Tariffs, Investment, and the Missing Trade Collapse

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August 2026

ABSTRACT

U.S. tariff rates in 2025 rose to levels not seen since the Great Depression, yet imports *increased*. To account for the missing trade collapse, we develop an open-economy New Keynesian model with tariff heterogeneity, inventories, and shocks to investment that capture the AI-driven boom. The model matches the untargeted paths of imports, output, and inflation; we use it to decompose the effects of tariffs and the investment boom. Absent the investment boom, imports would have fallen by 10 percent and activity would have contracted by 0.7 percent. The effects of tariffs depend on which goods are tariffed: tariffs on consumption and intermediates act like shocks to supply; tariffs on capital goods act like shocks to demand. The concentration of the 2025 tariff increases on consumption goods and the relative sparing of capital goods limited the damage to output while amplifying the inflationary impulse.

JEL Classification: E12, E52, F13, F41
Keywords: International Trade, Tariffs, Open Economy Macroeconomics, AI Boom

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The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Board, the Federal Reserve Bank of Minneapolis, or the Federal Reserve System. We thank Carter Mix (discussant) and seminar/conference participants in the Federal Reserve System, the International Monetary Fund, and New York University for their comments.

1. Introduction

In 2025, U.S. tariffs rose by 10 percentage points, to levels not seen since the Great Depression. Yet U.S. imports *increased* (Figure 1). Standard trade theory implies that increases in tariffs reduce trade volumes. The historical evidence agrees — the Smoot-Hawley tariffs led to declines in imports, and the 2018–2019 tariffs cut imports from China.[1]

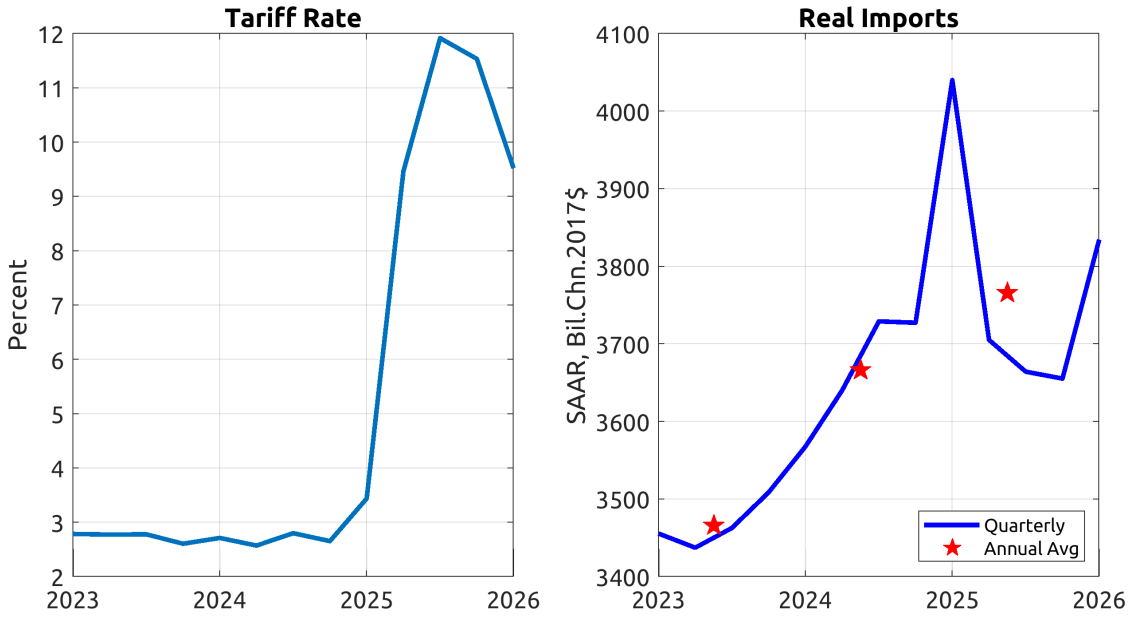


Figure 1: Average U.S. Tariff Rate and Real Imports

Notes: The left panel plots the aggregate effective tariff rate (customs duties as a share of the value of goods imports), in percent. The right panel plots total real imports. Both series are quarterly. Red stars mark calendar-year averages. See Appendix A for sources and construction.

This paper shows that the 2025 missing trade collapse is quantitatively explained by the interaction of three forces: end-use tariff heterogeneity, inventory front-loading, and an AI-driven investment boom. These observations are policy relevant because the composition of tariffs across end uses, not just the average tariff level, matters for the output-inflation tradeoff that policymakers face.

The 10 percentage point increase in the aggregate tariff rate masks considerable variation across goods categories, each of which accounts for roughly a third of U.S. goods imports. As we document in Section 2, tariffs on consumption goods rose about 13 percentage points and those on intermediates about 9, but tariffs on capital goods rose only about 6, with AI-related categories seeing almost no increase because of carve-outs (Waugh, 2026). The import responses were

[1]See, for instance, Crucini and Kahn (1996) for an analysis of the macroeconomic effects of the trade war that erupted during the Great Depression and Amiti et al. (2019); Fajgelbaum et al. (2020); Cavallo et al. (2021); Flaaen et al. (2020) for an analysis of the 2018–2019 trade war between the United States and China.

just as uneven: consumption-goods imports fell, intermediate-goods imports surged in the first quarter of 2025 before dropping sharply, and capital-goods imports rose through the year.

While consumption-goods imports fell in a straightforward way, the behavior of intermediates suggests that anticipation effects and inventory building are important factors. A smaller tariff increase implies a smaller decline in imports, not an increase — so the rise in capital-goods imports requires entertaining other forces. Finally, these forces operated together, which prevents simple characterizations of what tariffs did to output and inflation. This motivates the model, the elements that we build into it, and our use of it to decompose the effects of tariffs and other shocks.

We build a New Keynesian open-economy model with a rich trade structure (consumption goods, capital goods, and intermediates) and inventory dynamics. Our main quantitative exercise feeds in three sets of shocks, each disciplined by an observable series: the actual path of tariffs by end use; shocks to the marginal efficiency of investment (MEI), capturing the AI-driven boom, calibrated so that the model fits aggregate investment; and shocks to uncovered interest parity (UIP), calibrated so that the model reproduces the real exchange rate. Nothing else is fitted. The model nonetheless matches the untargeted paths of imports (in aggregate and across categories), GDP, consumption, and inflation. Given this success, we decompose the effects of tariff changes, the dollar, and investment shocks on the macroeconomy.

In the model, the dynamics of trade are shaped by different forces. Tariffs on consumption goods drive the fall in consumption-goods imports, just as standard trade theory predicts. Inventory accumulation ahead of the tariffs produces the first-quarter surge in imported intermediates and their subsequent drawdown. The investment boom is so strong that imports of capital goods increase despite their tariffs. And because capital goods are roughly a third of imports, the induced import demand from the investment boom is large enough to hold up aggregate imports. Absent the investment boom, imports would have declined by 10 percent.

We find that tariff increases alone would have generated stagflationary effects — reducing GDP by about 0.7 percent while raising inflation by 0.7 percentage points. What separates that counterfactual from the growth actually observed in 2025 and 2026 is the investment boom and the sequence of positive MEI shocks behind it. As with trade, the model implies the investment boom was strong enough to support growth in the U.S. economy despite a large drag coming from tariffs, while adding modestly to the increase in prices.

The macroeconomic effects of tariffs depend critically on which types of goods are tariffed. Tariffs on consumption goods and intermediates act like supply shocks: they pass through quickly to import prices, raising the cost of consumption goods and of materials, so inflation rises and GDP falls modestly. These are the effects usually attributed to tariffs. Tariffs on capital goods are strikingly different and act like negative demand shocks: they generate the largest

declines in GDP and are *deflationary*. The mechanism is essentially that of a negative MEI shock (Justiniano et al., 2010). Tariffs on capital goods reduce investment and labor demand, and ultimately cause a fall in marginal costs that passes through to lower prices. As a consequence, we find that the relatively small tariffs on capital goods account for three-fourths of the output costs from tariffs and dampen inflation.

To further illustrate that the composition of tariffs matters, we study a counterfactual experiment in which tariffs rise uniformly across goods categories, while holding the average tariff fixed. That is, tariffs on capital goods are higher relative to the actual schedule, and those on consumption goods are lower. This alternative trade policy deepens the downturn: GDP would have fallen by one percent (0.3 percentage points more than the actual policy), and investment would have fallen by twice as much, while the spike in inflation would have been about 0.3 percentage points *smaller*. Thus, the concentration of tariffs on consumption goods in 2025 and the relative sparing of capital goods limited the costs to output while amplifying the inflationary impulse.

These same composition issues in the model help rationalize empirical evidence that tariff shocks are more contractionary and less inflationary than a textbook supply-shock view would suggest (Den Besten et al., 2026; Barnichon and Singh, 2025; Schmitt-Grohé and Uribe, 2025). Two long-run trends are at work. The U.S. economy has become far more open, and the composition of imports has tilted markedly toward capital goods. We recalibrate the model to the import-to-GDP ratio and the end-use composition of imports prevailing in each year and feed in a common tariff shock. For output the two trends reinforce each other as a larger import share means tariffs matter more, and tariffs land more heavily on the most contractionary category (capital goods). The magnitudes are large: the output cost of a broad-based tariff has more than tripled since World War II. For inflation they work against each other as rising openness amplifies the inflationary impulse, but the tilt toward capital goods dampens it. Thus we find that the inflationary impulse has remained relatively stable over time.

1.1. Related Literature

Our paper speaks to several literatures. First, it connects to a nascent literature on the economic consequences of artificial intelligence for international trade. Goldfarb and Trefler (2019) study how AI reshapes comparative advantage and the geography of production, while Waugh (2026) and de Soyres et al. (2026) document the rapid rise of AI-related products in recent U.S. and global trade flows. Relative to this work, which is largely descriptive or concerned with long-run reallocation, we embed an AI-driven investment boom in a general-equilibrium open-economy model and trace out its macroeconomic consequences, showing that the associated surge in imported capital goods was central to the resilience of U.S. imports and activity in 2025.

Second, we contribute to a literature on how tariffs affect investment and capital accumulation. Crucini and Kahn (1996) study the aggregate effects of the Smoot-Hawley tariffs, and Caldara et al. (2020) show that trade-policy uncertainty depresses investment and activity. Ravikumar et al. (2019) and Baqaee and Malmberg (2025) emphasize the large long-run output costs of tariffs on investment goods, while Caldara et al. (2026) and Alessandria et al. (2025) examine the transmission of tariffs to firm-level and aggregate outcomes. We add to this literature by isolating the transmission of tariffs on capital goods and showing that they act like an adverse shock to the marginal efficiency of investment, generating a contraction in activity together with a *deflationary*, rather than inflationary, response of prices.

Third, our paper joins a fast-growing literature on the macroeconomic effects of tariffs in New Keynesian open-economy models. Barattieri et al. (2021) show that tariffs can be contractionary over the business cycle in the presence of nominal rigidities, and Erceg et al. (2023), Barbiero et al. (2019), Bergin and Corsetti (2023), Monacelli (2025), Auclert et al. (2025), Bianchi and Coulibaly (2025), and Auray et al. (2025) study the transmission of tariffs to inflation, output, the exchange rate, and the optimal monetary response, while Cuba-Borda et al. (2025) emphasize the role of global value chains in shaping the inflation response. Relative to this work, our contribution is to combine tariff heterogeneity across end uses (consumption, intermediates, and capital) with inventories in imported inputs, and to show that this framework quantitatively accounts for the missing trade collapse of 2025.

Finally, we relate to a body of empirical work on the effects of tariffs. Studies of the 2018–2019 trade war document near-complete pass-through of tariffs to U.S. import and retail prices (Amiti et al., 2019; Fajgelbaum et al., 2020; Cavallo et al., 2021; Flaaen et al., 2020). A more recent time-series literature finds that tariff shocks are contractionary, with the inflation response shaped by the systematic monetary reaction and often deflationary in the postwar period (Den Besten et al., 2026; Barnichon and Singh, 2025; Schmitt-Grohé and Uribe, 2025; Franconi and Hack, 2025). Our model rationalizes these findings and clarifies how the sign of the inflation response depends on the composition of tariffed goods.

The rest of the paper is organized as follows. Section 2 documents the key facts about U.S. trade and macroeconomic variables in 2025. Section 3 develops the New Keynesian open-economy model, Section 4 describes the calibration, and Section 5 studies the transmission of tariff shocks by end use. Section 6 uses the model to account for the 2025 experience, decomposes the roles of tariffs, the AI investment boom, and the exchange rate, and presents the uniform-tariff counterfactual; Appendix C develops a two-sector extension. Section 7 examines how the transmission of tariffs has changed over the last 150 years, and Section 8 concludes.

2. U.S. Trade and Macro Outcomes in 2025

U.S. tariffs on goods imports rose by roughly 10 percentage points over 2025, returning the average effective tariff to a level not seen since the Great Depression. The textbook response to a trade-cost shock of this magnitude is a large contraction in trade. The Smoot-Hawley episode (Crucini and Kahn, 1996) and the decline in U.S. imports from China during the 2018–2019 trade war (Fajgelbaum et al., 2020; Amiti et al., 2019) are canonical examples. Yet aggregate real U.S. goods imports *rose* over the course of 2025. The missing trade collapse is the puzzle that the rest of the paper sets out to explain.

The aggregate dynamics, however, mask a great deal of variation. Two dimensions of heterogeneity are central to everything that follows — *what* the U.S. imports, and *how* the tariffs landed across those categories. We organize the data, and later the model, around three end-use categories: consumption goods, intermediate goods, and capital goods.[2]

Trade variables. Figure 2 splits real goods imports into the three end-use categories: consumption goods, intermediates, and capital goods. Each of these three categories accounts for about one-third of U.S. imports in 2024.

The top row reports the evolution of the average tariff rate facing each category before and after the 2025 increases. The incidence of tariffs is very uneven. Tariffs on consumption goods rose by about 13 percentage points (to roughly 18 percent), those on intermediates by about 9 percentage points, while tariffs on capital goods rose only about 6 percentage points. Many capital categories tied to AI investment saw very small increases, reflecting the carve-outs for semiconductors and related electronics from the 2025 tariff regime (Waugh, 2026).

These differences in tariff incidence are associated with very different trade quantity dynamics, as shown in the bottom row of Figure 2. Imported real consumption goods declined as tariffs jumped. Imported intermediates experienced a large increase in 2025Q1, as firms accelerated purchases and accumulated inventories in anticipation of tariff announcements. This increase was then followed by a very large decline as those tariffs took hold and inventories were drawn down.

Capital is the exception that defines the puzzle. Despite a modest tariff increase, real capital-goods imports kept climbing over 2025 and grew sharply. As discussed in Waugh (2026), the surge in capital-goods imports was largely driven by AI-related products, whose imports increased by more than 70 percent between 2023 and 2025.

Macro variables. Figure 3 reports the behavior of key U.S. macro variables. Despite the large increase in tariffs, the U.S. economy was fairly resilient in 2025, with GDP growing above trend. Underlying the growth in GDP was a surge in overall investment activity throughout 2025 and

[2]Throughout the paper, we refer to intermediate goods and materials interchangeably.

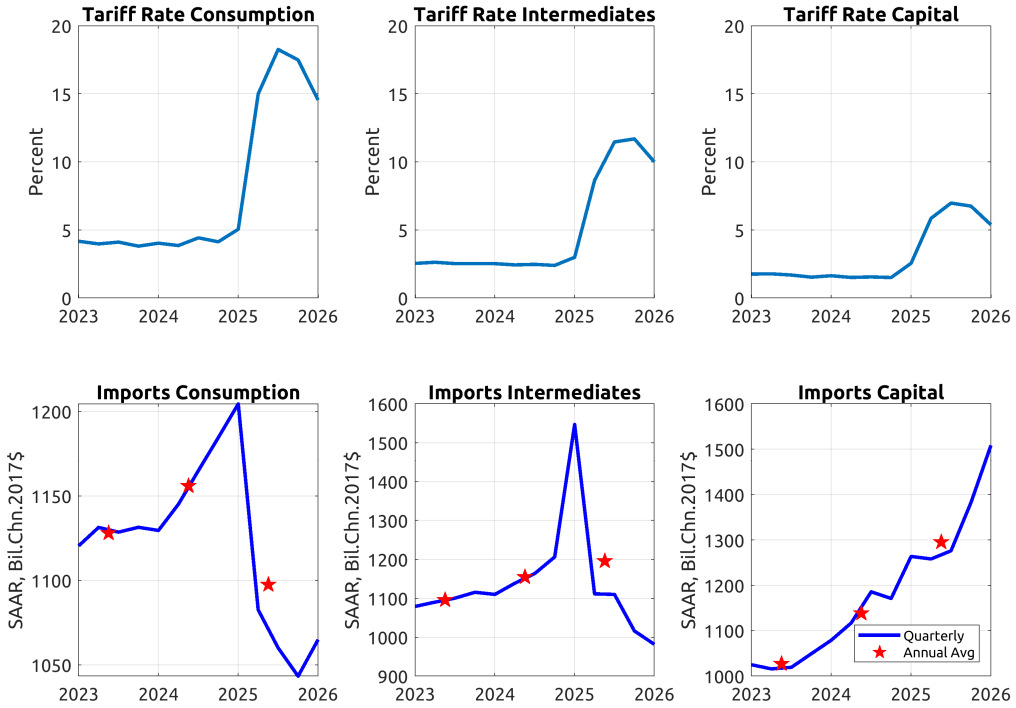


Figure 2: The Composition of U.S. Imports and Tariff Incidence

Notes: The top row plots effective tariff rates (in percent) on consumption, intermediate, and capital goods. The bottom row plots real imports of each end-use category (chained 2017$, seasonally adjusted at an annual rate) in levels, without detrending. Red stars mark calendar-year averages; all series are quarterly. For tariff rates, the end-use categories are constructed from HS-level customs data mapped to BEC5 classes. For real imports, we use data from the Census. See details in Appendix A.

into 2026.[3] At the same time, the disinflationary trend that started in 2023 halted, with core PCE inflation reaching 3.1 percent in the first quarter of 2026, about 0.9 percentage points above the Survey of Professional Forecasters (SPF) forecast from November 2024 (bottom right panel). Finally, following the tariff announcement of April 2025, the dollar experienced a 6 percent depreciation (bottom left panel).

Taking stock. Three facts emerge from the data. First, aggregate U.S. goods imports rose despite the largest tariff increase in nearly a century — there was no trade collapse. Second, both tariff incidence and import dynamics differ sharply across categories. Whereas tariffs on imported consumption goods rose steeply, resulting in a large decline in imported consumer goods, tariffs on imported capital goods increased modestly and those imports actually moved

[3]We measure investment (I^*) as equipment plus intellectual-property products and the change in inventories, excluding nonresidential structures and residential investment. The latter two categories were still contracting through 2025 under the lagged effects of the 2022 monetary tightening, and both are largely domestically sourced, so they lie outside the import-intensive capital channel that transmits tariffs and the AI boom in our model. Accordingly, we define GDP as the sum of I^* plus real consumption expenditures plus net exports. See Appendix A for additional details.



Figure 3: Aggregate Variables in 2025–26

Notes: GDP and investment are real, in logs, detrended by a linear trend constructed using data from 2015Q1 to 2019Q4, and expressed as percent deviations from that trend. The exchange rate is the percent change in the real broad U.S. dollar. Inflation is four-quarter core PCE inflation (in percent), with the dotted line showing the November 2024 SPF forecast. All series are quarterly; see Appendix A.

up sharply. Imported intermediates surged ahead of tariff announcements. Third, despite higher inflation, the U.S. economy proved to be quite resilient largely because of an (AI-driven) investment boom that boosted imports of capital goods. These facts motivate a model with three ingredients working together — heterogeneity in tariffs across end uses, inventories in imported intermediates, and an investment shock boosting capital accumulation and imports of capital goods. We turn to that model next.

3. Model

We develop a two-country New Keynesian open-economy model to analyze the transmission of tariff shocks and their effects on trade flows and macroeconomic outcomes. The model builds on Galí and Monacelli (2005) and Corsetti et al. (2010) and uses standard ingredients. Motivated by the evidence above, we incorporate a richer trade structure than is typical: it allows for trade in consumption goods, intermediate inputs, and capital goods, each potentially facing a different tariff, and it embeds inventories in imported intermediates. Trade flows are also subject to import adjustment costs.

We organize the section as a walk down the production chain. The upstream layers are standard and we treat them briefly; the two downstream blocks that carry the paper's results — inventories in imported materials, and capital goods — we treat in full.

The complete set of equations and equilibrium conditions is collected in Appendix D.1.

3.1. Environment and the Production Chain

There are two countries, indexed by i, j, with country 1 the U.S. and country 2 the Rest of the World. Each is specialized in the production of one good, produced with labor, capital, and materials. Households consume a bundle of domestic and foreign goods, supply labor to unions that set wages subject to nominal rigidities, and save in domestic bonds, U.S. bonds, and domestic capital. All the prices that we discuss below are real, expressed in units of the U.S. consumption bundle.

The production chain has four layers:

$$\underbrace{Y_{i,t}}_{\text{(i) country good}} \longrightarrow \underbrace{X_{ji,t}(\omega)}_{\substack{\text{(ii) wholesale} \\ \text{retailers}}} \longrightarrow \underbrace{X_{ji,t}}_{\substack{\text{(iii) final} \\ \text{retailers}}} \longrightarrow \underbrace{C_{ji,t},\ I^s_{ji,t},\ I_{ji,t}}_{\substack{\text{(iv) end uses:} \\ \text{consumption, materials, investment}}}$$

Country i produces a homogeneous good $Y_{i,t}$. Wholesale retailers buy it and transform it into differentiated varieties $X_{ji,t}(\omega)$ for each destination j. Final retailers aggregate those varieties into a country-specific composite $X_{ji,t}$, keeping source countries separate. The composite is then allocated across end uses — consumption, materials, and investment goods. Policy enters at layer (iv). The same physical good, imported from j into i, faces a tariff that depends on what it is used for:

$$\tau^c_{ij,t} \text{ (consumption)}, \qquad \tau^m_{ij,t} \text{ (materials)}, \qquad \tau^I_{ij,t} \text{ (capital)}.$$

3.2. Production and Price Setting (Layers (i)–(iii))

These layers are standard, and we describe them briefly. Appendix D.1 states each condition.

(i) The country good. Gross output $Y_{i,t}$ is a CES aggregate of value added and materials $M_{i,t}$. Value added is Cobb-Douglas in utilized capital and labor. Real marginal cost $mc_{i,t}$ is the corresponding CES aggregate of the price of value added $p^v_{i,t}$ and the price of materials $p^m_{i,t}$.

(ii) Wholesale retailers. Wholesale retailers buy the homogeneous good $Y_{i,t}$ at marginal cost $mc_{i,t}$ and transform it one-for-one into differentiated varieties, and sell into destination markets. They are monopolistically competitive and face Rotemberg price adjustment costs. All sticky-price frictions in the goods market live in this layer; everything downstream operates with

flexible prices and competitive behavior. Optimization delivers a domestic Phillips curve,

$$(\pi_{ii,t}-1)\pi_{ii,t}=\frac{\varepsilon-1}{\kappa}\left[mc_{i,t}\cdot\frac{\varepsilon}{\varepsilon-1}-p_{ii,t}\right]+\beta E_t\Lambda_{i,t+1}(\pi_{ii,t+1}-1)\pi_{ii,t+1}\frac{X_{ii,t+1}}{X_{ii,t}}, \tag{1}$$

where $\pi_{ii,t}$ is gross domestic price inflation and $p_{ii,t}$ the real price; $\Lambda_{i,t+1}$ is the household's stochastic discount factor. The term $mc_{i,t}\cdot\varepsilon/(\varepsilon-1)$ is the desired price, marginal cost times the markup and ε is the elasticity of substitution in the final-retailer CES demand curve. As is standard, when marginal cost rises above what the current price justifies, retailers want to raise prices, and Rotemberg costs slow the adjustment. An analogous condition governs export prices.

Dominant-currency pricing. An important modeling choice lives here. We allow the Rotemberg cost on export prices, κ_i^*, to differ across countries. For the U.S. $(i=1)$ we set $\kappa_1^*=0$, so exporters freely adjust foreign-currency prices and the law of one price holds, $Q_{ij,t}p_{ji,t}=p_{ii,t}$ where $Q_{ij,t}$ is the real exchange rate. For foreign exports to the U.S., κ_2^* is large and foreign exporters face sticky dollar prices. When tariffs hit, foreign exporters cannot easily cut their dollar prices to absorb the tariff, so the tariff passes through to U.S. buyers — consistent with the near-complete pass-through documented for the 2018–2019 trade war.

(iii) Final retailers. Final retailers are competitive. They buy differentiated varieties from wholesale retailers and aggregate them into the country-specific composite $X_{ij,t}$ with a CES technology, which yields the usual downward-sloping demand curve for each variety. The composite is then split across the three end uses,

$$X_{ij,t}=C_{ij,t}+I_{ij,t}+I^s_{ij,t}, \tag{2}$$

so the same physical good from country j serves as consumption, capital, and materials. Demand for the end uses is described next.

3.3. The End-Use Bundles (Layer (iv))

Each end use draws on domestic and foreign sources through the same Armington structure, so we state it once rather than three times. Let $x\in\{c,m,I\}$ index the end use, and let Z^x stand for the quantity associated with it: Z^c is consumption, Z^m is materials, and Z^I is capital goods. So $Z^c_{ij,t}$ is what we elsewhere write as $C_{ij,t}$, the consumption goods country i imports from country j; likewise $Z^m_{ij,t}$ is $M_{ij,t}$ and $Z^I_{ij,t}$ is $I_{ij,t}$. Bundles carry a single country index, so $Z^c_{i,t}$ is $C_{i,t}$, $Z^m_{i,t}$ is $M_{i,t}$, and $Z^I_{i,t}$ is $I_{i,t}$.

Everything that can differ across the three uses carries the superscript x: the price of the bundle $p^x_{i,t}$, the price of goods from source j $p^x_{ij,t}$, the Armington elasticity η_x, the home-bias weight ω^x_{ij}, the import adjustment cost ψ^x_{ij}, and the tariff $\tau^x_{ij,t}$.

The bundle assembled in country i is

$$Z^x_{i,t} = \left(\sum_{j=1}^{N} (\omega^x_{ij})^{1/\eta_x} \left((1 - \Psi^x_{ij,t}) Z^x_{ij,t} \right)^{\frac{\eta_x - 1}{\eta_x}} \right)^{\frac{\eta_x}{\eta_x - 1}}, \qquad \Psi^x_{ij,t} = \frac{\psi^x_{ij}}{2} \left(\frac{Z^x_{ij,t}}{Z^x_{ij,t-1}} \cdot \frac{Z^x_{ii,t-1}}{Z^x_{ii,t}} - 1 \right)^2, \tag{3}$$

with $\psi^x_{ii} = 0$. The term $\Psi^x_{ij,t}$ imposes quadratic costs on changes in the composition of bilateral import flows relative to domestic flows, as in Erceg et al. (2023). These costs let the model match the evidence that the short-run trade elasticity is well below the long-run elasticity. Absent the adjustment costs, optimality delivers the familiar demand schedule,

$$Z^x_{ij,t} = \omega^x_{ij} \left(\frac{p^x_{ij,t}}{p^x_{i,t}} \right)^{-\eta_x} Z^x_{i,t}. \tag{4}$$

The full first-order condition with adjustment costs is in Appendix D.1.

Where tariffs enter. For consumption and capital goods, the source-j price in (4) is simply the cum-tariff price,

$$p^c_{ij,t} = \tau^c_{ij,t}\, p_{ij,t}, \qquad p^I_{ij,t} = \tau^I_{ij,t}\, p_{ij,t}, \tag{5}$$

where $p_{ij,t}$ is the ex-tariff price set by the wholesale retailers in layer (ii). The price of imported materials $p^m_{ij,t}$ is not the tariff-inclusive market price; it is pinned down by the inventory block, where the tariff is paid by an inventory producer that buys physical goods and sells inventory input to a materials-producing firm. We discuss this block next.

3.4. Inventories in Imported Materials

The materials bundle $M_{i,t}$ that enters gross output is the Armington aggregate (3) with $x = m$. What differs, relative to, say, consumption, is what is being aggregated: $M_{ij,t}$ is produced out of an inventory stock which we introduce following the approach of Auclert et al. (2025). For each country pair (i, j), a *materials-producing firm* buys inputs from an *inventory producer* at price $q^s_{ij,t}$ and produces effective materials $M_{ij,t}$, which it sells on at price $p^m_{ij,t}$. This is the price that enters the demand curve (4) for intermediates.

The materials-producing firm. It chooses flow usage $\tilde{M}_{ij,t}$ and inventory stock $S_{ij,t}$ to solve

$$\max_{\{\tilde{M}_{ij,s},\, S_{ij,s}\}_{s \geq t}} E_t \sum_{s \geq t} \beta^{s-t} \Lambda_{i,t,s} \left[p^m_{ij,s}\, M_{ij,s} - q^s_{ij,s} I^s_{ij,s} \right], \tag{6}$$

subject to, for all $s \geq t$,

$$M_{ij,s} = \left[(1 - \chi_i)^{1/\varepsilon_S}\, \tilde{M}^{\frac{\varepsilon_S - 1}{\varepsilon_S}}_{ij,s} + \chi_i^{1/\varepsilon_S}\, S^{\frac{\varepsilon_S - 1}{\varepsilon_S}}_{ij,s-1} \right]^{\frac{\varepsilon_S}{\varepsilon_S - 1}}, \tag{7}$$

$$I^s_{ij,s} = S_{ij,s} - (1-\delta_s)S_{ij,s-1} + \tilde{M}_{ij,s}. \tag{8}$$

This formulation is somewhat non-standard, so let us explain it carefully. The first part of the objective is the revenue $p^m_{ij,t}M_{ij,t}$ from selling effective materials. The term $q^s_{ij,t}I^s_{ij,t}$ is the cost of purchasing new inventories, which decomposes into three components: the flow drawn from inventory and used in production ($\tilde{M}_{ij,t}$), replacement of depreciated inventories ($\delta_s S_{ij,t-1}$), and any net increase in the stock ($S_{ij,t} - S_{ij,t-1}$).

The CES technology (7) has two inputs: $\tilde{M}_{ij,t}$, the flow drawn out of inventory, which depletes the stock, and $S_{ij,t-1}$, the existing stock on the shelf, predetermined from last period's choice. Every unit drawn off the shelf creates a hole that must be replenished at cost $q^s_{ij,t}$. This creates a non-trivial trade-off between drawing down inventory and purchasing new inputs. The optimal flow usage is

$$\tilde{M}_{ij,t} = (1-\chi_i)\left(\frac{q^s_{ij,t}}{p^m_{ij,t}}\right)^{-\varepsilon_S} M_{ij,t}, \tag{9}$$

so that when the replacement cost q^s is steep, the firm draws less off the shelf. When output is valuable (p^m high) it draws more off the shelf. The condition governing how much inventory to carry into tomorrow is

$$q^s_{ij,t} = \beta E_t \Lambda_{i,t+1}\left[p^m_{ij,t+1}\,\chi_i^{1/\varepsilon_S}\left(\frac{M_{ij,t+1}}{S_{ij,t}}\right)^{1/\varepsilon_S} + (1-\delta_s)\,q^s_{ij,t+1}\right]. \tag{10}$$

The left-hand side is the marginal cost of holding a unit of inventory. The right-hand side is the discounted marginal benefit: the stock is productive next period through (7), and undepreciated inventories can be carried forward and valued at $q^s_{ij,t+1}$. The way to think about this condition (10) is that it helps pin down $S_{ij,t}$. So, essentially, given the prices, (10) determines the benefit of carrying a unit of inventory into tomorrow, and that benefit falls with $S_{ij,t}$.

The inventory producer. The inventory producer goes to the goods market, buys physical inputs at the tariff-inclusive price $\tau^m_{ij,t}p_{ij,t}$, and transforms them into inventory inputs $I^s_{ij,t}$, which it sells to the materials-producing firm at price $q^s_{ij,t}$. It solves

$$\max_{\{I^s_{ij,s}\}_{s\geq t}} E_t \sum_{s\geq t}\beta^{s-t}\Lambda_{i,t,s}\left[q^s_{ij,s}\,I^s_{ij,s} - \left(I^s_{ij,s} + \frac{\gamma_s}{2}(I^s_{ij,s} - I^s_{SS})^2\right)\tau^m_{ij,s}\,p_{ij,s}\right], \tag{11}$$

where the quadratic term captures costs of adjusting inventories and prevents infinite front-loading. The first-order condition implies

$$q^s_{ij,t} = \left(1 + \gamma_s\left(I^s_{ij,t} - I^s_{SS}\right)\right)\left(\tau^m_{ij,t}p_{ij,t}\right). \tag{12}$$

Front-loading. Equations (10) and (12) together deliver front-loading in response to *antici-*

pated tariffs. Suppose tariffs on materials are expected to increase next period, so $\tau^m_{ij,t+1}$ rises. Equation (12) implies that the future value of inventories, $E_t q^s_{ij,t+1}$, rises with the increase in tariffs. Then from (10), higher future inventory prices raise the current demand for inventories, thus increasing the inventory stock, $S_{ij,t}$, today. Then through the accumulation equation (8), a higher stock requires buying more, so imported materials purchases $I^s_{ij,t}$ rise *before* the tariff takes effect.

3.5. Capital Goods

Capital is produced in two steps. The investment bundle $I_{i,t}$ is the Armington aggregate (3) with $x = I$. Capital producers then purchase that bundle and convert it into new installed capital, facing convex adjustment costs and a marginal efficiency of investment (MEI) shock. They solve

$$\max_{\{I_{i,s}\}_{s\geq t}} E_t \sum_{s\geq t} \beta^{s-t} \Lambda_{i,t,s} \left[Q^k_{i,s} \, I_{i,s} \, \xi^{MEI}_{i,s} - \left(I_{i,s} + \frac{\gamma_I}{2} \left(\frac{I_{i,s}}{I_{i,s-1}} - 1 \right)^2 I_{i,s} \right) p^I_{i,s} \right], \tag{13}$$

where $Q^k_{i,s}$ is the real price of capital. This problem is subject to the capital accumulation equation, for all $s \geq t$,

$$K_{i,s} = I_{i,s} \, \xi^{MEI}_{i,s} + (1 - \delta_k) K_{i,s-1}. \tag{14}$$

A key feature here is the MEI shock ξ^{MEI}. A positive shock means each unit of investment creates more capital, effectively making investment cheaper in efficiency units, which naturally leads to a higher level of investment. The first-order condition delivers the real price of capital:

$$Q^k_{it} \xi^{MEI}_{i,t} = \left(1 + \frac{\gamma_I}{2} (\frac{I_{it}}{I_{it-1}} - 1)^2 + \gamma_I \frac{I_{it}}{I_{it-1}} (\frac{I_{it}}{I_{it-1}} - 1) \right) p^I_{it} - \beta E_t \Lambda_{i,t+1} \gamma_I \left(\frac{I_{it+1}}{I_{it}} \right)^2 (\frac{I_{it+1}}{I_{it}} - 1) p^I_{it+1}. \tag{15}$$

From equation (15) we can gain intuition for why tariffs on investment transmit to the economy in the same fashion as an MEI shock. A higher $\tau^I_{ij,t}$ implies a higher price of the investment bundle p^I_{it}. A higher p^I_{it} makes it costlier to produce the same amount of capital from a unit of the investment bundle, hence acting as a negative MEI shock.

3.6. Households and the Labor Market

Households. Households in country i have habits in consumption and choose consumption, labor supply, and savings in domestic bonds, U.S. bonds, and domestic capital. Households' demand across source countries for consumption goods follows (3) and (4) with $x = c$. Three intertemporal conditions result: a standard consumption Euler equation, a no-arbitrage condition linking the return on capital to the return on bonds, and an Euler equation for foreign holdings of U.S. bonds.

We assume U.S. bonds are the only internationally traded asset, subject to quadratic holding costs. Those costs ensure stationarity of the net foreign asset position and open a wedge between domestic and U.S. returns — a deviation from uncovered interest parity. We introduce a shock $\xi_{i,t}^{UIP}$ which scales that wedge. This is the shock that we use in Section 6 to match the path of the real exchange rate.

The labor market. Labor is supplied by households, but wages are set by labor unions. Unions have market power and adjust nominal wages sluggishly, exactly as wholesale retailers do for goods prices. Nominal wage rigidity in the model comes entirely from this friction. Each household supplies labor to a continuum of unions, which differentiate it and sell to a competitive labor packer; unions set nominal wages subject to Rotemberg adjustment costs, yielding a wage Phillips curve that mirrors (1) exactly, with the household's marginal rate of substitution between labor and consumption in place of marginal cost. Because nominal wages adjust slowly, the real wage is also sluggish in response to shocks.

3.7. Monetary Policy

The central bank follows an inertial Taylor rule responding to domestic inflation as in Galí and Monacelli (2005):

$$\log R_{i,t}^{n} = (1-\rho_{r,i})\log R_{SS} + \rho_{r,i}\log R_{i,t-1}^{n} + (1-\rho_{r,i})\kappa_{\pi,i}\log(\pi_{ii,t}^{4q}) + \xi_{i,t}^{m}, \tag{16}$$

where $\pi_{ii,t}^{4q}$ is four-quarter domestic inflation and $\xi_{i,t}^{m}$ is a monetary policy shock.

3.8. Market Clearing and GDP

Goods and bond markets clear country by country. The aggregate resource constraint requires that gross output be absorbed by consumption, materials purchases, fixed investment, and utilization costs, summed across destinations. Domestic bonds are in zero net supply outside the U.S., and U.S. bonds clear globally.

One accounting definition matters for what follows, because inventory accumulation is part of the story:

$$GDP_{i,t} = C_{i,t} + I_{i,t} + \sum_{j=1}^{N}\big(\Delta S_{ij,t}\big) + NX_{i,t} = Y_{i,t} - \sum_{j=1}^{N}\tilde{M}_{ij,t}, \tag{17}$$

where $NX_{i,t}$ are net exports and $\Delta S_{ij,t} \equiv I_{ij,t}^{s} - \tilde{M}_{ij,t}$ is the change in inventories of inputs from country j. The second equality follows from goods market clearing: value added equals gross output minus total intermediate input usage. Front-loading therefore shows up in measured GDP through inventory investment as well as through net exports, which matters for reading the 2025Q1 numbers in Section 6.

3.9. The Balance of Payments

Using the foreign household's budget constraint, we obtain a balance-of-payments condition linking the change in the net foreign asset position to the trade balance:

$$B_{i1t} + \frac{\varphi_{it}}{2}\left(B_{i1t} - \bar{b}_i\right)^2 - B_{i1t-1}\frac{Q_{i1t}}{Q_{i1t-1}}\frac{R^n_{1,t-1}}{\pi_{1t}} = EX_{it} - IM_{it}, \tag{18}$$

where B_{i1t} is country i's real holdings of U.S. bonds and $\bar{b}_i$ is their steady-state level. The term $\varphi_{it} \equiv \varphi_i \xi^{UIP}_{i,t}$ is the cost of adjusting those holdings away from $\bar{b}_i$ — the quadratic holding cost introduced above, scaled by the UIP shock. Exports and imports aggregate across the three end uses,

$$EX_{it} = Y_{i,t}p_{ii,t} - p_{ii,t}C_{ii,t} - p_{ii,t}I^s_{ii,t} - p_{ii,t}I_{ii,t}, \qquad IM_{it} = \sum_{j\neq i}^{N} p_{ij,t}\big(C_{ij,t} + I^s_{ij,t} + I_{ij,t}\big). \tag{19}$$

This completes the description of the model environment.

4. Calibration

Table 1 reports the calibration of the model. A period is one quarter. The preference and technology parameters are standard: we set the discount factor to $\beta = 0.99$, the inverse intertemporal elasticity of substitution to $\sigma = 1$, the inverse Frisch elasticity to $\varphi = 1$, the habit parameter to $h = 0.75$, the capital depreciation rate to $\delta_k = 0.025$, the capital share in value added to $\alpha = 0.33$, and the materials share in gross output to $\nu = 0.40$. The capital adjustment cost is set to $\gamma_I = 1.7$, following Gertler and Karadi (2011).

We set the Armington elasticity across source countries to $\eta = 5$, a standard value in the international macro literature, and we set the import adjustment cost $\psi^C = \psi^M = \psi^I$ so that the short-run aggregate trade elasticity is about one-half of its long-run value, in line with the evidence in Boehm et al. (2023).

The home-bias parameters $\omega^c_{11}, \omega^m_{11}, \omega^I_{11}$ are chosen to match the import content of consumption, materials, and investment in the U.S. economy in 2024. For consumption and investment, we use Census imports by end use together with BEA NIPA expenditure aggregates: imported consumer goods (consumer goods, food, and part of autos and services) relative to personal consumption imply an import share of consumption of about 6 percent, while imported capital goods relative to nonresidential investment in equipment and intellectual-property products imply an import share of investment of about 30 percent. For materials, we rely on the input-output structure, scaling imported industrial supplies by gross output net of value added, which implies an import share of materials of about 9 percent. These targets pin down home-

bias parameters of $\omega_{11}^c = 0.94$, $\omega_{11}^m = 0.91$, and $\omega_{11}^I = 0.70$. Capital goods are thus the most import-intensive of the three uses, which makes investment especially exposed to tariffs.

At these parameters the model's steady state reproduces the aggregate trade structure of the U.S. economy in 2024: total imports of goods and services are about 15 percent of GDP, and consumption, materials, and investment goods each account for roughly one-third of total imports.

The inventory parameters are disciplined by two targets, following Auclert et al. (2025). The inventory share in the materials bundle, χ, is set to deliver a steady-state ratio of inventories to sales of about 1.5 months, consistent with the data, and the inventory adjustment cost γ_s is set so that the elasticity of this ratio to a 10 percent permanent increase in the tariff is about 150 percent. In addition, we set the depreciation rate of inventories to $\delta_s = 0$, so that the inventory stock does not physically decay.

Nominal rigidities are governed by the Rotemberg costs on domestic prices, imported-goods prices, and wages, each set to 500 so as to imply a slope of the corresponding Phillips curve of about 0.01. We assume dominant-currency pricing by setting the Rotemberg cost on U.S. exports to $\kappa_1^* = 0$, in line with the evidence in Gopinath et al. (2020), so that the law of one price holds for U.S. exports while foreign exporters to the U.S. face sticky dollar prices. Monetary policy follows an inertial Taylor rule with an interest-rate smoothing coefficient of $\rho_r = 0.75$ and a response to four-quarter inflation of $\kappa_\pi = 1.5$, both conventional values.

Finally, we set the persistence of the tariff, MEI, and UIP shocks to $\rho = 0.95$. We model tariffs as highly persistent but stationary, rather than permanent, because tariff measures can be reversed — as the February 2026 Supreme Court ruling striking down the International Emergency Economic Powers Act (IEEPA) tariffs illustrated.

5. How Tariff Shocks Affect Macroeconomic Activity

We begin by describing how tariff changes are transmitted to macroeconomic activity in our model. The key result is that the sign and size of these effects depend on which type of good is taxed.

Figure 4 shows the response of key macroeconomic variables to a 10 percent increase in tariffs on imported consumption goods (blue solid line), imported materials (red dashed line), and imported investment goods (dotted black line). In each case the tariff increase is transitory, with a persistence of 0.95. To isolate the transmission of each type of tariff, we consider the three shocks one at a time.

The effects of tariffs differ sharply depending on which type of good is taxed. Tariffs on consumption goods cause a small decline in output — about 0.2 percent below trend — together

Table 1: Baseline Calibration

Parameter		Value	Target / Source
Preferences			
Discount factor	β	0.99	Standard
Inverse IES	σ	1.00	Standard
Inverse Frisch elasticity	φ	1.00	Standard
Habit formation	h	0.75	Standard
Technology			
Materials share in production	ν	0.40	Standard
Capital share in value added	α	0.33	Standard
Elast. subst. VA/materials	ε_Y	1.00	Standard
Elast. subst. capital/labor	ε_k	1.00	Standard
Capital depreciation rate	δ_k	0.025	Standard
Capital adjustment cost	γ_I	1.70	Gertler and Karadi (2011)
Price Setting			
Elast. subst. across varieties	ε	6.00	20% SS markup
Rotemberg cost, domestic	κ	500	PC slope ≈ 0.01
Rotemberg cost, imports	κ_2^*	500	PC slope ≈ 0.01
Rotemberg cost, exports	κ_1^*	0	Dominant-currency pricing
Rotemberg cost, wages	κ_w	500	PC slope ≈ 0.01
Trade			
Trade elasticity	$\eta_c = \eta_m = \eta_I$	5.00	Standard
Home bias, consumption	ω_{11}^c	0.94	Import share, C
Home bias, materials	ω_{11}^m	0.91	Import share, M
Home bias, investment	ω_{11}^I	0.70	Import share, I
Import adjustment cost	$\psi^C = \psi^M = \psi^I$	2.00	SR/LR trade elast. $= 1/2$
Inventories			
Inventory share in materials	χ	0.0046	Inv./sales $= 1.5$ months
Elast. subst. inv./purchases	ε_S	1.00	Auclert et al. (2025)
Inventory adjustment cost	γ_s	1.20	see text
Inventory depreciation rate	δ_s	0.00	Auclert et al. (2025)
Monetary Policy			
Interest rate smoothing	ρ_r	0.75	Standard
Taylor coeff. on inflation	κ_π	1.50	Standard
Shock Persistence & Country Sizes			
Tariff / MEI / UIP persistence	ρ	0.95	see text
Population share, U.S. / RoW	n_1, n_2	0.25, 0.75	Standard

Notes: Parameters are defined in Section 3 and Appendix D.1, which states the equation in which each parameter appears.

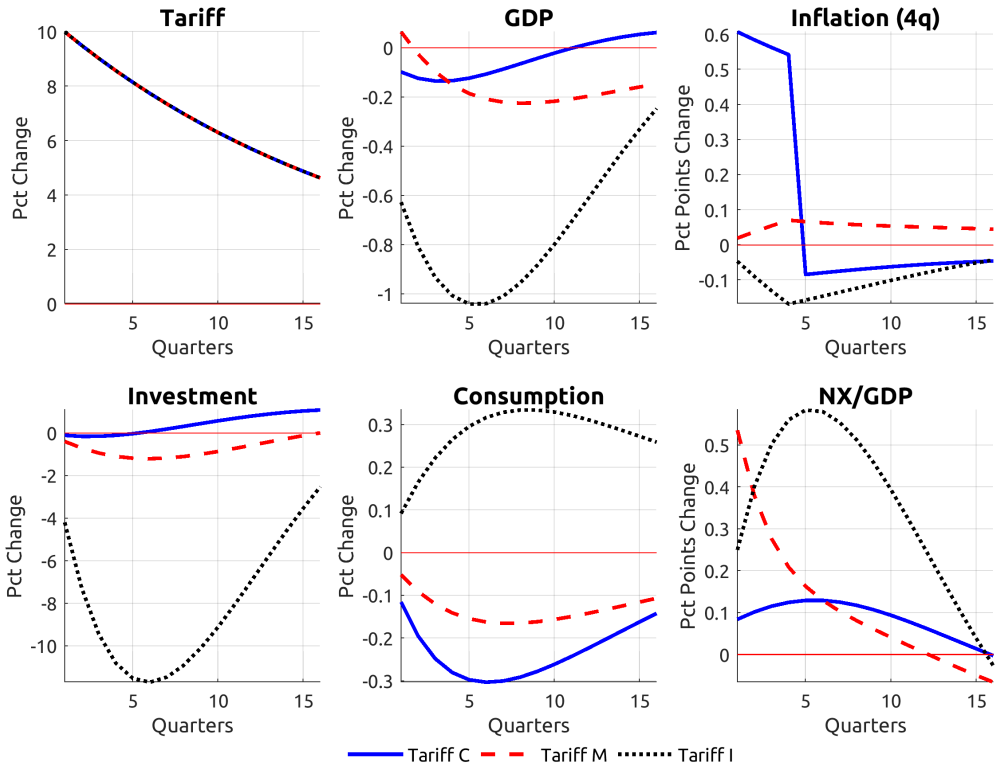


Figure 4: Impulse Responses to Tariff Shocks

Notes: The figure reports model-generated responses to a 10 percent increase in the tariff on consumption goods (blue solid), intermediate goods (red dashed), and investment goods (dotted black); each shock has persistence 0.95. The horizontal axis is quarters after the shock.

with a relatively large increase in inflation, since consumption tariffs feed directly into the consumer price index. Tariffs on investment goods, by contrast, generate a much larger decline in GDP, of more than one percent, as investment collapses; and, strikingly, they are *deflationary*, with inflation falling in response to the tariff increase. Tariffs on materials have a negative effect on activity comparable to tariffs on consumption goods, but generate much milder inflationary effects.

Figure 5 unpacks the differential response of inflation by plotting the components that determine it. For tariffs on consumption, the increase in CPI inflation is much larger than the response of domestic price inflation (shown in the second panel), because the tariff feeds directly into the price of imported consumption goods. To see this, note that CPI inflation can be written, to first order, as:

$$\hat{\pi}_{it} = (1 - \omega_{ij}^{c})\,\hat{\pi}_{ii,t} + \omega_{ij}^{c}\left(\Delta\hat{\tau}_{ij,t}^{c} + \hat{\pi}_{ij,t}\right),$$

where $\Delta\hat{\tau}_{ij,t}^{c}$ is the change in the tariff on imported consumption goods. With an imported consumption-goods share ω_{12}^{c} of about 6 percent and near-complete pass-through of the tariff

to the price of imported goods, a 10 percent tariff raises inflation by roughly 60 basis points on impact.

For tariffs on investment goods, the effects are indirect and operate through marginal costs. Thus, their effects on CPI inflation are modulated through the Phillips curve:

$$\hat{\pi}_{ii,t} = \tfrac{\varepsilon-1}{\kappa}\left(\widehat{mc}_{i,t} - \hat{p}_{ii,t}\right) + \beta\, E_t\hat{\pi}_{ii,t+1},$$

where marginal costs are a weighted average of wages, the user cost of capital, and material prices:

$$\widehat{mc}_{i,t} = (1-\nu_i)\left[\alpha(\hat{r}^k_{i,t} - \hat{u}_{i,t}) + (1-\alpha)\hat{w}_{i,t}\right] + \nu_i\,\hat{p}^m_{i,t}.$$

A tariff on investment goods lowers marginal costs — both wages and the price of materials fall as investment and activity contract — so domestic firms cut their prices and inflation declines. These mechanics are very similar to how MEI shocks operate, where negative shocks induce

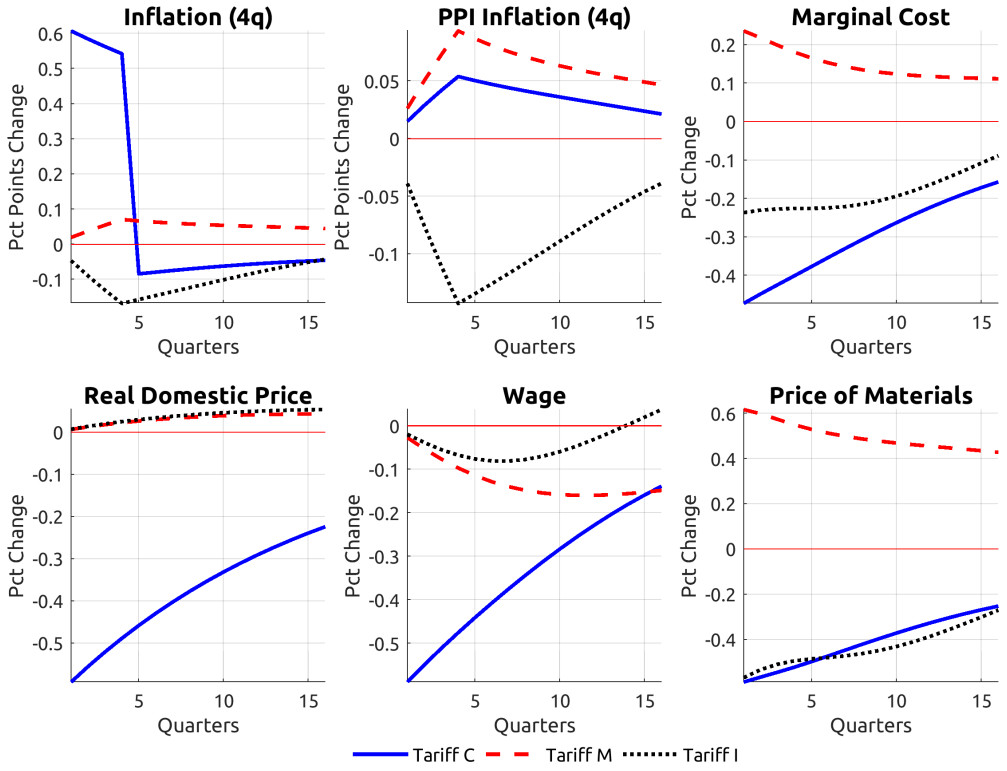


Figure 5: Impulse Responses to Tariff Shocks: Inflation Components

Notes: The figure reports model-generated responses of the components determining inflation to the same 10 percent tariff shocks as in Figure 4 (consumption in blue solid, intermediates in red dashed, investment in dotted black).

declines in output and inflation, as in Justiniano et al. (2010) and Raffo (2010). To illustrate this point, Figure 6 compares the response of the economy to an increase in the tariff on investment goods (blue solid line) to an adverse marginal efficiency of investment shock (MEI, red dashed

line), sized to deliver the same decline in investment and the same persistence as the tariff shock.

The two transmissions are remarkably similar: both shocks depress investment and labor demand, lower marginal costs, and thereby generate a small deflationary effect, alongside an offsetting increase in consumption. Intuitively, a higher tariff on investment goods raises the price of the investment bundle and thus the cost of producing a unit of installed capital — exactly as an adverse MEI shock does. The consumption increase is somewhat larger under the investment tariff because households receive the tariff revenue as a lump-sum transfer; the dotted black line removes this transfer and renders the two responses nearly indistinguishable.[4]

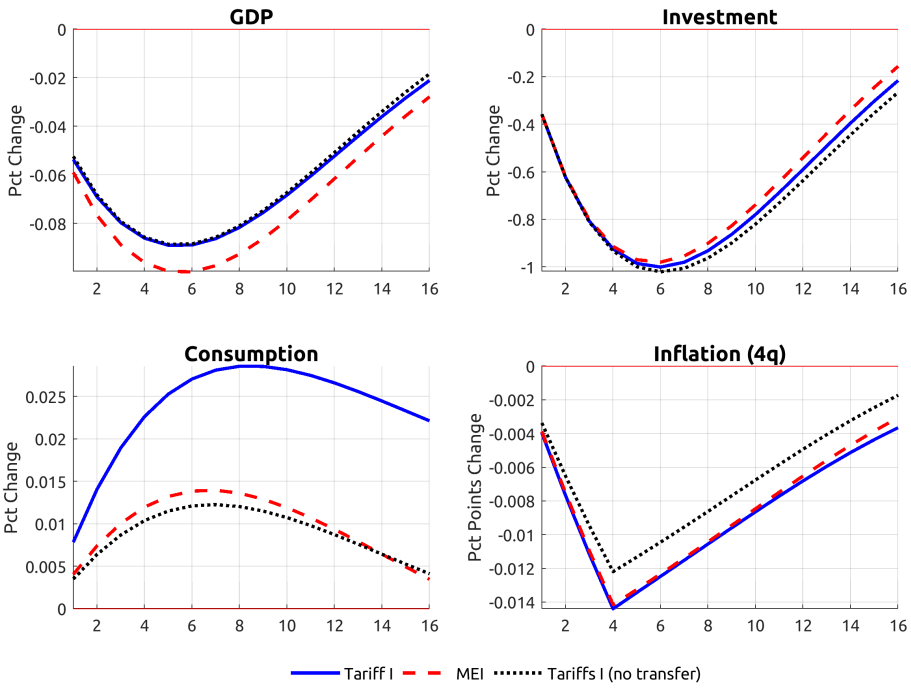


Figure 6: Tariffs on Investment vs. MEI Shock

Notes: The figure reports model-generated responses to a tariff on investment goods (blue solid), a contractionary MEI shock sized to deliver the same drop in investment and with the same persistence (red dashed), and the same investment-tariff shock assuming that tariff revenues are not rebated to U.S. consumers (dotted black).

Finally, Figure 7 shows how inventories allow the model to capture the front-loading of imports in response to *anticipated* tariffs on imported materials. We compare the baseline model with inventories (blue solid line) to a version without them (red dashed line), feeding in a tariff on materials that is announced today but takes effect only in the future. In the model with inventories, firms respond to the news by accumulating imported materials ahead of the increase, generating a pronounced spike in materials imports on impact that is subsequently

[4]The two shocks still differ slightly because tariffs open a wedge between the price that domestic firms pay for investment goods and the unit revenue received by foreign exporters. The macroeconomic effect of this wedge is, however, very small.

unwound, consistent with the front-loading observed in the 2025 data. Inventories also smooth the response of inflation: because firms can draw on stockpiled inputs once the tariff is in place, the effective price of materials rises more gradually than the tariff itself, so the pass-through to marginal costs and to domestic prices is spread out over time rather than concentrated at the moment the tariff takes effect. In the version without inventories, by contrast, imports of materials simply fall when the tariff hits and the price of materials jumps immediately.

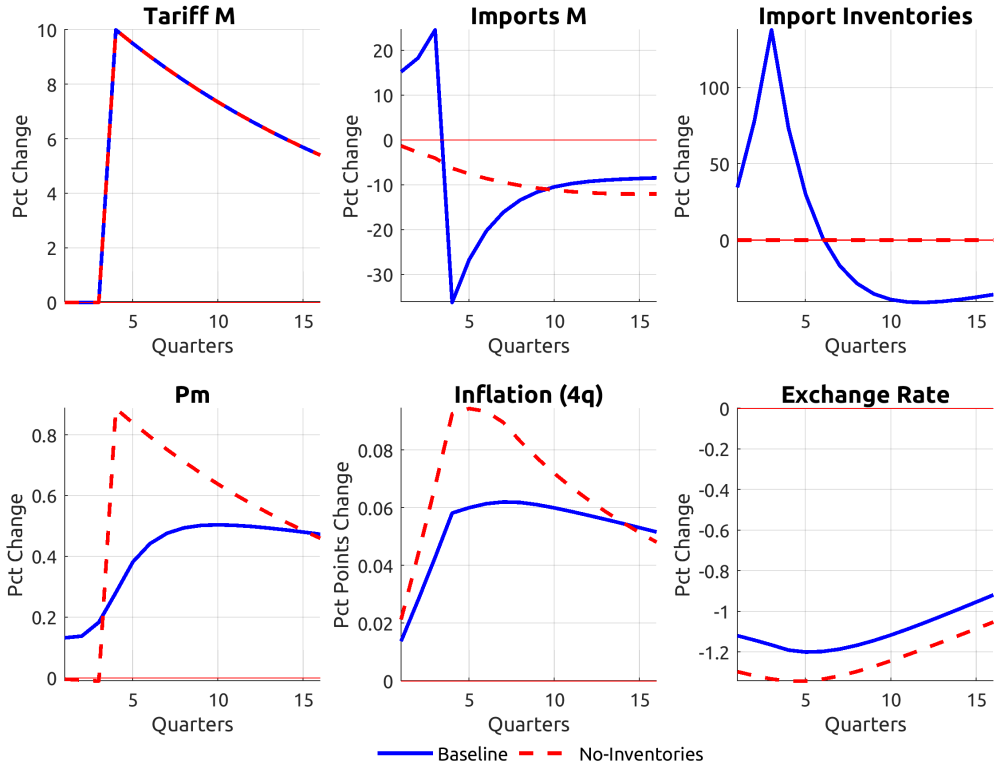


Figure 7: Tariff News and Inventories

Notes: The figure reports model-generated responses to an anticipated (news) increase in the tariff on imported materials, comparing the baseline model with inventories (blue solid) to a version without inventories (red dashed). The horizontal axis is quarters after the shock.

6. The Missing Trade Collapse

Section 5 studied how each shock transmits to the economy in isolation. We now bring these mechanisms together and use the calibrated model as an accounting device for the 2025–26 experience. We feed in three sets of shocks. **First**, tariff shocks to τ^c_{12}, τ^m_{12}, and τ^I_{12}, which are perfectly anticipated in 2025Q1 and calibrated to the heterogeneous paths of effective tariffs by end-use category documented in Section 2. In particular, we assume

$$\log \tau^x_{ij,t} = \rho_{\tau^x} \log \tau^x_{ij,t-1} + \varepsilon^x_{\tau,ij,t} + \sum_{s=1}^{4} \varepsilon^x_{\tau,ij,t-s}, \tag{20}$$

where x indexes the end use of the imported good.

The contemporaneous innovation $\varepsilon^x_{\tau,ij,t}$ captures unanticipated tariff changes, while the lagged terms allow tariff changes to be announced up to four quarters before they take effect. **Second**, a series of unanticipated MEI shocks capturing the AI-driven investment boom, calibrated to the realized path of aggregate investment over 2025Q1–2026Q1. **Third**, a series of unanticipated UIP shocks, calibrated to the realized path of the real exchange rate over 2025Q1–2026Q1. All shocks have persistence $\rho = 0.95$.

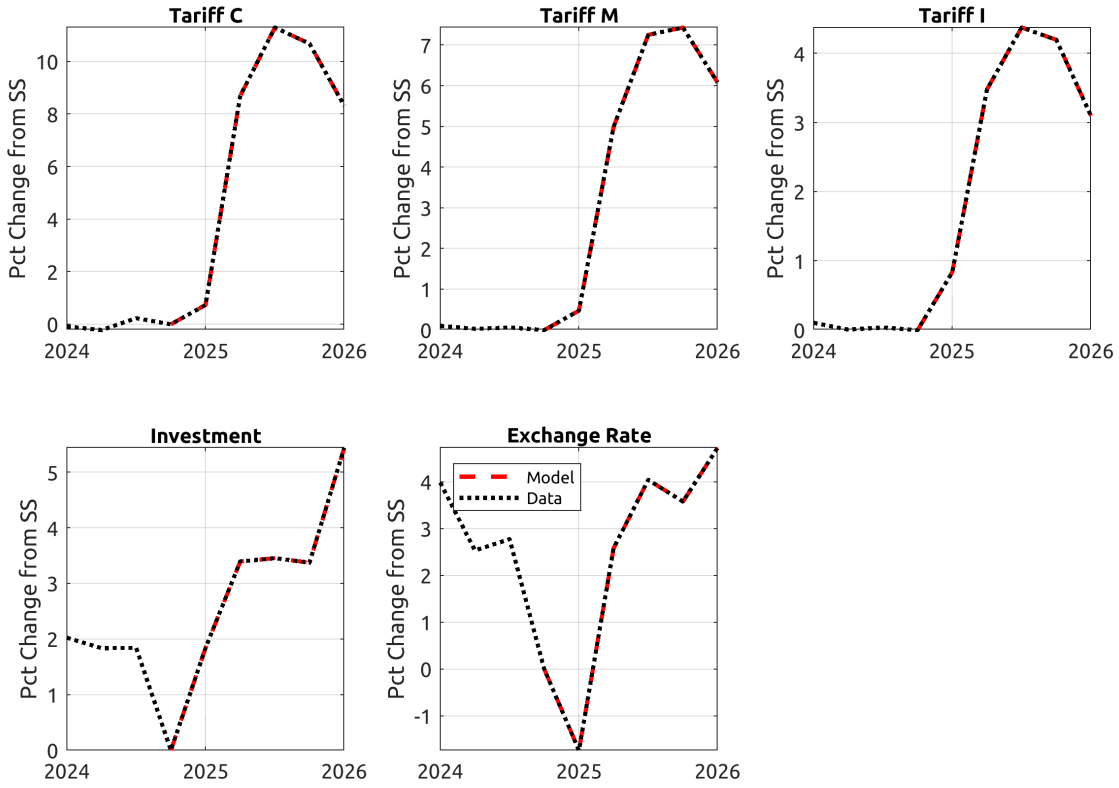


Figure 8: Inputs to the Model: Tariffs, Investment Boom, and Exchange Rate

Notes: The figure plots the model (red dashed) against the data (black dotted) for the series the shocks are calibrated to match: the three end-use tariffs, aggregate investment, and the real exchange rate. Data series are expressed as deviations from their 2024Q4 value (percent for investment and the exchange rate, percentage points for tariffs); by construction the model tracks these targets. A higher value of the exchange rate variable indicates a depreciation of the broad U.S. dollar. See Appendix A for the underlying data.

Figure 8 plots these inputs against their empirical targets. The three tariff paths reproduce the uneven incidence documented in Section 2 — a large increase in tariffs on imported consumption goods, a smaller increase on intermediates, and a modest increase on capital goods — while the investment panel captures the AI-driven boom that the MEI shocks are calibrated

to match. By construction, the model tracks these targeted series closely.[5]

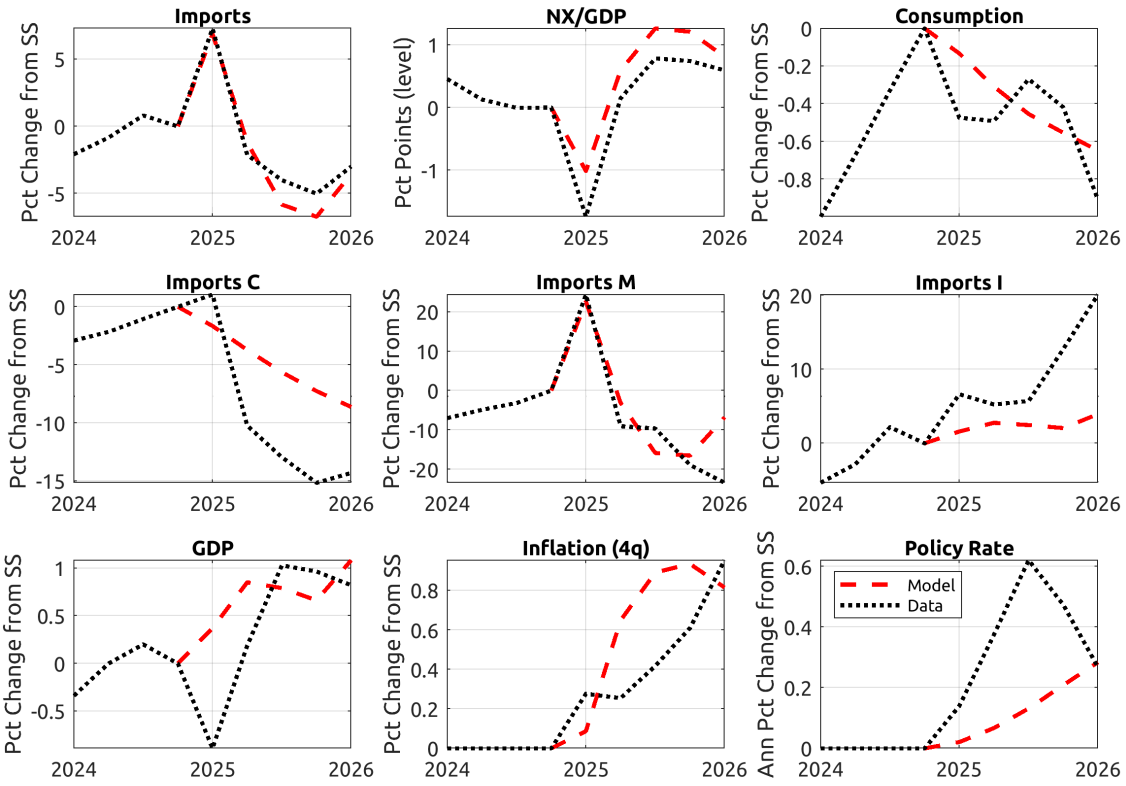


Figure 9: U.S. Data vs. Model: Baseline Model

Notes: The figure plots the model (red dashed) against the data (black dotted) for variables *not* targeted in the calibration. The data counterpart for GDP, consumption, and imports represents log deviations from a linear trend, normalized to zero in 2024Q4. For inflation and the policy rate we report the difference between actual values and the SPF forecasts from November 2024. See Appendix A for additional details.

Given these inputs, we ask how well the model reproduces the behavior of trade and macroeconomic variables that are *not* targeted in the calibration. As shown in Figure 9, the model performs remarkably well along multiple dimensions.

The model successfully captures the behavior of aggregate imports, which remain broadly stable despite the large tariff increases. This aggregate stability masks substantial heterogeneity across import categories — the same category-by-category responses traced out one shock at a time in Section 5 now play out together. Imports of consumption goods, which face the largest tariff increase, decline steadily over the year. In anticipation of higher tariffs, the inventory front-loading mechanism illustrated in Figure 7 causes imports of materials to jump considerably in 2025Q1, consistent with the data, before being drawn down as the tariffs take hold.

[5]In the filtering exercise the tariff rates are scaled by 0.8 to account for the (tariff-free) services share of total imports and are entered as deviations from 2024Q4.

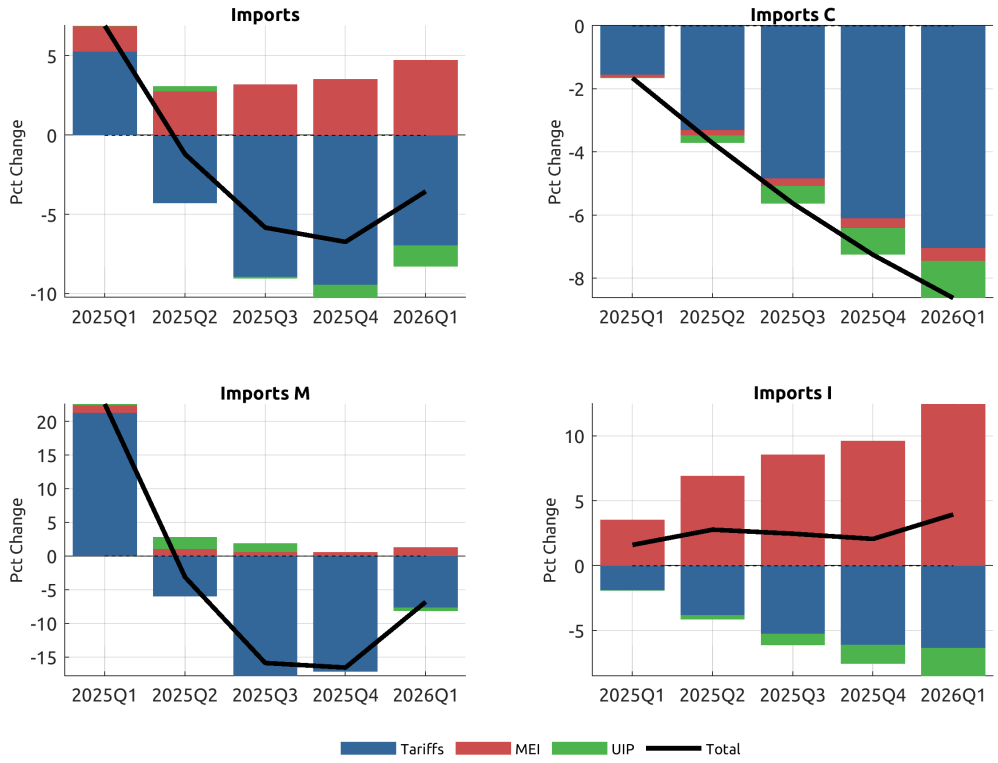


Figure 10: Accounting for the Dynamics of Trade

Notes: The figure reports the contribution of each shock group — tariffs (blue), MEI (red), and UIP (green) — to the response of aggregate imports and imports by end use, quarter by quarter over 2025. Bars stack the shock contributions; the black line is the total (model) response. Values are percent deviations from the steady state.

Imports of capital goods, which face relatively low tariffs and are pulled up by MEI shocks, instead increase steadily throughout the year. The near-stability of aggregate imports is thus the net result of three very different category dynamics.[6]

Turning to domestic activity, consumption declines by approximately 0.6 percent, matching the data closely. Net exports initially plummet in Q1, driven by the import front-loading, before rising as imports subsequently decline. Overall, GDP increases by about 1 percent by the end of 2025, in line with the observed data. Essentially, the expansionary MEI shock more than offsets the contractionary pull of the tariffs, which is in line with the transmission we studied in Section 5. The model also generates an increase in inflation of about 0.9 percentage points above baseline and in the policy rate of about 25 basis points above steady state by year-end. These model-implied changes are comparable to the difference between the actual 2025 values

[6]This simplified version of the model underpredicts the pickup in capital-goods imports observed in the data. As shown in the Appendix, when we extend our stylized theoretical approach to include two distinct production sectors (traditional and AI), a calibration of parameters and shocks as in our benchmark model delivers quantitative results for consumer-, intermediate-, and capital-goods imports in line with the data, without sacrificing the fit of other variables. See Figure 17 for details.

for inflation and the federal funds rate and their forecasts in the November 2024 SPF, the last projections made in 2024.

6.1. Accounting for the Dynamics of Trade

We now use the quantitative success of the model as an accounting device, decomposing the dynamics of trade into the contributions of the three shocks. Figure 10 reports this decomposition for imports. Tariff shocks depress imports over the year, though the anticipation effect generates an initial spike in material imports in Q1 through inventory front-loading. The MEI shocks, capturing the AI-driven investment boom, have a strongly expansionary effect on imports, especially of import-intensive capital goods. The UIP shocks contribute to a small decline through expenditure-switching effects. The key takeaway is that the boom in investment demand accounts for much of the 2025 missing trade collapse: stripping out the MEI contribution from Figure 10, aggregate imports would have fallen by nearly 10 percent by the end of 2025.

The tariff shock is itself heterogeneous across end uses, and this composition matters for trade. Figure 11 decomposes the total tariff contribution to import dynamics into the parts coming from consumption, intermediate, and capital tariffs. While the three types of tariffs have broadly similar negative effects on imports by the end of the year, tariffs on materials generate a particularly large spike in Q1 due to the inventory front-loading mechanism, as firms accelerate purchases of imported inputs ahead of the anticipated increase.

6.2. The Shocks and Macroeconomic Aggregates

The top row of Figure 12 applies the same decomposition to the macroeconomic aggregates. Tariff shocks alone have a stagflationary effect: GDP declines by about 0.7 percent while inflation increases by roughly 0.7 percentage points. The UIP shocks modestly boost both GDP and inflation by causing net exports and imported-goods prices to rise.[7] On net, the AI investment boom offsets much of the contractionary effect of the tariffs, accounting for the resilience of output over 2025.

Finally, the bottom row of Figure 12 decomposes the macroeconomic effects of the tariff shock by end use. While all tariffs are contractionary, their impacts differ substantially. Tariffs on capital goods generate the largest negative effect on GDP, as they induce a substantial decline in investment — a finding that aligns with Baqaee and Malmberg (2025), who emphasize the particularly harmful long-run effects of tariffs on investment goods. Turning to inflation, tariffs on consumption goods emerge as the primary driver of the 2025 price acceleration, directly raising the cost of final goods purchased by households. Unlike tariffs on consumption and materials, tariffs on capital goods have a *deflationary* effect: by severely depressing investment

[7] Appendix B reports the decomposition for NX and the exchange rate.

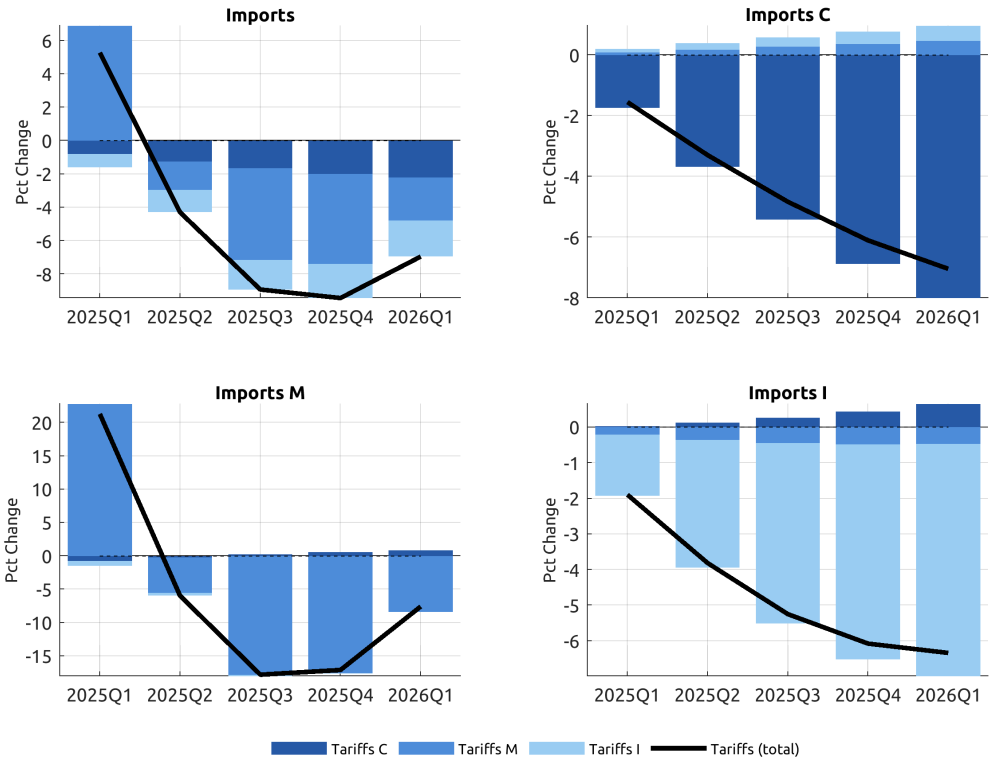


Figure 11: Inside the Tariff Shock

Notes: The figure reports the total tariff contribution to import dynamics from Figure 10, split into the parts due to consumption (dark blue), intermediate (medium blue), and investment (light blue) tariffs. Bars stack the three components; the black line is the combined tariff contribution. Values are percent deviations from steady state.

demand, they reduce labor demand and put downward pressure on wages and marginal costs. The asymmetric effect of different tariffs on inflation — tariffs on consumption and intermediates are inflationary, whereas tariffs on capital goods are deflationary — represents a key contribution of our theoretical approach that may help explain recent empirical evidence on tariff pass-through over time and across countries. We return to this point in Section 7.

6.3. Counterfactual Exercise: Uniform Tariffs

Having established that tariffs on capital goods are especially contractionary, we now ask how much the *composition* of the 2025 tariff increase mattered for macroeconomic outcomes. Figure 13 isolates the tariff shocks — holding aside the MEI and UIP shocks — and compares our baseline calibration, which feeds in the actual heterogeneous tariff paths by end use (blue solid), against a counterfactual in which every end-use tariff rises by the same amount, equal to the average tariff path in 2025 (red dashed). By construction the two experiments deliver the same average tariff (top-right panel); they differ only in how that average is distributed across consumption, materials, and investment goods. The uniform scenario implies substantially higher

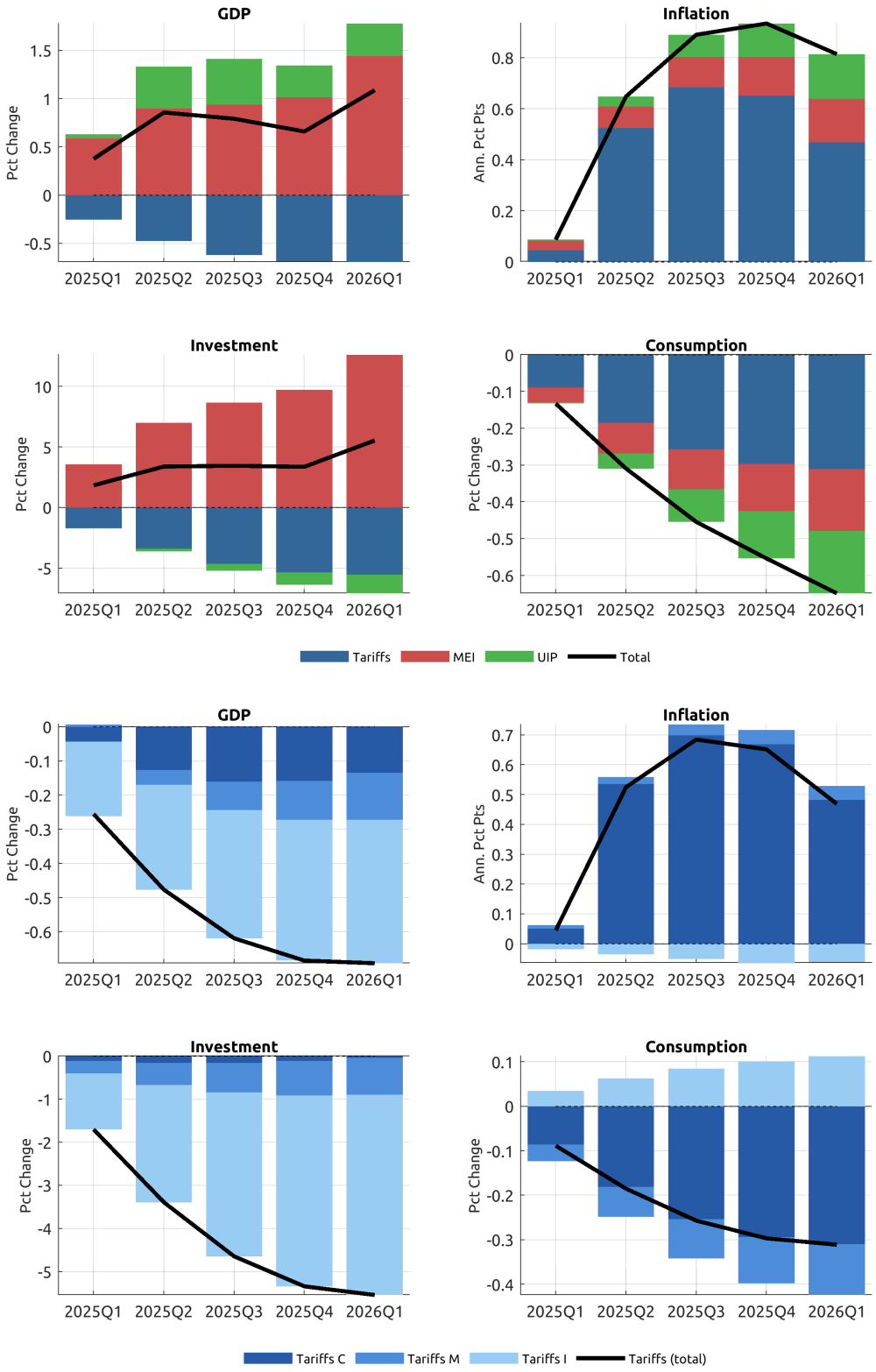


Figure 12: Shock (top) and Tariff (bottom) Contributions to Macroeconomic Aggregates

Notes: The top row reports the contribution of tariffs (blue), MEI (red), and UIP (green) to GDP, inflation, investment, and consumption. The bottom row reports the tariff contribution split into consumption, intermediate, and investment tariffs. Bars stack the contributions; the black line is the total. Values are deviations from steady state (percent for quantities, annualized percentage points for inflation).

duties on investment goods, moderately lower duties on consumption goods, and materials tariffs that are little changed.

The macroeconomic effects are substantially more contractionary. Under uniform tariffs, the higher capital tariff rates generate an investment decline of nearly 10 percent by year-end, twice as large as in the baseline. Consequently, GDP contracts by almost 1 percent rather than 0.7 percent. The inflation response is also markedly weaker. The stronger deflationary force from higher capital tariffs, combined with the smaller inflationary impulse from lower consumption tariffs, reduces the peak increase in CPI inflation to about 0.4 percentage points, roughly half the baseline peak of just under 0.7 percentage points.

This counterfactual reveals that the heterogeneous distribution of the 2025 announced tariffs contributed to the resilience of the U.S. economy. Specifically, the concentration of the 2025 tariff increases on imported consumption and intermediate goods, with little increase in capital tariffs, was essential for limiting the macroeconomic damage and leaving room for the AI investment boom to support aggregate activity.

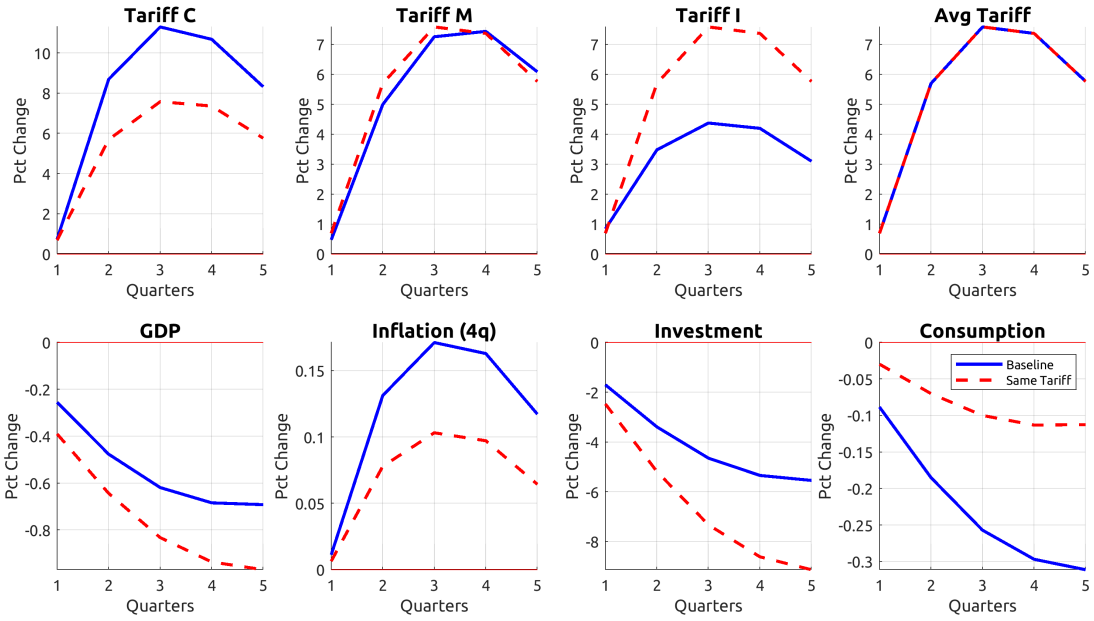


Figure 13: Counterfactual: Heterogeneous vs. Uniform Tariffs

Notes: The figure compares the model's response to the tariff shocks alone (excluding the MEI and UIP shocks) under two scenarios: the baseline, using the actual heterogeneous tariff paths by end use (blue solid), and a counterfactual in which every end-use tariff rises by the same amount, equal to the average tariff path in 2025 (red dashed). By construction the two scenarios share the same average tariff (top-right panel). The horizontal axis is quarters, starting in 2025Q1. Responses are deviations from the steady state.

7. Historical Transmission of Tariff Shocks

The lessons from Section 5 suggest that the macroeconomic effects of tariffs crucially depend on the specific imported goods that are taxed. It follows that, historically, the macroeconomic effects of tariffs may have changed with the evolution of international trade. Here we explore this idea by using long historical data on the size and composition of U.S. imports to recalibrate our model and tracing out how the same tariff shock would have propagated in different periods.

As shown in Figure 14, historical data on U.S. trade reveal two long-run trends. First, after falling through the first half of the twentieth century, the U.S. import-to-GDP ratio rose steadily in the postwar decades, from roughly 4 percent in the 1940s to around 15 percent today (left panel). Second, the *composition* of U.S. imports shifted markedly: the capital-goods share climbed from near zero in the early postwar period to roughly 30 percent today, while the intermediate-goods share fell correspondingly, leaving the consumption share comparatively stable (right panel). In sum, the United States today imports far more overall than in the 1940s, and a much larger share of those imports is capital goods.

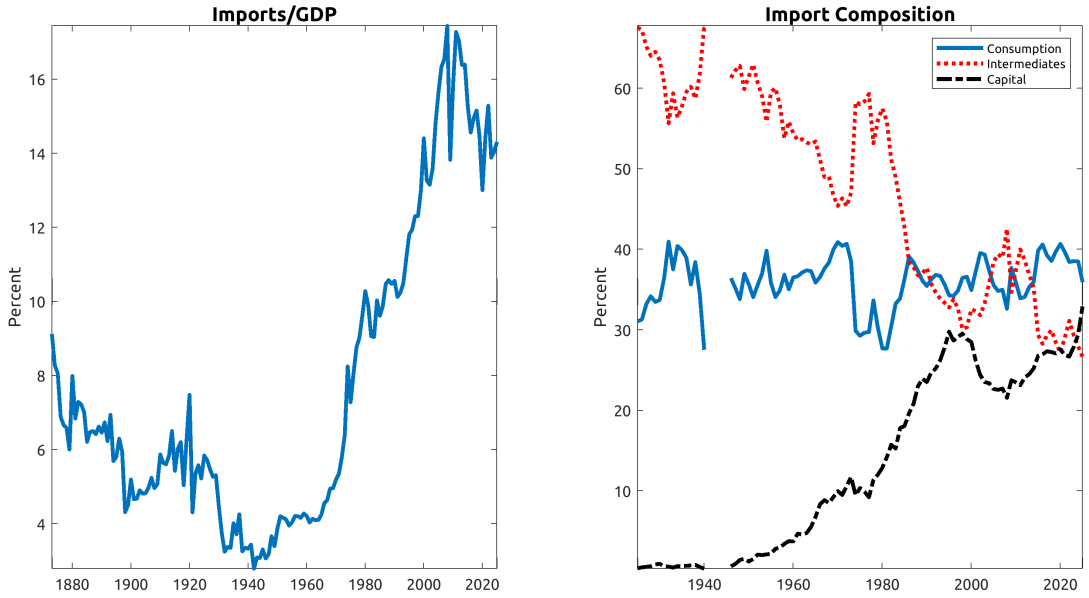


Figure 14: Evolution of U.S. Import Shares: 1870–2025

Notes: The left panel plots total imports as a share of GDP (percent), in levels, from the Global Macro Database of Müller et al. (2025). The right panel plots the share of imports accounted for by consumption (blue solid), intermediate (red dotted), and capital (black dash-dot) goods (percent), from the Carter et al. (2006). All series are annual; see Appendix A for additional details.

These two trends have opposing implications for how tariffs transmit to the macroeconomy. Figure 15 presents model-based experiments providing a quantitative assessment of these his-

torical changes. Specifically, we recalibrate the baseline model to the aggregate and good-specific import shares of each year and feed in a common 10 percent tariff shock, tracing out the peak GDP decline, the one-year change in inflation, and the price-level deviation after twelve quarters. The output cost of a uniform tariff more than triples between the early twentieth century and today, with both forces contributing to this finding. A higher import-to-GDP ratio makes the economy more exposed to any trade-cost shock, and a larger imported capital-goods share tilts that exposure toward the most contractionary type of tariff. In contrast, the inflationary effects of tariffs have remained relatively stable over time as two forces work against each other. Higher trade openness raises the inflationary impulse of a uniform tariff in the postwar years, while a larger imported capital-goods share strengthens the deflationary effects of capital-goods tariffs. Quantitatively, the two forces roughly offset: over the sample, the peak price-level response to a 10 percent uniform tariff fluctuates narrowly in the 0.2–0.4 percent range. A higher capital-goods share also makes the price-level increase from a temporary tariff less persistent, as shown in the third panel of Figure 15.

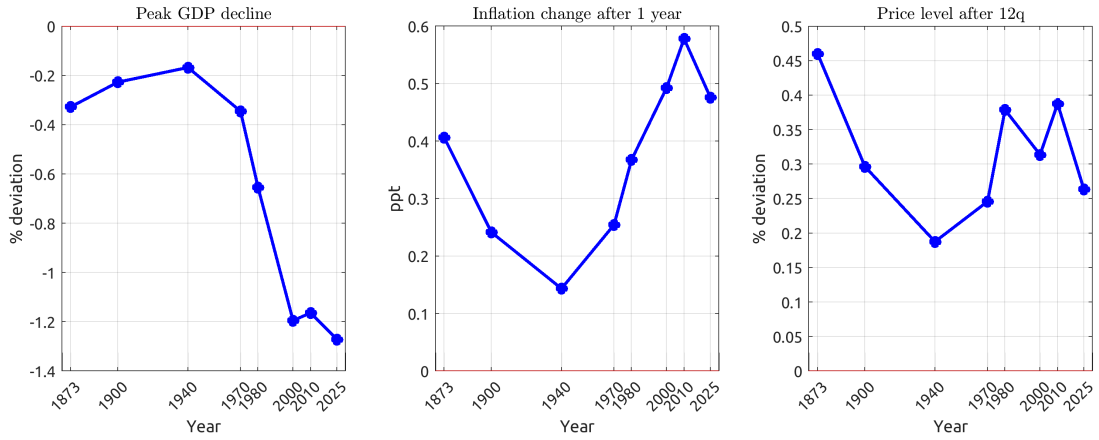


Figure 15: Elasticity of GDP and Inflation to Tariffs: 1870–2025

Notes: The figure reports the model-implied response to a common 10 percent tariff shock when the model is recalibrated to match i) the ratio of U.S. imports over GDP prevailing in each year shown and ii) the composition of imports across consumption goods, intermediate goods and capital goods. Each marker is a separate recalibration; the import shares are those in Figure 14.

These results also offer a structural interpretation of a recent time-series literature that estimates the macroeconomic effects of tariffs directly from the historical record. Den Besten et al. (2026), drawing on 180 years of U.S. trade policy, and Schmitt-Grohé and Uribe (2025) find that tariff shocks are contractionary and that their inflationary bite is muted — indeed, in the postwar period often deflationary. Through the lens of our model, this evolution is not a puzzle but a compositional consequence: as U.S. imports tilted toward capital goods, a growing share of any broad-based tariff increase came to load on the end use that behaves like a negative shock to the marginal efficiency of investment, depressing investment and labor demand and pushing marginal costs — and hence prices — down.

8. Conclusion

U.S. tariff rates in 2025 rose to levels not seen since the Great Depression, yet U.S. imports increased rather than collapsed. This paper resolves this puzzle through the lens of a two-country New Keynesian model with tariffs on consumption goods, intermediate inputs, and capital goods. Three features are essential for understanding the missing trade collapse. First, the anticipation of tariff increases in early 2025 triggered substantial inventory accumulation, particularly in imported materials, generating a front-loading of imports that offset subsequent declines. Second, the AI-driven investment boom created strong demand for capital goods, which faced relatively moderate tariffs compared to consumption and intermediate goods. Third, the heterogeneous distribution of tariffs across goods categories mattered critically for both trade flows and macroeconomic outcomes.

Our quantitative analysis shows that the model successfully accounts for the behavior of imports and key macroeconomic aggregates throughout 2025 and early 2026.

The paper highlights an important asymmetry in the macroeconomic effects of tariffs. While tariffs on consumption goods and intermediates are stagflationary — raising inflation and reducing output — tariffs on capital goods are deflationary. This arises because investment tariffs depress capital and labor demand, putting downward pressure on wages and marginal costs. This finding has important implications for understanding the aggregate effects of trade policy and suggests that the composition of tariff protection is a first-order consideration for macroeconomic stabilization.

Looking forward, if the AI-driven investment boom persists and continues to pull in imported capital goods, the capital-goods share of U.S. imports — already at a historical high — would rise further. Through the lens of our model, this would make future uniform tariff increases even more costly for output, while their inflationary bite would be increasingly muted by the deflationary force of capital tariffs. Put differently, the very structural shift that helped the U.S. avoid a trade collapse in 2025 would, if it continues, leave aggregate activity more exposed to broad-based trade-cost shocks going forward, even as it tempers their inflationary consequences.

References

Alessandria, George, Jiaxiaomei Ding, Shafaat Yar Khan, and Carter Mix (2025) "The Tariff Tax Cut: Tariffs as Revenue," Working Paper 33784, National Bureau of Economic Research.

Amiti, Mary, Stephen J. Redding, and David E. Weinstein (2019) "The Impact of the 2018 Tariffs on Prices and Welfare," *Journal of Economic Perspectives*, 33 (4), 187–210.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2025) "The Macroeconomics of Tariff Shocks," Working Paper 33726, National Bureau of Economic Research.

Auray, Stéphane, Michael B. Devereux, and Aurélien Eyquem (2025) "Trade Wars, Nominal Rigidities, and Monetary Policy," *The Review of Economic Studies*, 92 (4), 2228–2270.

Baqaee, David and Hannes Malmberg (2025) "Long-Run Effects of Trade Wars," Working Paper 33702, National Bureau of Economic Research.

Barattieri, Alessandro, Matteo Cacciatore, and Fabio Ghironi (2021) "Protectionism and the Business Cycle," *Journal of International Economics*, 129, 103417.

Barbiero, Omar, Emmanuel Farhi, Gita Gopinath, and Oleg Itskhoki (2019) "The Macroeconomics of Border Taxes," *NBER Macroeconomics Annual*, 33 (1), 395–457.

Barnichon, Régis and Aayush Singh (2025) "What Is a Tariff Shock? Insights from 150 Years of Tariff Policy," Working Paper 2025-26, Federal Reserve Bank of San Francisco.

Bergin, Paul R. and Giancarlo Corsetti (2023) "The Macroeconomic Stabilization of Tariff Shocks: What Is the Optimal Monetary Response?" *Journal of International Economics*, 143, 103758.

Bianchi, Javier and Louphou Coulibaly (2025) "The Optimal Monetary Policy Response to Tariffs," Working Paper 33560, National Bureau of Economic Research.

Boehm, Christoph E., Andrei A. Levchenko, and Nitya Pandalai-Nayar (2023) "The Long and Short (Run) of Trade Elasticities," *American Economic Review*, 113 (4), 861–905.

Caldara, Dario, Francesco Ferrante, Matteo Iacoviello, and Immo Schott (2026) "Trade Policy Sentiment and Corporate Investment," Working Paper.

Caldara, Dario, Matteo Iacoviello, Patrick Molligo, Andrea Prestipino, and Andrea Raffo (2020) "The Economic Effects of Trade Policy Uncertainty," *Journal of Monetary Economics*, 109, 38–59.

Carter, Susan B., Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright eds. (2006) *Historical Statistics of the United States: Earliest Times to the Present, Millennial Edition*, New York: Cambridge University Press.

Cavallo, Alberto, Gita Gopinath, Brent Neiman, and Jenny Tang (2021) "Tariff Pass-Through at the Border and at the Store: Evidence from U.S. Trade Policy," *American Economic Review: Insights*, 3 (1), 19–34.

Corsetti, Giancarlo, Luca Dedola, and Sylvain Leduc (2010) "Optimal Monetary Policy in Open Economies," in *Handbook of Monetary Economics*, Vol. 3, 861–933: Elsevier.

Crucini, Mario J. and James Kahn (1996) "Tariffs and Aggregate Economic Activity: Lessons from the Great Depression," *Journal of Monetary Economics*, 38 (3), 427–467.

Cuba-Borda, Pablo, Albert Queralto, Ricardo Reyes-Heroles, and Mikaël Scaramucci (2025) "Trade Costs and Inflation Dynamics," Working Paper 2508, Federal Reserve Bank of Dallas.

Den Besten, Tamar, Régis Barnichon, Diego Känzig, and Aayush Singh (2026) "The Macroeconomic Effects of Tariffs: Insights from 180 Years of U.S. Trade Policy," Working Paper 35102, National Bureau of Economic Research.

Erceg, Christopher, Andrea Prestipino, and Andrea Raffo (2023) "Trade Policies and Fiscal Devaluations," *American Economic Journal: Macroeconomics*, 15 (4), 104–140.

Fajgelbaum, Pablo D., Pinelopi K. Goldberg, Patrick J. Kennedy, and Amit K. Khandelwal (2020) "The Return to Protectionism," *The Quarterly Journal of Economics*, 135 (1), 1–55.

Flaaen, Aaron, Ali Hortaçsu, and Felix Tintelnot (2020) "The Production Relocation and Price Effects of U.S. Trade Policy: The Case of Washing Machines," *American Economic Review*, 110 (7), 2103–2127.

Franconi, Alessandro and Lukas Hack (2025) "Import Tariffs and the Systematic Response of Monetary Policy," Working Paper 1035, Banque de France.

Galí, Jordi and Tommaso Monacelli (2005) "Monetary Policy and Exchange Rate Volatility in a Small Open Economy," *The Review of Economic Studies*, 72 (3), 707–734.

Gertler, Mark and Peter Karadi (2011) "A Model of Unconventional Monetary Policy," *Journal of Monetary Economics*, 58 (1), 17–34.

Goldfarb, Avi and Daniel Trefler (2019) "AI and International Trade," in Ajay Agrawal, Joshua Gans, and Avi Goldfarb eds. *The Economics of Artificial Intelligence: An Agenda*, 463–492: University of Chicago Press.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller (2020) "Dominant Currency Paradigm," *American Economic Review*, 110 (3), 677–719.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti (2010) "Investment Shocks and Business Cycles," *Journal of Monetary Economics*, 57 (2), 132–145.

Monacelli, Tommaso (2025) "Tariffs and Monetary Policy," Discussion Paper 20142, Centre for Economic Policy Research.

Müller, Karsten, Chenzi Xu, Mohamed Lehbib, and Ziliang Chen (2025) "The Global Macro Database: A New International Macroeconomic Dataset," Working Paper 33714, National Bureau of Economic Research.

Raffo, Andrea (2010) "Technology Shocks: Novel Implications for International Business Cycles," International Finance Discussion Paper 992, Board of Governors of the Federal Reserve System.

Ravikumar, B., Ana Maria Santacreu, and Michael Sposi (2019) "Capital Accumulation and Dynamic Gains from Trade," *Journal of International Economics*, 119, 93–110.

Schmitt-Grohé, Stephanie and Martín Uribe (2025) "Transitory and Permanent Import Tariff Shocks in the United States: An Empirical Investigation," Working Paper 33997, National Bureau of Economic Research.

de Soyres, François, Alex Haag, Mike Liu, and Eva Van Leemput (2026) "The Global Trade Effects of the AI Infrastructure Boom," FEDS Notes, Board of Governors of the Federal Reserve System.

Waugh, Michael E. (2026) "Trade in AI-Related Products," Working Paper 35053, National Bureau of Economic Research.

A. Data

This appendix documents the source and construction of every empirical series used in the paper. Unless noted otherwise, all series are quarterly and are pulled from Haver Analytics; the mnemonic (database in brackets) is given for each. National-accounts quantities are real, chained 2017 dollars (BEA NIPA, `USECON`); trade-by-end-use quantities are from the Census Bureau's monthly International Trade release (`USINT`), seasonally adjusted, real (chained 2017$, $mil.).

Common transformations. The following operations recur below and are referenced by name:

- *Monthly → quarterly.* Monthly Census flows are aggregated to the quarter by *summing*; monthly rates are aggregated by *averaging*.
- *Detrended log.* Take logs and remove a linear trend estimated on 2015Q1–2019Q4; the plotted object is the log deviation from that fitted trend (in percent).
- *Rebased to 2024Q4.* For the filtering exercise, each series is expressed as its deviation from its 2024Q4 value; log deviations are scaled by 100 (percent), rates and ratios are kept in levels (percentage points).

A.1. Quarterly Data

Macroeconomic aggregates.

- **GDP** — we do not use headline real GDP; instead we construct the model-consistent expenditure concept GDP $= C + I^* + NX$, using the components defined below. Detrended log, then rebased to 2024Q4.
- **Consumption** — `CH@USECON` (real PCE); detrended log, rebased.
- **Investment** — I^* is equal to equipment (`FNEH@USECON`) + intellectual-property products (`FNPH@USECON`) + change in private inventories (`VH@USECON`). Detrended log, rebased. Our empirical investment concept is nonresidential investment in equipment and intellectual-property products plus the change in private inventories; we exclude nonresidential structures and residential investment. These two categories are dominated by the interest-rate cycle rather than by the tariff and AI-investment shocks that are the focus of our analysis: both remained on a downward trajectory through 2025 as the housing and commercial-real-estate sectors continued to absorb the monetary tightening that began in 2022, and including them would blur the investment signal the model is calibrated to match. They are also the least trade-exposed components of investment — structures

and residential building are overwhelmingly domestically sourced — so they fall largely outside the import-intensive capital channel through which tariffs and the AI boom transmit in our framework. Equipment and IP products, by contrast, are where the AI-driven capital-goods surge and the associated rise in imports are concentrated.

- **Net exports / NX-to-GDP** — real net exports (`XNETH@USECON`) as a share of the GDP concept defined above (not headline nominal GDP); level deviation from 2024Q4. Real exports `XH@USECON` and total real imports of goods and services `MH@USECON` (detrended log, rebased) are used for the aggregate export/import lines.

Imports by end use. Real goods imports by end-use category, Census monthly, summed to quarterly:

- **Total real imports** — total real imports of goods and services, `MH@USECON`.
- **Consumer imports** — consumer goods ex-autos (`TMMECNH`) + foods, feeds & beverages (`TMMEFBH`) $+\frac{1}{2}\times$autos (`TMMEAVH`) $+ 0.33\times$ real imported services $-$ pharmaceuticals. Detrended log, rebased.
- **Intermediate imports** — industrial supplies (`TMMEIMH`) $+\frac{1}{2}\times$autos $+ 0.33\times$ real imported services $+$ pharmaceuticals. Detrended log, rebased.
- **Capital imports** — capital goods ex-autos (`TMMECGH`) $+ 0.33\times$ real imported services. Detrended log, rebased.

The end-use aggregates split autos evenly between consumption and intermediates, allocate a fixed 0.33 share of real imported services (`MSH@USECON`, deflated) across the three uses, and reassign pharmaceuticals from consumption to intermediates. Real pharmaceutical imports are nominal pharma (`BM40100@USINT`) deflated by its own price index (`PI40100@USINT`) normalized to 2017.

Inflation.

- **Core PCE inflation** — core PCE price index `JCBM@USECON`, four-quarter change (percent). In the filter we plot the gap between realized inflation and the Survey of Professional Forecasters expectations formed before the tariff announcements (SPF, see below); this isolates the tariff-driven surprise.

Interest rate and exchange rate.

- **Policy rate** — federal funds target `FFEDTAR@USECON` (Wu–Xia shadow rate `FFEDSHDW@USECON` at the lower bound). Entered in the filter as the deviation of the realized rate from the SPF-expected path (annualized), isolating the monetary surprise.
- **Real exchange rate** — real broad trade-weighted dollar `FXTWBDIC@USECON`; percent deviation from 2024Q4. The model's real exchange rate Q_{12} is the negative of this series, so a dollar appreciation is a fall in Q_{12}.

Effective tariff rates. End-use effective tariff rates for consumption, intermediate, and capital goods, plus the aggregate rate, constructed by the authors from U.S. Census Bureau customs data. The construction proceeds as follows:

- *Raw data.* Monthly customs value and calculated duties at the HS6 (six-digit Harmonized System) product level from the Census Bureau, covering 1989–2026.
- *Harmonizing HS vintages.* Because the HS nomenclature is revised roughly every five years, each period's codes are first mapped to a common HS2017 basis using the World Customs Organization concordance tables (HS1992/1996/2002/2007/2012/2022 $\rightarrow$ HS2017). One-to-many mappings take the first target code; codes with no HS2017 equivalent are left unclassified.
- *End-use classification.* Each HS2017 code is assigned to an end-use category using the UN Broad Economic Categories, Revision 5 (BEC5): capital (CAP), intermediate (INT), consumption (CONS), or other. Products with dual BEC5 codes (e.g. "INT/CONS") are assigned to their first listed category to keep the categories mutually exclusive.
- *Aggregation.* Within each quarter and category we sum customs values and duties across HS6 codes, and define the effective tariff rate as total duties divided by total customs value (a value-weighted rate, not an average of product-level rates). The aggregate rate is computed the same way over all categories.

In the filtering exercise the rates are scaled by 0.8 to account for the (tariff-free) services share of total imports and are entered as deviations from 2024Q4.

Expectations (Survey of Professional Forecasters). The SPF (Philadelphia Fed) supplies the pre-tariff expected paths used to form the inflation and policy-rate surprises above: the three-month Treasury-bill rate and core PCE inflation forecasts. Expected core PCE is cumulated from the 2024Q4 index level using the forecast quarterly rates; the realized-minus-expected gap is the object plotted for 2025 onward.

A.2. Yearly Data

The long historical series in Section 7 come from two additional sources:

- **Imports-to-GDP (1870–2025).** Total imports as a share of GDP, from the Global Macro Database of Müller et al. (2025).
- **Import composition by end use (1870–2025).** The shares of consumption, intermediate, and capital goods in total imports, from the Carter et al. (2006).

B. Additional Results

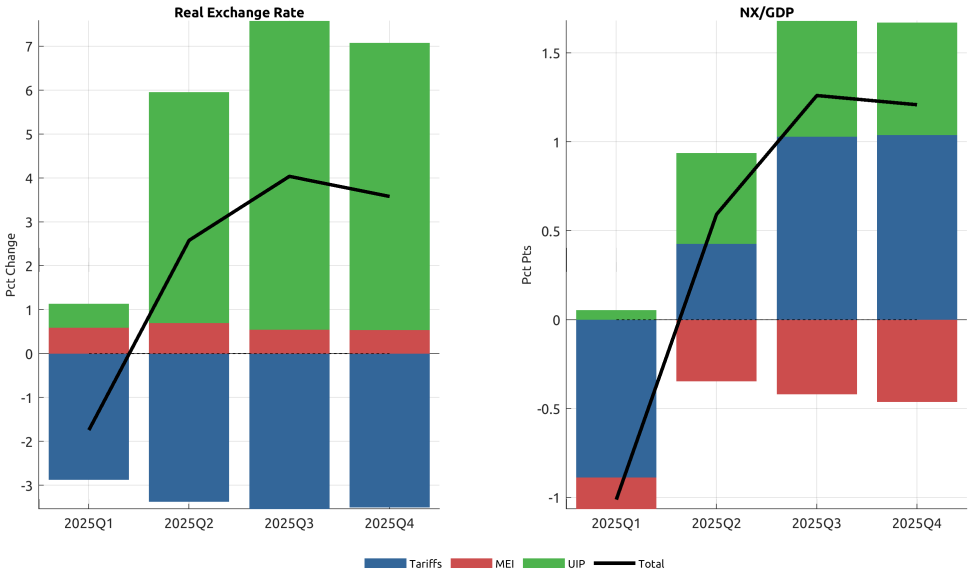


Figure 16: Baseline Model: Drivers of the Exchange Rate and NX

Notes: The figure reports the contribution of tariffs (blue), MEI (red), and UIP (green) to the real exchange rate and NX/GDP over 2025. Bars stack the shock contributions; the black line is the total (model) response. Values are deviations from the 2024Q4 level (percent for the exchange rate, percentage points for NX/GDP). This is a model decomposition and involves no additional data.

C. Extension: Two-Sector Model

The AI investment boom of 2025 was not uniform across all types of capital. Rather, the surge in investment was particularly concentrated in equipment, especially information technology products, which grew by almost 20 percent above trend. This sectoral concentration has important implications for trade dynamics, as different types of capital goods have vastly different import intensities. Introducing sector heterogeneity also lets the model speak to a salient feature of the 2025 tariff schedule: AI-related capital goods (semiconductors, computers, and related hardware) were largely carved out from the tariff increases, as discussed in Waugh (2026).

Because the AI sector's import-intensive capital faced little or no tariff, the investment boom could pull in imports without being choked off by the trade-cost shock hitting the rest of the economy.

To capture these sectoral dynamics, we extend our baseline model to include two distinct sectors indexed by k. The first sector ($k = 1$) represents traditional non-AI production, which accounts for the bulk of final expenditure and features a relatively low import share of around 25 percent for investment goods. The second sector ($k = 2$) represents AI-related capital (primarily IT equipment and related hardware), which has a substantially higher import share of about 70 percent, consistent with the high import intensity of computer and electronic equipment. This sectoral heterogeneity allows us to study how the concentration of the investment boom in the import-intensive AI sector amplifies the effects on trade flows.

Key new equations. Extending the model to multiple sectors adds a sector dimension to production, the final-use bundles, the pricing block, the inventory block, and market clearing. We highlight the equations that change relative to the one-sector baseline. We relegate the full set of sectoral pricing equations to Appendix D.

(i) Two CES layers for each final use. Each end use is now built from *two* nested CES aggregators: an outer layer across sectors k and an inner Armington layer across source countries j. For consumption,

$$C_{i,t} = \left(\sum_{k=1}^{S} \left(\gamma^c_{i,k}\right)^{\frac{1}{\varepsilon_c}} C_{i,kt}^{\frac{\varepsilon_c - 1}{\varepsilon_c}} \right)^{\frac{\varepsilon_c}{\varepsilon_c - 1}}, \qquad C_{i,kt} = \left(\sum_{j=1}^{N} \left(\omega^c_{ij,k}\right)^{\frac{1}{\eta_c}} C_{ij,kt}^{\frac{\eta_c - 1}{\eta_c}} \right)^{\frac{\eta_c}{\eta_c - 1}}, \tag{C.1}$$

where $\gamma^c_{i,k}$ is the expenditure share of sector k (with $\sum_k \gamma^c_{i,k} = 1$), ε_c is the elasticity across sectors, and η_c is the Armington elasticity across countries. Investment has the same two-layer structure but with an input-output block: sector-k capital is assembled from investment goods sourced across *supplier* sectors l and then across countries,

$$I_{i,kt} = \left(\sum_{l=1}^{S} \left(\gamma^I_{i,kl}\right)^{\frac{1}{\varepsilon_I}} I_{i,kl,t}^{\frac{\varepsilon_I - 1}{\varepsilon_I}} \right)^{\frac{\varepsilon_I}{\varepsilon_I - 1}}, \qquad I_{i,kl,t} = \left(\sum_{j=1}^{N} \left(\omega^I_{ij,kl}\right)^{\frac{1}{\eta_I}} I_{ij,kl,t}^{\frac{\eta_I - 1}{\eta_I}} \right)^{\frac{\eta_I}{\eta_I - 1}}. \tag{C.2}$$

The materials bundle $M_{i,kt}$ takes the same two-layer form: sector-k production uses an intermediate bundle sourced across supplier sectors l and then across countries,

$$M_{i,kt} = \left(\sum_{l=1}^{S} \left(\gamma^m_{i,kl}\right)^{\frac{1}{\varepsilon_m}} M_{i,kl,t}^{\frac{\varepsilon_m - 1}{\varepsilon_m}} \right)^{\frac{\varepsilon_m}{\varepsilon_m - 1}}, \qquad M_{i,kl,t} = \left(\sum_{j=1}^{N} \left(\omega^m_{ij,kl}\right)^{\frac{1}{\eta_m}} M_{ij,kl,t}^{\frac{\eta_m - 1}{\eta_m}} \right)^{\frac{\eta_m}{\eta_m - 1}}, \tag{C.3}$$

where $M_{ij,kl,t}$ is the intermediate input used by sector k, sourced from supplier sector l and imported from country j. The key new objects are the sector-specific home-bias weights $\omega^c_{ij,k}$, $\omega^m_{ij,kl}$, and $\omega^I_{ij,kl}$, which let import intensity differ across the non-AI and AI sectors, and the sourcing shares $\gamma^m_{i,kl}, \gamma^I_{i,kl}$, which govern the cross-sector input-output structure.

(ii) Sector-level inventories. The inventory problem is now solved at the level of each bilateral sector-to-sector input flow $M_{ij,kl,t}$, rather than for a single aggregate material. That is, inventory decisions are now made separately for each $M_{ij,kl,t}$, so firms can stock up on distinct country-sector input combinations — the imported hardware input from country j used by the AI sector, say, separately from the domestic input used by the non-AI sector. Inventories $S_{ij,kl,t}$ are held over the input from supplier sector l in country j used by sector k in country i, and accumulate according to $S_{ij,kl,t} = (1-\delta_s)S_{ij,kl,t-1} + I^s_{ij,kl,t}$, where $I^s_{ij,kl,t}$ is materials purchases for that flow. This substantially expands the number of inventory states but leaves the front-loading mechanism unchanged.

(iii) Sector-specific production and pricing. Each sector k in country i produces gross output with its own CES technology over value added and materials,

$$Y_{i,kt} = A_{i,kt}\left[(1-\nu_{i,k})^{1/\varepsilon_Y} V_{i,kt}^{\frac{\varepsilon_Y-1}{\varepsilon_Y}} + \nu_{i,k}^{1/\varepsilon_Y} M_{i,kt}^{\frac{\varepsilon_Y-1}{\varepsilon_Y}}\right]^{\frac{\varepsilon_Y}{\varepsilon_Y-1}}, \tag{C.4}$$

with sector-specific materials share $\nu_{i,k}$ and capital share $\alpha_{i,k}$ in the value-added aggregate $V_{i,kt} = (u_{i,kt}K_{i,kt-1})^{\alpha_{i,k}} L_{i,kt}^{1-\alpha_{i,k}}$. Nominal rigidities also become sector specific: wholesale retailers set prices separately in each sector, so the model features a distinct Phillips curve for every sector k (with its own Rotemberg cost κ_k and marginal cost $mc_{i,kt}$), and the sectoral consumption prices aggregate into the CPI through the outer CES weights $\gamma^c_{i,k}$.

(iv) Sectoral resource constraint. Market clearing now holds sector by sector. For each sector k in country i,

$$Y_{i,kt} = \sum_{j=1}^{N} \frac{n_j}{n_i} C_{ji,kt} + \sum_{j=1}^{N}\sum_{l=1}^{S} \frac{n_j}{n_i} I^s_{ji,lk,t} + \sum_{j=1}^{N}\sum_{l=1}^{S} \frac{n_j}{n_i} I_{ji,lk,t} + a\left(u_{i,kt}\right) K_{i,kt-1}, \tag{C.5}$$

where the first double sum collects demand for sector-k output used for materials purchases by every user sector l in every country j, and the second collects demand for sector-k output used as new investment goods. Summing over k recovers the aggregate resource constraint of the baseline model.

Calibration of the new parameters. Table 2 reports the sector-specific parameters, which are the only additions relative to Table 1; all remaining parameters are unchanged.[8] We interpret the AI sector as the data-center/compute operator (NAICS 511 software and 518 data processing and cloud), whose capital is predominantly imported hardware.[9] Our calibration strategy is to discipline the AI sector directly from the input-output data and then back out the non-AI sector residually. Specifically, we take the import intensity of AI capital from the 2024 BEA Use and Import matrices, which imply that AI-related capital is highly import-intensive (home bias $\omega^I_{11,2} = 0.30$, i.e. a 70 percent import share). We then set the non-AI import shares so that the γ-weighted aggregate import shares reproduce the same steady-state targets as the one-sector baseline in Table 1: the shares of consumption, materials, and capital goods in total imports and the import share of investment. This yields a non-AI investment home bias of $\omega^I_{11,1} = 0.75$ (a 25 percent import share), so that the two-sector split leaves the economy-wide import composition unchanged and concentrates import-intensive capital in the AI sector.

The two new sets of expenditure weights, $\gamma^c_{i,k}$ and $\gamma^I_{i,kl}$, are disciplined from national accounts data. The consumption share of the AI sector is small: households do not directly purchase data-center or compute services in any quantity, so the AI sector's share of final consumption expenditure in the BEA Use table (final-demand column for personal consumption) is only a couple of percent. We accordingly place essentially all consumption in the non-AI sector, $\gamma^c_{i,1} = 0.98$. The investment sourcing shares $\gamma^I_{i,kl}$ are chosen so that the AI sector accounts for about 20 percent of aggregate investment. This target matches the 2025 ratio of investment in information-processing equipment to investment in total equipment plus intellectual-property products from NIPA Table 5.3.5, which captures the share of capital formation tied to IT hardware and software.[10] We therefore direct 80 percent of each sector's investment inputs to the non-AI sector and 20 percent to the AI sector, and apply the same 80/20 split to materials sourcing. Finally, the cross-sector elasticities are set to unity ($\varepsilon_c = \varepsilon_m = \varepsilon_I = 1.00$), so the outer CES layer is Cobb-Douglas.

Figure 17 presents the results from this two-sector extension, repeating the accounting exercise of Section 6 but now feeding the shocks through the two-sector economy. The exercise differs from the one-sector baseline only in how the shocks map into the richer sectoral structure. **First**, the MEI shock is applied *exclusively to the AI sector*, and is still calibrated to match the realized path of aggregate investment. Because the AI sector is the import-intensive one, concentrating

[8] The only exception is the trade adjustment cost parameter that we recalibrate to maintain a similar trade elasticity as in the baseline model.

[9] We identify the AI sector with the data-center/compute segment and its associated hardware capital. The AI-capital import share is anchored to the imported content of the underlying hardware commodity (BEA commodity 334, computer and electronic products, which is roughly 65 percent imported) combined with the hardware share of data-center capital expenditure.

[10] Using investment in information-processing equipment relative to the sum of equipment and intellectual-property-products investment in NIPA Table 5.3.5.

Table 2: Additional Calibration: Two-Sector Extension

Parameter		**Non-AI ($k = 1$)**	**AI ($k = 2$)**
Consumption expenditure share	$\gamma^c_{i,k}$	0.98	0.02
Home bias, consumption	$\omega^c_{11,k}$	0.94	0.94
Home bias, materials	$\omega^m_{11,kl}$	0.91	0.91
Home bias, investment	$\omega^I_{11,kl}$	0.75	0.30
IO sourcing share (materials)	$\gamma^m_{i,kl}$	0.80	0.20
IO sourcing share (investment)	$\gamma^I_{i,kl}$	0.80	0.20
Elast. subst. across sectors (C/M/I)	$\varepsilon_c = \varepsilon_m = \varepsilon_I$	1.00	

the investment boom there pulls in imported capital goods far more forcefully than a uniform shock would. **Second**, we keep the consumption and materials tariffs (τ^c_{12} and τ^m_{12}) at their baseline paths, but impose the investment tariff τ^I_{12} *only on the non-AI sector*, mirroring the 2025 carve-outs that spared AI-related hardware. To keep the two exercises comparable, we scale up this non-AI investment tariff so that the *average* tariff on investment goods — weighted across the two sectors — equals the single investment tariff fed into the one-sector model. **Third**, we feed in the same UIP shocks, calibrated to match the realized path of the real exchange rate.

The model continues to match the targeted series (aggregate investment and the exchange rate) by construction. For the untargeted aggregates — GDP, consumption, net exports, and inflation (top and bottom rows) — the two-sector model produces dynamics that are qualitatively and quantitatively close to the one-sector baseline: consumption declines by about half a percent, net exports plunge in 2025Q1 with the front-loading before recovering, and GDP rises by roughly half a percent over the year. The clearest improvement is in the composition of trade in the middle row. The AI-concentrated boom and the AI tariff carve-out together let imported investment goods (Imports I) climb steadily through 2025, tracking the strong data path more tightly than the baseline, while consumption imports (Imports C) fall sharply under the high consumption tariff and material imports (Imports M) show the pronounced Q1 front-loading spike followed by a drawdown. This improvement occurs because the MEI shock in the import-intensive AI sector generates a large increase in demand for imported capital goods, amplifying the trade response precisely where the data are strongest. These results suggest that sectoral heterogeneity in import intensity is an important driver of trade dynamics during 2025, and that the concentration of the AI boom in import-intensive sectors — together with the tariff carve-out that shielded it — played a key role in preventing a trade collapse despite large tariff increases.[11]

[11] Appendix B reports the shock decomposition for the main variables in the two-sector model.

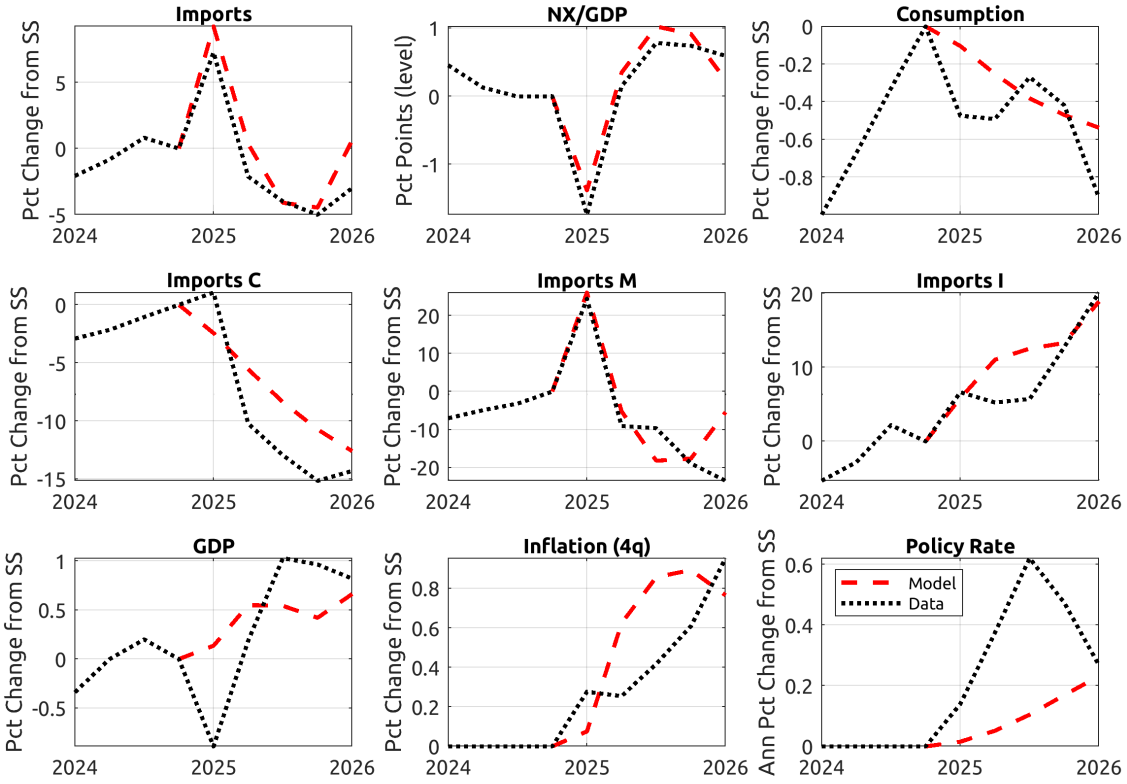


Figure 17: U.S. Data vs. Model: Two-Sector Model

Notes: As in Figure 9, the figure plots the model (red dashed) against the data (black dotted) for untargeted variables, now with the shocks fed through the two-sector (non-AI vs. AI) economy: the MEI shock hits only the AI sector and the investment tariff only the non-AI sector. The data counterpart for GDP, consumption, and imports represents log deviations from a linear trend, normalized to zero in 2024Q4. For inflation and the policy rate we report the difference between actual values and the SPF forecasts from November 2024. See Appendix A for additional details.

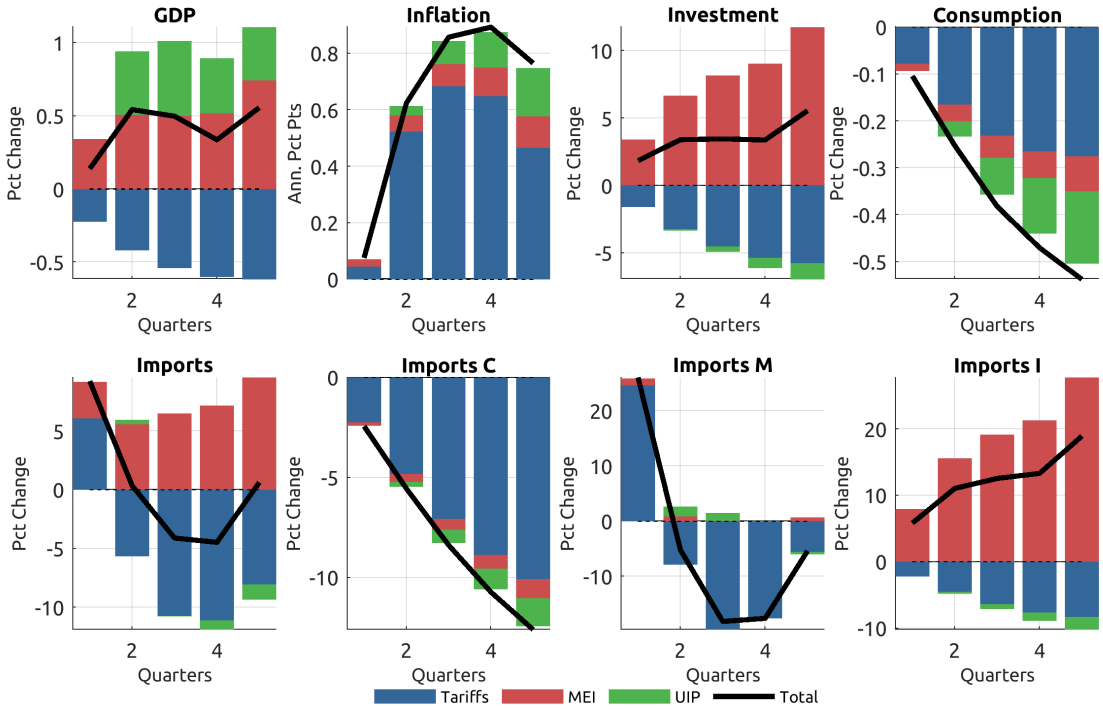


Figure 18: Two-Sector Model: Shock Decomposition

Notes: The figure reports the contribution of tariffs (blue), MEI (red), and UIP (green) to imports and macroeconomic aggregates in the two-sector economy, analogous to Figures 10 and 12. Bars stack the shock contributions; the black line is the total. Values are deviations from the 2024Q4 level. This is a model decomposition and involves no additional data.

D. Model Equations

This appendix collects the full set of equilibrium conditions. Appendix D.1 summarizes the conditions for the one-sector baseline of Section 3. Appendix D.2 states the general multi-sector system used in the extension of Section 3 and solved in Dynare. Throughout, $i, j = 1, \ldots, N$ index countries (country 1 is the U.S.), and in the multi-sector case $k, l = 1, \ldots, S$ index sectors.

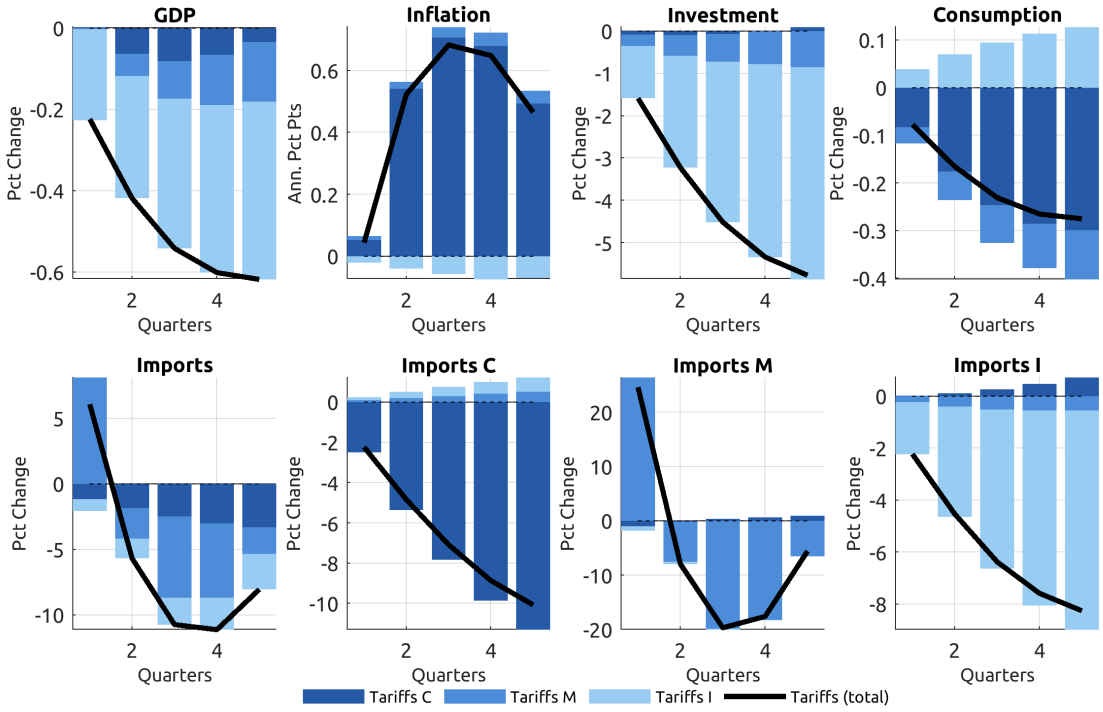


Figure 19: Two-Sector Model: Inside the Tariff Shock

Notes: The figure reports the total tariff contribution in the two-sector economy, split into consumption, intermediate, and investment tariffs, analogous to Figure 11. Bars stack the components; the black line is the combined tariff contribution. Values are deviations from the 2024Q4 level. This is a model decomposition and involves no additional data.

D.1. One-Sector Baseline

Households: intertemporal.

$$\Lambda_{i,t} = \frac{U^c_{i,t}}{U^c_{i,t-1}}, \tag{D.1}$$

$$U^c_{i,t} = (C_{i,t} - hC_{i,t-1})^{-\sigma} - \beta h \left(C_{i,t+1} - hC_{i,t}\right)^{-\sigma}, \tag{D.2}$$

$$1 = \beta E_t \Lambda_{i,t+1} \frac{R^n_{i,t}}{\pi_{i,t+1}}, \tag{D.3}$$

$$1 + \varphi_i \, \xi^{UIP}_{i,t} \left(B_{i1,t} - \bar{b}_i\right) = \beta E_t \Lambda_{i,t+1} \frac{R^n_{1,t}}{\pi_{1,t+1}} \frac{Q_{i1,t+1}}{Q_{i1,t}}, \qquad i \neq 1, \tag{D.4}$$

$$1 = \beta E_t \Lambda_{i,t+1} \frac{r^k_{i,t+1} + (1-\delta_k) Q^k_{i,t+1}}{Q^k_{i,t}}. \tag{D.5}$$

Consumption bundle. The bundle, its import-adjustment cost, and the demand for each source j are

$$C_{i,t} = \left(\sum_{j=1}^{N} \left(\omega_{ij}^{c}\right)^{1/\eta_c} \left((1-\Psi_{ij,t}^{C})C_{ij,t}\right)^{\frac{\eta_c-1}{\eta_c}} \right)^{\frac{\eta_c}{\eta_c-1}}, \qquad \Psi_{ii,t}^{C} = 0, \tag{D.6}$$

$$\Psi_{ij,t}^{C} = \frac{\psi^{C}}{2}\left(\frac{C_{ij,t}}{C_{ij,t-1}} \frac{C_{ii,t-1}}{C_{ii,t}} - 1 \right)^{2}, \tag{D.7}$$

with the intratemporal optimality condition (defining the cum-tariff price $\tau_{ij}^{c} p_{ij,t}$)

$$\begin{aligned} \tau_{ij}^{c} p_{ij,t} = {} & \left(\omega_{ij}^{c}\right)^{1/\eta_c} \left(\frac{C_{i,t}}{C_{ij,t}}\right)^{1/\eta_c} (1-\Psi_{ij,t}^{C})^{-1/\eta_c} p_{i,t}^{c} - \left(\omega_{ij}^{c}\right)^{1/\eta_c} \left(\frac{C_{i,t}}{C_{ij,t}}\right)^{1/\eta_c} (1-\Psi_{ij,t}^{C})^{-1/\eta_c} \frac{\partial \Psi_{ij,t}^{C}}{\partial C_{ij,t}} p_{i,t}^{c} \\ & - \beta E_t \Lambda_{i,t+1} \left(\omega_{ij}^{c}\right)^{1/\eta_c} \left(\frac{C_{i,t+1}}{C_{ij,t+1}}\right)^{1/\eta_c} (1-\Psi_{ij,t+1}^{C})^{-1/\eta_c} \frac{\partial \Psi_{ij,t+1}^{C}}{\partial C_{ij,t}} p_{i,t+1}^{c}, \end{aligned} \tag{D.8}$$

which, absent adjustment costs, reduces to $C_{ij,t} = \omega_{ij}^{c}\left(\tau_{ij}^{c} p_{ij,t}/p_{i,t}^{c}\right)^{-\eta_c} C_{i,t}$, with the consumption-price index normalized to $p_{i,t}^{c} = 1$.

Labor market (sticky wages).

$$(\pi_{i,t}^{w} - 1)\pi_{i,t}^{w} = \frac{\varepsilon_w - 1}{\kappa_w}\left[\frac{\varepsilon_w}{\varepsilon_w - 1} \frac{\bar{\varphi}\, L_{i,t}^{\varphi}}{U_{i,t}^{c}} - w_{i,t} \right] + \beta E_t \Lambda_{i,t+1} (\pi_{i,t+1}^{w} - 1)\pi_{i,t+1}^{w} \frac{L_{i,t+1}}{L_{i,t}}, \tag{D.9}$$

$$\pi_{i,t}^{w} = \frac{w_{i,t}}{w_{i,t-1}} \pi_{i,t}. \tag{D.10}$$

Gross output and value added. Firms combine value added and materials, and value added is Cobb-Douglas in capital and labor:

$$Y_{i,t} = A_{i,t}\left[(1-\nu_i)^{1/\varepsilon_Y} V_{i,t}^{\frac{\varepsilon_Y-1}{\varepsilon_Y}} + \nu_i^{1/\varepsilon_Y} M_{i,t}^{\frac{\varepsilon_Y-1}{\varepsilon_Y}}\right]^{\frac{\varepsilon_Y}{\varepsilon_Y-1}}, \tag{D.11}$$

$$M_{i,t} = \nu_i \left(\frac{p^m_{i,t}}{mc_{i,t}}\right)^{-\varepsilon_Y} Y_{i,t} A_{i,t}^{\varepsilon_Y-1}, \tag{D.12}$$

$$V_{i,t} = (1-\nu_i) \left(\frac{p^v_{i,t}}{mc_{i,t}}\right)^{-\varepsilon_Y} Y_{i,t} A_{i,t}^{\varepsilon_Y-1}, \tag{D.13}$$

$$V_{i,t} = (u_{i,t}K_{i,t-1})^{\alpha_i} L_{i,t}^{1-\alpha_i}, \tag{D.14}$$

$$w_{i,t} = p^v_{i,t}(1-\alpha_i)\frac{V_{i,t}}{L_{i,t}}, \tag{D.15}$$

$$r^k_{i,t} = p^v_{i,t}\alpha_i \frac{V_{i,t}}{K_{i,t-1}}, \tag{D.16}$$

$$\frac{r^k_{i,t}}{u_{i,t}} = \iota_0\iota_1 \exp\big(\iota_1(u_{i,t}-1)\big). \tag{D.17}$$

Materials bundle. Materials are an Armington aggregate across sources with adjustment costs $\Psi^M_{ij,t} = \frac{\psi^M}{2}\big(\frac{M_{ij,t}}{M_{ij,t-1}}\frac{M_{ii,t-1}}{M_{ii,t}} - 1\big)^2$ ($\Psi^M_{ii} = 0$):

$$M_{i,t} = \left(\sum_{j=1}^{N} \left(\omega^m_{ij}\right)^{1/\eta_m} \left((1-\Psi^M_{ij,t})M_{ij,t}\right)^{\frac{\eta_m-1}{\eta_m}}\right)^{\frac{\eta_m}{\eta_m-1}}, \tag{D.18}$$

with demand FOC (defining the imported-materials price $p^m_{ij,t}$)

$$\begin{aligned} p^m_{ij,t} = {} & \left(\omega^m_{ij}\right)^{1/\eta_m}\left(\frac{M_{i,t}}{M_{ij,t}}\right)^{1/\eta_m}(1-\Psi^M_{ij,t})^{-1/\eta_m}p^m_{i,t} - \left(\omega^m_{ij}\right)^{1/\eta_m}\left(\frac{M_{i,t}}{M_{ij,t}}\right)^{1/\eta_m}(1-\Psi^M_{ij,t})^{-1/\eta_m}\frac{\partial\Psi^M_{ij,t}}{\partial M_{ij,t}}p^m_{i,t} \\ & - \beta E_t\Lambda_{i,t+1}\left(\omega^m_{ij}\right)^{1/\eta_m}\left(\frac{M_{i,t+1}}{M_{ij,t+1}}\right)^{1/\eta_m}(1-\Psi^M_{ij,t+1})^{-1/\eta_m}\frac{\partial\Psi^M_{ij,t+1}}{\partial M_{ij,t}}p^m_{i,t+1}, \end{aligned} \tag{D.19}$$

which, absent adjustment costs, reduces to $M_{ij,t} = \omega^m_{ij}\big(p^m_{ij,t}/p^m_{i,t}\big)^{-\eta_m}M_{i,t}$.

Inventories. For each source j the materials producer combines a flow $\tilde{M}_{ij,t}$ drawn from stock with the beginning-of-period stock $S_{ij,t-1}$, and the inventory producer supplies materials pur-

chases $I^s_{ij,t}$ at price $q^s_{ij,t}$:

$$M_{ij,t} = \left[(1-\chi_i)^{1/\varepsilon_S}\tilde{M}_{ij,t}^{\frac{\varepsilon_S-1}{\varepsilon_S}} + \chi_i^{1/\varepsilon_S} S_{ij,t-1}^{\frac{\varepsilon_S-1}{\varepsilon_S}}\right]^{\frac{\varepsilon_S}{\varepsilon_S-1}}, \tag{D.20}$$

$$\tilde{M}_{ij,t} = (1-\chi_i)\left(\frac{q^s_{ij,t}}{p^m_{ij,t}}\right)^{-\varepsilon_S} M_{ij,t}, \tag{D.21}$$

$$q^s_{ij,t} = \beta E_t \Lambda_{i,t+1}\left[p^m_{ij,t+1}\chi_i^{1/\varepsilon_S}\left(\frac{M_{ij,t+1}}{S_{ij,t}}\right)^{1/\varepsilon_S} + (1-\delta_s)q^s_{ij,t+1}\right], \tag{D.22}$$

$$q^s_{ij,t} = \left(1+\gamma_s(I^s_{ij,t}-I^s_{SS})\right)\tau^m_{ij}p_{ij,t}, \tag{D.23}$$

$$S_{ij,t} = (1-\delta_s)S_{ij,t-1} + I^s_{ij,t} - \tilde{M}_{ij,t}. \tag{D.24}$$

Retailers and pricing. Domestic inflation satisfies $\pi_{ii,t} = (p_{ii,t}/p_{ii,t-1})\pi_{i,t}$. The domestic Rotemberg Phillips curve and, under dominant-currency pricing, the export blocks are

$$(\pi_{ii,t}-1)\pi_{ii,t} = \frac{\varepsilon-1}{\kappa_i}\left[mc_{i,t}\frac{\varepsilon}{\varepsilon-1} - p_{ii,t}\right] + \beta E_t\Lambda_{i,t+1}(\pi_{ii,t+1}-1)\pi_{ii,t+1}\frac{X_{ii,t+1}}{X_{ii,t}}, \tag{D.25}$$

$$Q_{ij,t}\,p_{ji,t} = p_{ii,t} \qquad \text{(U.S. exports, } i=1,\ \kappa^*_1=0), \tag{D.26}$$

$$(\pi_{ji,t}-1)\pi_{ji,t} = \frac{\varepsilon-1}{\kappa^*_i}\left[mc_{i,t}\frac{\varepsilon}{\varepsilon-1} - Q_{ij,t}p_{ji,t}\right] + \beta E_t\Lambda_{i,t+1}(\pi_{ji,t+1}-1)\pi_{ji,t+1}\frac{X_{ji,t+1}}{X_{ji,t}} \quad (i=2), \tag{D.27}$$

$$Q_{ij,t} = \frac{Q_{i1,t}}{Q_{j1,t}}, \qquad Q_{ii,t} = 1. \tag{D.28}$$

Investment and capital. The investment bundle is an Armington aggregate with adjustment cost $\Psi^I_{ij,t} = \frac{\psi^I}{2}\left(\frac{I_{ij,t}}{I_{ij,t-1}}\frac{I_{ii,t-1}}{I_{ii,t}} - 1\right)^2$; capital producers choose investment subject to convex costs and the MEI shock $\xi^{MEI}_{i,t}$:

$$I_{i,t} = \left(\sum_{j=1}^{N}\left(\omega^I_{ij}\right)^{1/\eta_I}\left((1-\Psi^I_{ij,t})I_{ij,t}\right)^{\frac{\eta_I-1}{\eta_I}}\right)^{\frac{\eta_I}{\eta_I-1}}, \tag{D.29}$$

$$\begin{aligned}\tau^I_{ij}p_{ij,t} = {}& \left(\omega^I_{ij}\right)^{1/\eta_I}\left(\frac{I_{i,t}}{I_{ij,t}}\right)^{1/\eta_I}(1-\Psi^I_{ij,t})^{-1/\eta_I}p^I_{i,t} - \left(\omega^I_{ij}\right)^{1/\eta_I}\left(\frac{I_{i,t}}{I_{ij,t}}\right)^{1/\eta_I}(1-\Psi^I_{ij,t})^{-1/\eta_I}\frac{\partial\Psi^I_{ij,t}}{\partial I_{ij,t}}p^I_{i,t} \\ & - \beta E_t\Lambda_{i,t+1}\left(\omega^I_{ij}\right)^{1/\eta_I}\left(\frac{I_{i,t+1}}{I_{ij,t+1}}\right)^{1/\eta_I}(1-\Psi^I_{ij,t+1})^{-1/\eta_I}\frac{\partial\Psi^I_{ij,t+1}}{\partial I_{ij,t}}p^I_{i,t+1},\end{aligned} \tag{D.30}$$

$$K_{i,t} = I_{i,t}\,\xi^{MEI}_{i,t} + (1-\delta_k)K_{i,t-1}, \tag{D.31}$$

$$q^k_{i,t}\xi^{MEI}_{i,t} = \left(1+\tfrac{\gamma_I}{2}\left(\tfrac{I_{i,t}}{I_{i,t-1}}-1\right)^2 + \gamma_I\tfrac{I_{i,t}}{I_{i,t-1}}\left(\tfrac{I_{i,t}}{I_{i,t-1}}-1\right)\right)p^I_{i,t} - \beta E_t\Lambda_{i,t+1}\gamma_I\left(\tfrac{I_{i,t+1}}{I_{i,t}}\right)^2\left(\tfrac{I_{i,t+1}}{I_{i,t}}-1\right)p^I_{i,t+1}. \tag{D.32}$$

The investment demand FOC, absent adjustment costs, reduces to $I_{ij,t} = \omega^I_{ij}\big(\tau^I_{ij} p_{ij,t}/p^I_{i,t}\big)^{-\eta_I} I_{i,t}$.

Market clearing, balance of payments, and GDP.

$$Y_{i,t} = \sum_{j=1}^{N} \frac{n_j}{n_i} C_{ji,t} + \sum_{j=1}^{N} \frac{n_j}{n_i} I^s_{ji,t} + \sum_{j=1}^{N} \frac{n_j}{n_i} I_{ji,t} + a(u_{i,t}) K_{i,t-1}, \tag{D.33}$$

$$\sum_{i=1}^{N} B_{i1,t} = 0, \qquad B_{ii,t} = 0 \;\; (i \neq 1), \tag{D.34}$$

$$B_{i1,t} + \tfrac{\varphi_i}{2}\left(B_{i1,t} - \bar{b}_i\right)^2 - B_{i1,t-1} \frac{Q_{i1,t}}{Q_{i1,t-1}} \frac{R^n_{1,t-1}}{\pi_{1,t}} = EX_{i,t} - IM_{i,t}, \tag{D.35}$$

$$EX_{i,t} = Y_{i,t} p_{ii,t} - p_{ii,t} C_{ii,t} - p_{ii,t} I^s_{ii,t} - p_{ii,t} I_{ii,t}, \tag{D.36}$$

$$IM_{i,t} = \sum_{j \neq i} p_{ij,t} C_{ij,t} + \sum_{j \neq i} p_{ij,t} I^s_{ij,t} + \sum_{j \neq i} p_{ij,t} I_{ij,t}, \tag{D.37}$$

$$NX_{i,t} = EX_{i,t} - IM_{i,t}. \tag{D.38}$$

Real GDP can be expressed equivalently on the output and expenditure sides,

$$GDP_{i,t} = Y_{i,t} - \sum_{j=1}^{N} \tilde{M}_{ij,t} = C_{i,t} + I_{i,t} + \sum_{j=1}^{N} \left(I^s_{ij,t} - \tilde{M}_{ij,t}\right) + NX_{i,t}, \tag{D.39}$$

where $a(u_{i,t}) = \iota_0\big(\exp(\iota_1(u_{i,t} - 1)) - 1\big)$.

Monetary policy. The central bank follows an inertial Taylor rule in four-quarter inflation:

$$\log R^n_{i,t} = (1 - \rho_{r,i}) \log R_{SS} + \rho_{r,i} \log R^n_{i,t-1} + (1 - \rho_{r,i}) \kappa_{\pi,i} \log\left(\pi^{4q}_{ii,t}\right) + \xi^m_{i,t}. \tag{D.40}$$

Exogenous processes. Tariffs (with anticipated "news" components at horizon H), TFP, MEI, UIP, and factor-bias shocks follow

$$\log \tau^x_{ij,t} = \rho_{\tau^x} \log \tau^x_{ij,t-1} + \varepsilon^x_{\tau,ij,t} + \varepsilon^{tot}_{\tau,ij,t} + \text{(news terms)}, \qquad x \in \{c, m, I\}, \tag{D.41}$$

$$\log A_{i,t} = \rho_A \log A_{i,t-1} + \varepsilon_{A,i,t}, \tag{D.42}$$

$$\log \xi^{MEI}_{i,t} = \rho_{MEI} \log \xi^{MEI}_{i,t-1} + \varepsilon_{MEI,i,t}, \tag{D.43}$$

$$\log \xi^{UIP}_t = \rho_{UIP} \log \xi^{UIP}_{t-1} + \varepsilon_{UIP,t}. \tag{D.44}$$

D.2. Multi-Sector Model

The multi-sector model adds a sector index $k, l = 1, \ldots, S$. Each final use is built from two nested CES layers: an outer layer across sectors (weights γ, elasticities $\varepsilon_c, \varepsilon_m, \varepsilon_I$) and an inner Armington layer across source countries (weights ω, elasticities η). Investment and materials additionally carry an input-output structure, so a sector-k bundle draws on supplier sectors l. Equations without a sector index are unchanged from Appendix D.1.

Households. The intertemporal conditions are as in Appendix D.1; only the intratemporal block gains the sectoral layer. Consumption is

$$C_{i,t} = \left(\sum_{k=1}^{S} \left(\gamma^c_{i,k}\right)^{1/\varepsilon_c} C_{i,kt}^{\frac{\varepsilon_c - 1}{\varepsilon_c}} \right)^{\frac{\varepsilon_c}{\varepsilon_c - 1}}, \tag{D.45}$$

$$C_{i,kt} = \gamma^c_{i,k} \left(p^c_{i,kt}\right)^{-\varepsilon_c} C_{i,t}, \tag{D.46}$$

$$C_{i,kt} = \left(\sum_{j=1}^{N} \left(\omega^c_{ij,k}\right)^{1/\eta_c} \left((1 - \Psi^C_{ij,kt}) C_{ij,kt}\right)^{\frac{\eta_c - 1}{\eta_c}} \right)^{\frac{\eta_c}{\eta_c - 1}}, \tag{D.47}$$

with $\sum_k \gamma^c_{i,k} = 1$, $\Psi^C_{ij,kt} = \frac{\psi^C}{2}\left(\frac{C_{ij,kt}}{C_{ij,kt-1}} \frac{C_{ii,kt-1}}{C_{ii,kt}} - 1\right)^2$, and demand FOC

$$\tau^c_{ij,k} p_{ij,kt} = \left(\omega^c_{ij,k}\right)^{1/\eta_c} \left(\frac{C_{i,kt}}{C_{ij,kt}}\right)^{1/\eta_c} (1 - \Psi^C_{ij,kt})^{-1/\eta_c} p^c_{i,kt} - (\text{adjustment-cost terms, as in Appendix D.1}). \tag{D.48}$$

Sectoral production and pricing. Each sector produces gross output with its own technology, and nominal rigidities are sector specific (a separate Phillips curve, Rotemberg cost $\kappa_{i,k}$, and

marginal cost $mc_{i,kt}$ per sector):

$$Y_{i,kt} = A_{i,kt}\left[(1-\nu_{i,k})^{1/\varepsilon_Y} V_{i,kt}^{\frac{\varepsilon_Y-1}{\varepsilon_Y}} + \nu_{i,k}^{1/\varepsilon_Y} M_{i,kt}^{\frac{\varepsilon_Y-1}{\varepsilon_Y}}\right]^{\frac{\varepsilon_Y}{\varepsilon_Y-1}}, \tag{D.49}$$

$$M_{i,kt} = \nu_{i,k}\left(\frac{p^m_{i,kt}}{mc_{i,kt}}\right)^{-\varepsilon_Y} Y_{i,kt} A_{i,kt}^{\varepsilon_Y-1}, \tag{D.50}$$

$$V_{i,kt} = (1-\nu_{i,k})\left(\frac{p^v_{i,kt}}{mc_{i,kt}}\right)^{-\varepsilon_Y} Y_{i,kt} A_{i,kt}^{\varepsilon_Y-1}, \tag{D.51}$$

$$V_{i,kt} = \left(u_{i,kt}K_{i,kt-1}\right)^{\alpha_{i,k}\xi^{\alpha}_{i,kt}} L_{i,kt}^{1-\alpha_{i,k}\xi^{\alpha}_{i,kt}}, \tag{D.52}$$

$$w_{i,t} = p^v_{i,kt}\big(1-\alpha_{i,k}\xi^{\alpha}_{i,kt}\big)\frac{V_{i,kt}}{L_{i,kt}}, \tag{D.53}$$

$$r^k_{i,kt} = p^v_{i,kt}\,\alpha_{i,k}\xi^{\alpha}_{i,kt}\frac{V_{i,kt}}{K_{i,kt-1}}, \tag{D.54}$$

$$\frac{r^k_{i,kt}}{u_{i,kt}} = \iota_0\iota_1 \exp\big(\iota_1(u_{i,kt}-1)\big), \tag{D.55}$$

$$(\pi_{ii,kt}-1)\pi_{ii,kt} = \frac{\varepsilon-1}{\kappa_{i,k}}\left[mc_{i,kt}\frac{\varepsilon}{\varepsilon-1} - p_{ii,kt}\right] + \beta E_t\Lambda_{i,t+1}(\pi_{ii,kt+1}-1)\pi_{ii,kt+1}\frac{Y_{i,kt+1}}{Y_{i,kt}}, \tag{D.56}$$

$$Q_{ij,t}p_{ji,kt} = p_{ii,kt} \qquad (i=1), \tag{D.57}$$

$$(\pi_{ji,kt}-1)\pi_{ji,kt} = \frac{\varepsilon-1}{\kappa^*_{i,k}}\left[mc_{i,kt}\frac{\varepsilon}{\varepsilon-1} - Q_{ij,t}p_{ji,kt}\right] + \beta E_t\Lambda_{i,t+1}(\pi_{ji,kt+1}-1)\pi_{ji,kt+1}\frac{Y_{i,kt+1}}{Y_{i,kt}} \quad (i=2). \tag{D.58}$$

Intermediate bundles with input-output structure. Sector-k materials draw on supplier sectors l, then on countries j:

$$M_{i,kt} = \left(\sum_{l=1}^{S}\left(\gamma^m_{i,kl}\right)^{1/\varepsilon_m} M_{i,kl,t}^{\frac{\varepsilon_m-1}{\varepsilon_m}}\right)^{\frac{\varepsilon_m}{\varepsilon_m-1}}, \tag{D.59}$$

$$M_{i,kl,t} = \gamma^m_{i,kl}\left(\frac{p^m_{i,kl,t}}{p^m_{i,kt}}\right)^{-\varepsilon_m} M_{i,kt}, \tag{D.60}$$

$$M_{i,kl,t} = \left(\sum_{j=1}^{N}\left(\omega^m_{ij,kl}\right)^{1/\eta_m}\left((1-\Psi^M_{ij,klt})M_{ij,kl,t}\right)^{\frac{\eta_m-1}{\eta_m}}\right)^{\frac{\eta_m}{\eta_m-1}}, \tag{D.61}$$

with $\sum_l \gamma^m_{i,kl} = 1$, $\Psi^M_{ij,klt} = \frac{\psi^M}{2}\big(\frac{M_{ij,klt}}{M_{ij,klt-1}}\frac{M_{ii,klt-1}}{M_{ii,klt}} - 1\big)^2$, and the demand FOC defining $p^m_{ij,kl,t}$ having the same form as in Appendix D.1 with the kl index appended (reducing to $M_{ij,kl,t} = \omega^m_{ij,kl}\big(\tau^m_{ij,l}p_{ij,lt}/p^m_{i,kl,t}\big)^{-\eta_m}M_{i,kl,t}$ absent adjustment costs).

Sector-level inventories. Inventories are held over each bilateral supplier-sector input flow $M_{ij,kl,t}$:

$$M_{ij,kl,t} = \left[(1-\chi_{i,k})^{1/\varepsilon_S} \tilde{M}_{ij,kl,t}^{\frac{\varepsilon_S-1}{\varepsilon_S}} + \chi_{i,k}^{1/\varepsilon_S} S_{ij,kl,t-1}^{\frac{\varepsilon_S-1}{\varepsilon_S}}\right]^{\frac{\varepsilon_S}{\varepsilon_S-1}}, \tag{D.62}$$

$$\tilde{M}_{ij,kl,t} = (1-\chi_{i,k}) \left(\frac{q^s_{ij,kl,t}}{p^m_{ij,kl,t}}\right)^{-\varepsilon_S} M_{ij,kl,t}, \tag{D.63}$$

$$q^s_{ij,kl,t} = \beta E_t \Lambda_{i,t+1} \left[p^m_{ij,kl,t+1} \chi_{i,k}^{1/\varepsilon_S} \left(\frac{M_{ij,kl,t+1}}{S_{ij,kl,t}}\right)^{1/\varepsilon_S} + (1-\delta_s) q^s_{ij,kl,t+1}\right], \tag{D.64}$$

$$q^s_{ij,kl,t} = \left(1+\gamma_s(I^s_{ij,kl,t} - I^s_{SS})\right) \tau^m_{ij,l} p_{ij,lt}, \tag{D.65}$$

$$S_{ij,kl,t} = (1-\delta_s) S_{ij,kl,t-1} + I^s_{ij,kl,t} - \tilde{M}_{ij,kl,t}. \tag{D.66}$$

Investment with input-output structure. Sector-k capital is assembled from investment goods sourced across supplier sectors l and then countries j:

$$I_{i,kt} = \left(\sum_{l=1}^{S} \left(\gamma^I_{i,kl}\right)^{1/\varepsilon_I} I_{i,kl,t}^{\frac{\varepsilon_I-1}{\varepsilon_I}}\right)^{\frac{\varepsilon_I}{\varepsilon_I-1}}, \tag{D.67}$$

$$I_{i,kl,t} = \gamma^I_{i,kl} \left(\frac{p^I_{i,kl,t}}{p^I_{i,kt}}\right)^{-\varepsilon_I} I_{i,kt}, \tag{D.68}$$

$$I_{i,kl,t} = \left(\sum_{j=1}^{N} \left(\omega^I_{ij,kl}\right)^{1/\eta_I} \left((1-\Psi^I_{ij,klt}) I_{ij,kl,t}\right)^{\frac{\eta_I-1}{\eta_I}}\right)^{\frac{\eta_I}{\eta_I-1}}, \tag{D.69}$$

$$I_{ij,kl,t} = \omega^I_{ij,kl} \left(\frac{\tau^I_{ij,l} p_{ij,lt}}{p^I_{i,kl,t}}\right)^{-\eta_I} I_{i,kl,t}, \tag{D.70}$$

$$K_{i,kt} = I_{i,kt}\, \xi^{MEI}_{i,kt} + (1-\delta_k) K_{i,kt-1}, \tag{D.71}$$

$$I_{i,t} = \sum_{k=1}^{S} I_{i,kt}, \tag{D.72}$$

with the sector-specific Tobin's-q condition taking the same form as in Appendix D.1 indexed by (i,k), and $\Psi^I_{ij,klt} = \frac{\psi^I}{2}\left(\frac{I_{ij,klt}}{I_{ij,klt-1}} \frac{I_{ii,klt-1}}{I_{ii,klt}} - 1\right)^2$.

Market clearing, balance of payments, and GDP. Market clearing holds sector by sector:

$$Y_{i,kt} = \sum_{j=1}^{N} \frac{n_j}{n_i} C_{ji,kt} + \sum_{j=1}^{N}\sum_{l=1}^{S} \frac{n_j}{n_i} I^s_{ji,lk,t} + \sum_{j=1}^{N}\sum_{l=1}^{S} \frac{n_j}{n_i} I_{ji,lk,t} + a(u_{i,kt}) K_{i,kt-1}, \tag{D.73}$$

$$L_{i,t} = \sum_{k=1}^{S} L_{i,kt}, \qquad \sum_{i=1}^{N} B_{i1,t} = 0, \qquad B_{ii,t} = 0 \ (i \neq 1), \tag{D.74}$$

$$EX_{i,t} = \sum_{k=1}^{S} Y_{i,kt} p_{ii,kt} - \sum_{k=1}^{S} p_{ii,kt} C_{ii,kt} - \sum_{k=1}^{S}\sum_{l=1}^{S} p_{ii,lt} I^{s}_{ii,kl,t} - \sum_{k=1}^{S}\sum_{l=1}^{S} p_{ii,lt} I_{ii,kl,t}, \tag{D.75}$$

$$IM_{i,t} = \sum_{k=1}^{S}\sum_{j\neq i} p_{ij,kt} C_{ij,kt} + \sum_{k=1}^{S}\sum_{l=1}^{S}\sum_{j\neq i} p_{ij,lt} I^{s}_{ij,kl,t} + \sum_{k=1}^{S}\sum_{l=1}^{S}\sum_{j\neq i} p_{ij,lt} I_{ij,kl,t}, \tag{D.76}$$

$$NX_{i,t} = EX_{i,t} - IM_{i,t}. \tag{D.77}$$

Real GDP nets sector-k gross output of the materials it uses, or equivalently sums final expenditure:

$$GDP_{i,t} = \sum_{k=1}^{S} \left(Y_{i,kt} - \tilde{M}_{i,kt}\right) = C_{i,t} + I_{i,t} + \sum_{j=1}^{N}\sum_{k=1}^{S}\sum_{l=1}^{S} \left(I^{s}_{ij,kl,t} - \tilde{M}_{ij,kl,t}\right) + NX_{i,t}. \tag{D.78}$$

The balance-of-payments identity, the Taylor rule, and the exogenous processes (now country-sector-specific for $A_{i,kt}$, $\xi^{MEI}_{i,kt}$, $\xi^{\alpha}_{i,kt}$, and country-pair-sector-specific for the tariffs $\tau^{x}_{ij,kt}$) are as in Appendix D.1.