Tariffs, Manufacturing Employment, and Supply Chains

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Abstract

I use a dynamic general-equilibrium model with supply-chain adjustment frictions to study the effects of tariffs on manufacturing employment. The model has four distinct manufacturing sectors: upstream goods with high trade elasticities ("oil"); upstream goods with low trade elasticities ("steel"); downstream goods with high trade elasticities ("toys"); and downstream goods with low trade elasticities ("cars"). Across-the-board tariffs on all imports reduce manufacturing employment more in the short run than the long run. Targeted tariffs on "steel" or "cars" reduce overall manufacturing employment while tariffs on "toys" or "oil" increase it, but only the protected sectors grow; employment falls in all other manufacturing sectors. In all scenarios, the trade deficit shrinks in the short run but grows in the long run.

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1 Introduction

U.S. trade policy in the second Trump administration is predicated on the premise that free trade has "deindustrialized" the country and that tariffs are needed to rebuild the manufacturing sector. However, U.S. manufacturing firms rely heavily on imported intermediate inputs, especially upstream industries like steel, aluminum, and semiconductors. Moreover, ramping up domestic manufacturing requires investments that take years to pay off. This paper studies how tariffs affect manufacturing employment dynamics using a general-equilibrium model with a detailed input-output production structure and convex costs of adjusting intermediate inputs and reallocating factors across sectors.

The model has four key features: international trade in both intermediate inputs and final goods, so that a tariff on one sector affects others through supply-chain linkages; costs of adjusting intermediate inputs, which make shocks to upstream sectors ramify slowly down the supply chain (Liu and Tsyvinski, 2024); costs of reallocating factors across sectors, so that protected sectors cannot scale up quickly; and endogenous bilateral and aggregate trade imbalances.

The model is calibrated to the 2020 OECD inter-country input-output table (OECD, 2023), with four regions: the United States, China, and two groups of other trade partners that faced below- and above-median tariff increases in 2025. I divide the goods sector into subsectors by clustering its industries on their trade elasticities and their positions in the supply chain (Antràs et al., 2012), which identifies four distinct goods sectors: (i) high-elasticity upstream goods like petroleum; (ii) low-elasticity upstream goods like metals; (iii) high-elasticity downstream goods like textiles and electronics; and (iv) low-elasticity downstream goods like vehicles and machinery.

I use the calibrated model to evaluate the impact of tariffs on the dynamics of employment in each of the four goods sectors. The results highlight four main results. First, broad-based tariffs reduce overall goods employment in the short run more than in the long run due to adjustment frictions.[1] Second, narrowly targeted tariffs can raise overall goods employment, but they induce more reallocation across individual goods sectors than net growth: the protected sector always gains at the expense of the other three. Third, there is a tradeoff between goods employment and aggregate output: tariffs on "toys", which raise goods employment the most, reduce real GDP.[2] Fourth, tariffs reduce the trade deficit in the short run, but they actually increase it in the long run, which pushes more workers out of the goods sector.

[1] The long-run effect is negative in my baseline calibration and many of the alternatives I consider in the sensitivity analyses shown in the appendix, but it is positive in one alternative calibration with much higher trade elasticities.

[2] Tariffs on "oil," which also raise goods employment, increase output slightly in the baseline calibration, but this result is sensitive to my choice of trade elasticities.

This paper contributes to the growing literature on the effects of tariffs on the manufacturing sector. Itskhoki and Mukhin (2025) show that tariffs are ineffective at boosting manufacturing employment, and that the optimal tariff is lower if manufacturing employment is one of the social planner's objectives. Flaaen and Pierce (2024) show that steel and aluminum tariffs in the first Trump administration reduced U.S. manufacturing employment by making inputs more expensive. Cuba-Borda et al. (2025) show that shocks to intermediate input tariffs cause persistent increases in inflation.

The paper also contributes to the broader literature on the effects of tariffs during the second Trump administration, such as Ignatenko et al. (2025), Pujolas and Rossbach (2024), Cavallo et al. (2025), and Alessandria et al. (2025a). My results indicate that the 2025 tariff shock would reduce manufacturing employment in both the short run and the long run. The high-elasticity downstream sector ("toys") would be the only sector that expands—employment in the rest of the manufacturing sector, including industries like cars where tariffs were justified by "national security" concerns, would fall.

2 Model

The model builds on Kehoe et al. (2018) and Steinberg (2020). There are I countries indexed by i, j and S sectors indexed by s, r. Each country is populated by a household that works, consumes, and saves; a producer in each sector that transforms capital, labor, and intermediate inputs into gross output; a distributor in each sector that combines domestic and foreign products into nontradable composites; a retailer that combines these composites into consumption and investment goods; and a government that levies import tariffs.

2.1 Producers

In each country i and sector s, a representative producer uses capital, labor, and intermediate inputs to create output according to a constant-elasticity-of-substitution technology, net of the cost of adjusting employment as in Kehoe and Ruhl (2009) and Sargent (1978):

$$Y_{i,t}^s = \left\{ (\lambda_i^{s,v})^{\frac{1}{\eta}} \left[(K_{i,t}^s)^{\alpha_i^s} (L_{i,t}^s)^{1-\alpha_i^s} \right]^{\frac{\eta-1}{\eta}} + \left[\sum_{r=1}^{S} (\lambda_i^{s,r})^{\frac{1}{\xi}} \left(M_{i,t}^{s,r} \right)^{\frac{\xi-1}{\xi}} \right]^{\frac{\eta-1}{\eta}\frac{\xi}{\xi-1}} \right\}^{\frac{\eta}{\eta-1}} - \phi_L \left(\frac{L_{i,t}^s}{L_{i,t-1}^s} - 1 \right)^2 L_{i,t-1}^s. \tag{1}$$

$Y_{i,t}^s$ is the producer's gross output, and $K_{i,t}^s$, $L_{i,t}^s$, and $M_{i,t}^{s,r}$ are its capital, labor, and intermediate inputs from sector r. The parameters are: $\lambda_i^{s,v}$, value added's share of gross output; α_i^s, capital's share of value added; $\lambda_i^{s,r}$, the share of sector-r intermediates in gross output; η, the elasticity of substitution between value added and intermediates; ξ, the elasticity of

substitution between intermediates from different sectors; and ϕ_L, the labor adjustment cost.

Capital adjustment costs are modeled as in Lucas and Prescott (1971) and Eaton et al. (2016). The law of motion for sectoral capital is

$$K^s_{i,t+1} = (1-\delta)K^s_{i,t} + \Phi\left(\frac{X^s_{i,t}}{K^s_{i,t}}\right)K^s_{i,t}, \qquad \Phi(x) = \frac{1}{\phi_K}\left[\delta^{1-\phi_K}x^{\phi_K} - (1-\phi_K)\delta\right] \tag{2}$$

where $X^s_{i,t}$ is investment, δ is the depreciation rate, and ϕ_K governs the size of capital adjustment costs.

Producers choose employment, investment, and intermediate inputs in each period to maximize the present value of their dividends,

$$\sum_{t=0}^{\infty}\Lambda_{i,t}\left[P^{s,y}_{i,t}Y^s_{i,t} - W_{i,t}L^s_{i,t} - P^x_{i,t}X^s_{i,t} - \sum_{r=1}^{S}P^{r,m}_{i,t}M^{s,r}_{i,t}\right], \tag{3}$$

where $P^{s,y}_{i,t}$ is the price of the producer's output, $W_{i,t}$ is the wage in country i, $P^x_{i,t}$ is the price of investment in country i, $P^{r,m}_{i,t}$ is the price of the intermediate composite from sector r in country i, and $\Lambda_{i,t}$ is the date-0 price of one unit of the numeraire delivered in period t, as valued by country i's household, which owns the producer.

2.2 Distributors

Each country i and sector s has a distributor that aggregates the products of domestic and foreign producers in that sector into nontradable composites as in Armington (1969). Final goods and intermediate inputs are aggregated separately; I describe only the intermediate distributor.

$$G^{s,m}_{i,t} = \left[\sum_{j=1}^{I}\mu^{s,m}_{i,j}\left(Z^{s,m}_{i,j,t}\right)^{\frac{\zeta^s-1}{\zeta^s}}\right]^{\frac{\zeta^s}{\zeta^s-1}} - \phi_Z\sum_{j=1}^{I}\left(\frac{Z^{s,m}_{i,j,t}}{Z^{s,m}_{i,j,t-1}} - 1\right)^2 Z^{s,m}_{i,j,t-1}, \tag{4}$$

where $G^{s,m}_{i,t}$ is the intermediate composite, $Z^{s,m}_{i,j,t}$ is the quantity purchased from country j, $\mu^{s,m}_{i,j}$ is the expenditure share on products from country j, and ζ^s is the elasticity of substitution between countries, also known as the Armington elasticity. It differs across sectors, which plays a crucial role in the calibration.

The second term is the cost of adjusting the quantity purchased from each source country, which takes the quadratic form from Steinberg (2020) and Liu and Tsyvinski (2024). As Steinberg (2020) shows, these adjustment costs imply that the elasticity of imports to a change in tariffs will be lower in the short run than in the long run.

Like producers, distributors choose inputs to maximize the present value of their divi-

dends,

$$\sum_{t=0}^{\infty} \Lambda_{i,t} \left[P_{i,t}^{s,m} G_{i,t}^{s,m} - \sum_{j=1}^{I} P_{j,t}^{s,y} (1 + \tau_{i,j,t}^{s}) Z_{i,j,t}^{s,m} \right], \tag{5}$$

where $P_{i,t}^{s,m}$ is the price of the sectoral intermediate composite and $\tau_{i,j,t}^{s}$ is the tariff levied by country i on sector-s products from country j. The final distributor's technology and problem are identical with f in place of m: it buys $Z_{i,j,t}^{s,f}$ from each country j, combines these purchases into the final composite $G_{i,t}^{s,f}$ using share parameters $\mu_{i,j}^{s,f}$, and sells the composite at price $P_{i,t}^{s,f}$.

2.3 Retailers

Each country i has retailers that combine the final distributors' sectoral composites into nontradable consumption and investment goods. The retailers' technologies are

$$C_{i,t} = \left[\sum_{s=1}^{S} \varepsilon_i^{s,c} \left(Z_{i,t}^{s,c} \right)^{\frac{\rho^c - 1}{\rho^c}} \right]^{\frac{\rho^c}{\rho^c - 1}}, \quad X_{i,t} = \left[\sum_{s=1}^{S} \varepsilon_i^{s,x} \left(Z_{i,t}^{s,x} \right)^{\frac{\rho^x - 1}{\rho^x}} \right]^{\frac{\rho^x}{\rho^x - 1}}, \tag{6}$$

where $C_{i,t}$ and $X_{i,t}$ are the consumption and investment goods, $Z_{i,t}^{s,c}$ and $Z_{i,t}^{s,x}$ are the quantities of the sector-s final composite used to produce them, $\varepsilon_i^{s,c}, \varepsilon_i^{s,x}$ are the sectoral expenditure shares, and ρ^c, ρ^x are the elasticities of substitution between sectors. Construction is not traded and is used only to produce investment goods: $\varepsilon_i^{s,c} = 0$ for construction, and the investment retailer buys construction output directly from the domestic construction producer, so $Z_{i,t}^{s,x}$ is construction output in that sector.

2.4 Households

The representative household in country i has preferences over consumption $C_{i,t}$ given by

$$\sum_{t=0}^{\infty} \beta^t \frac{1}{1-\gamma} C_{i,t}^{1-\gamma}, \tag{7}$$

where β is the discount factor and $1/\gamma$ is the intertemporal elasticity of substitution. Labor $\bar{L}_i$ is supplied inelastically. Households choose consumption and saving, which takes the form of internationally traded bonds, $B_{i,t+1}$, to maximize lifetime utility subject to the budget constraints,

$$P_{i,t}^{c} C_{i,t} + Q_t B_{i,t+1} = W_{i,t} \bar{L}_i + B_{i,t} + D_{i,t} + T_{i,t}, \tag{8}$$

where $P_{i,t}^{c}$ and $W_{i,t}$ are the consumption price and wage rate in country i, respectively; Q_t is the price of a bond that pays one unit of the numeraire, a U.S. consumer price index, in period $t+1$; $D_{i,t}$ is the sum of all dividends generated by country i's producers and

distributors; and $T_{i,t}$ is a transfer from country i's government. Producers and distributors value dividends at the household's present-value prices, $\Lambda_{i,t} = \beta^t (C_{i,t}/C_{i,0})^{-\gamma} (P^c_{i,0}/P^c_{i,t})$.

2.5 Equilibrium

An equilibrium is a sequence of prices and quantities that collectively solve the problems of the agents described above and satisfy the following market clearing conditions:

$$Y^s_{i,t} = \sum_{j=1}^{I} \left(Z^{s,m}_{j,i,t} + Z^{s,f}_{j,i,t} \right), \tag{9}$$

$$G^{s,m}_{i,t} = \sum_{r=1}^{S} M^{r,s}_{i,t}, \tag{10}$$

$$G^{s,f}_{i,t} = Z^{s,c}_{i,t} + Z^{s,x}_{i,t}, \tag{11}$$

$$X_{i,t} = \sum_{s=1}^{S} X^s_{i,t}, \tag{12}$$

$$\bar{L}_i = \sum_{s=1}^{S} L^s_{i,t}, \tag{13}$$

$$0 = \sum_{i=1}^{I} B_{i,t+1}. \tag{14}$$

If tariffs are constant in the long run, the economy converges to a steady state. As in Kehoe et al. (2018), however, the steady state is not unique: any vector of long-run bondholdings $(B_{i,\infty})_{i=1}^I$ is consistent with a steady state, and the one the economy reaches depends on the transition. Thus, trade imbalances are endogenous both along the transition and in the long run, and the adjustment-cost parameters ϕ_L, ϕ_K, ϕ_Z, which do not enter the steady-state conditions directly, still affect long-run outcomes.

3 Calibration

The model's production technologies are calibrated so that its free-trade steady state replicates the most recent OECD inter-country input-output (ICIO) table,[3] and its adjustment costs make the short-run trade response to tariff increases consistent with empirical estimates. The strategy is similar to Steinberg (2020), except for how I aggregate goods industries. Table 1 summarizes the model calibration.

[3] https://www.oecd.org/en/data/datasets/inter-country-input-output-tables.html.

3.1 Sectoral aggregation

I first aggregate the ICIO data. I use the United States and China as separate countries and split all other countries into two regions: low-tariff partners, which received below-median tariff increases in 2025; and high-tariff partners, which received above-median increases. The low-tariff group, which accounts for 51% of U.S. goods imports, includes Canada, Mexico, the European Union, the United Kingdom, Switzerland, and Taiwan. The high-tariff group, which accounts for 27% of imports, includes Japan, Korea, India, Brazil, and most of Southeast Asia. This split allows me to study trade diversion (Section 4.5).

Following Kehoe et al. (2018), I aggregate industries into goods (ISIC codes A–C), services (D–E and G–T), and construction (F). Construction is the only nontraded sector and is used only to produce investment goods, so if reindustrialization requires new capital, some employment that could otherwise shift to goods must instead flow into the construction sector, at least temporarily.

I then cluster the goods industries along two dimensions: the trade elasticity, which governs how easily domestic products substitute for foreign ones, which I take from Caliendo and Parro (2015); and position in the supply chain, measured by Antràs et al. (2012)'s upstreamness, which governs how shocks to one industry spread to others. A hierarchical clustering procedure, first on upstreamness and then on the trade elasticity, identifies four sectors (Panel (a) of Table 1): (i) high-elasticity upstream goods like raw minerals and refined petroleum ("oil"); (ii) low-elasticity upstream goods like chemicals, plastics, and basic metals ("steel"); (iii) high-elasticity downstream goods like textiles and electronics ("toys"); and (iv) low-elasticity downstream goods like machinery and vehicles ("cars").

Figure 1 shows the U.S. supply chain and the exposure of each sector to trade. "Oil" and "steel" sell mostly intermediate inputs to other sectors, especially "cars" and construction, while "toys" buys relatively few intermediate inputs and sells mainly to services. The United States runs a trade deficit in every goods sector. "Toys" is by far the most exposed to trade relative to its size, and "cars" has the largest imports in absolute terms. Imports of "oil" and "steel" are mostly intermediate inputs, while imports of "toys" and "cars" are mostly final goods.

3.2 Producer parameters

The elasticity of substitution between value added and intermediates, η, and the elasticity of substitution between intermediates from different sectors, ξ, are set to zero based on Atalay (2017), who estimates them to be 0.05 and 0.03, respectively. Following Kehoe et al. (2018), the capital shares, α_i^s, are set to match an aggregate capital share of 0.34 and the sectoral shares of labor compensation in 2023 as reported by the U.S. Bureau of Economic Analysis. Given these values, the share parameters, $\lambda_i^{s,v}$ and $\lambda_i^{s,r}$, are set so that the entries in the

ICIO satisfy the producers' first-order conditions. The capital adjustment cost, ϕ_K, is set to the value used by Steinberg (2019b). The labor adjustment cost, ϕ_L, is set to the value used by Kehoe and Ruhl (2009). The initial capital stock in each sector, $K^s_{i,0}$, is set so that each country's aggregate level of investment in the ICIO table is consistent with a steady state.

3.3 Distributor parameters

For the goods sectors, I set the long-run Armington elasticities, ζ^s, by reconciling the high industry-level estimates of Caliendo and Parro (2015) with the lower estimates for the goods sector as a whole from Kehoe et al. (2018) and Steinberg (2019b). Steinberg (2019b) also shows that the trade balance for intermediate inputs, which are mostly upstream goods, is more volatile than that for final goods, which implies a higher elasticity for the former.

I set ζ^s to eight for high-elasticity upstream goods ("oil"), two for low-elasticity upstream goods ("steel"), four for high-elasticity downstream goods ("toys"), and one for low-elasticity downstream goods ("cars"). For the services sector, I use Kehoe et al. (2018)'s estimate of one, which is consistent with the very low volatility of the U.S. services trade balance. These values are chosen rather than estimated: they preserve the ranking of the sector-level estimates of Caliendo and Parro (2015) while bringing their levels down toward the estimates for the goods sector as a whole. The appendix describes how I compute the sector-level estimates and reports results under alternative values of ζ^s.

Given these values, the expenditure shares, $\mu^{s,m}_{i,j}, \mu^{s,f}_{i,j}$ are set so that the entries in the ICIO satisfy the distributors' first-order conditions when all tariffs are set to zero. The supply-chain adjustment cost, ϕ_Z, is chosen so that the short-run trade elasticity following an unanticipated symmetric tariff on all goods from all countries is 0.5, which is in the middle of the range of empirical estimates.[4]

3.4 Retailer parameters

The elasticity of substitution between different sectors in consumption, ρ^c, is set to Atalay (2017)'s estimate of 0.65. The elasticity of substitution between sectors in investment, ρ^x, is set to 1 as in Bems (2008) and Kehoe et al. (2018). Given these values, the expenditure shares, $\varepsilon^{s,c}_i, \varepsilon^{s,x}_i$, are set so that the ICIO data satisfy the retailers' first-order conditions.

3.5 Household parameters

The household's discount factor, β, is set to match a long-run real interest rate of 2%. The intertemporal elasticity of substitution, $1/\gamma$, is set to 0.5. Each country's aggregate

[4] I measure it as the one-period change in the ratio of imported to domestic purchases relative to the change in their relative price, averaged across goods sectors and partners using base-period trade weights. Estimates range from 0.2 (Alessandria and Choi, 2021) to 0.95 (Gallaway et al., 2003); see also Heathcote and Perri (2002) and Boehm et al. (2023). The appendix reports results with short-run elasticities of 0.2 and 1.

labor supply, $\bar{L}_i$, is set to its total labor compensation in the ICIO data, with the initial wage normalized to one. Initial bondholdings are set so that, in the absence of tariffs introduced in the next section, the ICIO data represent a stationary equilibrium, which requires each country's current account to be balanced at the observed trade imbalances: $B_{i,0} = -NX_i/(1-\beta)$, where NX_i is country i's trade balance in the ICIO data.[5]

4 Experiments

I now evaluate how U.S. import tariffs affect employment in each of the four goods sectors. I first study tariffs on all trade partners, on each goods sector separately and on all four together. Each experiment sets the relevant tariff to 25%, the rate the Trump administration has applied in most of its Section 232 ("national security") tariff orders. All experiments are unanticipated, once-and-for-all reforms. I then turn to macroeconomic outcomes and to other scenarios: tariffs on one region, frictionless adjustment, retaliation, and the 2025 tariffs.

Throughout, goods employment is defined as the total quantity of labor used across the four goods sectors. Because each country's aggregate labor is fixed, changes in goods employment represent reallocation of workers between the goods sectors and the rest of the economy (services and construction). The model does not distinguish between workers and hours and there is no unemployment. The appendix reports the numbers behind the figures in this section.

4.1 Reindustrialization vs. reallocation in the long run

Panel (a) of Figure 2 shows how tariffs affect employment in U.S. goods sectors in the long run. The effects on overall goods employment differ greatly depending on which sector is targeted. The biggest long-run employment gain is achieved by a tariff on high-elasticity downstream goods ("toys"), which increases total goods employment by about 0.8%. Domestic products in this sector are highly substitutable for foreign ones, and it is the most exposed to imports: imports equal 74% of U.S. gross output in this sector, compared with 16–25% in the other goods sectors. The "toys" sector gains workers equal to about 4% of goods employment, almost five times the increase in overall goods employment, while employment in the other three goods sectors falls.

The biggest long-run employment loss is caused by a tariff on low-elasticity downstream

[5]Thus, the United States, which runs a trade deficit, is a net creditor in the model, unlike in the data. The United States has long earned positive net investment income despite a negative net international investment position, which Gourinchas and Rey (2007) attribute to a return differential and Hausmann and Sturzenegger (2007) to unmeasured "dark matter" assets. $B_{i,0}$ should therefore be read as the capitalized value of net income flows. Starting from observed positions would make the pre-tariff benchmark equilibrium a long transition toward current account balance, as in Kehoe et al. (2018), and mix the effects of tariffs with that transition. This approach isolates the effects of tariffs.

goods ("cars"), which reduces overall goods employment by about 1.8%. Substituting away from foreign products is harder in this sector. In this scenario, employment in the "cars" sector itself does rise, but only slightly, and employment in the other three goods sectors falls by more than three times as much.

The effects of tariffs on upstream goods also depend on the trade elasticity. Tariffs on high-elasticity upstream goods ("oil") increase total goods employment in the long run by about 0.4%. The "oil" sector gains workers equal to 2.7% of goods employment, and the other three goods sectors collectively lose 2.3%, most of it in the high-elasticity downstream sector ("toys"), which loses 1.6%. "Toys", the sector most exposed to import competition, bears the brunt of the real appreciation that accompanies the tariff. Tariffs on low-elasticity upstream goods ("steel"), in contrast, reduce total goods employment by about 0.4%. The "steel" sector gains workers equal to 0.8% of goods employment, but the other three goods sectors collectively lose about 1.6 times as many, mostly in "oil".

Tariffs on all goods sectors together reduce goods employment in the long run by about 1.2%, even though tariffs on two of the four sectors increase it when levied alone. In this scenario, the "toys" sector is the only one that gains workers, and it gains far fewer than in the "toys"-only scenario; the other three sectors all lose workers, especially "oil". The reason is that a tariff on all goods covers far more imports than a tariff on any single sector, so it has much larger effects on the U.S. terms of trade. The dollar appreciates in real terms by 14% in the long run, compared with 1–5% under tariffs on individual sectors, which crowds out U.S. exports in every sector. The terms-of-trade gain raises real consumption permanently, and much of the additional spending goes to services, drawing more workers out of the goods sectors. Thus, the economy-wide effects of a broad-based tariff more than offset the gains from protecting individual sectors.

These results depend on the long-run Armington elasticities ζ_s, over which I have exercised some discretion in the calibration. The appendix reports the results under six alternative sets of elasticities, including the higher values implied by Caliendo and Parro (2015) and the lower values of Kehoe et al. (2018). In every case, tariffs on "steel" and "cars" lower long-run goods employment, and in every case but one, tariffs on "toys" raise it (with a uniform elasticity of two, the effect is -0.04%). The gain from tariffs on "oil" is less robust: in five of the seven cases, tariffs on "oil" lower goods employment slightly. The long-run effect of tariffs on all goods depends on the average level of the elasticities: it is negative whenever the average elasticity is five or less, but positive under the much higher Caliendo and Parro (2015) elasticities.

4.2 Adjustment dynamics

Panels (b) through (f) show how employment in each goods sector evolves over time, relative to total pre-tariff goods employment.

Tariffs on high-elasticity downstream goods ("toys") raise employment in that sector steadily, while reducing employment in the other three goods sectors at about the same pace. Because the gain in "toys" is only somewhat larger than the losses elsewhere, overall goods employment grows slowly: it falls slightly on impact and is about 0.2% higher after five years and 0.5% higher after ten years, compared with 0.8% in the long run. The dynamics are similar for tariffs on "steel", "oil", and "cars". In each case, overall goods employment moves gradually toward its long-run level, with little or no overshooting.

The effects of adjustment frictions are most visible in the case of tariffs on all four goods sectors together. Overall goods employment falls by 0.7% on impact and continues to fall for seven years, reaching a trough of 1.6% below its pre-tariff level, before partially recovering to its long-run level of about 1.2% below. The three sectors that lose workers in the long run—"oil", "steel", and "cars"—contract quickly, reaching their long-run levels within about five years, while employment in the "toys" sector does not rise above its pre-tariff level until year 4 and expands only gradually after that, as the sector accumulates capital and as distributors shift their purchases from foreign to domestic suppliers. Thus, goods employment falls by more in the short run than in the long run, and it never returns to its pre-tariff level.

4.3 Macroeconomic consequences

Tariffs also affect the size of the U.S. economy. Panel (a) of Figure 3 compares the long-run effects of tariffs on goods employment with the effects on U.S. real GDP.[6] Tariffs on low-elasticity goods ("steel" and "cars") and on all goods reduce both goods employment and real GDP. Tariffs on high-elasticity downstream goods ("toys"), which raise goods employment the most, reduce real GDP by 0.2%. Tariffs on high-elasticity upstream goods ("oil") are the only ones that raise both goods employment and real GDP, by 0.4% and 0.2%, respectively. This exception is fragile, however: it disappears under most of the alternative elasticities in the appendix. Thus, in most cases, tariffs that raise goods employment also shrink the economy.[7]

Tariffs on "oil" are the only tariffs that raise real GDP in the long run because they are the only tariffs that boost investment: the U.S. capital stock rises by 0.7% under tariffs

[6] I measure real GDP from the production side, as the sum across sectors of gross output minus intermediate inputs, each valued at its price in the no-tariff equilibrium. Thus, real GDP measures the quantity of goods and services the economy produces; changes in the terms of trade affect real income, and therefore consumption, but not real GDP.

[7] Alessandria et al. (2025a) highlight one potential way around this tradeoff. They show that if tariff revenue is used to finance an investment subsidy, output will rise in the long run.

on "oil" and falls under every other tariff. The reason is that "oil" is not used directly to produce investment goods and contributes little indirectly as well, so tariffs on this sector raise wages (by 0.6%) while leaving the price of investment goods almost unchanged. "Cars" and "toys", by contrast, account for about a fifth of U.S. investment spending, so tariffs on these sectors raise the relative price of capital. Thus, whether a tariff raises real GDP depends on whether it makes investment more expensive, not on whether it raises goods employment.

Evaluating the normative consequences of tariffs is beyond this paper's scope. In every scenario, aggregate consumption rises in the long run even though aggregate output falls in all but one, but this is sensitive to the assumption that tariff revenue is rebated lump-sum to consumers. Moreover, empirical evidence indicates that the effect of tariffs on consumers is not evenly distributed; in particular, low-income consumers buy more imported goods and are thus more exposed to tariffs.[8]

4.4 Trade imbalances

Tariffs also affect the U.S. trade deficit, but more so in the short run than in the long run. Panel (b) of Figure 3 shows how the aggregate U.S. trade balance responds in each scenario. Tariffs on all goods narrow the trade deficit from its pre-tariff level of 3.05% of GDP to 1.78% on impact, mainly because tariffs improve the U.S. terms of trade; the value of imports falls by about 17% even though the real quantity barely changes. Over time, foreign buyers switch away from U.S. goods, which the appreciation has made more expensive, and the improvement in the trade balance disappears. From year 7 onward, the deficit is larger than before the tariffs, and in the long run it settles at 3.15% of GDP, about 0.1% of GDP higher. This is because households save part of the temporary improvement in the trade balance, increasing the long-run U.S. net foreign asset position. The pattern is similar for the targeted tariffs, just on a smaller scale.

The appendix reports goods versus services and bilateral trade balances, and a version of the model in which a portfolio adjustment cost forces the trade deficit back to its initial level in the long run. In that version, the long-run declines in goods employment are smaller, especially under tariffs on all goods.

4.5 Tariffs on one region vs. all

Tariffs on only one region may be less effective, because imports can be diverted to untaxed foreign suppliers rather than to domestic producers. Panel (c) of Figure 3 compares the long-run effects on goods employment of tariffs on all regions with the effects of tariffs on China,

[8]For example, Carroll and Hur (2023) find that the 2018 trade war disproportionately hurt low-income and low-wealth households, and Fajgelbaum and Khandelwal (2024) find that the "de minimis" tariff exemption for low-value, direct-to-consumer imports disproportionately benefits these households.

the low-tariff partners, and the high-tariff partners separately. Diversion is substantial—a tariff on "toys" from China alone, for example, raises imports of "toys" from each of the other two regions by 17%—but it does little to change the effects of single-sector tariffs on goods employment. In each sector, the effects of taxing each region separately add up almost exactly to the effect of taxing all regions at once: under tariffs on "toys", for example, the sum of the single-region effects is 0.77%, compared with 0.84% when all regions are taxed.

The interaction is larger under tariffs on all goods. Tariffs on all goods from China alone would leave goods employment almost unchanged (−0.02%): the "toys" sector would gain workers equal to 1.1% of goods employment, about as many as the "oil" sector would lose. Tariffs on the low-tariff partners alone would lower goods employment by 0.8%, and tariffs on the high-tariff partners alone would lower it by 0.3%. Tariffs on all regions at once would lower it by 1.2%, more than the sum of the three. When every partner is taxed, imports cannot be diverted elsewhere, so the U.S. real exchange rate appreciates by much more—14%, compared with 2–6% under tariffs on any single region—and crowds out U.S. exports in every sector. As a result, the "toys" sector gains workers equal to only 0.4% of goods employment when all regions are taxed.

4.6 The role of adjustment frictions

Panel (d) of Figure 3 shows sector-level employment dynamics under tariffs on all goods sectors in a version of the model without any adjustment frictions. Without frictions, total goods employment falls by 1.0% on impact, more than in the baseline, because there is nothing to slow the exit of workers from the contracting sectors. But it settles at about 0.6% below its pre-tariff level after only one period, rather than continuing to fall for seven years as in the baseline model. The "toys" sector expands immediately instead of gradually.

Adjustment frictions shape not only how quickly tariffs change goods employment, but also by how much they change it in the long run. The reason is that the long-run steady state depends on the degree to which U.S. households save during the transition to smooth consumption. With frictions, imports adjust slowly, so the U.S. trade deficit shrinks substantially in the short run. The resulting increase in net foreign assets finances permanently higher consumption, which draws more workers into services. The appendix reports results with one friction at a time and with weaker and stronger supply-chain frictions.

4.7 Consequences of retaliation

The scenarios considered thus far assume that other countries do not respond when the United States imposes tariffs. Theory, however, predicts that the optimal strategy for these countries is to retaliate and enact tariffs of their own (Pujolas and Rossbach, 2024). Panel (e) of Figure 3 shows sector-level employment dynamics with tariffs on all goods sectors when the other countries in the model retaliate symmetrically. In this case, overall goods

employment falls by about 2.1% at its trough, compared with 1.6% without retaliation, but the long-run decline is smaller (0.9% versus 1.2%). This is because retaliation leads to less real exchange rate appreciation (9% versus 14%), making U.S. goods relatively more competitive compared to the baseline exercise. However, U.S. real GDP falls by nearly three times more in the long run.

4.8 The 2025 Trump tariffs

Finally, I consider a scenario designed to approximate the increase in tariffs during the first year of the second Trump administration, which brought U.S. tariffs to levels not seen since the Smoot-Hawley era. The 2025 tariffs combined country-specific rates on most products from a given country with sector-specific rates on products such as steel, aluminum, and vehicles from all countries. I measure each product's tariff increase between 2024 and December 2025 and aggregate to the model's sectors and regions using 2024 import weights, as described in the appendix. For imports from China, the resulting tariff rates are 28.0% in "oil", 19.2% in "steel", 16.0% in "toys", and 22.7% in "cars". The corresponding rates are 3.9%, 10.3%, 4.9%, and 6.7% for the low-tariff partners and 7.4%, 16.2%, 13.2%, and 14.3% for the high-tariff partners.

Panel (f) of Figure 3 shows the results, which are qualitatively similar to the across-the-board tariff experiment, but quantitatively smaller because the average tariff is lower than 25%, especially for the low-tariff partners. Total goods employment falls by 0.2% on impact and 0.7% after five years, and then continues to decline more slowly; in the long run, it is about 0.9% lower than before the tariffs.[9] As in the across-the-board case, the high-elasticity downstream sector ("toys") is the only one that grows, while employment in "oil" falls substantially and employment in "steel" and "cars" falls slightly. Thus, the model predicts that the 2025 tariff shock, if made permanent, would reduce overall manufacturing employment in both the short run and the long run, and would not generate growth in the sectors that the Trump administration has prioritized due to national-security concerns.

5 Conclusion

Can tariffs boost manufacturing employment? For the most part, no. Broad-based tariffs on all imported goods would reduce goods-sector employment in the short run, and supply-chain adjustment frictions would deepen the decline for several years. They would also reduce it in the long run unless trade elasticities are at the upper end of the range of industry-level estimates. Tariffs targeted at goods with high trade elasticities ("toys" and "oil") would boost overall goods-sector employment, but tariffs on low-elasticity goods ("steel"

[9]The long-run effect is negative under every set of Armington elasticities I consider in the appendix, ranging from -0.9% to -0.03% under the much higher Caliendo and Parro (2015) elasticities.

and "cars") would reduce it. Moreover, such targeted tariffs would move workers between individual goods sectors more than they would change aggregate goods-sector employment—reallocation, rather than reindustrialization.

This paper is silent on whether using tariffs to boost manufacturing employment is a good idea, but it highlights a tradeoff: tariffs that expand the manufacturing sector are likely to shrink the economy as a whole. Policymakers may accept this tradeoff for non-economic reasons like national security, but the sectors typically prioritized for national-security tariffs, such as autos and metals, have low trade elasticities and are the hardest to expand with tariffs. A 25% tariff raises employment in the "cars" sector by less than 2% and in the "steel" sector by less than 6%, compared with more than 20% in the "toys" sector, and tariffs on both "cars" and "steel" reduce overall goods employment.

This analysis also assumes that tariffs are expected to be permanent. During the first Trump administration, tariffs were not expected to last more than a few years (Alessandria et al., 2025b), and tariff uncertainty is more likely to reduce investment in manufacturing than increase it (Caldara et al., 2020). Incorporating such uncertainty is a promising but computationally challenging direction for future research (Steinberg, 2019a).

Finally, tariffs change goods employment in the model only by moving workers across sectors (and, in the appendix, by changing aggregate labor supply). In practice, workers who leave contracting sectors may spend time unemployed, especially if wages adjust slowly (Rodríguez-Clare et al., 2026), and trade imbalances shape this adjustment (Dix-Carneiro et al., 2023). An unemployment margin would plausibly deepen the short-run decline in goods employment under broad-based tariffs, because the workers released by the contracting sectors would not be immediately absorbed by the expanding ones. Quantifying this is another direction for future research.

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Table 1: Calibration

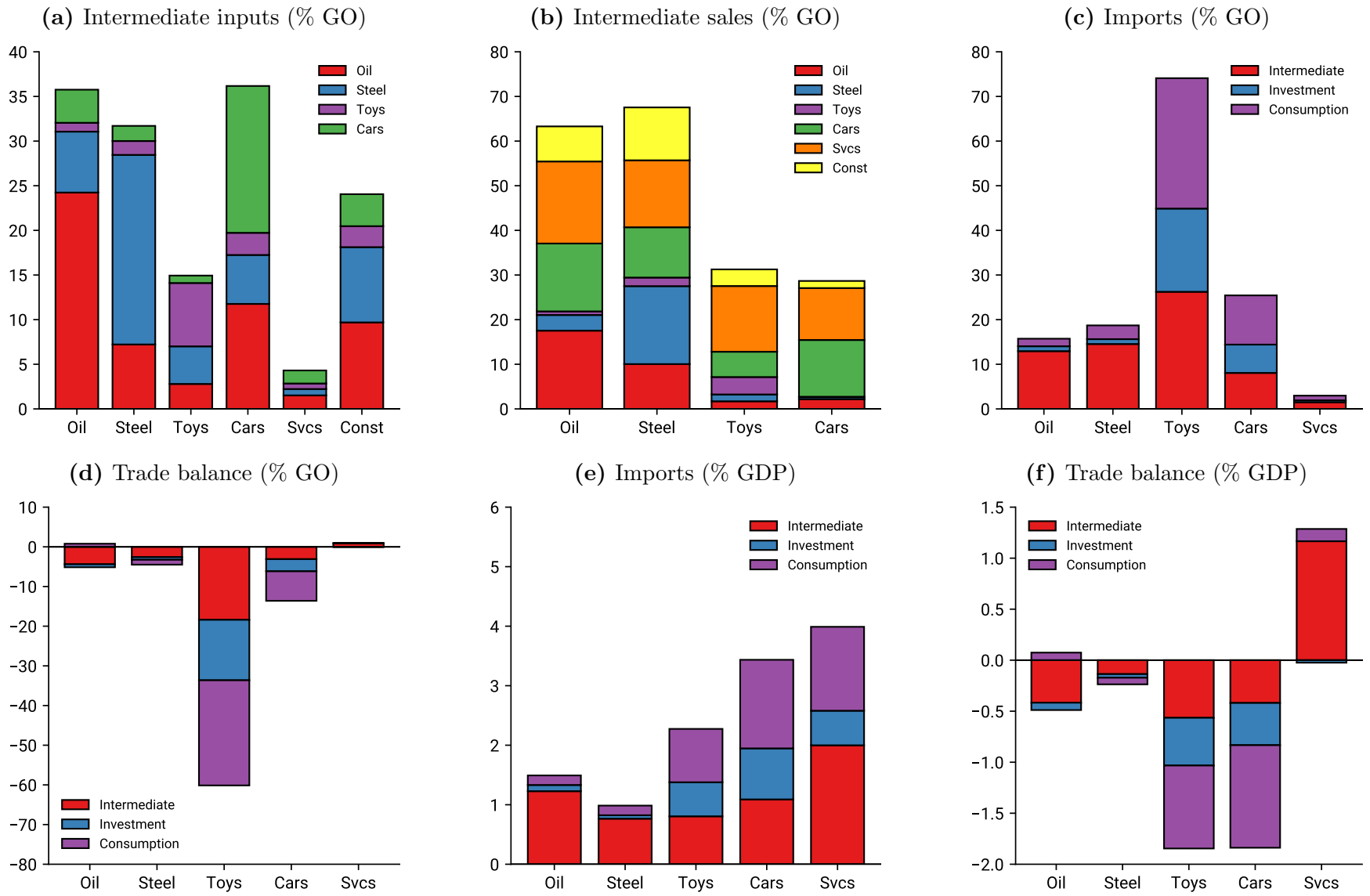
Sector	Industries	Upstreamness	Trade elasticity	Share of goods emp.
(a) Goods industry clusters				
High-elasticity upstream ("oil")	Agriculture, Mining (energy), Mining (non-energy), Mining support, Wood products, Paper products, Refined petroleum, Fabricated metals	3.0	19.1	28.3
Low-elasticity upstream ("steel")	Chemicals, Rubber + plastics, Minerals, Basic metals	3.0	2.9	13.8
High-elasticity downstream ("toys")	Fishing, Textiles, Electronics, Electrical equipment	2.2	11.8	17.8
Low-elasticity downstream ("cars")	Food + beverages, Pharmaceuticals, Machinery + equipment, Motor vehicles, Other trans. equip., Other mfg	1.9	2.1	40.1

(b) Parameter values

Parameter	Meaning	Value	Target
Producer technology			
η	Elasticity of substitution between value added and intermediates	0	Atalay (2017)
ξ	Elasticity of substitution between intermediates from different sectors	0	Atalay (2017)
$\lambda_i^{s,v}$	Share of value added in gross output	Varies	ICIO data
$\lambda_i^{s,r}$	Share of intermediates in gross output	Varies	ICIO data
δ	Depreciation rate	0.06	Standard
$K_{i,0}^s$	Initial sectoral capital stock	Varies	ICIO data
ϕ_K	Capital adjustment cost	0.52	Steinberg (2019b)
ϕ_L	Labor adjustment cost	6.5	Kehoe and Ruhl (2009)
Distributor technology			
ζ^s	Long-run Armington elasticity	Varies	Multiple sources
$\mu_{i,j}^{s,m}, \mu_{i,j}^{s,f}$	Share of expenditures from country j	Varies	ICIO data
ϕ_Z	Supply-chain adjustment cost	2.9	SR trade elast. = 0.5
Retailer technology			
ρ^c	Elasticity of substitution between sectors in consumption	0.65	Atalay (2017)
ρ^x	Elasticity of substitution between sectors in investment	1	Bems (2008)
$\varepsilon_i^{s,c}, \varepsilon_i^{s,x}$	Sectoral expenditure shares	Varies	ICIO data
Household preferences			
β	Discount factor	0.98	Standard
γ	Inverse of the intertemporal elasticity of substitution	2.0	Standard
$\bar{L}_i$	Aggregate labor (fixed)	Varies	ICIO data
$B_{i,0}$	Initial bondholdings	Varies	ICIO data

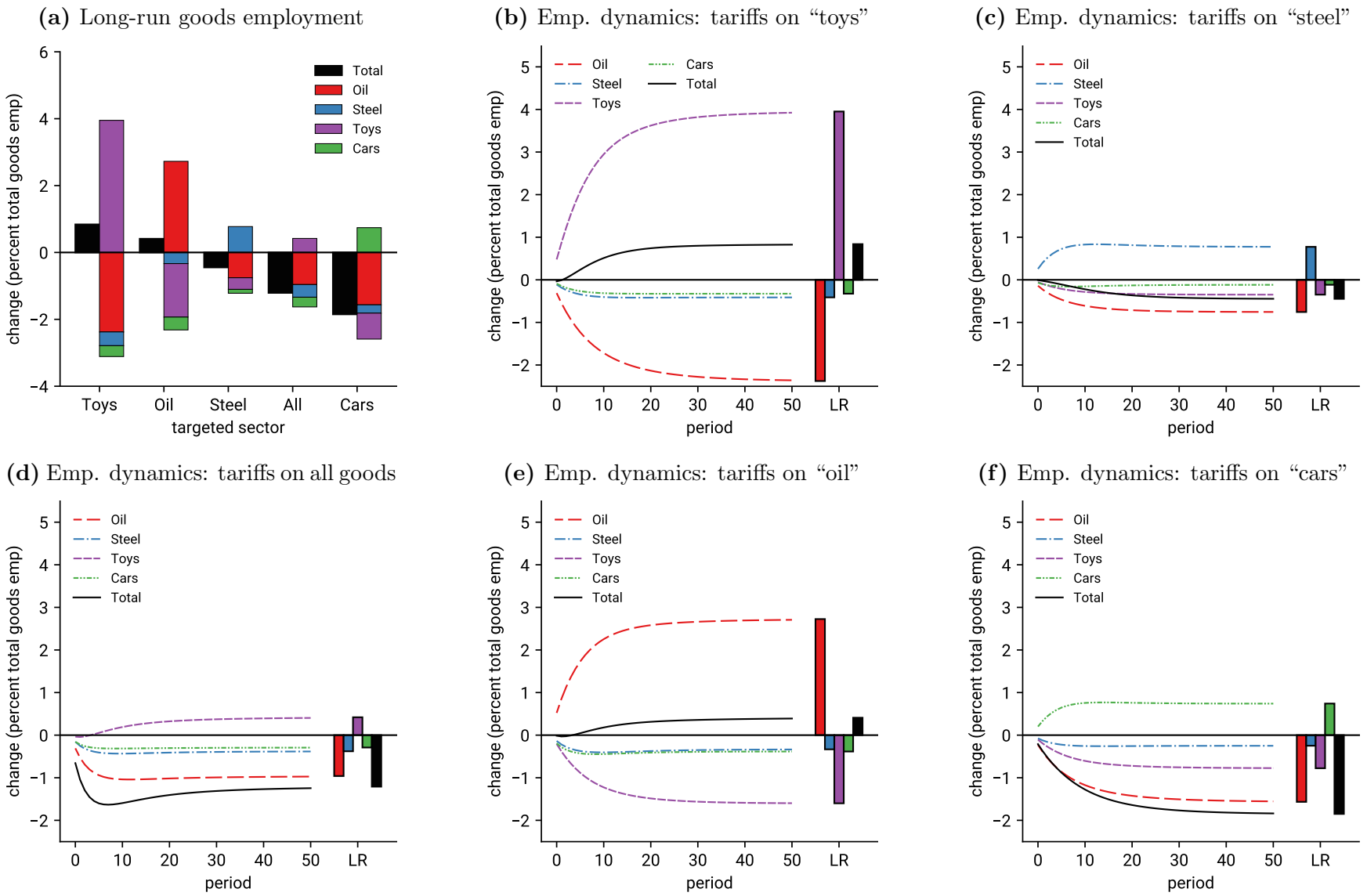
Notes: (a) Upstreamness for each industry calculated following Antràs et al. (2012). Trade elasticities are trade-weighted averages of the estimates of Caliendo and Parro (2015) across the industries in each sector; upstreamness is an unweighted average. See the appendix for details. Share of goods employment is each sector's share of goods-sector labor compensation in 2023 from the U.S. Bureau of Economic Analysis table "Components of Value Added by Industry."

Figure 1: Supply-chain linkages and sectoral trade exposure in the United States



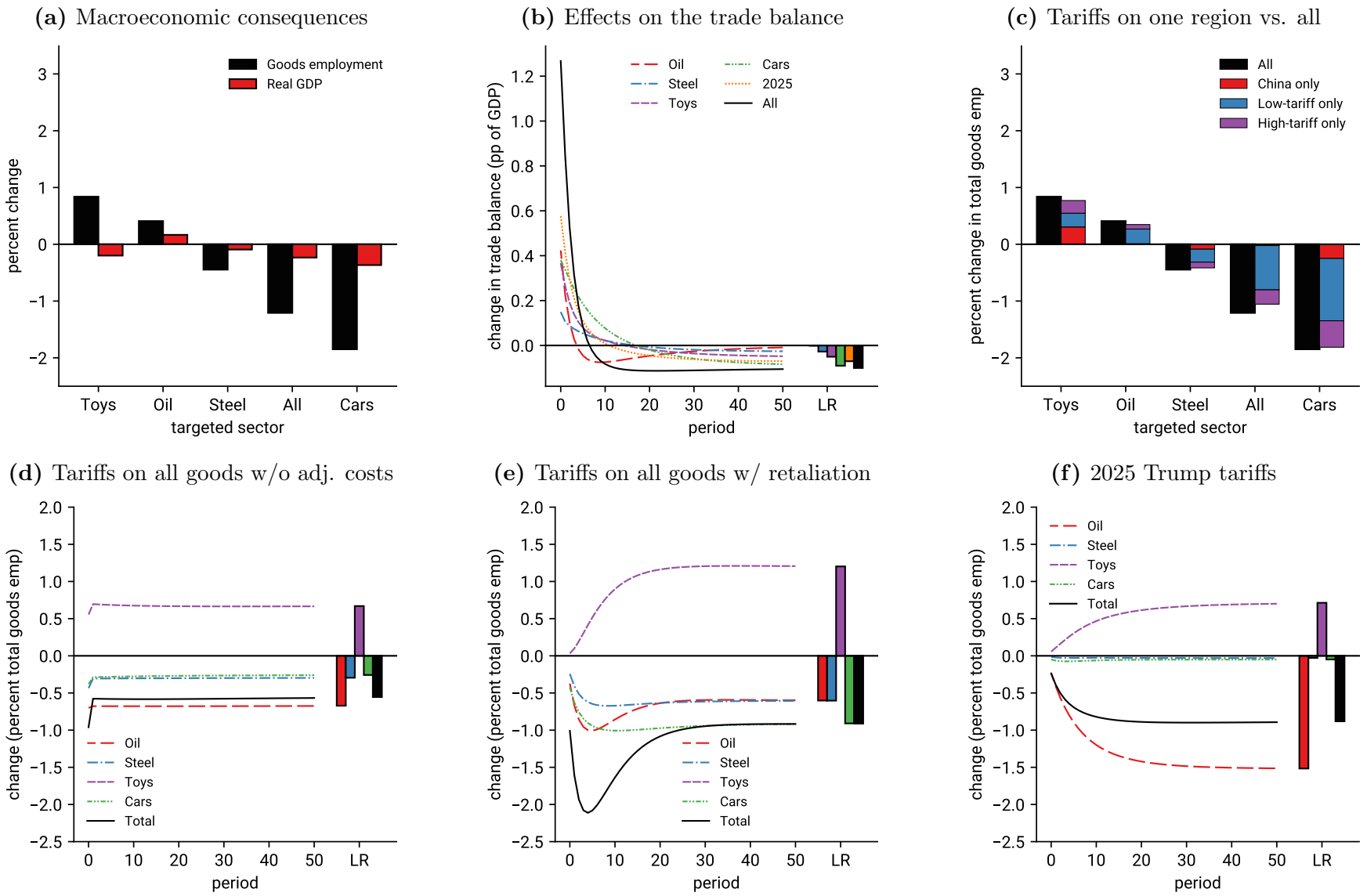
Notes: (a) Intermediate input expenditures as percentage of sectoral gross output. (b) Intermediate sales to other sectors as percentage of sectoral gross output. (c) Imports by use (intermediate, consumption, investment) as percentage of sectoral gross output. (d) Same as (c), but net exports instead of imports. (e,f) Same as (c,d) but as percentages of U.S. GDP. Source: 2020 OECD Inter-Country Input-Output Table.

Figure 2: Employment effects of U.S. tariffs on goods sectors



Notes: (a) Long-run change in total employment across all four goods sectors in different tariff scenarios. (b) Sectoral employment dynamics with tariff on high-elasticity downstream goods ("toys"). (c) Sectoral employment dynamics with tariff on low-elasticity upstream goods ("steel"). (d) Sectoral employment dynamics with tariff on all goods sectors. (e) Sectoral employment dynamics with tariff on high-elasticity upstream goods ("oil"). (f) Sectoral employment dynamics with tariff on low-elasticity downstream goods ("cars").

Figure 3: Other results and scenarios



Notes: (a) Long-run effects of tariffs on total goods employment versus real GDP. (b) Change in the U.S. trade balance relative to the no-tariff equilibrium; each line shows a different tariff scenario. (c) Long-run employment effects of tariffs on all regions versus tariffs on China, the low-tariff partners, or the high-tariff partners only. (d) Sectoral employment dynamics with tariffs on all goods in model without adjustment frictions. (e) Sectoral employment dynamics with tariffs on all goods and symmetric retaliation by other countries. (f) Sectoral employment dynamics under the Trump 2025 tariff schedule.

Online appendix

A Complete model

This appendix lays out the complete model: every agent's problem and first-order conditions, the government budget constraint, the market-clearing conditions, and the initial and terminal conditions. It also describes the solution method.

A.1 Environment

There are $I = 4$ countries indexed by i, j: the United States, China, the low-tariff partners, and the high-tariff partners. There are $S = 6$ sectors indexed by s, r: the four goods sectors ("oil", "steel", "toys", and "cars"), services, and construction. I let $\mathcal{T}$ denote the set of five traded sectors and use the superscript cn for construction. Construction output is not traded and is not used as an intermediate input; it is used only to produce investment goods. Time is discrete, $t = 0, 1, \ldots$, and there is no uncertainty. In each experiment, the economy starts in the no-tariff steady state, the path of tariffs is announced unexpectedly at the start of period 0, and all agents have perfect foresight thereafter.

The prices in country i are: $P^{s,y}_{i,t}$, the price of sector-s gross output; $P^{s,m}_{i,t}$ and $P^{s,f}_{i,t}$, the prices of the sector-s intermediate and final composites; $P^{c}_{i,t}$ and $P^{x}_{i,t}$, the prices of consumption and investment goods; and $W_{i,t}$, the wage. Q_t is the price of an internationally traded bond that pays one unit of the numeraire in period $t+1$. Section A.7 defines the numeraire.

A.2 Producers

The producer in sector s of country i combines capital $K^s_{i,t}$ and labor $L^s_{i,t}$ into value added and combines value added with intermediate inputs $M^{s,r}_{i,t}$ from each traded sector r:

$$V^s_{i,t} = \left(K^s_{i,t}\right)^{\alpha^s_i} \left(L^s_{i,t}\right)^{1-\alpha^s_i}, \tag{A.1}$$

$$\tilde{Y}^s_{i,t} = \left\{ \left(\lambda^{s,v}_i\right)^{\frac{1}{\eta}} \left(V^s_{i,t}\right)^{\frac{\eta-1}{\eta}} + \left(\mathcal{M}^s_{i,t}\right)^{\frac{\eta-1}{\eta}} \right\}^{\frac{\eta}{\eta-1}}, \tag{A.2}$$

$$\mathcal{M}^s_{i,t} = \left[\sum_{r \in \mathcal{T}} \left(\lambda^{s,r}_i\right)^{\frac{1}{\xi}} \left(M^{s,r}_{i,t}\right)^{\frac{\xi-1}{\xi}} \right]^{\frac{\xi}{\xi-1}},$$

$$Y^s_{i,t} = \tilde{Y}^s_{i,t} - \phi_L \left(\frac{L^s_{i,t}}{L^s_{i,t-1}} - 1 \right)^2 L^s_{i,t-1}. \tag{A.3}$$

Here, α^s_i is capital's share of value added, $\lambda^{s,v}_i$ is the share of value added in gross output, $\lambda^{s,r}_i$ is the share of intermediates from sector r in gross output, η is the elasticity of substitution between value added and intermediates, and ξ is the elasticity of substitution between intermediates from different sectors. In the calibration, $\eta = \xi = 0$, so the technology is Leontief:

$\tilde{Y}^s_{i,t} = \min\{V^s_{i,t}/\lambda^{s,v}_i, \min_r M^{s,r}_{i,t}/\lambda^{s,r}_i\}$. Equation (A.3) says that changing employment uses up part of the sector's own output, and that the cost is scaled by last period's employment, as in Kehoe and Ruhl (2009). The parameter ϕ_L governs the size of this cost.

Capital in each sector accumulates according to

$$K^s_{i,t+1} = (1-\delta)K^s_{i,t} + \Phi\left(\frac{X^s_{i,t}}{K^s_{i,t}}\right)K^s_{i,t}, \qquad \Phi(x) = \frac{\delta^{1-\phi_K}x^{\phi_K} - (1-\phi_K)\delta}{\phi_K}, \tag{A.4}$$

where $X^s_{i,t}$ is investment and δ is the depreciation rate. The function Φ satisfies $\Phi(\delta) = \delta$ and $\Phi'(\delta) = 1$, so capital adjustment costs are zero in a steady state. Setting $\phi_K = 1$ eliminates them, and smaller values of ϕ_K make them larger.

The producer's operating profit before the capital-income wedge described below is

$$\Pi^s_{i,t} = P^{s,y}_{i,t}Y^s_{i,t} - W_{i,t}L^s_{i,t} - \sum_{r\in\mathcal{T}} P^{r,m}_{i,t}M^{s,r}_{i,t}, \tag{A.5}$$

and its dividend is

$$D^s_{i,t} = (1-\tau^k_i)\Pi^s_{i,t} - P^x_{i,t}X^s_{i,t}. \tag{A.6}$$

The wedge τ^k_i is a tax on capital income. It reconciles the capital share in the data with the investment rate in the data, given the interest rate and the depreciation rate; Section A.9 describes how I set it. The government rebates the revenue to the household.

The producer chooses $\{L^s_{i,t}, X^s_{i,t}, K^s_{i,t+1}, M^{s,r}_{i,t}\}_{t=0}^{\infty}$ to maximize $\sum_{t=0}^{\infty}\Lambda_{i,t}D^s_{i,t}$ subject to Eqs. (A.1)–(A.4), given $K^s_{i,0}$ and $L^s_{i,-1}$, where $\Lambda_{i,t}$ is the household's present-value price of the numeraire in period t, defined in Section A.5. When η and ξ are positive, the first-order condition for intermediates from sector r is

$$P^{s,y}_{i,t}\left(\frac{\tilde{Y}^s_{i,t}}{\mathcal{M}^s_{i,t}}\right)^{\frac{1}{\eta}}\left(\frac{\lambda^{s,r}_i\mathcal{M}^s_{i,t}}{M^{s,r}_{i,t}}\right)^{\frac{1}{\xi}} = P^{r,m}_{i,t}, \tag{A.7}$$

and the shadow price of value added is $P^{s,v}_{i,t} \equiv P^{s,y}_{i,t}(\lambda^{s,v}_i\tilde{Y}^s_{i,t}/V^s_{i,t})^{1/\eta}$. In the Leontief case, Eq. (A.7) is replaced by $M^{s,r}_{i,t} = \lambda^{s,r}_i\tilde{Y}^s_{i,t}$ and $\tilde{Y}^s_{i,t} = V^s_{i,t}/\lambda^{s,v}_i$, and the shadow price of value added is $P^{s,v}_{i,t} \equiv (P^{s,y}_{i,t} - \sum_r \lambda^{s,r}_i P^{r,m}_{i,t})/\lambda^{s,v}_i$. In either case, $\tilde{Y}^s_{i,t}$ has constant returns to scale, so $P^{s,y}_{i,t}\tilde{Y}^s_{i,t} = P^{s,v}_{i,t}V^s_{i,t} + \sum_{r\in\mathcal{T}} P^{r,m}_{i,t}M^{s,r}_{i,t}$ and operating profit is

$$\Pi^s_{i,t} = P^{s,v}_{i,t}V^s_{i,t} - P^{s,y}_{i,t}\phi_L\left(\frac{L^s_{i,t}}{L^s_{i,t-1}} - 1\right)^2 L^s_{i,t-1} - W_{i,t}L^s_{i,t}, \tag{A.8}$$

Letting $q^s_{i,t}$ denote the multiplier on Eq. (A.4) in units of period-t dividends and $x^s_{i,t} \equiv$

$X^s_{i,t}/K^s_{i,t}$, the first-order conditions for labor, investment, and capital are

$$(1-\alpha^s_i)P^{s,v}_{i,t}\frac{V^s_{i,t}}{L^s_{i,t}} = W_{i,t} + 2\phi_L P^{s,y}_{i,t}\left(\frac{L^s_{i,t}}{L^s_{i,t-1}}-1\right) - \frac{\Lambda_{i,t+1}}{\Lambda_{i,t}}\phi_L P^{s,y}_{i,t+1}\left[\left(\frac{L^s_{i,t+1}}{L^s_{i,t}}\right)^2-1\right], \tag{A.9}$$

$$P^x_{i,t} = q^s_{i,t}\,\Phi'\left(x^s_{i,t}\right), \tag{A.10}$$

$$q^s_{i,t} = \frac{\Lambda_{i,t+1}}{\Lambda_{i,t}}\left\{(1-\tau^k_i)\alpha^s_i P^{s,v}_{i,t+1}\frac{V^s_{i,t+1}}{K^s_{i,t+1}} + q^s_{i,t+1}\left[1-\delta+\Phi\left(x^s_{i,t+1}\right)-\Phi'\left(x^s_{i,t+1}\right)x^s_{i,t+1}\right]\right\}. \tag{A.11}$$

The wedge scales every term of the producer's operating profit, so it drops out of the labor condition and appears only in the capital condition.

A.3 Distributors

In each country i and traded sector $s \in \mathcal{T}$, there are two distributors, one for intermediate inputs ($u = m$) and one for final goods ($u = f$). Each buys sector-s output from producers in every country and combines it into a composite according to

$$G^{s,u}_{i,t} = \hat{G}^{s,u}_{i,t} - \phi_Z \sum_{j=1}^{I}\left(\frac{Z^{s,u}_{i,j,t}}{Z^{s,u}_{i,j,t-1}}-1\right)^2 Z^{s,u}_{i,j,t-1}, \quad \text{where}$$

$$\hat{G}^{s,u}_{i,t} = \left[\sum_{j=1}^{I}\mu^{s,u}_{i,j}\left(Z^{s,u}_{i,j,t}\right)^{\frac{\zeta^{s,u}-1}{\zeta^{s,u}}}\right]^{\frac{\zeta^{s,u}}{\zeta^{s,u}-1}}, \tag{A.12}$$

where $Z^{s,u}_{i,j,t}$ is the quantity bought from country j, $\mu^{s,u}_{i,j}$ is a share parameter, $\zeta^{s,u}$ is the Armington elasticity, and ϕ_Z governs the size of the supply-chain adjustment cost. Both distributors face the same adjustment cost parameter ϕ_Z. The adjustment cost uses up part of the composite.

The distributor's dividend is

$$D^{s,u}_{i,t} = P^{s,u}_{i,t}G^{s,u}_{i,t} - \sum_{j=1}^{I}\left(1+\tau^{s,u}_{i,j,t}\right)P^{s,y}_{j,t}Z^{s,u}_{i,j,t}, \tag{A.13}$$

where $\tau^{s,u}_{i,j,t}$ is country i's tariff on sector-s products from country j for use u, with $\tau^{s,u}_{i,i,t} = 0$. The distributor chooses $\{Z^{s,u}_{i,j,t}\}$ to maximize $\sum_{t=0}^{\infty}\Lambda_{i,t}D^{s,u}_{i,t}$, given $Z^{s,u}_{i,j,-1}$. The first-order

condition for purchases from country j is

$$\left(1+\tau_{i,j,t}^{s,u}\right) P_{j,t}^{s,y} = P_{i,t}^{s,u}\left[\mu_{i,j}^{s,u}\left(\frac{\hat{G}_{i,t}^{s,u}}{Z_{i,j,t}^{s,u}}\right)^{\frac{1}{\zeta^{s,u}}} - 2\phi_Z\left(\frac{Z_{i,j,t}^{s,u}}{Z_{i,j,t-1}^{s,u}}-1\right)\right] + \frac{\Lambda_{i,t+1}}{\Lambda_{i,t}}\phi_Z P_{i,t+1}^{s,u}\left[\left(\frac{Z_{i,j,t+1}^{s,u}}{Z_{i,j,t}^{s,u}}\right)^2 - 1\right]. \tag{A.14}$$

When purchases are constant, Eq. (A.14) reduces to the standard CES demand function and price index:

$$Z_{i,j,t}^{s,u} = \left(\mu_{i,j}^{s,u}\right)^{\zeta^{s,u}}\left[\frac{(1+\tau_{i,j,t}^{s,u})P_{j,t}^{s,y}}{P_{i,t}^{s,u}}\right]^{-\zeta^{s,u}} G_{i,t}^{s,u},$$

$$P_{i,t}^{s,u} = \left\{\sum_{j=1}^{I}\left(\mu_{i,j}^{s,u}\right)^{\zeta^{s,u}}\left[(1+\tau_{i,j,t}^{s,u})P_{j,t}^{s,y}\right]^{1-\zeta^{s,u}}\right\}^{\frac{1}{1-\zeta^{s,u}}}.$$

A.4 Retailers

The consumption retailer combines the final composites of the traded sectors, and the investment retailer combines the final composites of the traded sectors with construction output:

$$C_{i,t} = \left[\sum_{s\in\mathcal{T}}\varepsilon_i^{s,c}\left(Z_{i,t}^{s,c}\right)^{\frac{\rho^c-1}{\rho^c}}\right]^{\frac{\rho^c}{\rho^c-1}}, \tag{A.15}$$

$$X_{i,t} = \prod_{s\in\mathcal{T}\cup\{cn\}}\left(Z_{i,t}^{s,x}\right)^{\varepsilon_i^{s,x}}, \qquad \sum_{s\in\mathcal{T}\cup\{cn\}}\varepsilon_i^{s,x} = 1, \tag{A.16}$$

where $Z_{i,t}^{cn,x}$ is construction output, which the investment retailer buys at price $P_{i,t}^{cn,f} \equiv P_{i,t}^{cn,y}$. Equation (A.16) is the limit of the investment technology in the main text as ρ^x approaches one. Retailers face no adjustment costs and earn zero profits. Cost minimization implies

$$Z_{i,t}^{s,c} = (\varepsilon_i^{s,c})^{\rho^c}\left(\frac{P_{i,t}^{s,f}}{P_{i,t}^{c}}\right)^{-\rho^c} C_{i,t}, \qquad P_{i,t}^{c} = \left[\sum_{s\in\mathcal{T}}(\varepsilon_i^{s,c})^{\rho^c}\left(P_{i,t}^{s,f}\right)^{1-\rho^c}\right]^{\frac{1}{1-\rho^c}}, \tag{A.17}$$

$$P_{i,t}^{s,f} Z_{i,t}^{s,x} = \varepsilon_i^{s,x} P_{i,t}^{x} X_{i,t}, \qquad P_{i,t}^{x} = \prod_{s\in\mathcal{T}\cup\{cn\}}\left(\frac{P_{i,t}^{s,f}}{\varepsilon_i^{s,x}}\right)^{\varepsilon_i^{s,x}}. \tag{A.18}$$

A.5 Households

The household in country i supplies $\bar{L}_i$ units of labor inelastically, owns the country's producers and distributors, and trades the international bond. It chooses $\{C_{i,t}, B_{i,t+1}\}_{t=0}^{\infty}$ to maximize

$$\sum_{t=0}^{\infty} \beta^t \frac{C_{i,t}^{1-\gamma}}{1-\gamma} \tag{A.19}$$

subject to the budget constraints

$$P_{i,t}^c C_{i,t} + Q_t B_{i,t+1} = W_{i,t}\bar{L}_i + B_{i,t} + D_{i,t} + T_{i,t}, \tag{A.20}$$

and a no-Ponzi condition, given $B_{i,0}$. Here $B_{i,t}$ is the household's bond holdings at the start of period t, $D_{i,t} = \sum_{s=1}^{S} D_{i,t}^s + \sum_{s\in\mathcal{T}}(D_{i,t}^{s,m} + D_{i,t}^{s,f})$ is the sum of dividends, and $T_{i,t}$ is the government transfer. The Euler equation is

$$Q_t = \beta \left(\frac{C_{i,t+1}}{C_{i,t}}\right)^{-\gamma} \frac{P_{i,t}^c}{P_{i,t+1}^c}. \tag{A.21}$$

Producers and distributors value dividends at the household's present-value prices, $\Lambda_{i,t} = \beta^t (C_{i,t}/C_{i,0})^{-\gamma}(P_{i,0}^c/P_{i,t}^c)$, the date-0 prices of one unit of the numeraire delivered in period t. By Eq. (A.21), $\Lambda_{i,t+1}/\Lambda_{i,t} = Q_t$ in every country, so $\Lambda_{i,t} = Q_0 Q_1 \cdots Q_{t-1}$ and firms in all countries discount the future at the world interest rate.

A.6 Government

The government in country i collects tariff revenue and capital-income wedge revenue and rebates both to the household:

$$T_{i,t} = \sum_{s\in\mathcal{T}} \sum_{j\neq i} P_{j,t}^{s,y} \left(\tau_{i,j,t}^{s,m} Z_{i,j,t}^{s,m} + \tau_{i,j,t}^{s,f} Z_{i,j,t}^{s,f}\right) + \tau_i^k \sum_{s=1}^{S} \Pi_{i,t}^s. \tag{A.22}$$

In all of the experiments in the main text, the tariffs on intermediate and final purchases are the same, $\tau_{i,j,t}^{s,m} = \tau_{i,j,t}^{s,f} = \tau_{i,j,t}^{s}$.

A.7 Market clearing, the numeraire, and Walras's law

The market-clearing conditions are

$$Y_{i,t}^{s} = \sum_{j=1}^{I} \left(Z_{j,i,t}^{s,m} + Z_{j,i,t}^{s,f} \right), \quad s \in \mathcal{T}, \qquad Y_{i,t}^{cn} = Z_{i,t}^{cn,x}, \tag{A.23}$$

$$G_{i,t}^{s,m} = \sum_{r=1}^{S} M_{i,t}^{r,s}, \quad s \in \mathcal{T}, \qquad G_{i,t}^{s,f} = Z_{i,t}^{s,c} + Z_{i,t}^{s,x}, \quad s \in \mathcal{T}, \tag{A.24}$$

$$X_{i,t} = \sum_{s=1}^{S} X_{i,t}^{s}, \qquad \bar{L}_i = \sum_{s=1}^{S} L_{i,t}^{s}, \tag{A.25}$$

$$0 = \sum_{i=1}^{I} B_{i,t+1}. \tag{A.26}$$

The numeraire is a fixed-weight index of U.S. final-good prices that uses base-period U.S. consumption as weights:

$$\frac{\sum_{s \in \mathcal{T}} P_{US,t}^{s,f} \bar{Z}_{US}^{s,c}}{\sum_{s \in \mathcal{T}} \bar{Z}_{US}^{s,c}} = 1, \tag{A.27}$$

where $\bar{Z}_{US}^{s,c}$ is U.S. consumption of the sector-s final composite in the ICIO data. The bond pays one unit of this index.

To see that the system satisfies Walras's law, substitute the dividends in Eqs. (A.6) and (A.13) and the transfer in Eq. (A.22) into the household's budget constraint (A.20). The tariff and wedge payments cancel against the transfer. Using the retailers' zero-profit conditions and the market-clearing conditions for labor, investment goods, construction, and the intermediate and final composites, the domestic purchases also cancel, and the budget constraint becomes the current account identity

$$0 = NX_{i,t} + B_{i,t} - Q_t B_{i,t+1}, \tag{A.28}$$

$$NX_{i,t} = \sum_{s \in \mathcal{T}} \sum_{j \neq i} \left[P_{i,t}^{s,y} \left(Z_{j,i,t}^{s,m} + Z_{j,i,t}^{s,f} \right) - P_{j,t}^{s,y} \left(Z_{i,j,t}^{s,m} + Z_{i,j,t}^{s,f} \right) \right], \tag{A.29}$$

where $NX_{i,t}$ is the trade balance at producer prices. Every export of one country is an import of another, so $\sum_i NX_{i,t} = 0$. Summing Eq. (A.29) across countries then gives $\sum_i B_{i,t} = Q_t \sum_i B_{i,t+1}$. Thus, if the current account identity holds for $I - 1$ countries and the bond market clears, it also holds for the last country, whose budget constraint is redundant. In the computation, I impose Eq. (A.29) for the United States, China, and the low-tariff partners, and set the high-tariff partners' bond holdings using Eq. (A.26).

A.8 Equilibrium

Given initial conditions $\{K^s_{i,0}, L^s_{i,-1}, Z^{s,u}_{i,j,-1}, B_{i,0}\}$ and a path of tariffs, an equilibrium is a sequence of prices $\{W_{i,t}, P^{s,y}_{i,t}, P^{s,m}_{i,t}, P^{s,f}_{i,t}, P^c_{i,t}, P^x_{i,t}, Q_t\}$ and allocations such that (i) given prices, the allocations solve the problems of the producers, distributors, retailers, and households; (ii) the government budget constraint (A.22) holds; (iii) the market-clearing conditions (A.23)–(A.26) hold; and (iv) prices satisfy the normalization (A.27).

Initial and terminal conditions. In every experiment, the initial conditions are the values in the no-tariff steady state, which reproduces the ICIO data. I solve for the transition over $T = 100$ periods and assume that the economy has reached a steady state by the end of this horizon: in the last period, investment in each sector equals depreciation, bond holdings are constant ($B_{i,T+1} = B_{i,T}$), the bond price equals β, and the adjustment costs are switched off. The long-run bond positions $B_{i,T}$ are not set in advance. As discussed in the main text, the model has a continuum of steady states indexed by these positions, so the terminal steady state is solved for jointly with the transition.

The system of equations. In each period, the unknowns are the wage $W_{i,t}$; sectoral investment $X^s_{i,t}$, employment $L^s_{i,t}$, and output prices $P^{s,y}_{i,t}$; sectoral consumption $Z^{s,c}_{i,t}$; bond holdings $B_{i,t+1}$ for the first $I-1$ countries; the bond price Q_t; and the distributors' purchases $Z^{s,u}_{i,j,t}$ and composite prices $P^{s,u}_{i,t}$. All other variables follow directly from these. The equations are the numeraire (A.27); the current account identity (A.29) for $I-1$ countries; labor-market clearing and the Euler equation (A.21) in each country; the conditions that equate the marginal rate of substitution between each goods sector's consumption and services consumption to their relative price; the labor and capital conditions (A.9)–(A.11), with $q^s_{i,t}$ substituted out using Eq. (A.10), and goods-market clearing (A.23) in each country and sector; and the distributors' first-order conditions (A.14) and composite-market clearing (A.24). With four countries and six sectors, the system has 30,072 equations and unknowns over the 101 periods.

A.9 Calibration and solution method

I measure all quantities in units of 1% of U.S. value added in the 2020 ICIO data and set all base-period prices and the initial wage to one. The parameter values that are common across countries and the Armington elasticities are listed in Table 1. This subsection describes the parameters that vary by country and sector, all of which are set so that the no-tariff steady state reproduces the ICIO data exactly.

Labor, capital, and value added. I set U.S. labor compensation in each sector to 66% of total U.S. value added (one minus the aggregate capital share of 0.34) times the sector's share of total U.S. labor compensation in 2023 from the U.S. Bureau of Economic Analysis

table "Components of Value Added by Industry." The BEA table combines two pairs of ICIO industries that belong to different model sectors, chemicals with pharmaceuticals and agriculture with fishing; I split each pair in proportion to the industries' 2020 U.S. value added in the ICIO table. With a common wage of one, this makes each sector's labor input equal to its labor compensation. The U.S. capital share in each sector is then $\alpha^s_{US} = 1 - L^s_{US}/V^s_{US}$. In the other countries, I set the capital share to 0.34 in every sector. Each country's labor endowment is $\bar{L}_i = \sum_s (1-\alpha^s_i)V^s_i$. The capital-income wedge is set so that the capital stock implied by each country's investment in a steady state, X_i/δ, earns the interest rate $r = 1/\beta - 1$ after depreciation: $(r+\delta)X_i/\delta = (1-\tau^k_i) \times 0.34 \times \sum_s V^s_i$. For the United States, this gives $\tau^k = 0.073$ and a capital-output ratio of 3.9. Each sector's initial capital stock is $K^s_{i,0} = (1-\tau^k_i)\alpha^s_i V^s_i/(r+\delta)$.

Input-output shares. The shares $\lambda^{s,v}_i$ and $\lambda^{s,r}_i$ are each sector's value added and purchases of intermediates from sector r as fractions of its gross output. Given the Armington elasticities, the share parameters $\mu^{s,m}_{i,j}$ and $\mu^{s,f}_{i,j}$ are set so that the distributors' demand functions reproduce the ICIO's bilateral flows of intermediate and final goods at zero tariffs. Given ρ^c, the consumption weights $\varepsilon^{s,c}_i$ reproduce each country's consumption of each sector's final composite. The investment weights $\varepsilon^{s,x}_i$ equal each sector's share of investment spending, including construction. In the code, the value-added, distributor, and investment technologies also include scale parameters that set all base-period prices to one; these normalizations have no economic content, and I omit them from the equations above.

Bonds and lagged values. Initial bond holdings are $B_{i,0} = -NX_i/(1-\beta)$, as described in Section 3. The lagged values $L^s_{i,-1}$ and $Z^{s,u}_{i,j,-1}$ equal their values in the data.

Solution method. I stack the equilibrium conditions for all periods into a single system and solve it with Newton's method, computing the Jacobian by finite differences in parallel. The solver stops when the largest absolute residual falls below 10^{-8}. I compute the no-tariff equilibrium in the same way and use it as the initial guess for each experiment. If the solver fails to converge from this guess, I phase in the tariffs over four steps, using the solution at each step as the initial guess for the next.

B Sector definitions and trade elasticities

This appendix describes how I group the industries in the ICIO table into the model's four goods sectors and how I compute each sector's average trade elasticity. The code is in `programs/python/icio.py` in the replication package.

Industries and regions. I use the 2020 table from the 2023 edition of the OECD inter-country input-output (ICIO) tables (OECD, 2023), which reports flows among 45 industries in 76 countries and a rest-of-world aggregate. I aggregate the countries into the four regions described in Section 3: the United States, China, the low-tariff partners, and the high-tariff partners. The goods sector consists of the 22 industries in ISIC sections A (agriculture, forestry, and fishing), B (mining), and C (manufacturing). I aggregate construction (ISIC section F) into a single sector and all remaining industries into services. I then group the 22 goods industries into four sectors in three steps.

Step 1: upstreamness. I compute each industry's upstreamness using the measure of Antràs et al. (2012), $U = (I - \Delta)^{-1}\mathbf{1}$, where element (k, l) of Δ is the share of industry k's gross output that industry l purchases as intermediate inputs. I compute this measure on the four-region table, in which each region has the 22 goods industries plus services and construction, so each goods industry has one value of U for each region. I then average the four values with equal weights.

Step 2: trade elasticities. I assign each industry the trade elasticity that Caliendo and Parro (2015) estimate for the corresponding sector, using their preferred estimates (the 99% sample in their Table 1). These estimates are trade elasticities in the sense of the gravity literature, θ, which correspond to an Armington elasticity of $\theta + 1$. Most ICIO industries map one-to-one into a Caliendo and Parro (2015) sector. The exceptions are the following: fishing takes the estimate for agriculture; the three mining industries share the estimate for mining; pharmaceuticals takes the estimate for chemicals; and computer, electronic, and optical products takes the estimate for office, accounting, and computing machinery.[10]

Step 3: clustering. I first split the 22 industries into upstream and downstream groups by applying agglomerative hierarchical clustering with Ward linkage to their (standardized) upstreamness. Within each group, I then split the industries into high- and low-elasticity

[10]The ICIO industry for computer, electronic, and optical products also covers two other sectors in Caliendo and Parro (2015): radio, television, and communication equipment, for which they estimate a trade elasticity of 3.95, and medical, precision, and optical instruments, for which they estimate 8.71. Because this industry accounts for 58% of the trade in "toys", this choice affects that sector's average elasticity. Assigning the industry the simple average of the three estimates (8.54) instead, and holding the composition of the sectors fixed, would lower the average for "toys" from 11.8 to 9.2. This would not change the sector's position as the high-elasticity downstream sector, and it would not affect the Armington elasticities used in the model, which are chosen as described below.

sectors by applying the same procedure to the (standardized) logarithm of their trade elasticities. Table B.1 lists the industries in each of the four resulting sectors.

Sector-level elasticities. The trade elasticity of each sector reported in Table 1 is the average of its industries' elasticities, weighted by each industry's 2020 trade between the four model regions. This trade includes intermediate inputs and final goods, and it excludes trade among countries within the same partner region, which is internal to that region in the model. The resulting sector averages are 19.1 ("oil"), 2.9 ("steel"), 11.8 ("toys"), and 2.1 ("cars"). The upstreamness values in Table 1 are unweighted averages across each sector's industries. Table B.1 reports each industry's upstreamness, elasticity, and weight.

Elasticities used in the model. The Armington elasticities used in the model's baseline calibration, ζ^s, are not estimated. I choose them to preserve the ranking of the sector-level estimates above while bringing their levels down toward the lower estimates for the goods sector as a whole in Kehoe et al. (2018) and Steinberg (2019b), as described in Section 3.3. Table B.2 compares the two. Note that the high average for "oil" is driven in large part by refined petroleum, for which Caliendo and Parro (2015) estimate a trade elasticity of 64.9; excluding this industry, the average for "oil" is 12.0. Appendix D reports how the results change under alternative values of ζ^s, including the values implied by Caliendo and Parro (2015).

The 2025 tariffs. To construct the 2025 tariff shock in Section 4.8, I use the data from Waugh (2026), which contain import values and duties at the HS10 level for more than 30 U.S. trade partners from 2013 onward.[11] For each product, I measure the 2025 tariff shock as the December 2025 duty rate minus that product's 2024 duty rate. I map HS6 product codes to ISIC Rev. 4 industries, and ISIC industries to the ICIO industries listed in Table B.1; products that map to more than one model sector are split equally across those sectors. I then aggregate to the model's sectors and regions using 2024 import weights.

[11] The data are available at https://github.com/tradewartracker/how-restrictive-us-trade.

Table B.1: Goods industries, upstreamness, and trade elasticities

Sector	Industry	Upstreamness	θ^{CP}	Weight (%)
"Oil"	Mining (energy)	3.45	13.53	38.5
	Agriculture	2.41	9.11	13.7
	Mining (non-energy)	3.61	13.53	13.5
	Refined petroleum	2.75	64.85	13.4
	Fabricated metals	2.57	6.99	11.9
	Paper products	2.88	16.52	5.3
	Wood products	2.79	11.50	3.3
	Mining support	3.45	13.53	0.4
	Trade-weighted average		*19.13*	
"Steel"	Chemicals	3.18	3.13	43.2
	Basic metals	3.37	3.28	31.7
	Rubber + plastics	2.81	1.67	16.9
	Minerals	2.55	2.41	8.1
	Trade-weighted average		*2.87*	
"Toys"	Electronics	2.24	12.95	58.3
	Textiles	2.07	8.10	22.3
	Electrical equipment	2.23	12.91	18.3
	Fishing	2.10	9.11	1.0
	Trade-weighted average		*11.82*	
"Cars"	Motor vehicles	1.81	1.84	24.6
	Machinery + equipment	2.00	1.45	24.6
	Food + beverages	1.84	2.62	16.1
	Other mfg	1.98	3.98	13.5
	Pharmaceuticals	2.06	3.13	10.6
	Other trans. equip.	1.84	0.39	10.6
	Trade-weighted average		*2.14*	

Notes: Upstreamness is the measure of Antràs et al. (2012), computed on the four-region 2020 ICIO table and averaged across the four regions. θ^{CP} is the trade elasticity estimated by Caliendo and Parro (2015) (99% sample, Table 1) for the corresponding sector. Weight is the industry's share of its sector's 2020 trade between the four model regions (intermediate and final goods; trade within each partner region excluded). The trade-weighted average is the sector-level elasticity reported in Table 1.

Table B.2: Sector-level trade elasticities: estimates and model values

	"Oil"	"Steel"	"Toys"	"Cars"
Trade elasticity θ, Caliendo and Parro (2015) (trade-weighted)	19.1	2.9	11.8	2.1
Implied Armington elasticity, $\theta + 1$	20.1	3.9	12.8	3.1
Armington elasticity in the model, ζ^s	8	2	4	1

C Numerical results

This appendix reports the numbers behind Figures 2 and 3. Table C.1 reports the path of U.S. goods employment in each of the main scenarios, along with the long-run effects on real GDP, the aggregate capital stock, and the real exchange rate. Table C.2 reports the long-run change in employment in each goods sector, both as a percent change in the sector's own employment and as a contribution to the change in total goods employment. The contributions are the long-run values of the lines in panels (b)–(f) of Figure 2 and panels (d)–(f) of Figure 3, and they sum to the total. The numbers behind panel (c) of Figure 3 are in Table F.2. Table C.3 reports goods employment when construction is counted as part of the goods sector.

Table C.1: Goods employment and aggregate outcomes

	Goods employment (%)						Long run (%)		
	Impact	Year 5	Year 10	Trough	Year	Long run	Real GDP	Capital	Real appr.
"Oil"	-0.01	0.05	0.18	-0.03	1	0.41	0.17	0.70	4.61
"Steel"	-0.01	-0.11	-0.22	-0.45	71	-0.45	-0.09	-0.20	0.87
"Toys"	-0.04	0.24	0.51	-0.04	0	0.84	-0.20	-0.48	3.70
"Cars"	-0.21	-0.88	-1.28	-1.85	82	-1.85	-0.37	-1.02	2.78
All goods	-0.66	-1.60	-1.59	-1.63	7	-1.21	-0.23	-0.55	14.34
All goods, no adj. frictions	-0.96	-0.58	-0.58	-0.96	0	-0.55	-0.29	-0.71	13.64
All goods, retaliation	-1.01	-2.08	-1.64	-2.11	4	-0.91	-0.69	-1.82	9.21
2025 tariffs	-0.24	-0.69	-0.82	-0.90	31	-0.88	-0.21	-0.58	5.55

Notes: Percent changes relative to the no-tariff equilibrium. Each row is a 25% tariff on imports of the indicated sector from all countries, a 25% tariff on all goods, the same tariff in the model without adjustment frictions or with symmetric retaliation by all other countries, or the 2025 tariff schedule described in Section 4.8. "Impact" is the year the tariff is imposed, and "Year 5" and "Year 10" are five and ten years later. "Trough" is the minimum of goods employment over the transition and "Year" is the number of years after impact at which it is reached (– if goods employment never falls). "Long run" is the final period of the transition. Real GDP is measured at no-tariff prices as described in the main text. "Capital" is the sum of the sectoral capital stocks. "Real appr." is real exchange rate appreciation against the other three regions, weighted by U.S. exports to each region in the no-tariff equilibrium.

Table C.3 reports what happens to goods employment if construction is counted as part of the goods sector. Construction is used only to produce investment goods, so in the long run its employment moves in the same direction as the aggregate capital stock: it rises under tariffs on "oil", which raise the capital stock, and falls under all the other tariffs, which lower it (Table C.1). Adding construction therefore adds to the long-run change in goods employment under tariffs on "oil", "steel", and "cars", and offsets part of the increase under tariffs on "toys". Because the base is larger, however, all of the long-run percent changes are smaller. None of the long-run effects changes sign, and the ranking of the four single-sector tariffs is unchanged. Under tariffs on all goods, the combined employment of goods and construction still falls in both the short run and the long run: by 1.19% at its trough and 0.92% in the long run, compared with 1.63% and 1.21% for goods employment alone. Under the 2025 tariffs, it falls by 0.69% in the long run, compared with 0.88% for

Table C.2: Long-run employment by goods sector

	Own change (%)				Contribution (% of goods emp.)				
	"Oil"	"Steel"	"Toys"	"Cars"	"Oil"	"Steel"	"Toys"	"Cars"	Total
"Oil"	9.62	-2.41	-8.98	-0.96	2.73	-0.33	-1.60	-0.38	0.41
"Steel"	-2.67	5.61	-1.95	-0.29	-0.76	0.77	-0.35	-0.12	-0.45
"Toys"	-8.39	-2.99	22.17	-0.81	-2.38	-0.41	3.95	-0.33	0.84
"Cars"	-5.53	-1.80	-4.36	1.85	-1.57	-0.25	-0.78	0.74	-1.85
All goods	-3.39	-2.74	2.35	-0.72	-0.96	-0.38	0.42	-0.29	-1.21
All goods, no adj. frictions	-2.37	-2.14	3.75	-0.64	-0.67	-0.29	0.67	-0.26	-0.55
All goods, retaliation	-2.13	-4.37	6.75	-2.27	-0.60	-0.60	1.20	-0.91	-0.91
2025 tariffs	-5.35	-0.21	4.00	-0.12	-1.52	-0.03	0.71	-0.05	-0.88

Notes: Long-run (final-period) changes in U.S. employment in each goods sector relative to the no-tariff equilibrium, in the scenarios described in the notes to Table C.1. "Own change" is the percent change in the sector's employment. "Contribution" is the change in the sector's employment as a percent of total pre-tariff goods employment. "Total" is the percent change in total goods employment, which equals the sum of the four contributions.

goods employment alone, because construction employment falls by less (0.32%).

Table C.3: Goods and construction employment

	Goods			Goods + construction			Construction
	Impact	Trough	LR	Impact	Trough	LR	LR
Oil	-0.01	-0.03	0.41	-0.06	-0.07	0.35	0.23
Steel	-0.01	-0.45	-0.45	-0.08	-0.42	-0.42	-0.37
Toys	-0.04	-0.04	0.84	-0.05	-0.05	0.52	-0.12
Cars	-0.21	-1.85	-1.85	-0.19	-1.33	-1.32	-0.27
All	-0.66	-1.63	-1.21	-0.55	-1.19	-0.92	-0.33
2025	-0.24	-0.90	-0.88	-0.23	-0.70	-0.69	-0.32

Notes: Percent changes relative to the no-tariff equilibrium in the scenarios described in the notes to Table C.1. "Goods" is employment in the four goods sectors, as in the main text. "Goods + construction" adds construction employment. "Construction" is construction employment alone. "Impact", "Trough", and "LR" are defined as in Table C.1.

D Sensitivity to the Armington elasticities

The Armington elasticities of the four goods sectors, ζ^s, govern how strongly demand shifts from imported to domestic goods when tariffs raise the price of imports. As described in Appendix B, I choose these values rather than estimate them. To assess how much the results depend on this choice, I solve the model under six alternative sets of values, which are listed in Table D.1:

Caliendo–Parro. The Armington elasticities implied by the trade-weighted estimates of Caliendo and Parro (2015) reported in Table B.2: 20.1 ("oil"), 3.9 ("steel"), 12.8 ("toys"), and 3.1 ("cars").

KRS. The values used by Kehoe et al. (2018) and Steinberg (2019b), who distinguish between goods by use rather than by sector: three for intermediate inputs and two for final goods, in every goods sector. This case removes the differences across sectors that I emphasize in the baseline calibration and also lowers the average elasticity.

Half dispersion. The baseline values with half of their dispersion. I halve the deviation of the logarithm of each value from the logarithm of the trade-weighted mean and then rescale the values so that their trade-weighted mean is unchanged at 3.25.

Uniform. A single value for every goods sector and use. I experiment with three different values: 2, 3.25 (the trade-weighted mean of the baseline values), and 5.

For a given value of the supply-chain adjustment cost ϕ_Z, changing the long-run elasticities also changes the short-run elasticity. To isolate the role of the long-run elasticities, I re-set ϕ_Z for each alternative so that the short-run trade elasticity in the calibration experiment equals its baseline value of 0.5. The alternative calibrations therefore share the same short-run elasticity and differ only in the long run. Higher long-run elasticities require stronger frictions to deliver the same short-run elasticity, so ϕ_Z ranges from 2.5 in the uniform case with an elasticity of two to 4.6 in the Caliendo–Parro case and the uniform case with an elasticity of five. The long-run counterpart of the calibration statistic is the trade-weighted average Armington elasticity, which ranges from 2.0 to 9.0.

Long-run effects. Table D.2 reports the long-run changes in goods employment and real GDP under each single-sector tariff, the tariff on all goods, and the 2025 tariff schedule. Several results hold in every case. The ranking of the four single-sector tariffs is the same: tariffs on "toys" raise goods employment the most, followed by tariffs on "oil", "steel", and "cars". Tariffs on "steel" and "cars" lower long-run goods employment, and tariffs on "toys" raise it in every case but one (the uniform case with an elasticity of two, in which the effect is -0.04%). Tariffs on "steel", "toys", and "cars", tariffs on all goods, and the 2025 schedule

lower real GDP in every case; tariffs on all goods and the 2025 schedule lower it by 0.15–0.26% and 0.10–0.23%, respectively. The magnitudes depend on the elasticities. Figure D.3 compares the long-run effects in the baseline with those under the Caliendo–Parro and KRS elasticities. Under the Caliendo–Parro elasticities, the gain from tariffs on "toys" quadruples, to 3.4%, and the loss from tariffs on "cars" rises slightly, to 2.0%. Under the KRS elasticities, the gain from tariffs on "toys" almost disappears (0.08%), and the loss from tariffs on "cars" falls by half, to 0.9%.

Other results do depend on the elasticities. First, the gain from tariffs on "oil" is not robust. Tariffs on "oil" raise goods employment only in the baseline and half-dispersion cases, and they lower it slightly, by 0.03–0.34%, in the other five. They raise real GDP in the three cases in which "oil" has the highest elasticity—the baseline, Caliendo–Parro, and half-dispersion cases—and lower it slightly in the KRS and uniform cases. Second, the long-run effect of tariffs on all goods depends on the average level of the elasticities. Across the three uniform cases, as the elasticity rises from two to 3.25 to five, the long-run change in goods employment rises from −1.58% to −1.24% to −0.64% under tariffs on all goods, and from −0.87% to −0.77% to −0.56% under the 2025 schedule. In the Caliendo–Parro case, whose average elasticity is 9.0, tariffs on all goods raise goods employment in the long run, by 0.67%, while the 2025 schedule lowers it by only 0.03%. The reason is that higher elasticities allow tariffs to shift more demand from imported to domestic goods.

The dispersion of the elasticities across sectors amplifies the differences between sectors but does not create them. Comparing the baseline calibration with the uniform case at the same average elasticity, 3.25, the heterogeneity raises the gain from tariffs on "toys" (0.84% versus 0.52%), turns the small loss from tariffs on "oil" into a gain (0.41% versus −0.08%), and more than doubles the loss from tariffs on "cars" (−1.85% versus −0.80%), while it barely changes the effect of tariffs on all goods (−1.21% versus −1.24%) and makes the effect of the 2025 schedule slightly more negative (−0.88% versus −0.77%). The half-dispersion case lies in between for most results. That the ranking of the single-sector tariffs is the same even when every sector has the same elasticity suggests that the sectors' positions in the trade and production structure also matter. Imports of "toys" are equal to 74% of U.S. gross output in that sector, compared with 16–25% in the other three, so replacing imports with domestic production adds more employment relative to the size of the sector. "Cars," on the other hand, account for 42% of U.S. goods imports, so when every sector has the same elasticity, a tariff on them acts more like a broad-based tariff: in the uniform case with an elasticity of 3.25, it causes a long-run real appreciation of the dollar of 5.9%, compared with 1.4–3.2% under the other single-sector tariffs, which lowers U.S. goods exports by 17% and crowds out employment in the other goods sectors. Tariffs on "oil," finally, raise the cost of inputs used throughout the goods sector.

Transition dynamics. Table D.3 reports the transition of goods employment under tariffs on all goods and the 2025 schedule, and Figures D.1 and D.2 show sector-level employment dynamics under these two policies in each alternative case. The short-run effects are similar across the seven calibrations, because they share the same short-run elasticity. Under tariffs on all goods, goods employment falls by 0.57–0.73% on impact in every case, continues to fall for several years, and bottoms out 1.40–1.87% below its pre-tariff level in years 5–9. In every case, goods employment then recovers at least partly, so the trough is deeper than the long-run decline, and convergence to the new long-run level is slow, taking 30–44 years. Under the 2025 schedule, goods employment falls in the short run in every case, bottoming out 0.32–1.00% below its pre-tariff level in years 7–31. The sector-level patterns are also the same in every case: the targeted sector expands while the other goods sectors contract, so tariffs reallocate workers across goods sectors more than they change total goods employment. Under the 2025 schedule, "toys" is the only sector whose employment rises in the long run in every case except the Caliendo–Parro case, in which employment in "steel" and "cars" also rises slightly; the increase in "toys" is small in the KRS and uniform-two cases. Finally, the long-run effects of single-sector tariffs take a long time to materialize: under tariffs on "toys," for example, only 39–61% of the long-run change in goods employment has occurred after ten years in the five cases in which that change is not close to zero.

What differs across calibrations is mainly what happens after the trough. Across the uniform cases, a higher elasticity produces a shallower and earlier trough and a stronger subsequent recovery. Under tariffs on all goods, goods employment recovers by 2.2 p.p. from its trough in the Caliendo–Parro case, where it bottoms out in year 5 and exceeds its pre-tariff level from year 27 onward, but by only 0.3 p.p. in the KRS and uniform-two cases, where it bottoms out in year 9 and then recovers only slightly. Under the 2025 schedule, by contrast, goods employment remains below its pre-tariff level in every case, although in the Caliendo–Parro case the decline is small, bottoming out at 0.32% in year 7 and nearly disappearing in the long run. Thus, the elasticities determine whether the short-run decline in goods employment under tariffs on all goods is followed by a long-run gain or by a permanent loss.

In short, the elasticities matter more for the long-run effects of tariffs on all goods and on "oil" than for the other results. The ranking of the single-sector tariffs, the reallocation across sectors, the short-run decline under broad-based tariffs, the slow convergence, the long-run decline under the 2025 schedule, and the real GDP losses from tariffs on "steel", "toys", "cars", all goods, and the 2025 schedule hold under every set of elasticities I consider. Whether tariffs on "oil" raise goods employment, and whether tariffs on all goods raise it in the long run, by contrast, depend on the elasticities.

Table D.1: Alternative Armington elasticities

	"Oil"	"Steel"	"Toys"	"Cars"	Average	ϕ_Z
Baseline	8	2	4	1.05	3.25	2.90
Caliendo–Parro	20.13	3.87	12.82	3.14	9.02	4.64
KRS	3 / 2	3 / 2	3 / 2	3 / 2	2.47	2.95
Half dispersion	5.50	2.75	3.89	1.99	3.25	3.43
Uniform (2)	2	2	2	2	2.00	2.51
Uniform (3.25)	3.25	3.25	3.25	3.25	3.25	3.65
Uniform (5)	5	5	5	5	5.00	4.62

Notes: Armington elasticities ζ^s of the four goods sectors. In the KRS case, the first value applies to intermediate inputs and the second to final goods. "Average" is the long-run trade elasticity in the calibration experiment: the response of imported relative to domestic purchases to their relative price, averaged across goods sectors and partners with base-period trade weights, in the final period of an experiment in which every country imposes a 25% tariff on all goods imported from every other country. In every case, ϕ_Z is set so that the same statistic on impact, the short-run trade elasticity, equals its baseline value of 0.5. The Armington elasticity of services is 1.05 in every case.

Table D.2: Long-run effects under alternative Armington elasticities

	LR goods employment (%)						LR real GDP (%)					
Elasticities	Oil	Steel	Toys	Cars	All	2025	Oil	Steel	Toys	Cars	All	2025
Baseline	0.41	-0.45	0.84	-1.85	-1.21	-0.88	0.17	-0.09	-0.20	-0.37	-0.23	-0.21
Caliendo–Parro	-0.34	-0.67	3.39	-2.03	0.67	-0.03	0.08	-0.11	-0.20	-0.33	-0.15	-0.23
KRS (3 int., 2 final)	-0.03	-0.25	0.08	-0.92	-1.49	-0.88	-0.06	-0.02	-0.25	-0.08	-0.26	-0.14
Half dispersion	0.20	-0.38	0.85	-1.42	-1.20	-0.80	0.04	-0.06	-0.21	-0.22	-0.26	-0.18
Uniform 2	-0.11	-0.25	-0.04	-0.86	-1.58	-0.87	-0.07	-0.03	-0.21	-0.02	-0.20	-0.10
Uniform 3.25	-0.08	-0.32	0.52	-0.80	-1.24	-0.77	-0.08	-0.04	-0.25	-0.04	-0.26	-0.14
Uniform 5	-0.05	-0.39	1.31	-0.70	-0.64	-0.56	-0.10	-0.03	-0.27	-0.04	-0.26	-0.16

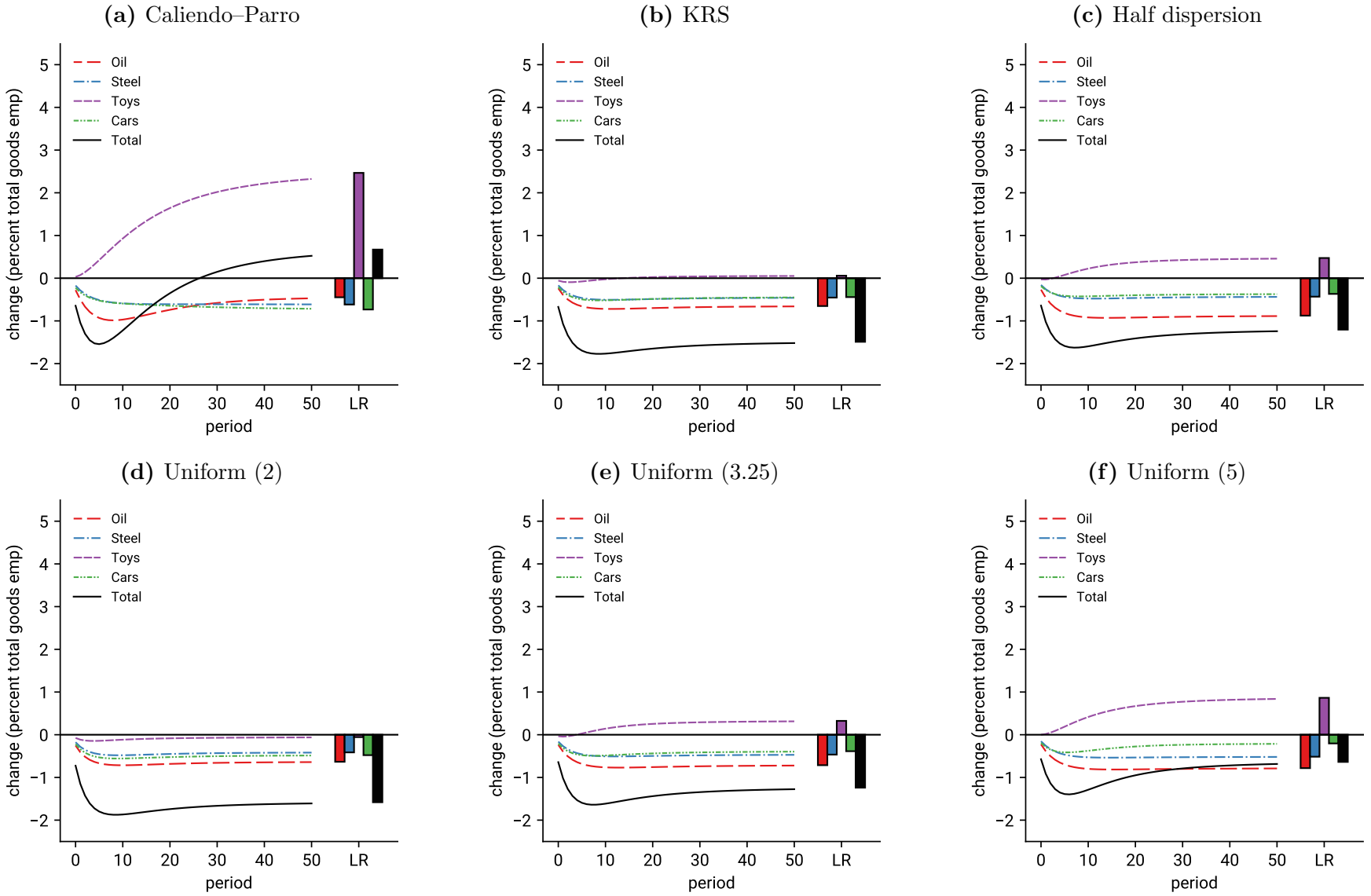
Notes: Long-run (final-period) percent changes in U.S. goods employment and real GDP relative to the no-tariff equilibrium of the same calibration, under a 25% tariff on imports of the indicated sector from all countries, a 25% tariff on all goods ("All"), and the 2025 tariff schedule ("2025"). Each row uses the Armington elasticities in Table D.1, with ϕ_Z re-set to keep the short-run trade elasticity at its baseline value.

Table D.3: Transition dynamics under alternative Armington elasticities

Experiment	Elasticities	ϕ_Z	Impact	Trough	Trough yr	Recovery yr	Conv. yr	Long run
All goods	Baseline	2.9	-0.66	-1.63	7	–	42	-1.21
All goods	Caliendo–Parro	4.639	-0.65	-1.54	5	27	44	0.67
All goods	KRS (3 int., 2 final)	2.95	-0.67	-1.77	9	–	31	-1.49
All goods	Half dispersion	3.431	-0.64	-1.63	7	–	42	-1.20
All goods	Uniform 2	2.506	-0.73	-1.87	9	–	30	-1.58
All goods	Uniform 3.25	3.654	-0.64	-1.64	7	–	40	-1.24
All goods	Uniform 5	4.624	-0.57	-1.40	6	–	42	-0.64
2025	Baseline	2.9	-0.24	-0.90	31	–	10	-0.88
2025	Caliendo–Parro	4.639	-0.13	-0.32	7	–	76	-0.03
2025	KRS (3 int., 2 final)	2.95	-0.31	-0.97	12	–	25	-0.88
2025	Half dispersion	3.431	-0.26	-0.87	15	–	25	-0.80
2025	Uniform 2	2.506	-0.34	-1.00	10	–	27	-0.87
2025	Uniform 3.25	3.654	-0.28	-0.90	11	–	32	-0.77
2025	Uniform 5	4.624	-0.23	-0.73	11	–	47	-0.56

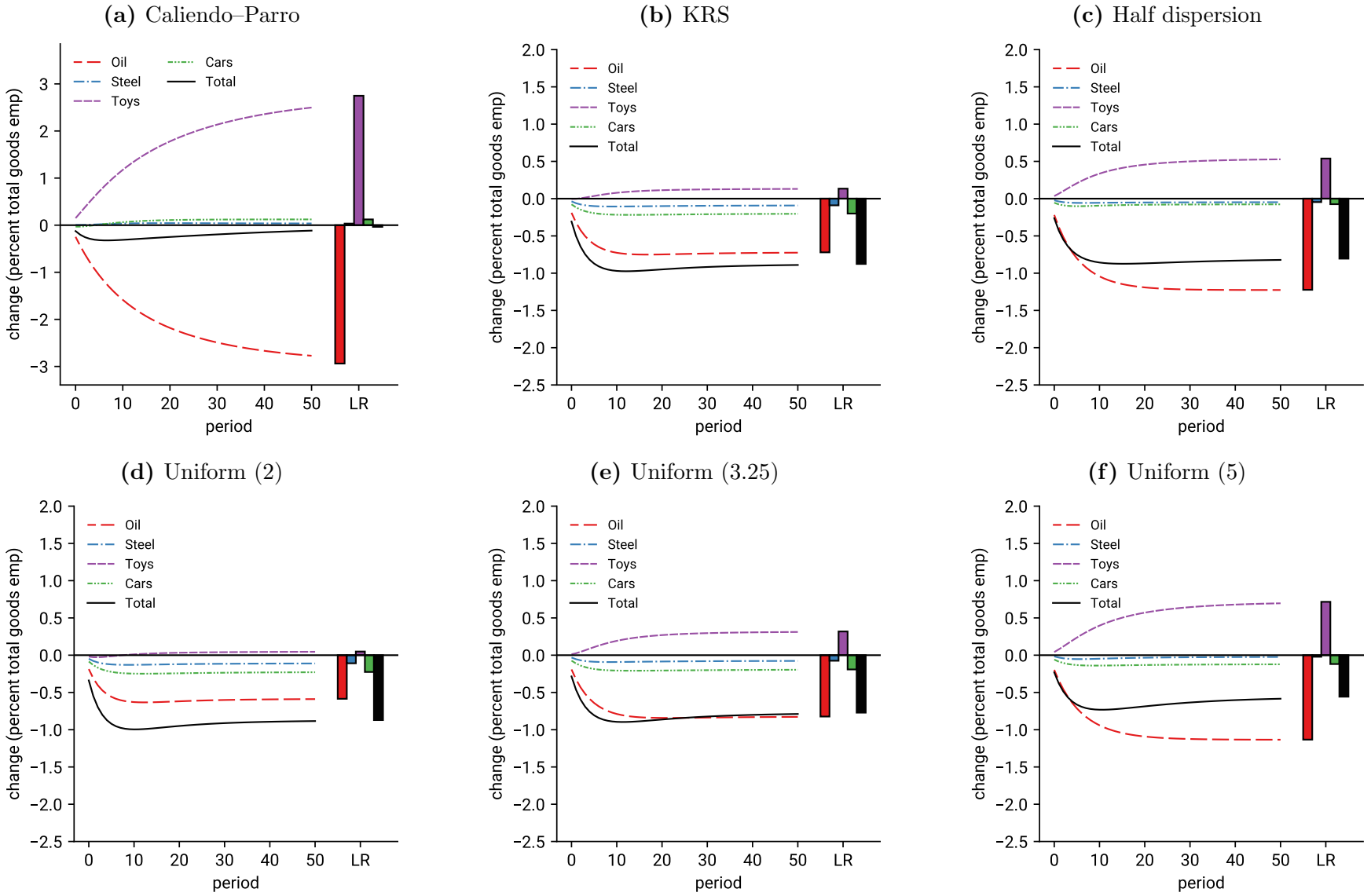
Notes: U.S. goods employment (percent change relative to the no-tariff equilibrium of the same calibration) under a 25% tariff on all goods from all countries and under the 2025 tariff schedule, for the Armington elasticities in Table D.1. "Trough yr" is the year in which goods employment reaches its minimum (– if it never falls). "Recovery yr" is the first year from which goods employment stays above its pre-tariff level (– if it never does). "Conv. yr" is the first year from which goods employment stays within 10% of its maximum deviation from its long-run value. "Long run" is the final period of the transition.

Figure D.1: Employment dynamics under tariffs on all goods and alternative Armington elasticities



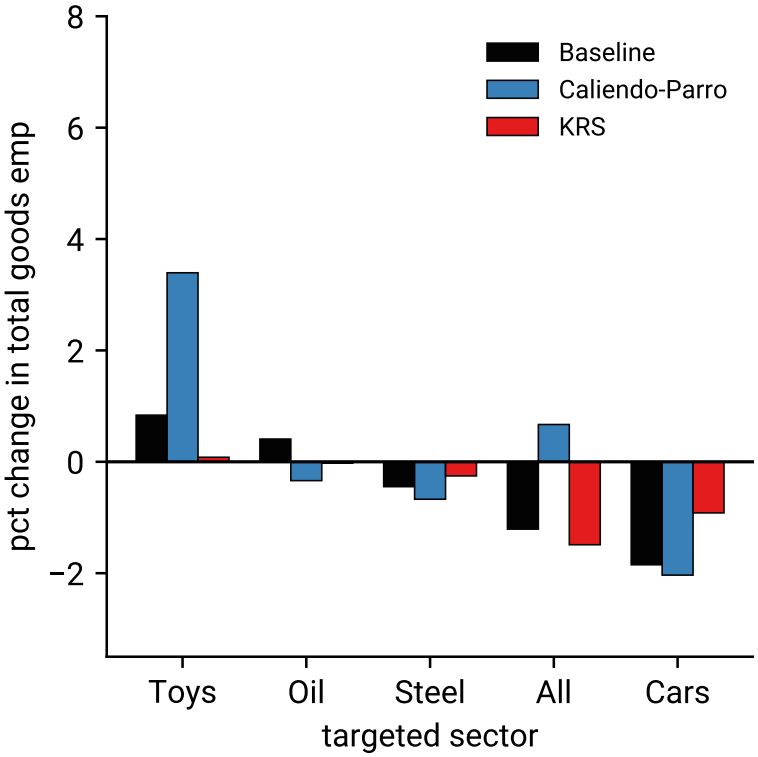
Notes: Change in sector-level employment (percent of baseline total goods employment) and total goods employment (percent) under a 25% tariff on all goods from all countries, for the Armington elasticities in Table D.1. Bars show the long run. Panel (d) of Figure 2 shows the baseline.

Figure D.2: Employment dynamics under the 2025 tariffs and alternative Armington elasticities



Notes: Same as Figure D.1, under the 2025 tariff schedule. Panel (f) of Figure 3 shows the baseline.

Figure D.3: Long-run goods employment under alternative Armington elasticities



Notes: Long-run effects of 25% tariffs on each goods sector and on all goods on U.S. goods employment under the baseline Armington elasticities and the alternative elasticities of Caliendo and Parro (2015) and Kehoe et al. (2018) listed in Table D.1.

E Adjustment frictions

This appendix reports two sets of additional results on the adjustment frictions: results under alternative strengths of the supply-chain frictions, and results with one friction at a time.

Strength of supply-chain frictions. The supply-chain adjustment cost ϕ_Z governs how quickly distributors can shift their sourcing in response to a change in relative prices, and thus how far the short-run trade elasticity falls below its long-run counterpart. As described in Section 3.3, I measure the short-run trade elasticity in an experiment in which every country unexpectedly and permanently imposes a 25% tariff on all goods imported from every other country, as the impact response of imported relative to domestic purchases to their relative price, averaged across goods sectors and trading partners using base-period trade weights. In the long run, this statistic equals the trade-weighted average of the Armington elasticities, 3.25. In the baseline calibration, $\phi_Z = 2.9$, and the short-run elasticity is 0.5.

Estimates of the short-run trade elasticity range from about 0.2 to about 1. To assess how much the results depend on where in this range the true value lies, I solve the model with two alternative values of ϕ_Z chosen to hit the two ends of the range: $\phi_Z = 0.66$, which delivers a short-run elasticity of 1, and $\phi_Z = 11.8$, which delivers 0.2. All other parameters are held at their baseline values. Note that ϕ_Z does not enter the steady-state equilibrium conditions, so the no-tariff equilibrium is the same in all three calibrations.

Table E.1 reports the dynamics of goods employment under tariffs on all goods and under the 2025 tariff schedule for each value of ϕ_Z, and Figure E.1 shows the corresponding sector-level dynamics. Stronger frictions make the short-run decline in goods employment deeper and longer. Under tariffs on all goods, goods employment bottoms out 1.18% below its pre-tariff level in year 6 when the short-run elasticity is 1, 1.63% below in year 7 in the baseline, and 2.22% below in year 14 when the short-run elasticity is 0.2. In none of these cases does goods employment return to its pre-tariff level. Instead, it converges to a permanently lower level, and it takes 42–46 years to complete 90% of this convergence. Under the 2025 schedule, goods employment falls steadily toward a permanently lower level, bottoming out 0.76%, 0.90%, and 1.16% below its pre-tariff level as the short-run elasticity falls from 1 to 0.5 to 0.2, and it completes 90% of this convergence by year 7, 10, and 19, respectively. In no case does it return to its pre-tariff level.

The strength of the frictions also affects the long run. Under tariffs on all goods, long-run goods employment falls by 0.89% when the short-run elasticity is 1, by 1.21% in the baseline, and by 1.81% when it is 0.2. As discussed in Section 4.6, the reason is that the long-run equilibrium depends on the net foreign assets that the United States accumulates during the transition. Stronger frictions slow the adjustment of imports, so tariffs narrow

the trade deficit by more in the short run: by up to 1.58 percentage points of GDP when the short-run elasticity is 0.2, compared with 1.27 in the baseline and 0.81 when it is 1. Households save part of this temporary income, and U.S. net foreign assets end up 15.5% of initial GDP higher than in the no-tariff equilibrium, compared with 7.7% in the baseline and 3.5% when the short-run elasticity is 1. The return on these assets finances permanently higher consumption, and the additional spending on services and construction draws workers out of the goods sectors.

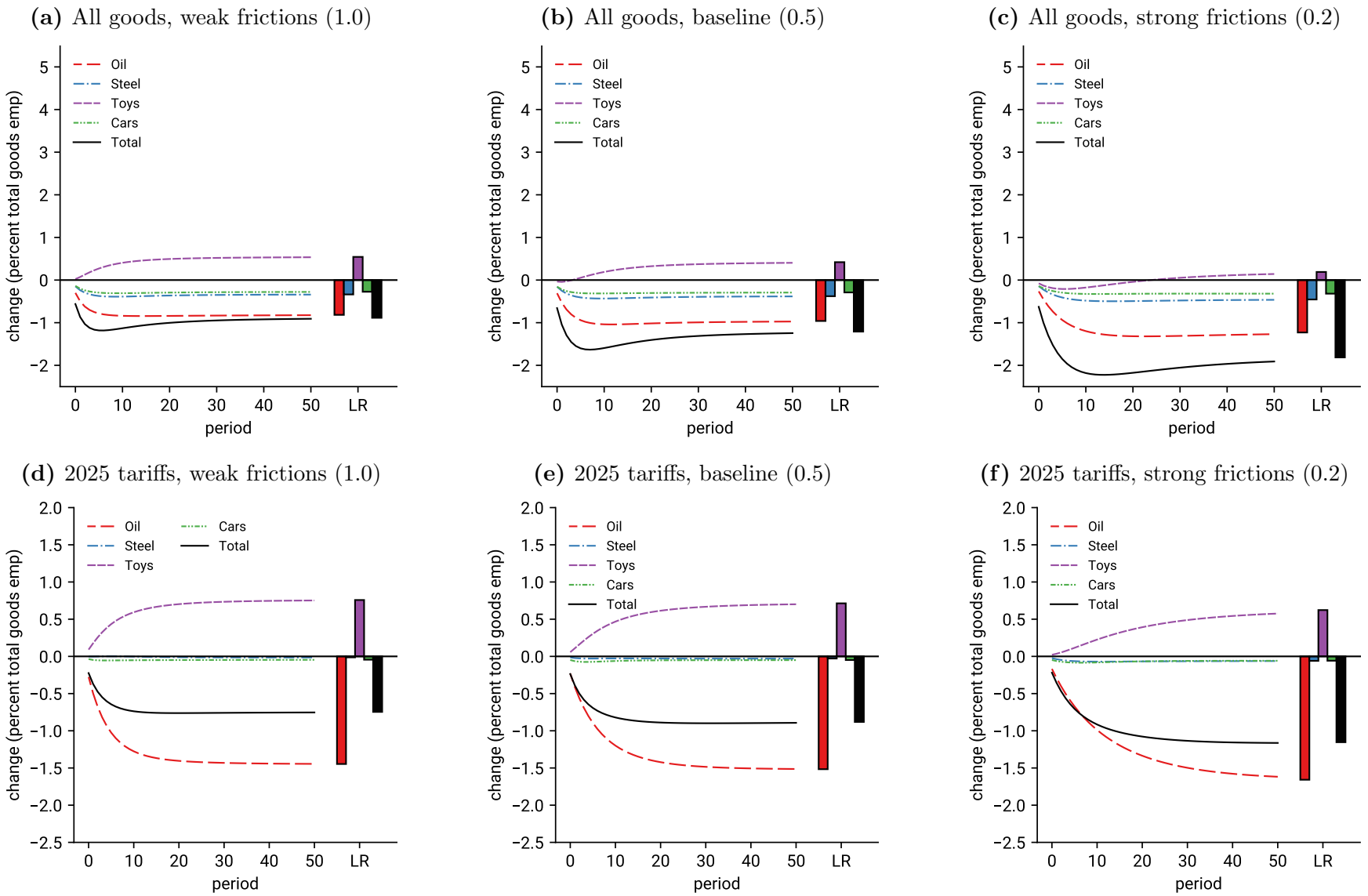
Figure E.2 shows that the long-run effects of the four single-sector tariffs are similar in all three calibrations. Tariffs on "toys" and "oil" raise long-run goods employment, while tariffs on "steel" and "cars" lower it, and the ranking of the four tariffs is unchanged. Long-run goods employment rises by 0.64–0.94% under tariffs on "toys" and falls by 1.79–2.02% under tariffs on "cars". In short, the strength of supply-chain frictions matters for how painful broad-based tariffs are, in both the short and the long run, but it does not change which tariffs raise goods employment.

Table E.1: Transition dynamics under alternative supply-chain frictions

Experiment	Frictions (SR elast.)	ϕ_Z	Impact	Trough	Trough yr	Recovery yr	Conv. yr	Long run
All goods	Weak (1.0)	0.66	-0.56	-1.18	6	–	43	-0.89
All goods	Baseline (0.5)	2.9	-0.66	-1.63	7	–	42	-1.21
All goods	Strong (0.2)	11.8	-0.63	-2.22	14	–	46	-1.81
2025	Weak (1.0)	0.66	-0.22	-0.76	20	–	7	-0.75
2025	Baseline (0.5)	2.9	-0.24	-0.90	31	–	10	-0.88
2025	Strong (0.2)	11.8	-0.22	-1.16	56	–	19	-1.15

Notes: U.S. goods employment (percent change relative to the no-tariff equilibrium) under a 25% tariff on all goods from all countries and under the 2025 tariff schedule, for three values of the supply-chain adjustment cost ϕ_Z. The number in parentheses is the short-run trade elasticity that each value of ϕ_Z delivers in the calibration experiment. "Trough yr" is the year in which goods employment reaches its minimum. "Recovery yr" is the first year from which goods employment stays above its pre-tariff level (– if it never does). "Conv. yr" is the first year from which goods employment stays within 10% of its maximum deviation from its long-run value. "Long run" is the final period of the transition.

Figure E.1: Employment dynamics under alternative supply-chain frictions



Notes: Change in sector-level employment (percent of baseline total goods employment) and total goods employment (percent) under a 25% tariff on all goods from all countries (top row) and under the 2025 tariff schedule (bottom row), for $\phi_Z = 0.66$ (left), $\phi_Z = 2.9$ (middle, the baseline), and $\phi_Z = 11.8$ (right). The number in parentheses in each panel title is the short-run trade elasticity. Bars show the long run.

One friction at a time. Table E.2 reports the dynamics of goods employment under tariffs on all goods in the baseline model, in the model without adjustment frictions, and in versions of the model with only one of the three frictions: labor adjustment costs (ϕ_L), capital adjustment costs (ϕ_K), or supply-chain adjustment costs (ϕ_Z). In each case, the other two adjustment-cost parameters are set to zero and all other parameters are held at their baseline values. The last four columns split the change in goods employment into the contribution of the "toys" sector, the only goods sector that gains workers in the long run, and the combined contribution of the other three.

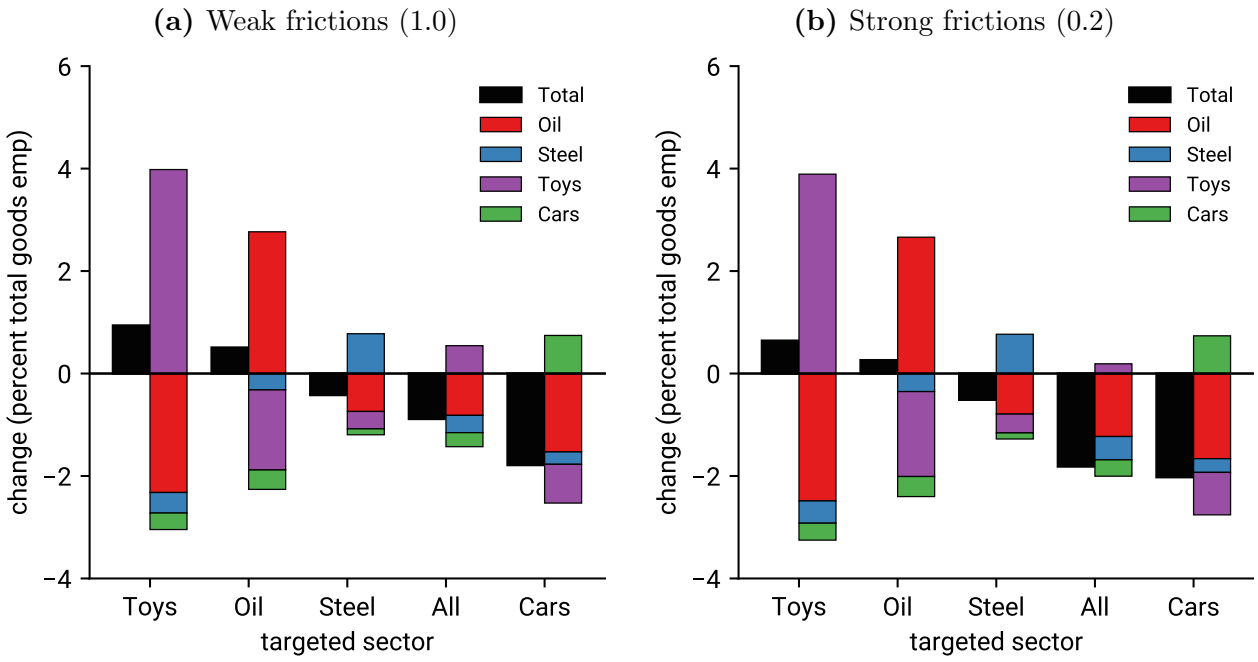
Labor adjustment costs alone slow the reallocation of workers, but they slow the expanding and contracting sectors alike. After five years, the "toys" sector has added 75% of the workers it gains in the long run and the other three sectors have shed 86% of the workers they lose, and goods employment falls gradually, never more than 0.03 percentage points below its long-run level. Capital adjustment costs alone make goods employment fall by more on impact than in the long run, but it recovers steadily as capital is reallocated. Supply-chain frictions alone produce a path much like the baseline. After five years, the "toys" sector has added 27% of its long-run gain, while the other three sectors have already shed all of their long-run loss. In the baseline, which combines all three frictions, the corresponding numbers are 13% and 102%. Supply-chain frictions also account for most of the difference between the long-run effects with and without frictions: goods employment falls by 0.99% in the long run with only supply-chain frictions, compared with 0.55% without frictions and 0.57–0.59% with only labor or capital adjustment costs.

Table E.2: Tariffs on all goods with one adjustment friction at a time

	Goods employment (%)						"Toys"		Other goods	
Adjustment frictions	Impact	Year 5	Year 10	Trough	Year	Long run	Year 5	Long run	Year 5	Long run
All frictions (baseline)	-0.66	-1.60	-1.59	-1.63	7	-1.21	0.05	0.42	-1.66	-1.63
No frictions	-0.96	-0.58	-0.58	-0.96	0	-0.55	0.68	0.67	-1.26	-1.22
Labor only	-0.24	-0.57	-0.62	-0.62	13	-0.59	0.49	0.66	-1.06	-1.24
Capital only	-1.00	-0.84	-0.74	-1.00	0	-0.57	0.58	0.66	-1.42	-1.24
Supply chain only	-1.09	-1.38	-1.32	-1.38	6	-0.99	0.14	0.50	-1.51	-1.49

Notes: Percent changes in U.S. goods employment relative to the no-tariff equilibrium under a 25% tariff on all goods from all countries. "All frictions" is the baseline model; "No frictions" sets $\phi_L = \phi_K = \phi_Z = 0$; the other rows keep only the indicated adjustment cost. "Impact," "Year 5," "Year 10," "Trough," "Year," and "Long run" are defined as in Table C.1. The last four columns are the changes in employment in the "toys" sector and in the other three goods sectors combined, as a percent of total pre-tariff goods employment.

Figure E.2: Long-run employment effects under alternative supply-chain frictions



Notes: Long-run effects of 25% tariffs on each goods sector and on all goods on U.S. goods employment, for $\phi_Z = 0.66$ (panel a) and $\phi_Z = 11.8$ (panel b). The number in parentheses is the short-run trade elasticity. Panel (a) of Figure 2 shows the baseline.

F Trade diversion

This appendix describes the two regions that make up the United States' non-China trading partners in the model and reports the effects of tariffs on each foreign region separately.

Regions. I split the non-China partners according to the tariffs they face under the 2025 schedule. Using the partner-level import and duty data described in Appendix B, I compute each partner's import-weighted increase in the U.S. tariff on goods between 2024 and December 2025. I treat the European Union as a single partner because it faces a common U.S. tariff policy, and I treat the countries without their own series in the data as a single residual partner. I then rank partners by their tariff increase and split them at the import-weighted median, which is the European Union (8.4%). The partners above the median make up the *high-tariff partners*: Brazil, India, Indonesia, Japan, Korea, Malaysia, Thailand, Vietnam, and the residual group. All other non-China partners—including Canada, Mexico, the European Union, the United Kingdom, Switzerland, Australia, and Taiwan—make up the *low-tariff partners*. Table F.1 reports each region's share of U.S. imports in each goods sector and the 2025 tariff increase it faces. The high-tariff partners account for 27% of U.S. goods imports and the low-tariff partners for 51%. Under the 2025 schedule, the tariff increase on goods from the high-tariff partners (12.9%) is about twice that on goods from the low-tariff partners (6.3%), and it is higher in every sector. I split the partners by their 2025 tariffs rather than, for example, by treaty status, because diversion among foreign suppliers matters most when they face different tariffs.

Tariffs on one region at a time. Table F.2 reports the long-run effects of 25% tariffs on each goods sector, and on all goods, levied on China only, on the low-tariff partners only, on the high-tariff partners only, and on all three regions. For each case, it reports the change in goods employment and in U.S. real imports of the targeted goods from each region. Figure F.1 plots the import responses.

There is substantial trade diversion. A tariff on one region lowers U.S. imports of the targeted goods from that region by 18–83% in the long run, depending on the sector, and raises imports of the same goods from the two untaxed regions by up to 33%. Diversion is strongest for high-elasticity goods. Under tariffs on "toys" from China only, imports of "toys" from China fall by 50%, while imports from each of the other two regions rise by 17%. Under tariffs on "oil" from the low-tariff partners only, imports of "oil" from China and the high-tariff partners rise by about 30%. Diversion is weakest for low-elasticity goods: tariffs on "cars" or "steel" from one region raise imports from the others by less than 6%.

Despite this diversion, the effects of single-sector tariffs on goods employment are close to additive across regions. The sum of the three single-region effects is 0.35% under tariffs on "oil", compared with 0.41% when all three regions are taxed at once; −0.42% vs. −0.45%

for "steel"; 0.77% vs. 0.84% for "toys"; and −1.81% vs. −1.85% for "cars". The gaps are largest for the two high-elasticity sectors, because each single-region tariff diverts part of the targeted imports to the other regions rather than to domestic producers. The interaction is largest under tariffs on all goods. Tariffs on all goods from China alone would leave long-run goods employment almost unchanged (−0.02%): "toys" would gain workers equal to 1.1% of goods employment, and "oil" would lose almost as many. Tariffs on all goods from the low-tariff partners would lower goods employment by 0.78%, and tariffs on the high-tariff partners would lower it by 0.25%. The sum of these effects is −1.05%, whereas tariffs on all three regions at once would lower goods employment by 1.21%. When every partner is taxed, imports cannot be diverted elsewhere, so more of the adjustment takes place through a real appreciation of the dollar—14% under tariffs on all regions versus 2–6% under tariffs on any single region—which crowds out U.S. exports and import-competing production in the untargeted sectors.

Figure F.2 shows sector-level employment dynamics under tariffs on all goods from each region separately and from all regions together. Tariffs on China alone leave goods employment almost unchanged throughout the transition, because the expansion of "toys" is matched by the contraction of "oil". Tariffs on the low-tariff partners alone lower goods employment gradually. Most of the decline is in "toys", which competes with imports from China and the high-tariff partners that become relatively cheaper as the dollar appreciates, whereas the low-tariff partners supply mostly "oil", "steel", and "cars". Tariffs on the high-tariff partners alone shift employment from "oil" toward "toys" and lower the total gradually, by 0.25% in the long run. Only tariffs on all regions produce the pronounced short-run decline in goods employment discussed in the main text.

Table F.1: Partner regions

	Share of U.S. imports (%)					2025 tariff increase (%)				
	"Oil"	"Steel"	"Toys"	"Cars"	All goods	"Oil"	"Steel"	"Toys"	"Cars"	All goods
China	7.8	19.2	44.0	12.9	21.4	28.0	19.2	16.0	22.7	18.9
Low-tariff partners	63.7	56.0	26.3	61.3	51.4	3.9	10.3	4.9	6.7	6.3
High-tariff partners	28.5	24.8	29.7	25.7	27.2	7.4	16.2	13.2	14.3	12.9

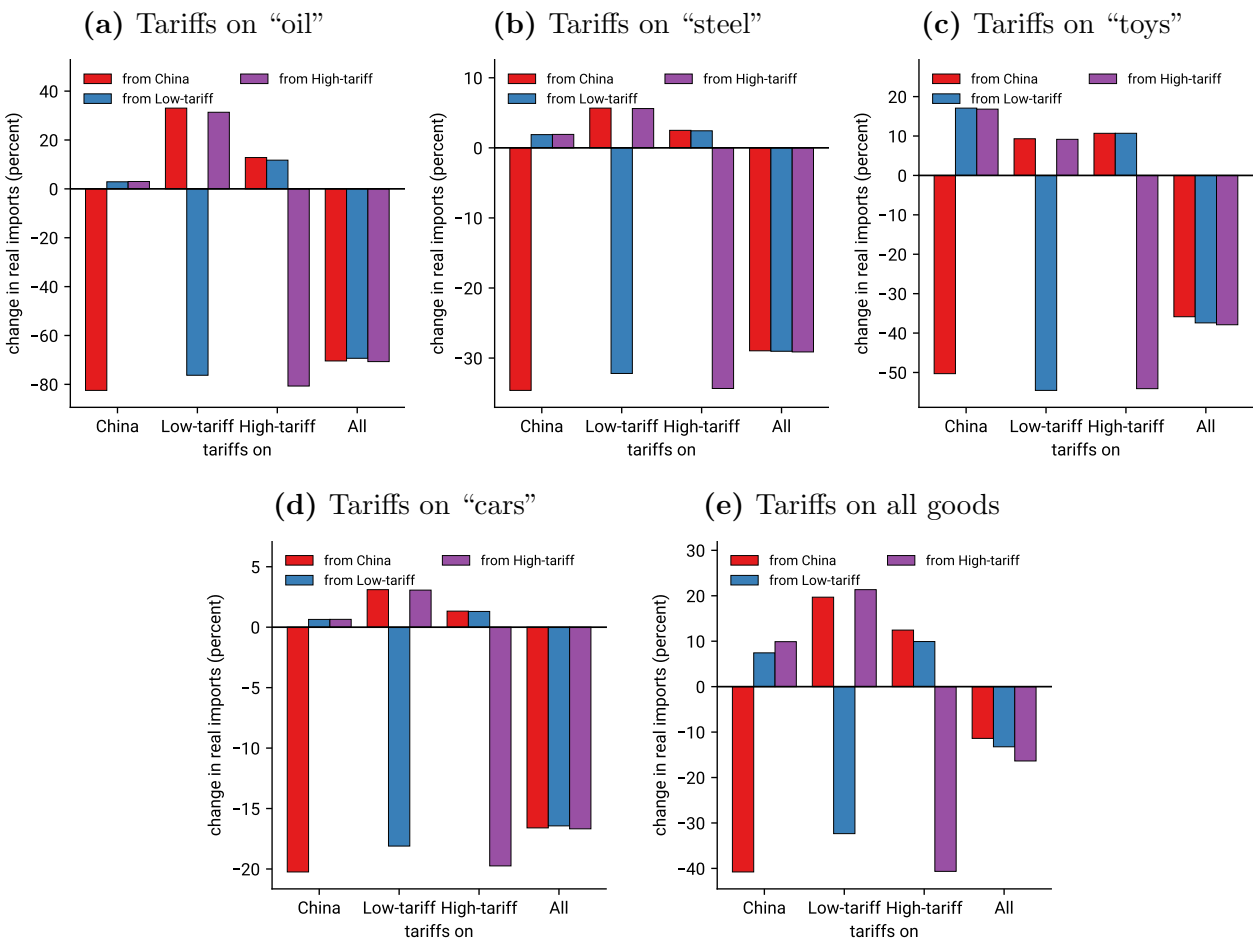
Notes: Share of U.S. imports: each region's share of U.S. imports (intermediate and final goods) in each sector in the 2020 ICIO data, as aggregated in the model. 2025 tariff increase: import-weighted (2024 imports) increase in the U.S. tariff between 2024 and December 2025, by sector, as used in the model's 2025 experiment; the "All goods" column weights sectors by the region's imports in the model. High-tariff partners: Brazil, India, Indonesia, Japan, Korea, Malaysia, Thailand, Vietnam, and the countries without their own series in the tariff data. Low-tariff partners: all other countries except China and the United States.

Table F.2: Tariffs on one region at a time

		Goods	Real imports of targeted goods from		
Targeted sector	Tariffs on	employment	China	Low-tariff	High-tariff
Oil	China	0.01	-82.5	2.9	3.0
	Low-tariff	0.26	33.0	-76.3	31.3
	High-tariff	0.08	12.8	11.7	-80.7
	All	0.41	-70.4	-69.3	-70.7
Steel	China	-0.09	-34.6	1.9	1.9
	Low-tariff	-0.23	5.7	-32.2	5.6
	High-tariff	-0.10	2.5	2.4	-34.3
	All	-0.45	-29.0	-29.0	-29.1
Toys	China	0.31	-50.3	17.1	16.8
	Low-tariff	0.24	9.3	-54.5	9.2
	High-tariff	0.22	10.7	10.7	-54.1
	All	0.84	-35.9	-37.4	-37.9
Cars	China	-0.25	-20.2	0.6	0.6
	Low-tariff	-1.10	3.1	-18.1	3.1
	High-tariff	-0.47	1.3	1.3	-19.7
	All	-1.85	-16.6	-16.4	-16.7
All	China	-0.02	-40.8	7.4	9.9
	Low-tariff	-0.78	19.7	-32.3	21.3
	High-tariff	-0.25	12.4	9.9	-40.7
	All	-1.21	-11.4	-13.2	-16.4

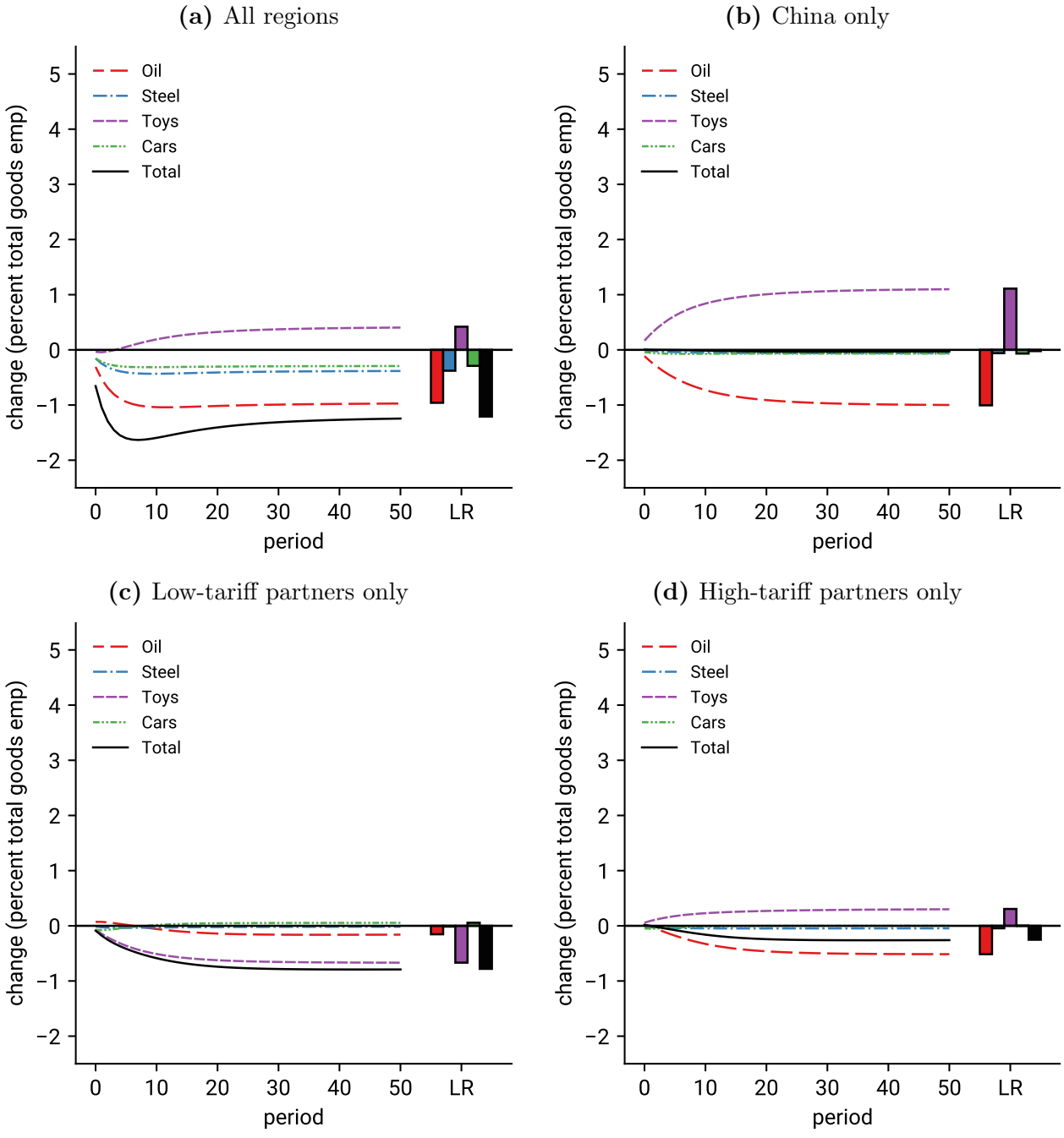
Notes: Long-run effects of a 25% tariff on the targeted sector ("All": all four goods sectors) levied on imports from China only, from the low-tariff partners only, from the high-tariff partners only, or from all three regions. Goods employment: percent change. Real imports: percent change in U.S. imports of the targeted goods from each region, at constant prices. All changes are relative to the no-tariff equilibrium.

Figure F.1: Trade diversion: U.S. real imports of the targeted goods by source



Notes: Long-run percent change in U.S. imports of the targeted goods from China, the low-tariff partners, and the high-tariff partners, at constant prices, under 25% tariffs on the targeted goods from the region indicated on the horizontal axis ("All": all three regions).

Figure F.2: Employment dynamics under tariffs on all goods from each region



Notes: Change in sector-level employment (percent of baseline total goods employment) and total goods employment (percent) under a 25% tariff on all goods from the region indicated. Bars show the long run. Panel (a) is the same as panel (d) of Figure 2.

G Endogenous labor supply

The baseline model holds each country's aggregate labor supply fixed, so tariffs change goods employment only by moving workers across sectors. This appendix shows how the results change when labor supply is endogenous. I replace the household's preferences in Appendix A.5 with the preferences proposed by Greenwood et al. (1988):

$$\sum_{t=0}^{\infty} \beta^t \frac{1}{1-\gamma} \left[C_{i,t} - \psi_i \frac{L_{i,t}^{1+1/\nu}}{1+1/\nu} \right]^{1-\gamma}, \tag{G.1}$$

where $L_{i,t}$ is the household's labor supply, $\psi_i > 0$ is the weight on the disutility of work, and ν is the Frisch elasticity of labor supply. In the budget constraint, Eq. (A.20), labor income becomes $W_{i,t}L_{i,t}$, and in the labor-market clearing condition, Eq. (A.25), $\bar{L}_i$ becomes $L_{i,t}$. Labor supply satisfies

$$\psi_i L_{i,t}^{1/\nu} = \frac{W_{i,t}}{P_{i,t}^c}, \tag{G.2}$$

so it depends only on the real wage and not on wealth. This is one reason I hold labor fixed in the baseline: the evidence on how trade affects aggregate employment is mixed, and Velasquez (2025) finds that greater trade openness reduces hours per worker through income effects that these preferences rule out. Let $H_{i,t} = C_{i,t} - \psi_i L_{i,t}^{1+1/\nu}/(1+1/\nu)$. The Euler equation becomes

$$Q_t = \beta \left(\frac{H_{i,t+1}}{H_{i,t}} \right)^{-\gamma} \frac{P_{i,t}^c}{P_{i,t+1}^c}, \tag{G.3}$$

and the present-value prices become $\Lambda_{i,t} = \beta^t (H_{i,t}/H_{i,0})^{-\gamma} (P_{i,0}^c/P_{i,t}^c)$. As in the baseline, $\Lambda_{i,t} = Q_0 Q_1 \cdots Q_{t-1}$. I set $\nu = 1$ and choose ψ_i so that each country's labor supply in the no-tariff equilibrium equals $\bar{L}_i$. The no-tariff equilibrium is therefore the same as in the baseline model, and all other parameters, including ϕ_Z, keep their baseline values.

Table G.1 reports the results for the main scenarios. With endogenous labor supply, aggregate employment moves with the real wage. In the long run, it changes by less than 0.2% under tariffs on "steel", "toys", and all goods and under the 2025 schedule. It rises by 0.50% under tariffs on "oil" and falls by 0.64% under tariffs on "cars".

The long-run effects on goods employment have the same signs as in the baseline (Figure G.1). Tariffs on "toys" raise goods employment by 0.86% (0.84% in the baseline), and tariffs on "steel" lower it by 0.62% (0.45%). The differences are largest for the two tariffs that change aggregate employment the most: tariffs on "oil" raise goods employment by 1.14% instead of 0.41%, which makes them the single-sector tariffs that raise it the most, and tariffs on "cars" reduce it by 2.67% instead of 1.85%. Tariffs on all goods reduce goods employment by 0.92% in the long run instead of 1.21%, and the 2025 schedule reduces it by

1.04% instead of 0.88%. Endogenous labor supply also amplifies the effects on real GDP of the tariffs that change aggregate employment the most. Tariffs on "oil" raise real GDP by 0.64% instead of 0.17%, and tariffs on "cars" reduce it by 0.98% instead of 0.37%. Tariffs on "oil" are still the only ones that raise real GDP.

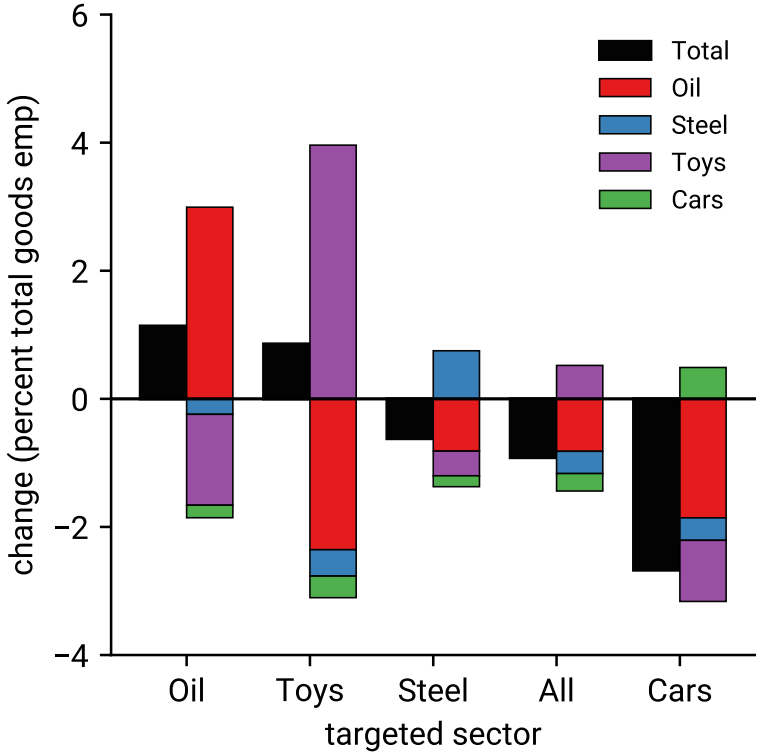
The short-run dynamics are also similar. Under tariffs on all goods, goods employment falls by 0.74% on impact and bottoms out 1.54% below its pre-tariff level after five years, compared with 0.66% and 1.63% after seven years in the baseline. Figure G.2 splits the log change in goods employment into the log change in aggregate employment and the log change in the goods sectors' share of aggregate employment. The short-run decline is almost entirely a decline in the goods share. Under tariffs on all goods, aggregate employment accounts for 0.10 of the 0.74 log points by which goods employment falls on impact, and it is slightly above its pre-tariff level when goods employment bottoms out. Under the 2025 schedule, it accounts for 0.06 of the 0.30 log points by which goods employment falls on impact. Thus, endogenous labor supply matters most for the single-sector tariffs that move the real wage the most, but it does not change the sign of any of the long-run effects or the short-run decline in goods employment under broad-based tariffs.

Table G.1: Results with endogenous labor supply

	Goods employment (%)					Total labor (%)		Real GDP, long run (%)	
	Impact	Trough	Year	Long run	Fixed labor	Impact	Long run	GHH	Fixed labor
"Oil"	0.00	–	–	1.14	0.41	-0.01	0.50	0.64	0.17
"Steel"	-0.04	-0.62	92	-0.62	-0.45	-0.03	-0.14	-0.23	-0.09
"Toys"	-0.06	-0.06	0	0.86	0.84	-0.02	-0.02	-0.22	-0.20
"Cars"	-0.31	-2.67	100	-2.67	-1.85	-0.09	-0.64	-0.98	-0.37
All goods	-0.74	-1.54	5	-0.92	-1.21	-0.10	0.07	-0.17	-0.23
2025 tariffs	-0.30	-1.05	81	-1.04	-0.88	-0.06	-0.17	-0.38	-0.21

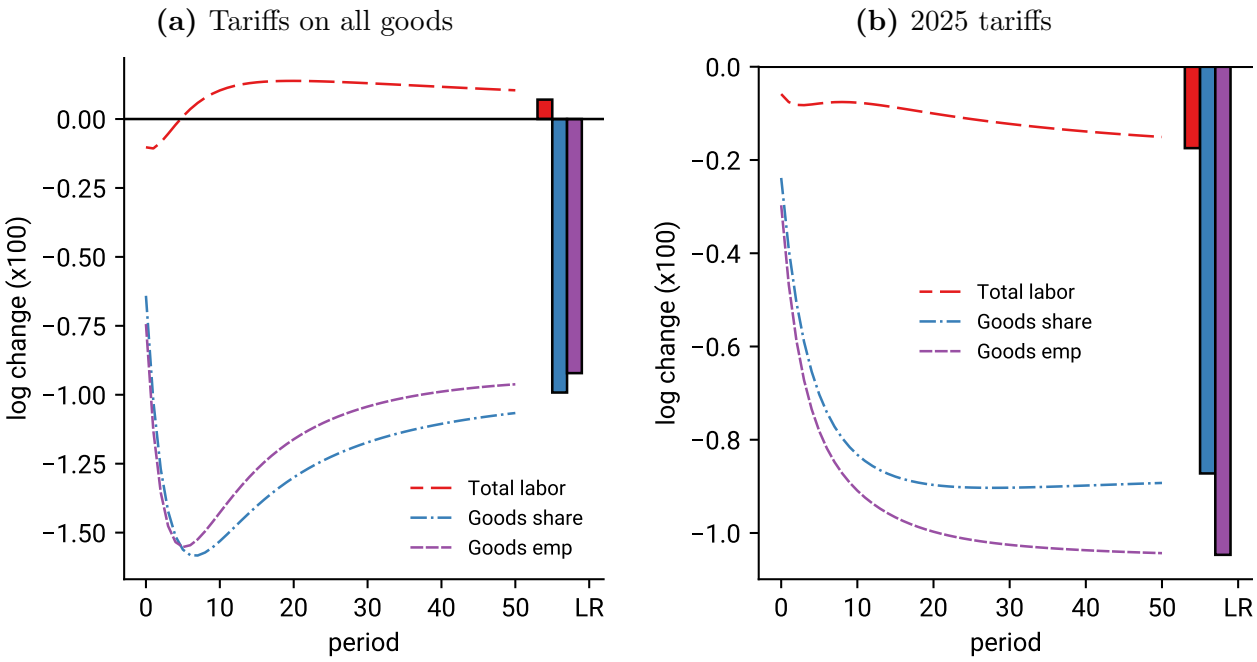
Notes: Percent changes relative to the no-tariff equilibrium in the model with endogenous labor supply, in the scenarios described in the notes to Table C.1. "Impact," "Trough," "Year," and "Long run" are defined as in Table C.1. "Fixed labor" columns repeat the long-run results of the baseline model from Table C.1. "Total labor" is aggregate U.S. employment.

Figure G.1: Long-run goods employment with endogenous labor supply



Notes: Long-run change in total employment across all four goods sectors in different tariff scenarios in the model with endogenous labor supply. Panel (a) of Figure 2 shows the baseline.

Figure G.2: Goods employment, aggregate employment, and the goods share with endogenous labor supply



Notes: Log change (×100) in U.S. goods employment ("Goods emp") relative to the no-tariff equilibrium in the model with endogenous labor supply, split into the log change in aggregate employment ("Total labor") and the log change in the goods sectors' share of aggregate employment ("Goods share"). The two components sum to the total. Bars show the long run.

H Trade deficits

This appendix provides more detail on how tariffs affect the U.S. trade balance. It first shows how tariffs change the composition of the trade deficit, and then asks how much of the long-run effect of tariffs on goods employment comes from the change in net foreign assets that the trade balance generates during the transition.

H.1 Composition of the trade deficit.

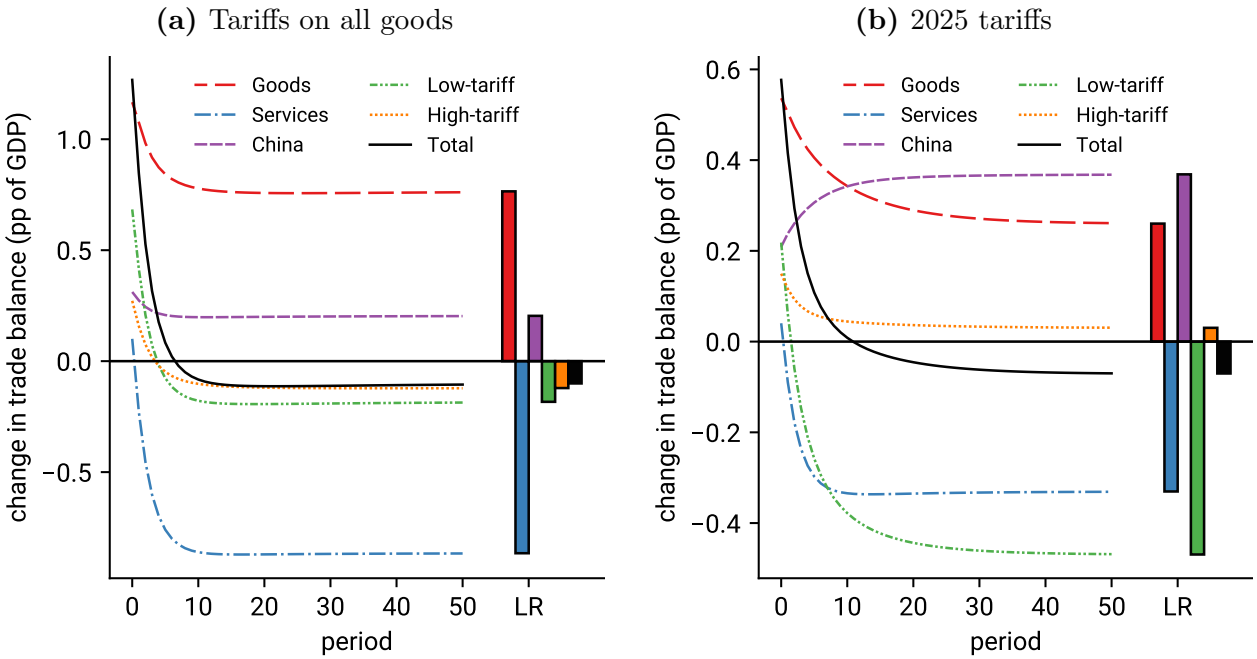
Figure H.1 splits the change in the U.S. trade balance into goods and services and into the bilateral balances with each region, under tariffs on all goods and under the 2025 tariffs. Under tariffs on all goods, the goods trade deficit narrows by 1.17 percentage points of GDP on impact and remains 0.77 percentage points narrower in the long run. The services trade surplus, by contrast, barely changes on impact but shrinks by 0.87 percentage points of GDP in the long run: U.S. real exports of services fall by 16% as the stronger dollar makes them less competitive, and real imports of services rise by 19% as consumption rises. Thus, tariffs on goods shift the U.S. trade deficit from goods to services rather than eliminating it. Bilateral balances also move in different directions. Under tariffs on all goods, the bilateral deficit with China narrows by 0.20 percentage points of GDP in the long run, while the deficits with the low-tariff and high-tariff partners widen by 0.18 and 0.12 percentage points. The 2025 tariffs, which tax China at much higher rates than other countries, narrow the bilateral deficit with China by 0.37 percentage points in the long run but widen the deficit with the low-tariff partners by 0.47 percentage points. Thus, tariffs can reduce the bilateral deficit with the countries they target without reducing the overall deficit.

H.2 Net foreign assets and the long run.

In the baseline model, households trade a single international bond, so trade imbalances are endogenous both along the transition and in the long run. As discussed in Section 2.5, the model therefore has a continuum of steady states, and the one to which the economy converges depends on the bonds that households accumulate along the transition. Tariffs change the trade balance in the short run, and households save or borrow to smooth consumption, so part of the long-run effect of a tariff works through the change in each country's net foreign assets. The rest of this appendix asks how much of the long-run effect on goods employment comes from this channel.

A portfolio adjustment cost. To shut down this channel in the long run, I add a small cost of holding bonds different from the initial position $B_{i,0}$, a standard device for pinning down a unique steady state in open-economy models (Schmitt-Grohé and Uribe, 2003). Each

Figure H.1: Composition of the change in the U.S. trade balance



Notes: Change in the U.S. goods and services trade balances, the bilateral trade balances with China, the low-tariff partners, and the high-tariff partners, and the total trade balance, relative to the no-tariff equilibrium, in percentage points of GDP. Bars show the long run.

household pays

$$\frac{\psi_B}{2}\bar{Y}\left(\frac{B_{i,t+1}-B_{i,0}}{\bar{Y}}\right)^2 \tag{H.1}$$

units of the numeraire in period t, where $\bar{Y}$ is U.S. GDP in the no-tariff equilibrium. The cost is rebated lump-sum, so it does not use up resources. Its only effect is to add a wedge to the Euler equation, Eq. (A.21), which becomes

$$Q_t + \psi_B\frac{B_{i,t+1}-B_{i,0}}{\bar{Y}} = \beta\left(\frac{C_{i,t+1}}{C_{i,t}}\right)^{-\gamma}\frac{P^c_{i,t}}{P^c_{i,t+1}}. \tag{H.2}$$

In a steady state, the right-hand side equals β in every country, so the wedge must be the same in every country. Because bonds are in zero net supply and the initial positions sum to zero, this requires $B_{i,\infty} = B_{i,0}$ for every country. The no-tariff equilibrium is therefore unchanged, and under any permanent tariff the economy converges to the unique steady state in which every country's bond holdings equal their initial level. The parameter ψ_B determines how quickly the economy gets to the predetermined steady-state level of bonds, and how much it can deviate from that level along the transition.

I consider three values: $\psi_B = 0.02$, 0.01, and 0.005. Under tariffs on all goods, U.S. net foreign assets peak 8.6–10.4% of initial GDP above their initial level eight or nine years after

the tariffs are imposed, and half of this deviation is eliminated over the following 27, 38, and 55 years, respectively, under the different bondholding cost calibrations. The cost itself is negligible: it never exceeds about 0.01% of GDP. Because convergence is slow, I solve these versions of the model over a 200-year horizon rather than 100 years.

Long-run effects. Table H.1 compares the long-run effects of each policy in the baseline model with those under the three values of ψ_B and in the steady state with $B_i = B_{i,0}$. Pinning down net foreign assets matters little for the single-sector tariffs. Long-run goods employment changes by about 0.3 percentage points or less, and tariffs on "toys" and "oil" still raise it while tariffs on "steel" and "cars" still lower it. It matters more for the broad-based tariffs. Under tariffs on all goods, long-run goods employment falls by 0.62% in the steady state with $B_i = B_{i,0}$, about half of the 1.21% decline in the baseline model. Under the 2025 tariffs, it falls by 0.56%, compared with 0.88% in the baseline.

The reason is that, in the baseline model, broad-based tariffs leave the United States with permanently higher net foreign assets: 7.7% of initial GDP higher under tariffs on all goods (Figure H.2). The return on these assets finances permanently higher consumption, much of which is spent on services and construction, and thus draws workers out of the goods sectors. Panel B of Table H.1 shows the counterpart in the trade balance. In the baseline model, tariffs leave the long-run trade deficit 0.03–0.10 percentage points of GDP wider for every policy except tariffs on "oil", for which it barely changes, whereas with the portfolio adjustment cost the long-run trade balance changes by no more than 0.04 percentage points in either direction. Real GDP is affected much less than goods employment: under tariffs on all goods, it falls by 0.23% in the long run in the baseline versus 0.29% in the steady state with $B_i = B_{i,0}$.

Transition dynamics. Figure H.3 shows the dynamics of goods employment under tariffs on all goods and under the 2025 tariffs for each value of ψ_B. The portfolio adjustment cost makes the short-run decline in goods employment deeper. Under tariffs on all goods, goods employment bottoms out 1.63% below its pre-tariff level in year 7 in the baseline and 2.15%, 2.57%, and 3.46% below in year 8 as ψ_B rises from 0.005 to 0.02. Under the 2025 tariffs, the trough deepens from 0.90% to 1.12–1.64%, and goods employment never returns to its pre-tariff level. The reason is that households cannot keep the foreign assets they would otherwise accumulate, so they spend more of the temporary gain from the tariffs during the transition. Under tariffs on all goods, consumption rises by 1.6–2.0% on impact, compared with 1.5% in the baseline, and from year 4 or 5 onward the trade deficit is wider than in the no-tariff equilibrium for a century or more, by up to 0.56 percentage points of GDP when $\psi_B = 0.02$ (Figure H.2). This additional spending on services and construction draws workers out of the goods sectors in the short and medium run. In other words, the portfolio adjustment cost does not eliminate the effect of the temporary improvement in the trade

balance on goods employment; it moves this effect from the long run into the short and medium run.

In short, the endogenous trade balance matters for the long-run effects of broad-based tariffs on goods employment, but not for which single-sector tariffs raise goods employment in the long run or for the result that broad-based tariffs reduce it in the short run.

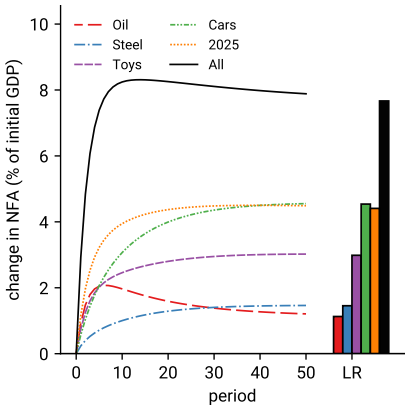
Table H.1: Long-run effects with a portfolio adjustment cost

	Baseline	$\psi_B = 0.02$	$\psi_B = 0.01$	$\psi_B = 0.005$	Steady state
A. Goods employment (% change)					
Oil	0.41	0.49	0.49	0.48	0.49
Steel	-0.45	-0.34	-0.35	-0.35	-0.34
Toys	0.84	1.05	1.05	1.03	1.05
Cars	-1.85	-1.53	-1.53	-1.55	-1.53
All goods	-1.21	-0.62	-0.65	-0.71	-0.62
2025	-0.88	-0.56	-0.57	-0.59	-0.56
B. Trade balance (change, p.p. of GDP)					
Oil	0.00	0.02	0.02	0.02	0.02
Steel	-0.03	0.00	0.00	0.00	0.00
Toys	-0.05	0.01	0.00	0.00	0.01
Cars	-0.09	0.00	-0.01	-0.01	0.00
All goods	-0.10	0.04	0.03	0.02	0.04
2025	-0.07	0.01	0.01	0.00	0.01

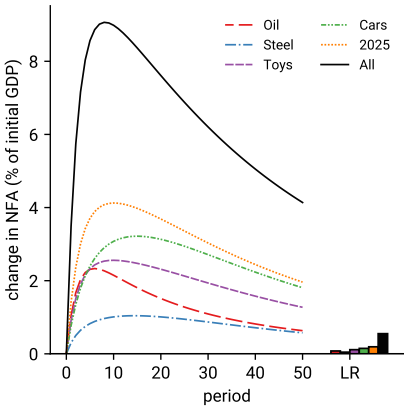
Notes: Long-run effects of 25% tariffs on each goods sector and on all goods from all countries and of the 2025 tariffs, relative to the no-tariff equilibrium. "Baseline" is the model in the main text, in which long-run bond holdings depend on the transition; the long run is the final period of a 100-year horizon. The ψ_B columns add the portfolio adjustment cost described in the text; the long run is the final period of a 200-year horizon. "Steady state" is the steady state with tariffs in which every country's bond holdings equal their initial level, which is the long run for every $\psi_B > 0$. Panel A: percent change in goods employment. Panel B: change in the U.S. trade balance, in percentage points of GDP.

Figure H.2: Net foreign assets and the trade balance with a portfolio adjustment cost

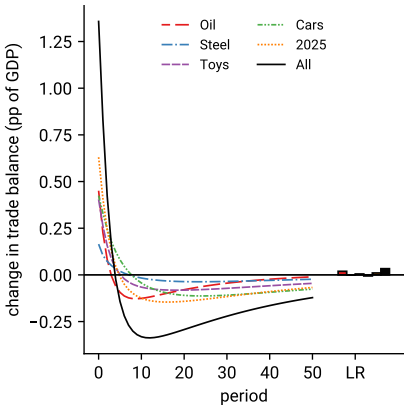
(a) Net foreign assets, baseline



(b) Net foreign assets, $\psi_B = 0.01$

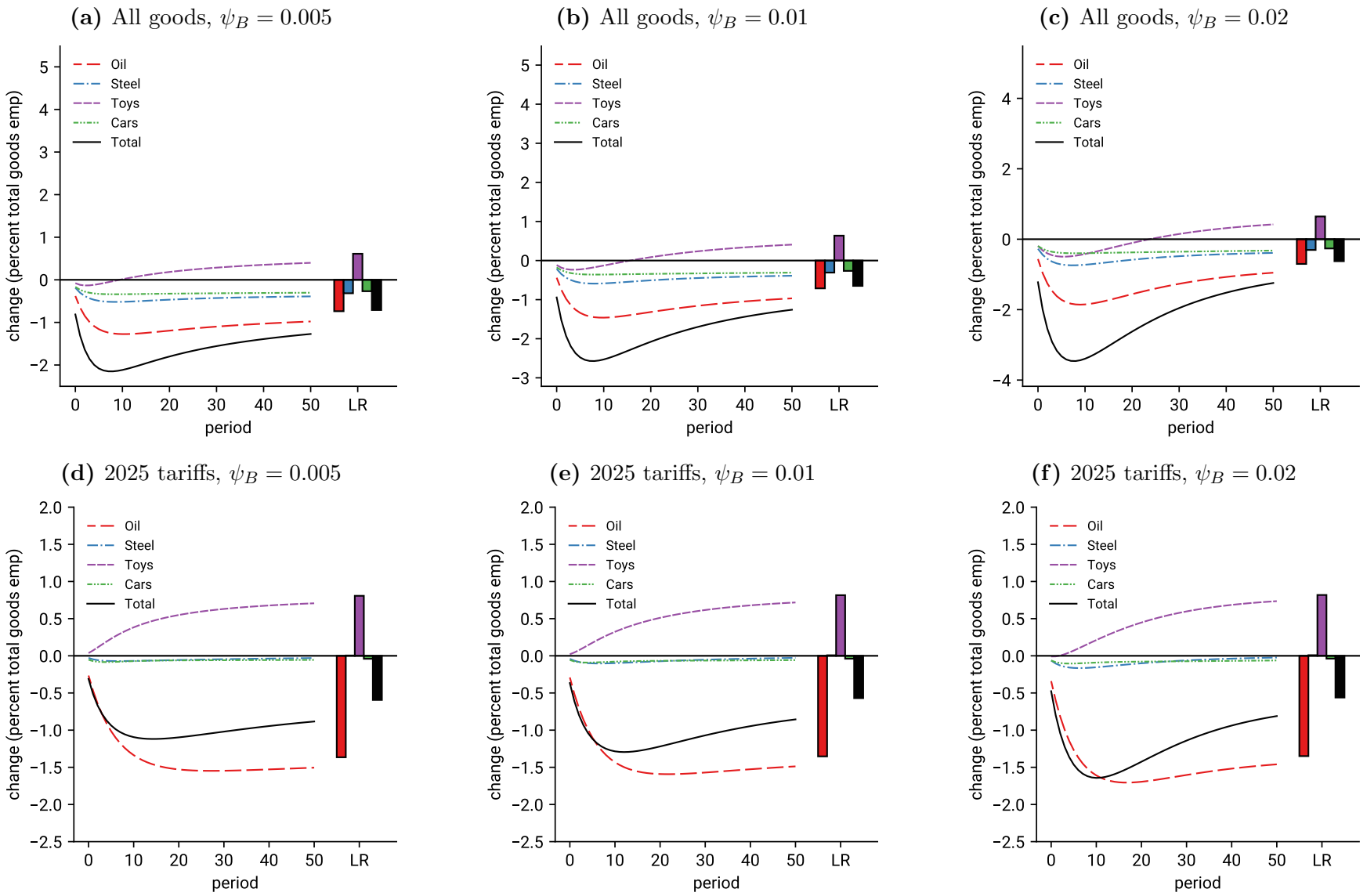


(c) Trade balance, $\psi_B = 0.01$



Notes: (a) and (b) Change in U.S. bond holdings relative to the no-tariff equilibrium, in percent of initial GDP, in the baseline model and with a portfolio adjustment cost $\psi_B = 0.01$. (c) Change in the U.S. trade balance relative to the no-tariff equilibrium, in percentage points of GDP, with $\psi_B = 0.01$; panel (b) of Figure 3 shows the baseline. Bars show the long run: year 100 in the baseline and year 200 with $\psi_B = 0.01$.

Figure H.3: Employment dynamics with a portfolio adjustment cost



Notes: Change in sector-level employment (percent of baseline total goods employment) and total goods employment (percent) under a 25% tariff on all goods from all countries (top row) and under the 2025 tariffs (bottom row), in the model with a portfolio adjustment cost ψ_B, solved over a 200-year horizon. Panels (d) of Figure 2 and (f) of Figure 3 show the baseline. Bars show year 200.

I Why some targeted tariffs lower goods employment

Tariffs on "toys" and "oil" raise overall long-run goods employment, while tariffs on "steel" and "cars" lower it, even though each tariff draws workers into the sector it protects. This appendix uses a simple toy model to show analytically which sector characteristics matter, and then measures these channels using the quantitative model's long-run steady state.

I.1 Toy model

Consider a static small open economy, where aggregate labor $\bar{L}$ and the trade balance are both fixed, and there are no intermediate inputs. Each sector j, which is either one of the goods sectors or services, produces with a Cobb-Douglas technology in which labor's share is $\theta_j = 1 - \alpha_j$. Capital is supplied elastically at a fixed rental rate, which is paid to the household.

Foreign prices are fixed at one, so with the wage w initially equal to one, the price of the home good in sector j is $p_j = w^{\theta_j}$, and foreign demand for exports satisfies $p_j X_j = A_j p_j^{1-\zeta_j}$. The household spends a fixed share β_j of its total spending E on sector j, and within each sector it combines home and foreign goods with Armington elasticity ζ_j. Let h_j denote the home share of domestic spending in sector j and M_j the value of imports.

Proposition. Starting from free trade, the effect of a small tariff $d\tau$ on imports of sector s on total goods employment $L_G = \sum_{g \in \mathcal{G}} L_g$ is

$$dL_G = \kappa_S \, \theta_s(\zeta_s - 1) h_s M_s \, d\tau - C \, (\kappa_G - c_G) \, d\hat{E}, \tag{I.1}$$

where $d\hat{E}$ is the change in spending measured in units of labor, $d(E/w)$;

$$\kappa_j = \frac{\theta_j \left[X_j + (\zeta_j - 1)\theta_j (X_j + h_j M_j) \right]}{\sum_k \theta_k \left[X_k + (\zeta_k - 1)\theta_k (X_k + h_k M_k) \right]}$$

is sector j's share of the workers released by a real appreciation, with $\kappa_G = \sum_{g \in \mathcal{G}} \kappa_g$ and $\kappa_S = 1 - \kappa_G$; and $c_G = \sum_{g \in \mathcal{G}} \theta_g h_g \beta_g / C$ is the goods sectors' share of the labor content of domestic spending, with $C = \sum_k \theta_k h_k \beta_k$.

Proof. Sector j's revenue is $R_j = h_j \beta_j E + p_j X_j$ and its employment is $L_j = \theta_j R_j / w$. Differentiating, using $dh_j = (\zeta_j - 1) h_j (1 - h_j)(d\tau_j - \theta_j \, d \log w)$ and $h_j(1 - h_j)\beta_j E = h_j M_j$,

$$dL_j = \theta_j h_j \beta_j \, d\hat{E} + \theta_j (\zeta_j - 1) h_j M_j \, d\tau_j - \theta_j \left[X_j + (\zeta_j - 1)\theta_j (X_j + h_j M_j) \right] d \log w.$$

Because aggregate labor is fixed, $\sum_j dL_j = 0$, which determines $d \log w$. Substituting it into $\sum_{g \in \mathcal{G}} dL_g$ gives Eq. (I.1). □

The first term is import substitution. Holding the wage and spending fixed, the tariff

draws $\theta_s(\zeta_s - 1)h_s M_s \, d\tau$ workers into sector s. Because aggregate labor is fixed, however, the wage must rise—i.e., the U.S. real exchange rate appreciates—until other sectors release the same number of workers. In total, the goods sectors release a share κ_G of those workers; the remaining share κ_S is the net gain for the goods sectors. The effect depends on the product of the sector's labor share and its elasticity: more workers are drawn into a sector if domestic goods more substitute easily for imports, and if producing those domestic goods takes more workers.

The second term is an income effect. Tariff revenue and capital income raise the household's spending, and the goods sectors account for a share c_G of the labor needed to meet this spending but must release a share κ_G of the workers it draws in. In the benchmark calibrated to U.S. data,[12] $\kappa_G = 0.69$ and $c_G = 0.14$, because the goods sectors are much more exposed to trade than they are important in domestic spending. Each of the four single-sector tariffs also raises spending in units of labor, so the income effect lowers goods employment in each case.

The Proposition suggests why tariffs on "steel" and "cars" lower goods employment. Their Armington elasticities are low—two for "steel" and close to one for "cars"—so a tariff on either causes little import substitution and mostly raises tariff revenue, which the household spends largely on services. Tariffs on the two high-elasticity sectors, "oil" and "toys", instead replace many imports with domestic output. In the calibrated version of the toy model, the income effect outweighs import substitution for "steel" and "cars" but not for "oil" and "toys", so a 25% tariff lowers goods employment by 0.16% and 0.91% in the first two cases and raises it by 0.80% and 0.42% in the last two.

Without capital ($\theta_j = 1$ in every sector), $d\hat{E}$ equals the tariff revenue, $M_s \, d\tau$, and the sign of Eq. (I.1) depends on sector s's characteristics only through $(\zeta_s - 1)h_s$. Calibrated to U.S. data, that version of the toy model gives the same signs for "oil", "steel", and "cars" (0.53%, −0.16%, and −0.96%), and a tariff on "toys" lowers goods employment only slightly (−0.05%). Thus, differences in the elasticities, which are the only differences across sectors in this version of the toy model, account for most of the pattern.

I.2 A static version of the model

The toy model leaves out intermediate inputs, investment, and the substitutability of goods and services in consumption. To see which of the model's parameters drive the results, I solve a static version of the model's steady state. It uses the technologies of Section 2 and all parameters are calibrated to the same U.S. data as in the main text. The static model differs from the full model in three ways. First, the United States is a small open economy: foreign prices and foreign demand for U.S. products are fixed. Second, capital is supplied elastically

[12] I set each sector's home sales, exports, and imports to their values in the U.S. block of the ICIO data, scaling imports so that trade is balanced, and set θ_j to one minus the model's capital share in sector j.

at a user cost proportional to the price of investment goods, and steady-state investment is a fixed fraction of capital income. Third, the trade balance is fixed at its initial level, as in the version of the full model in Appendix H in which net foreign assets return to their initial level.

Table I.1 reports the long-run effects of a 25% tariff on goods employment. The first row reports results from the full model with net foreign assets held at their initial level (Appendix H), and the second row reports the static model. The static model reproduces the effects of the four single-sector tariffs: the signs are the same, and the magnitudes are mostly similar. It does not reproduce the effect of the tariff on all goods (which raises goods employment in the static model) because it doesn't account for the general-equilibrium effects. Thus, I focus only on the single-sector tariffs. The tariff on "oil" raises goods employment mostly through its effect on intermediate inputs: a tariff on intermediate "oil" alone (with an exemption for "oil" used as final goods) raises goods employment by 0.74%, of the 0.89% under the full tariff. The tariff on "cars" lowers it mostly through its effect on final goods: a tariff on final "cars" alone (with an exemption for "cars" used as intermediates) lowers it by 1.12%, of the 1.29%.

The remaining rows change one set of parameters at a time. Setting the Armington elasticities of all four goods sectors to 3.25 eliminates the loss from the tariff on "cars" (0.03%) and narrows the gap between the tariffs on "oil" and "steel" (0.21% and −0.13%); in the full model with the same elasticities (Appendix D), the signs for "steel", "toys", and "cars" are unchanged, and the gain from the tariff on "oil" turns into a small loss. Setting the capital shares of all four goods sectors to their value-added-weighted average, 0.47, changes the magnitudes but not the signs. When both the elasticities and the capital shares are uniform, a tariff on any one of the four sectors raises goods employment, as the toy model suggests. Finally, giving each goods sector the average input structure of the goods sectors (the same value-added share and intermediate input requirements) changes the magnitudes but not the signs. Thus, differences in the sectors' elasticities matter more for the opposite signs of the single-sector tariffs than differences in their capital intensities or the input-output linkages among sectors, although the tariff on "steel" raises goods employment only when the capital shares are also uniform.

Table I.1: Long-run effects of single-sector tariffs on goods employment in the static model

	"Oil"	"Steel"	"Toys"	"Cars"	All goods
Full model	0.49	-0.34	1.05	-1.53	-0.62
Static model	0.89	-0.27	1.45	-1.29	0.80
Uniform elasticities	0.21	-0.13	1.02	0.03	0.78
Uniform capital shares	0.99	-0.12	0.92	-1.22	0.63
Uniform elasticities and capital shares	0.20	0.08	0.54	0.14	0.64
Uniform input structure	1.27	-0.20	0.51	-1.27	0.51

Notes: Percent change in U.S. goods employment under a permanent 25% tariff on imports of the indicated goods from all countries. "Full model" is the steady state of the full model with net foreign assets held at their initial level (Appendix H). The other rows report the static model described in the text. "Uniform elasticities" sets the Armington elasticities of the four goods sectors to 3.25. "Uniform capital shares" sets their capital shares to 0.47, the value-added-weighted average across goods sectors. "Uniform input structure" gives each goods sector the output-weighted average value-added share and intermediate input requirements of the four goods sectors.