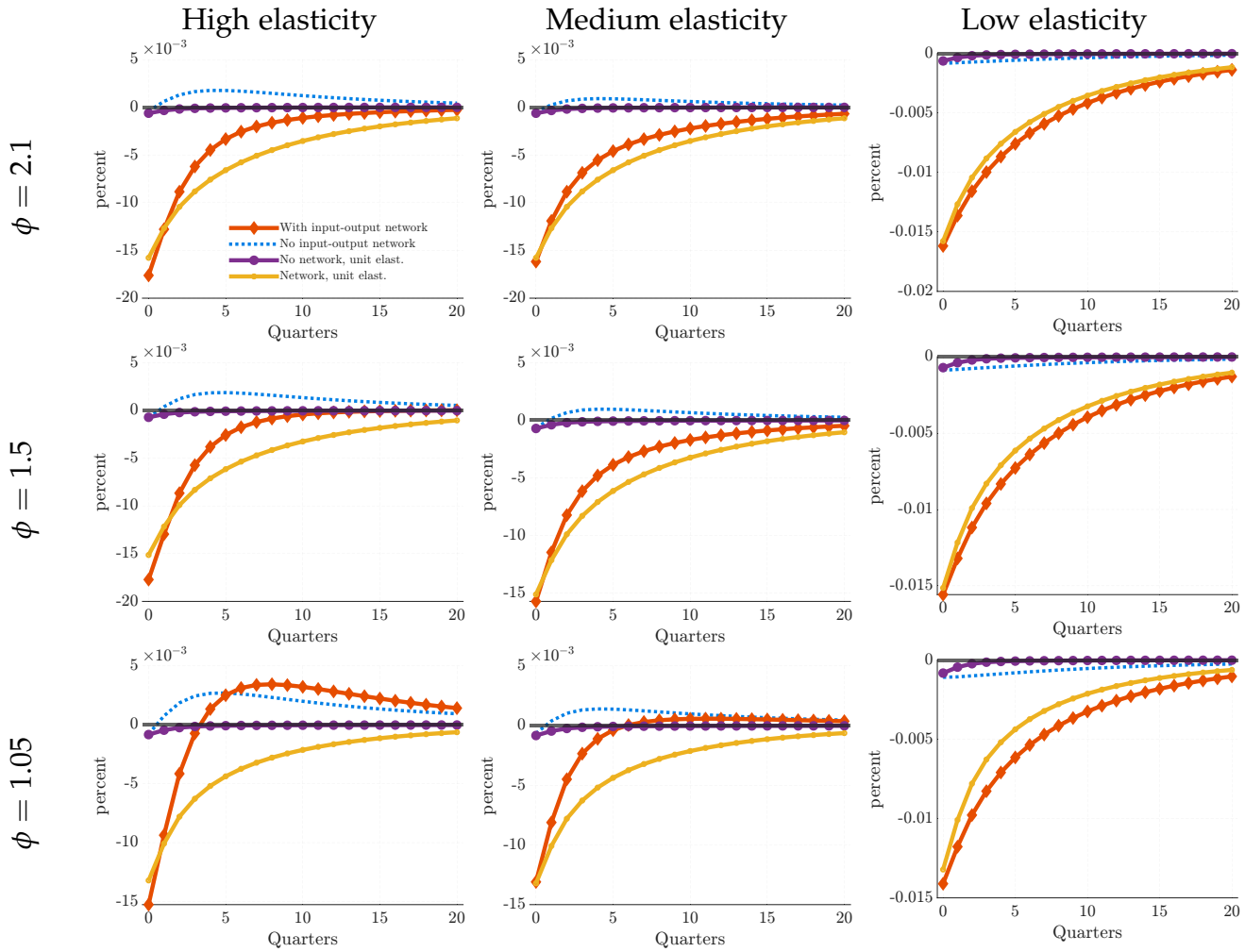
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.15: GDP responses with trade adjustment costs ($\iota = 0.3$)



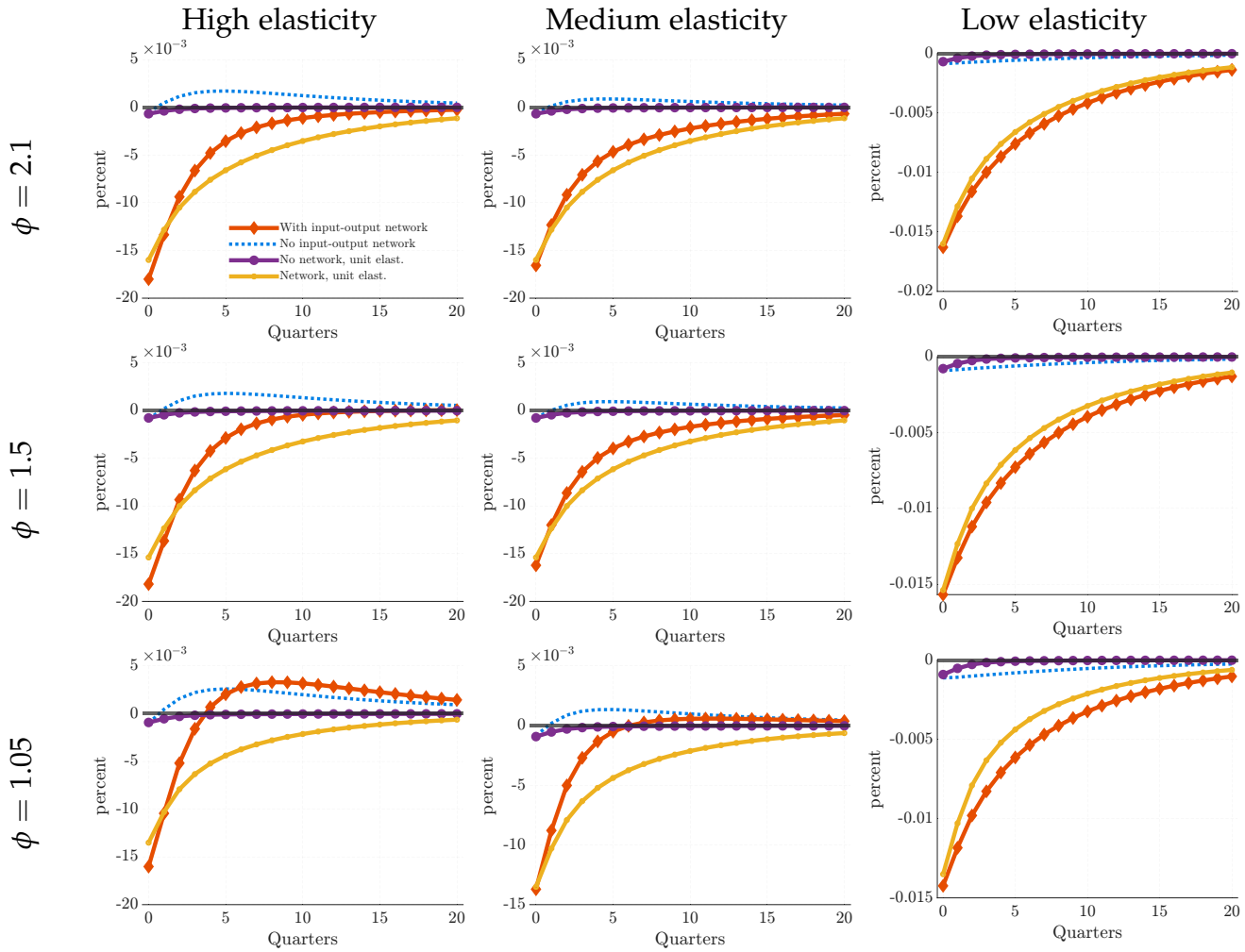
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.16: GDP responses with trade adjustment costs ($\iota = 0.4$)



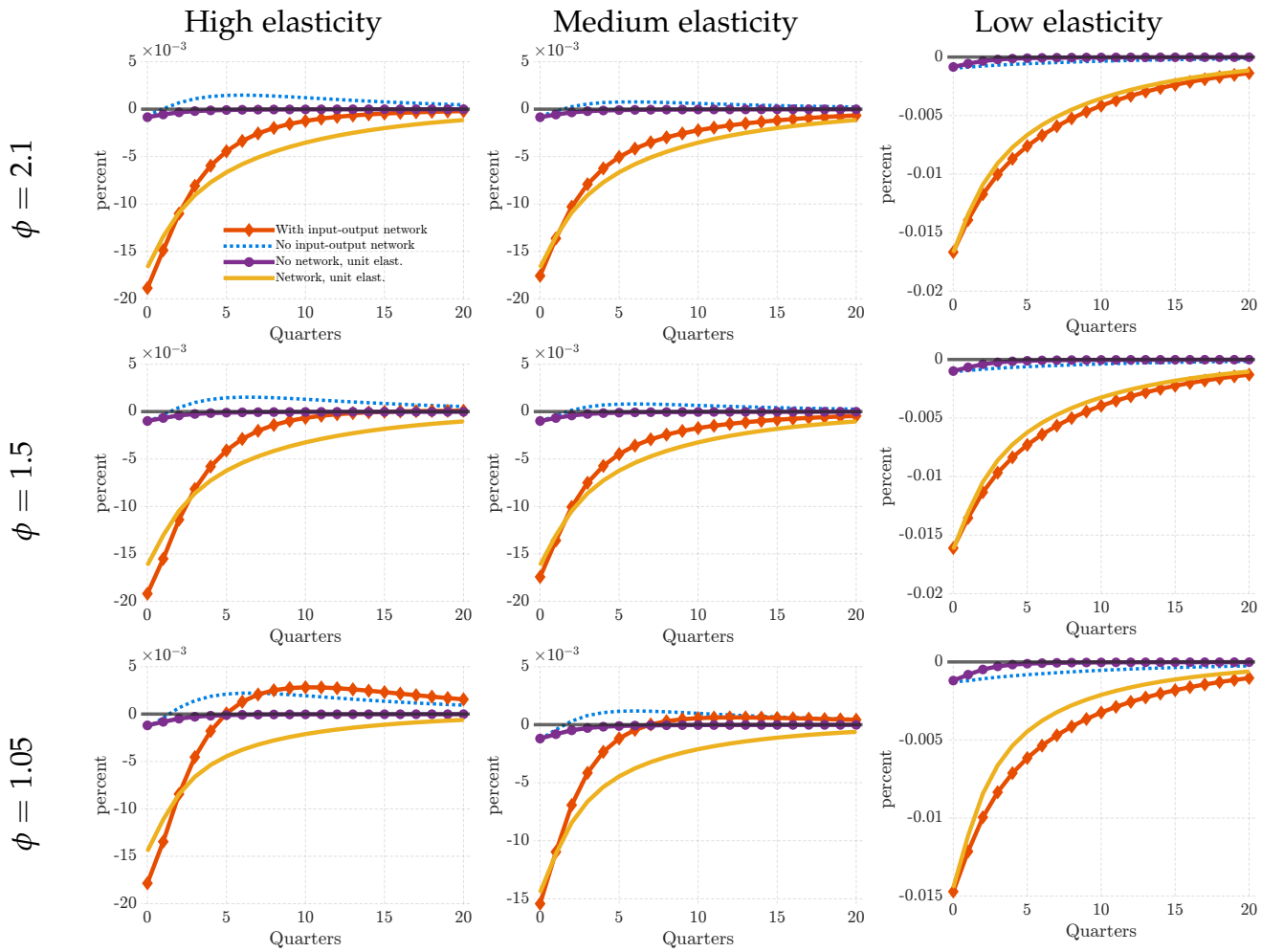
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.17: GDP responses with trade adjustment costs ($\iota = 0.5$)



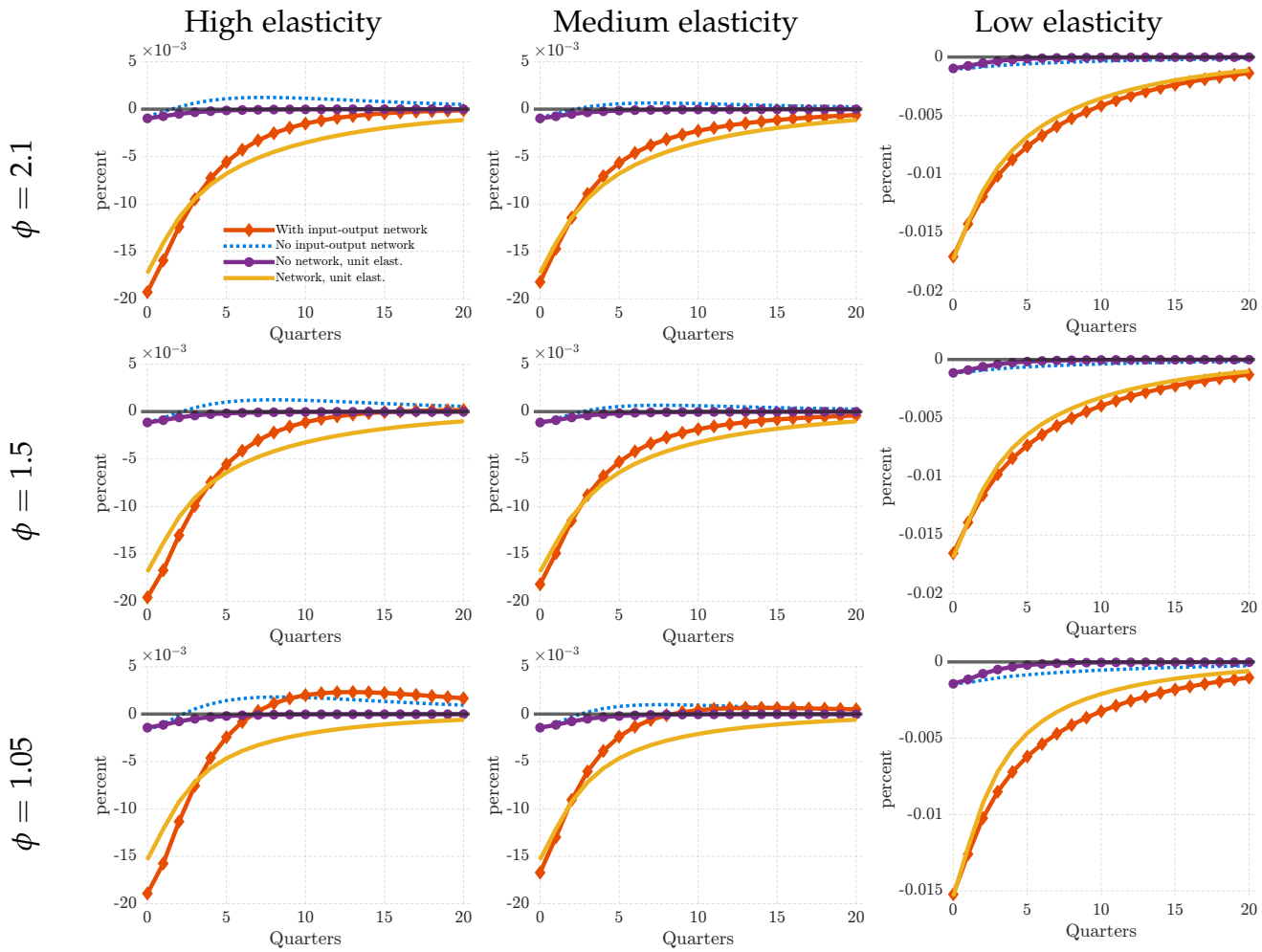
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.18: GDP responses with trade adjustment costs ($\iota = 1$)



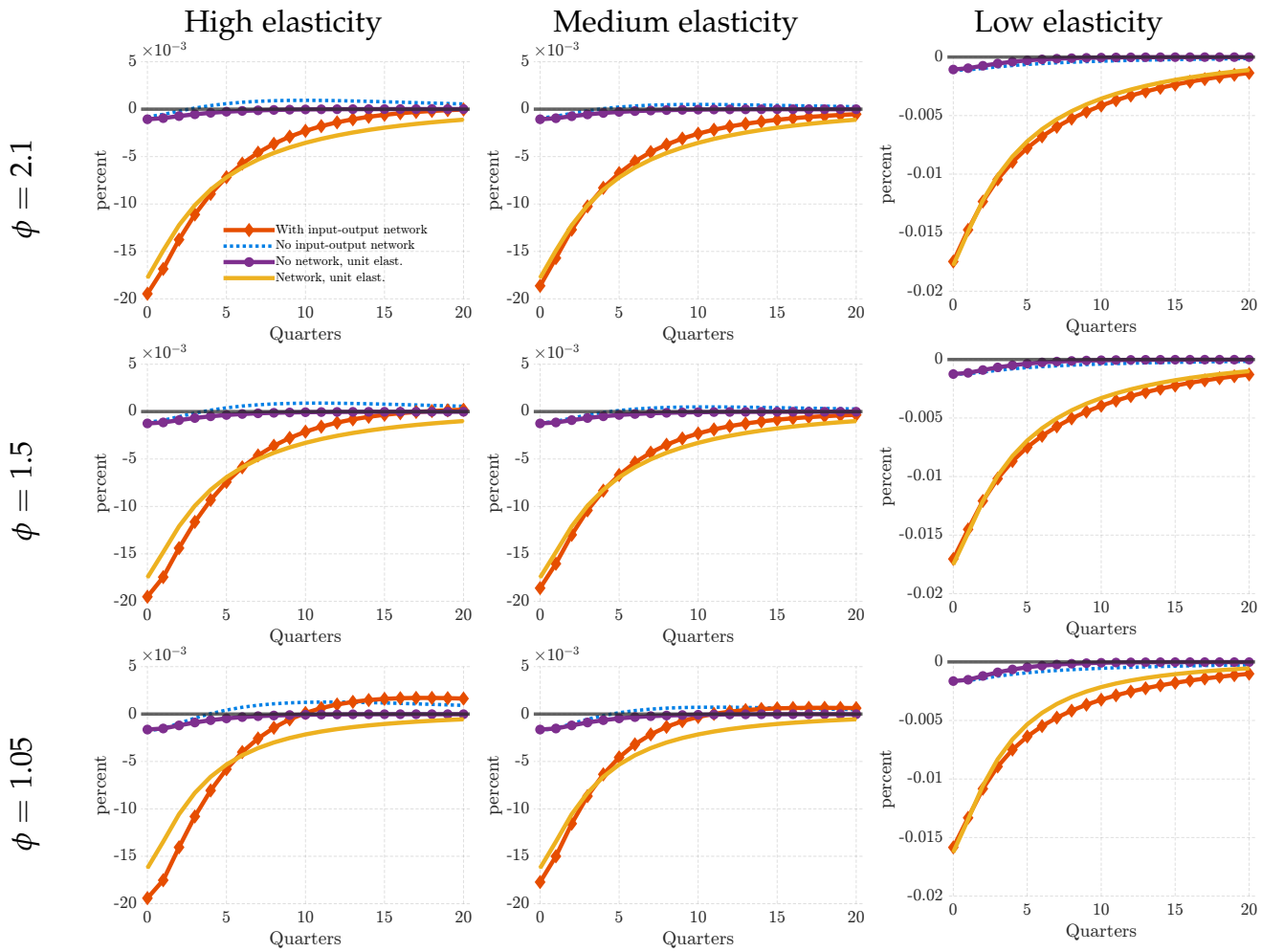
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.19: GDP responses with trade adjustment costs ($\iota = 2$)



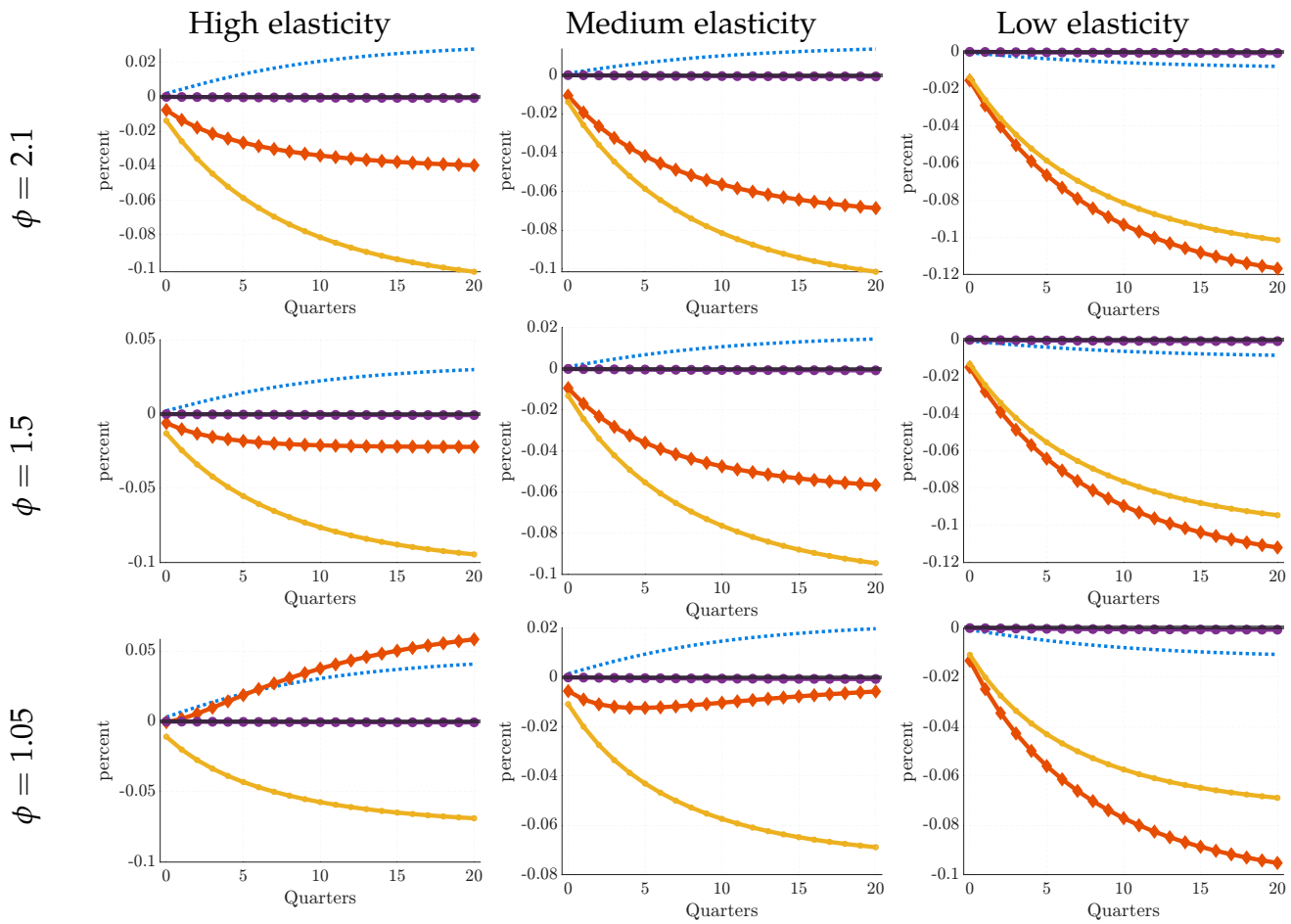
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.20: GDP responses with trade adjustment costs ($\iota = 5$)



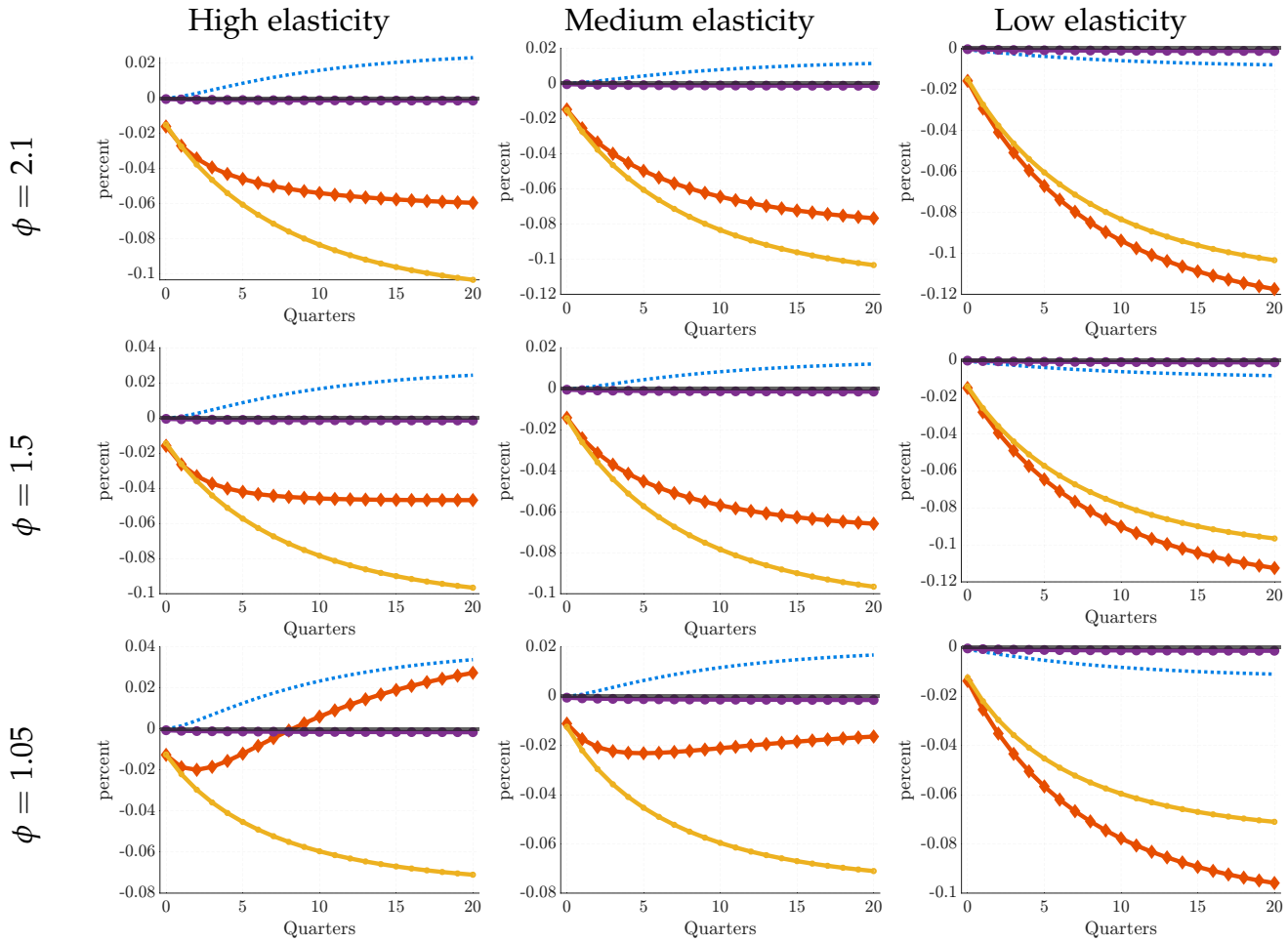
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.21: Cumulated GDP responses without trade adjustment costs ($\iota = 0$)



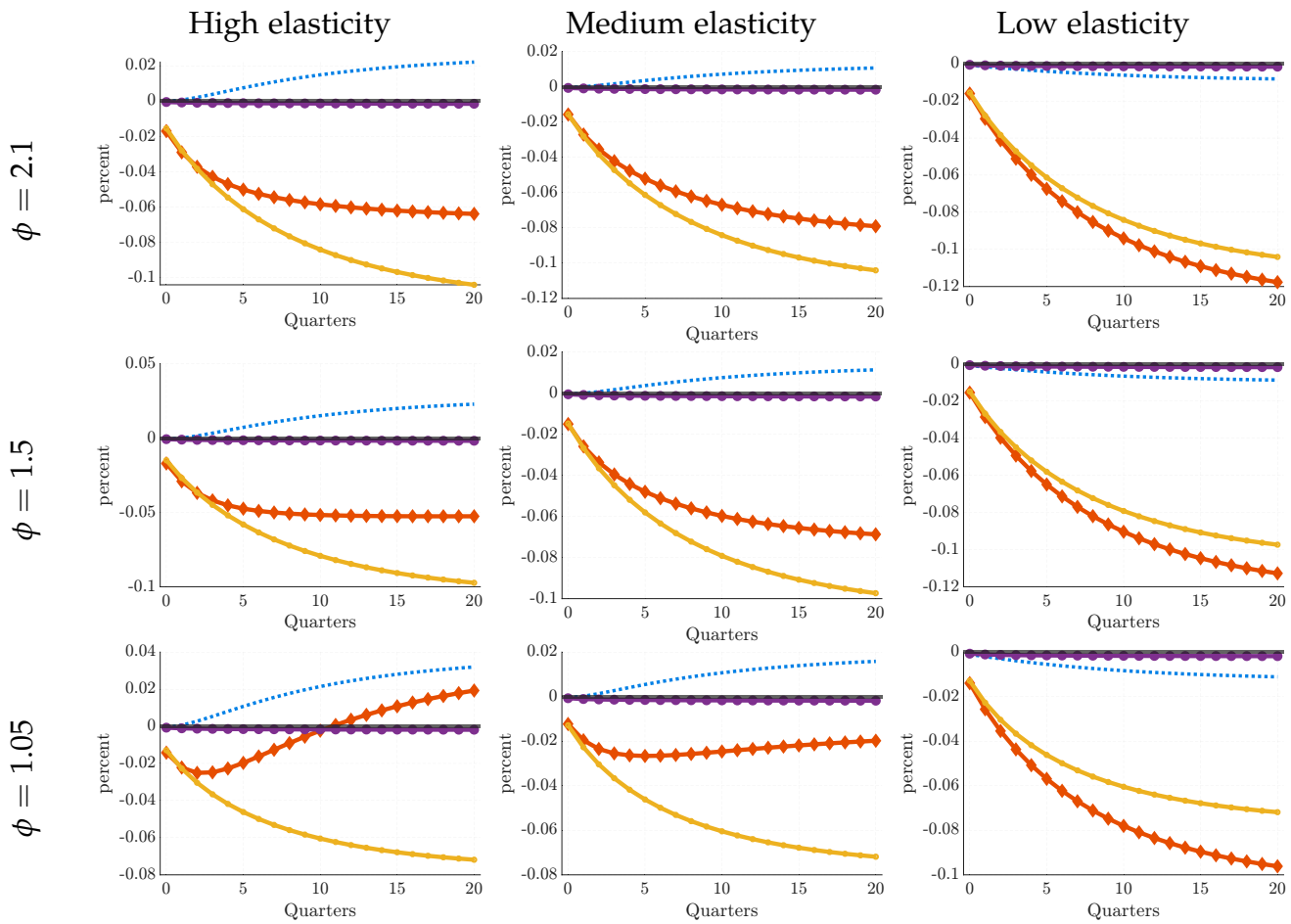
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.22: Cumulated GDP responses with trade adjustment costs ($\iota = 0.2$)



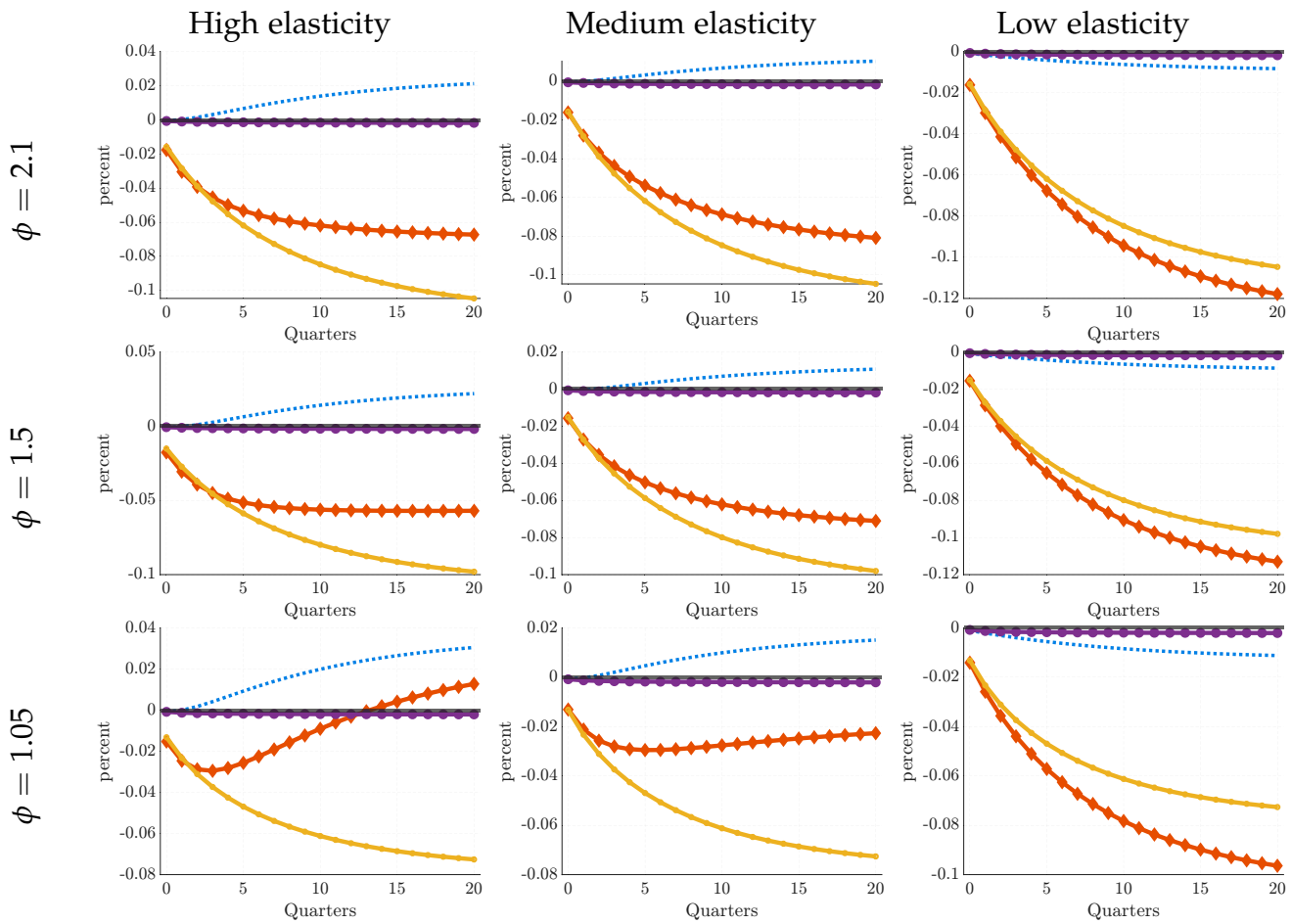
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.23: Cumulated GDP responses with trade adjustment costs ($\iota = 0.3$)



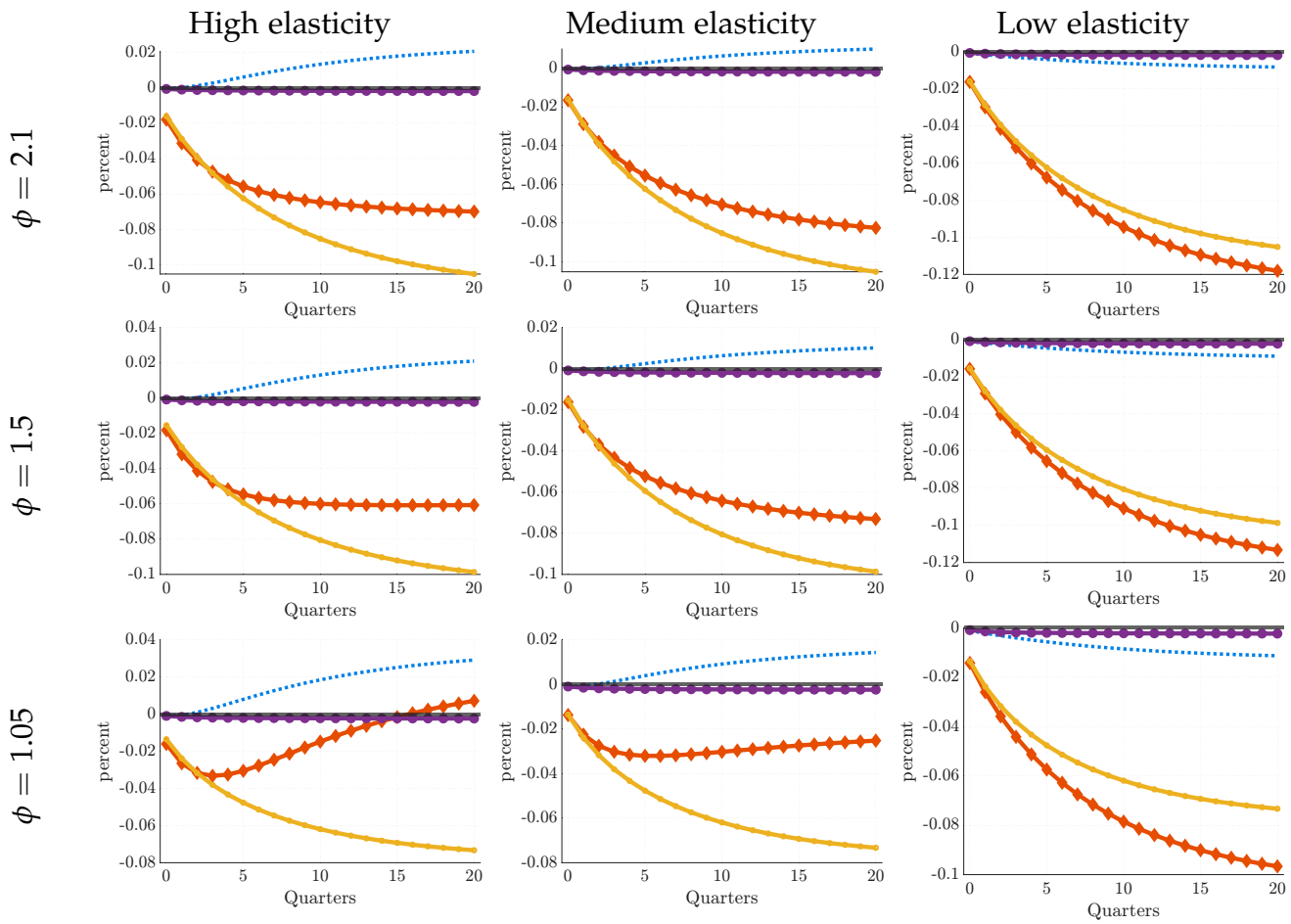
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.24: Cumulated GDP responses with trade adjustment costs ($\iota = 0.4$)



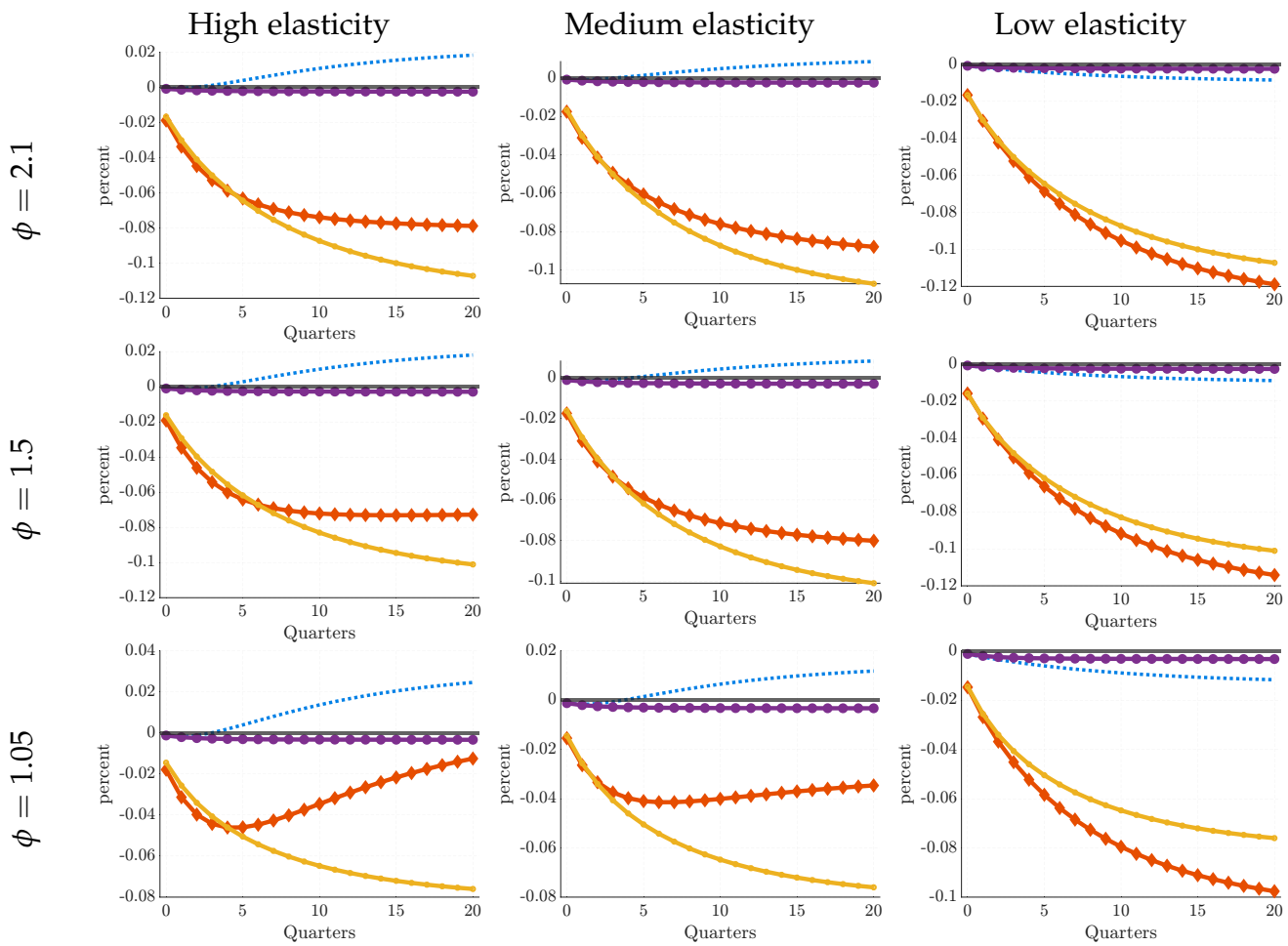
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.25: Cumulated GDP responses with trade adjustment costs ($\iota = 0.5$)



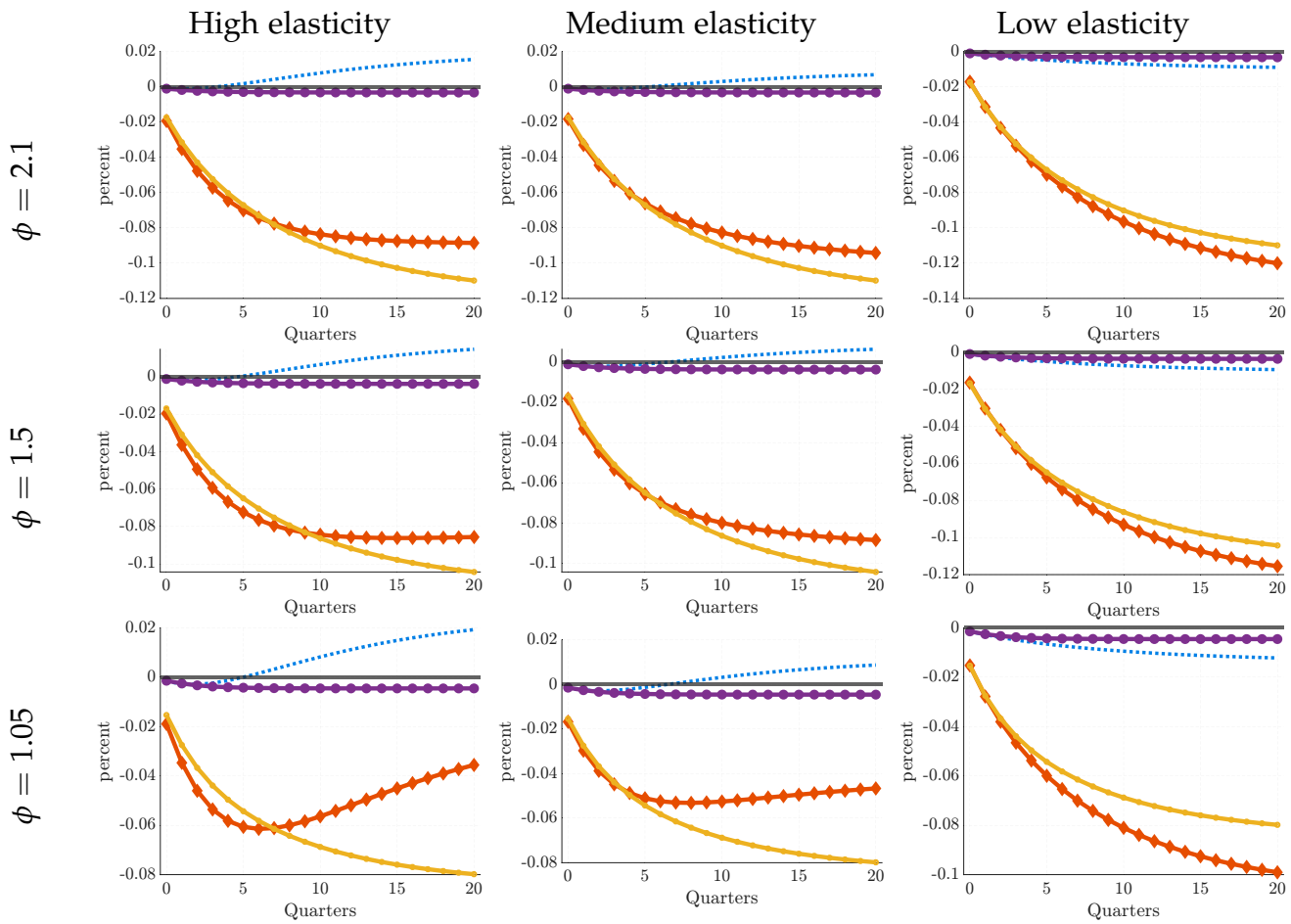
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.26: Cumulated GDP responses with trade adjustment costs ($\iota = 1$)



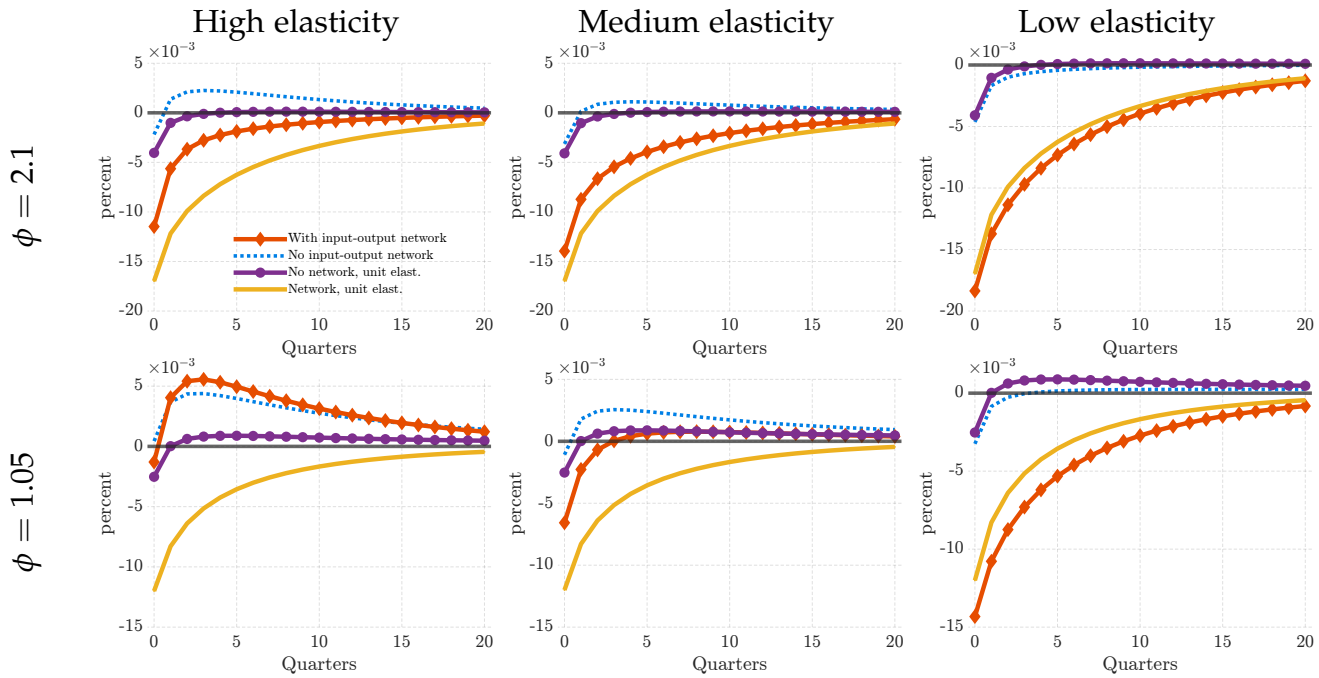
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.27: Cumulated GDP responses with trade adjustment costs ($\iota = 2$)



High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

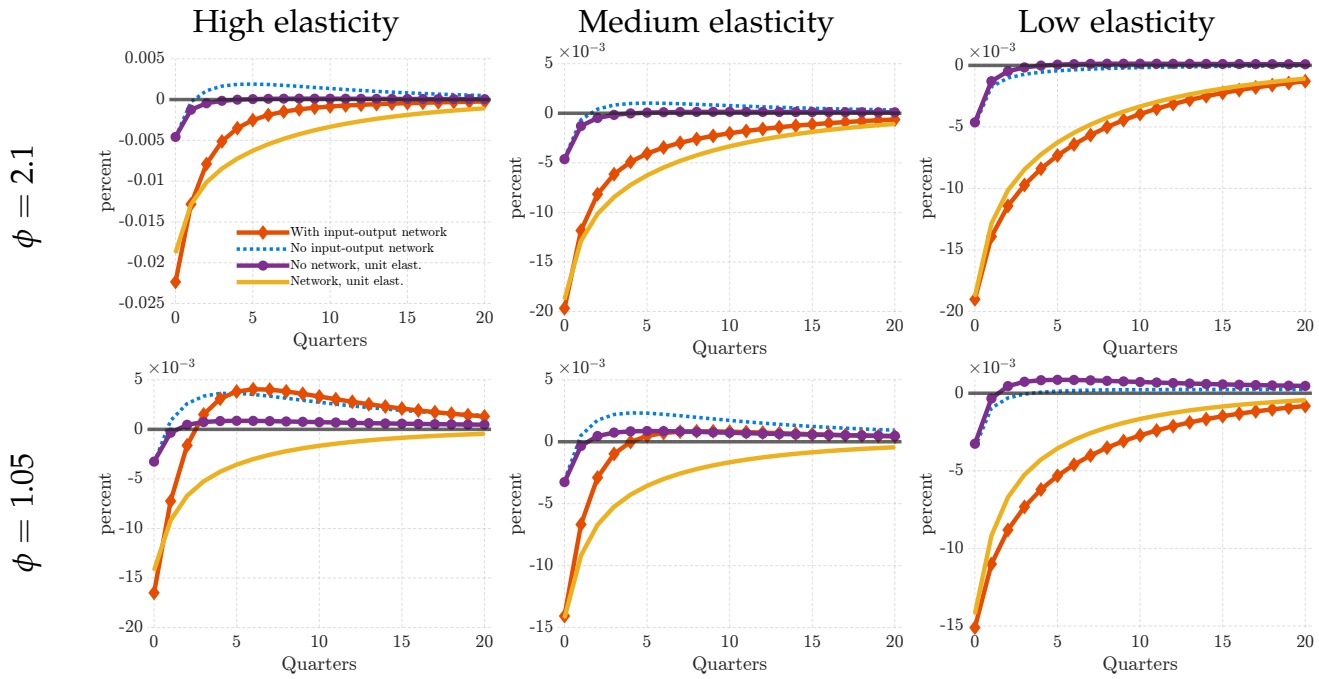
Figure C.28: GDP responses under CPI target ($\iota = 0$)



High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

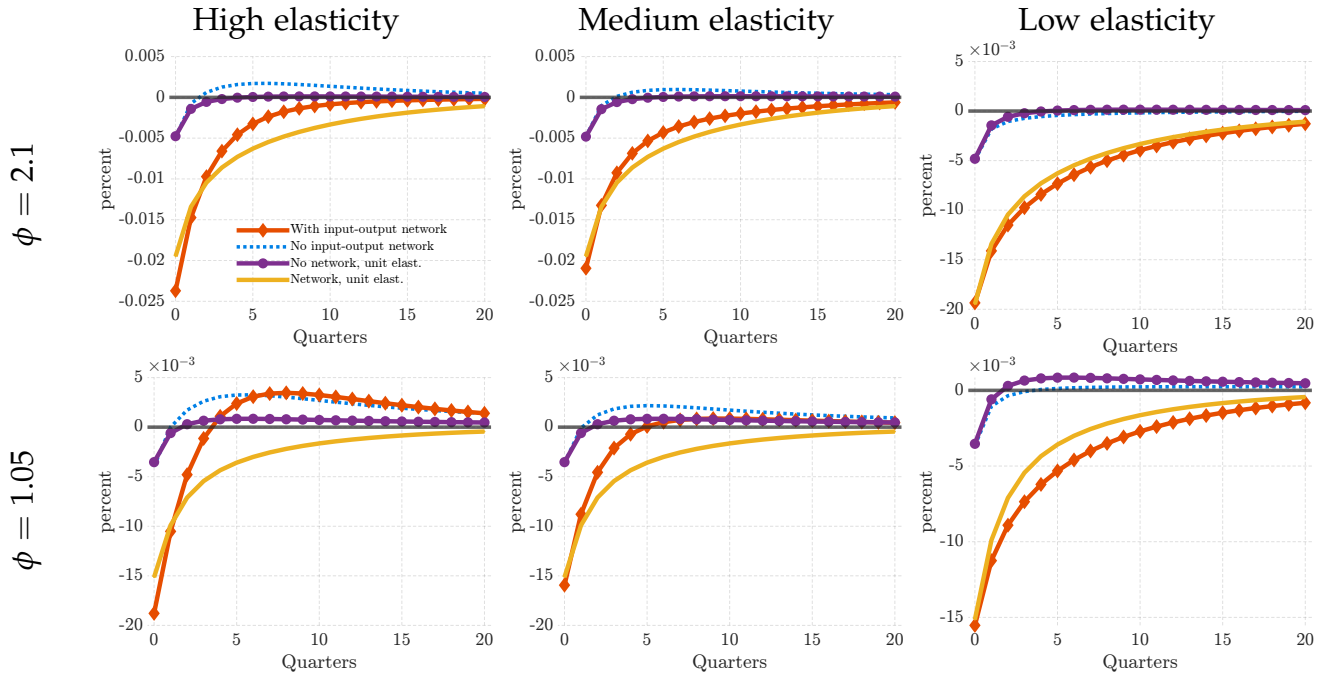
C.2 CPI target

Figure C.29: GDP responses under CPI target ($\iota = 0.4$)



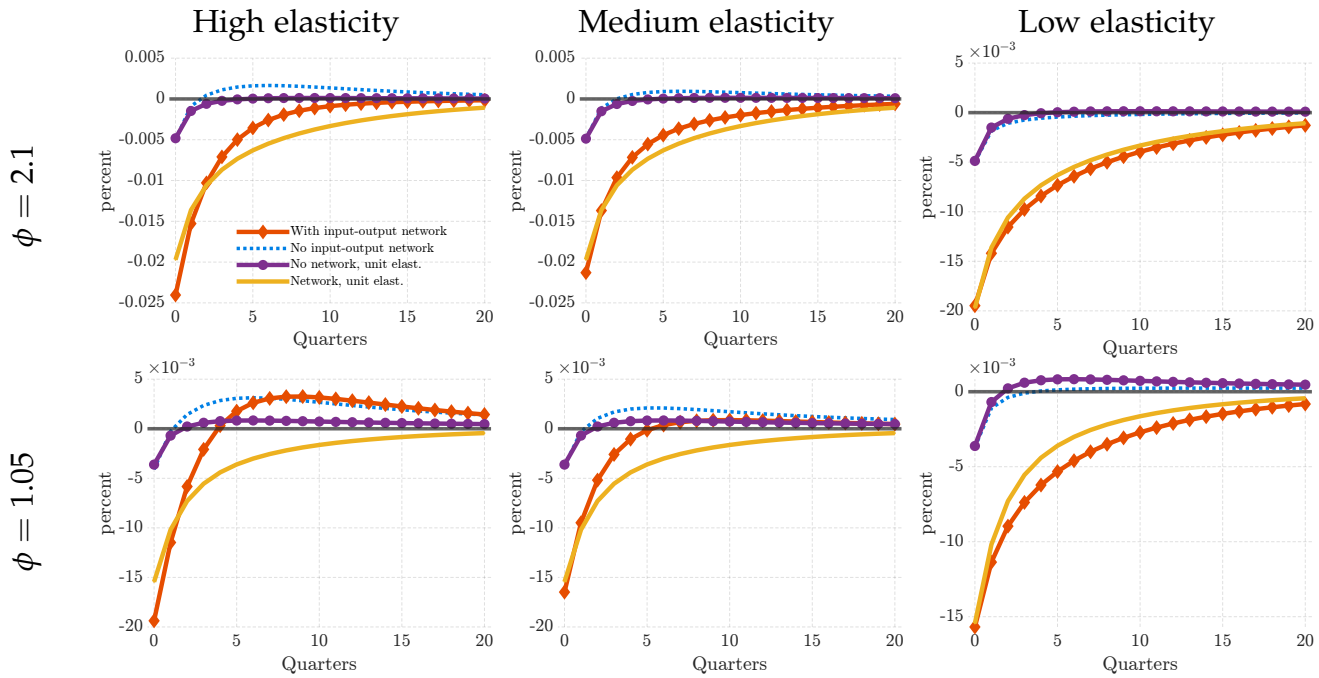
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.30: GDP responses under CPI target ($\iota = 0.8$)



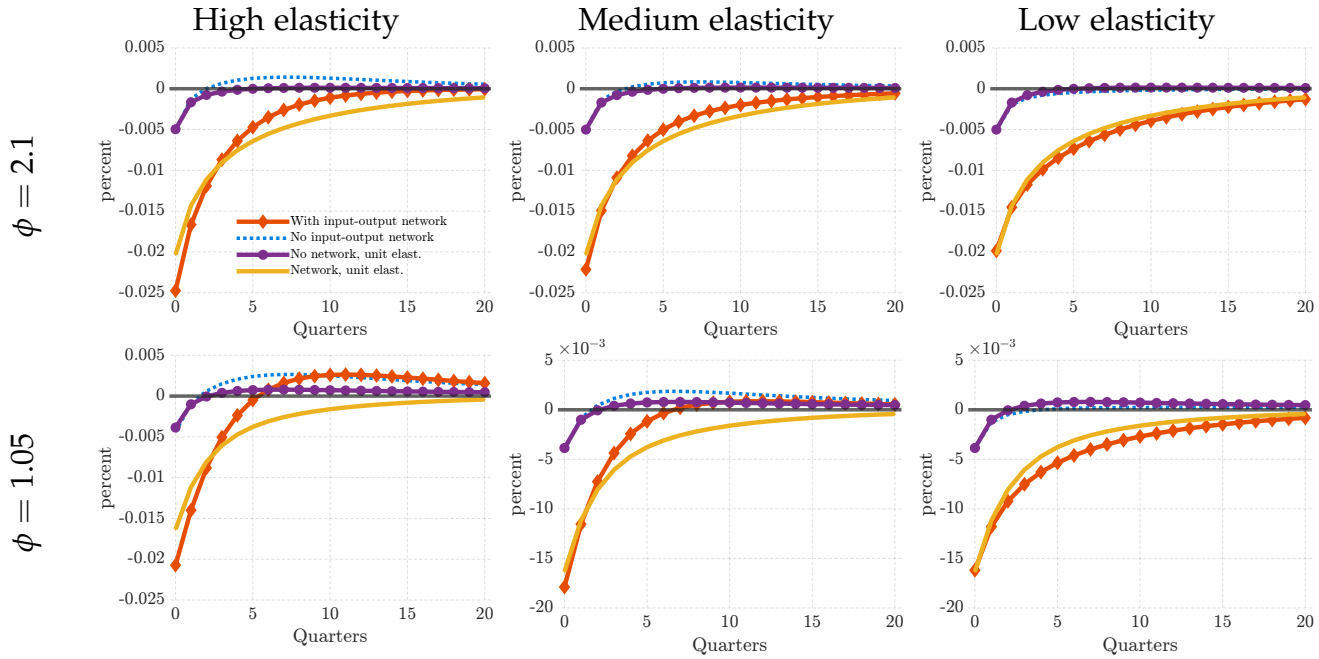
High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.31: GDP responses under CPI target ($\iota = 1$)



High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.

Figure C.32: GDP responses under CPI target ($\iota = 2$)



High elasticity: As calibrated from Soderbery (2015); Medium elasticity: Winsorized Soderbery (2015) elasticities at 5; Low elasticity: 0.5 for all sectors.