The 2025 Trade War: Dynamic Impacts Across U.S. States and the Global Economy*

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We use detailed tariff data and a dynamic trade and migration model with downward nominal wage rigidity to quantitatively assess the economic consequences of the recent increase in U.S. import tariffs and the responses of its trading partners. Higher tariffs trigger a temporary expansion in U.S. manufacturing employment at the expense of services and agriculture, while aggregate labor force participation barely changes. For the U.S. as a whole, real income is essentially unchanged by 2028, the last year we assume the high tariffs are in effect. The real income change becomes negative under full mirror retaliation by other countries or if tariffs are not rebated to workers. Importantly, our analysis disaggregates the U.S. into its 50 states, while incorporating migration and cross-state redistribution of the tariff-generated fiscal revenue, allowing us to analyze which states gain or lose more. Across countries, close U.S. trading partners such as Vietnam and Mexico are among the largest losers.

JEL codes: F1, F4.

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1 Introduction

In 2025, the U.S. government implemented a series of substantial tariff hikes, including additional duties of 25% on automobiles and auto parts, 50% on copper, aluminum, and steel, and new tariffs on goods from important trading partners such as Canada, Mexico, and China. Tariff rates on other countries also increased sharply, ranging from 10 to 50%. As a result, the average applied tariff rose to almost 15%—a level not seen since the 1930s.[1] While some of the tariff increases of 2025 were reversed by a Supreme Court decision in 2026, many others remain in place. This wildly volatile tariff policy could have significant economic implications.

This paper uses a dynamic quantitative trade and migration model to study the consequences of the recent tariff changes, focusing on total and sector-level employment, wages, and real income across U.S. states and other countries. Our baseline exercise assumes that tariffs revert to their 2024 levels after four years and that other countries react as they have done in the data, i.e., mostly without retaliating. However, we also analyze how the effects of the shock depend on its persistence, the extent of retaliation by other countries, or the ultimate recipients of the tariff revenues. We emphasize how the shock impacts the U.S., but turn to cross-country results toward the end of the paper.

We construct a new daily, product-level dataset of U.S. import tariffs and of the tariffs faced by U.S. exporters from January 2018 through May 2026. The dataset codes every change in U.S. tariffs, as well as all retaliatory tariffs imposed on U.S. exports, at the six-digit HS level. We use a large language model to identify tariff events in primary legal sources and extract their content, and cross-check the results against public trade-policy trackers and an earlier, manually coded version of the dataset. The resulting *Global Tariff Database: U.S. Trade War Extension* (henceforth GTD–U.S. Trade War) is publicly available.[2] Once aggregated up, the dataset indicates that the average U.S. import tariff rose from 2.2% in early 2025 to almost 15% by August 2025, falling to 9.8% by May of 2026. By

[1] We acknowledge that current U.S. trade policy operates in a rapidly shifting and uncertain environment. Importantly, our framework is not limited to the specific tariffs analyzed here and serves as a flexible tool to evaluate the economic impacts of any set of tariffs across sectors, U.S. states, and other countries.

[2] The GTD–U.S. Trade War is available at Feodora A. Teti's website (https://feodorateti.github.io/).

contrast, the average tariff faced by U.S. exports increased only slightly, from 1.8% in early 2025 to 2.5% by the end of May 2026.[3]

Our dataset differs from other recent tariff-tracking efforts in three key ways. First, we cover the full set of U.S. bilateral trade relationships rather than only selected ones. Second, we incorporate (i) exemptions for imports qualifying under trade agreements, such as the USMCA, using preference utilization rates, (ii) the bilateral "deals" put into effect through executive authority, and (iii) content-based tariff rules, under which the tariff rate applies only to specific components of an import. Third, following the methodology developed in Teti (2024), we assign to each bilateral relationship the correct baseline tariff: MFN, preferential, or the one applicable for countries not covered by normal trade relations, ensuring that new tariff measures are layered on the correct existing tariff rates and avoiding common pitfalls in some previous studies.

Besides tariff data, our quantitative analysis also requires sector-level input-output flows as well as trade flows between all pairs of U.S. states and other countries in our sample. We leverage multiple data sources and implications from a gravity model to construct sector-level trade flows among all region pairs in our sample. This dataset encompasses 110 regions (50 U.S. states, 59 additional countries, and an aggregated rest of the world region) and 15 sectors (home production, 12 manufacturing sectors, services, and agriculture) for our base year of 2024. The inclusion of services and agriculture—sectors rarely modeled thoroughly in previous papers—enables us to offer a more comprehensive cross-sector understanding of the implications of the recent tariff changes.

Our quantitative analysis makes use of the dynamic model developed by Rodriguez-Clare, Ulate, and Vasquez (2022, henceforth RUV) and employed by Ulate, Vasquez, and Zarate (2025, henceforth UVZ), but extends it in key ways to incorporate tariffs. Specifically, we develop a novel procedure that allows for a flexible pattern of tariff revenue

[3]We aggregate HS6 tariffs in three CES nests, first across products within each origin–sector category, then across origins within each sector, and finally across sectors, with elasticities of substitution of 6, 6, and 1, and 2024 trade flows from CEPII's BACI (Gaulier and Zignago, 2010). At each level, the aggregate is the single tariff that would raise the price of the bundle by as much as the actual tariffs do (given prices). Unlike a fixed-weight average, it allows buyers to substitute toward products with smaller tariff increases; unlike the ratio of duties collected to imports, it does so through a constant elasticity rather than through observed import shares, which also respond to other shocks and give prohibitive tariffs zero weight (Appendix B).

redistribution across U.S. states, so that tariff revenues collected on a given state's imports do not necessarily equal the tariff revenues that state ultimately receives. This is particularly relevant given the redistributive fiscal role of the U.S. federal government.

As in RUV and UVZ, the model features multiple sectors linked by an input-output structure, trade that satisfies the gravity equation, short-run involuntary unemployment due to downward nominal wage rigidity (henceforth DNWR), and endogenous labor supply on the extensive margin through a home-production sector. Trade takes place between regions (either U.S. states or other countries), and workers can move across sectors within a region and, in the United States, across states, subject to mobility costs. As in Caliendo et al. (2019), workers draw idiosyncratic shocks to the utility of working in each sector-region in each period. Based on these shocks, the costs of switching sectors and states, and expected real income in future periods, workers choose which sector to participate in and, in the United States, which state to live in.

As in Schmitt-Grohe and Uribe (2016), we capture DNWR by assuming that the nominal wage in any period must be no less than a factor δ times the nominal wage in the previous period.[4] We include a nominal anchor to prevent nominal wages from increasing enough as to make the DNWR never bind.[5] Specifically, we assume that world nominal GDP in dollars grows at an exogenous constant rate of γ. This assumption captures central banks' unwillingness to allow inflation or unemployment to become too high while keeping the model tractable. This nominal anchor allows us to incorporate a complex trade structure with multiple sectors and regions, intermediate inputs, and forward-looking mobility into our framework while still being able to solve the model.[6]

We quantify the impact of the shock using the "dynamic exact hat algebra" approach of Caliendo et al. (2019). This technique guarantees that our model matches sector-level production, trade, and reallocation patterns in the base year. We then introduce an unexpected increase in tariffs that reverts after a certain number of years. Besides the pa-

[4]See Section 3 for a summary of the evidence in favor of DNWR. As in Section 6.2 of RUV, we only apply the DNWR constraint in the manufacturing sectors, treating services and agriculture as if they operated under wage flexibility. Results in the case where DNWR applies to all sectors are available upon request.

[5]Our baseline analysis assumes flexible exchange rates between the U.S. dollar and other currencies.

[6]Utilizing other types of nominal anchors would prevent us from using the efficient Alvarez-and-Lucas-type algorithm developed by RUV to deal with the DNWR, increasing computation time substantially.

rameters implicitly calibrated by the exact hat algebra methodology using data from the base year (2024), we need to calibrate five parameters. These are the DNWR parameter, δ, the growth rate of world nominal GDP in dollars, γ, the inverse elasticities of mobility across sectors, ν, and across U.S. states, κ, and the trade elasticity, $\sigma - 1$. We set δ to one, so nominal wages cannot fall, and γ to 3%, in line with the inflation observed in recent years. Finally, we take σ from the trade literature, and obtain ν and κ from RUV.

Three forces shape the effects of the tariffs in our model. First, as in standard static trade models, the tariffs shift U.S. spending from foreign to domestic goods, improve the U.S. terms of trade, and generate tariff revenue, but they also raise the cost of imported inputs and distort the allocation of production. The trade elasticity affects the balance between these forces: the lower it is, the larger the terms-of-trade gain for the United States. Second, the adjustment is dynamic: since moving across sectors and states is costly, workers reallocate gradually, and since they are forward-looking, they respond to the expected path of tariffs, including their eventual removal. Third, DNWR makes the adjustment asymmetric: when the demand for a sector rises, its nominal wage rises, but when it falls, for instance because the sector's tariff protection is lowered, its nominal wage may not be able to fall fast enough and unemployment may arise.

Our analysis indicates that there are temporary employment increases in manufacturing, while services and agriculture experience temporary reductions. Aggregate labor force participation barely changes, as the tariff revenue, which is rebated to workers in the market sectors, offsets the fall in real wages. Once the shock dissipates, manufacturing wages face downward pressure as the economy adjusts to lower tariffs, generating some involuntary unemployment in the presence of DNWR.

For the United States as a whole, we find a decrease in the real wage of around 0.5% in 2028, the last year the elevated tariffs are active in our baseline specification. This decline is offset by the increase in tariff revenues, so that U.S. real income is essentially unchanged by 2028 (a gain of 1.53 basis points) and U.S. welfare rises very slightly.

The effect of the tariff shock varies significantly by state, with real income changes between 2024 and 2028 ranging from a fall of about 97 basis points to a gain of about 169

basis points. Among the states that lose the most are Texas, California, and Michigan, which allocate a higher share of their expenditure to final and intermediate goods from the countries most adversely affected by the new tariffs.

We study how different assumptions affect our results, considering alternative values for the trade elasticity, the persistence of the shock, the extent of retaliation by other countries, and the tightness of the DNWR, and shutting down, one at a time, tariff-revenue redistribution, input-output linkages, and migration across states. When the trade elasticity is low, the U.S. has stronger market power relative to its trading partners, so its gain from the tariffs is larger and overall labor force participation increases when tariffs are high. However, perhaps surprisingly, manufacturing employment experiences a less pronounced boost. The U.S. gain also grows with the duration of the higher tariffs, while shocks that last only one or two years reduce U.S. welfare. By contrast, retaliation by other countries reduces the U.S. gain, which turns into a loss under full mirror retaliation. Delaying the tariff revenue rebate to workers by two or three years (e.g., if the revenues are rebated to businesses instead) can turn the slight real income gain into a loss for workers.

Turning to cross-country results, the effects of the shock vary internationally and depend on the level of exposure to the new tariffs. Close U.S. trading partners such as Vietnam and Mexico are among the countries that suffer the largest real income losses. By contrast, some countries facing small increases in U.S. tariffs experience slight gains due to improved relative access to the U.S. market.

We emphasize that our model is designed to analyze the direct consequences of a tariff shock in a general equilibrium trade and migration model, taking into account tariff redistribution across U.S. states. It does not incorporate the broader ramifications that may arise from heightened uncertainty or shifts in geopolitical dynamics. The model also does not incorporate endogenous trade deficits, capital accumulation, or non-unitary elasticity of substitution across production inputs. Nevertheless, the framework provides valuable insights into the potential economic consequences of the shock as it propagates across regions and industries through global value chains.

Our paper contributes to the growing literature on the economic consequences of

recent trade tensions between the U.S. and China. Fajgelbaum et al. (2020) examine the effects of the 2018 trade war on the U.S., finding that higher tariffs led to real income losses of approximately 0.04% of U.S. GDP. Consistent with this, Amiti et al. (2019) analyze the incidence of tariffs on U.S. import prices and find that they did not decline, implying that the tariffs were largely passed on to U.S. consumers and producers.

Flaaen and Pierce (2019) study the employment effects on the U.S. manufacturing sector, finding that industries more exposed to tariff increases on their inputs experienced relative declines in employment. Work by Peake and Santacreu (2020) reinforces these results, showing that U.S. states with a larger value-added share in sectors reliant on imported intermediates experienced weaker employment and output growth after the tariff increases implemented during the first Trump administration.

Our research also relates to the literature on trade wars and optimal tariffs. Ossa (2014) and Lashkaripour (2021) examine optimal tariffs under trade conflict and emphasize the potential gains from cooperation. Itskhoki and Mukhin (2025) study optimal tariffs in the presence of trade imbalances, while Caliendo et al. (2025) develop a model with aggregate uncertainty that endogenizes trade imbalances and find that higher U.S. tariffs reduce trade deficits but lower real consumption.

A contemporaneous and closely related paper is Ignatenko et al. (2025), which uses a static model with endogenous trade imbalances—arising from trade in marketing services à la Melitz—to quantify the effects of the 2025 U.S. tariff increases on employment and welfare, compares them to outcomes under the optimal tariff, and examines how they vary with foreign retaliation. Relative to that paper, our contribution is to provide more detailed data for the tariff increases and to use a quantitative framework that incorporates dynamic adjustment, nominal rigidities, and distributional effects across U.S. states.

The remainder of the paper is organized as follows. Section 2 outlines the construction of the tariff dataset. Section 3 provides an overview of the model and Section 4 describes our calibration. Section 5 presents the results of our baseline analysis for U.S. states. Section 6 investigates the sensitivity of our results to changes in key assumptions. Section 7 focuses on how the results vary across countries and Section 8 concludes.

2 U.S. Trade Policy 2018–2026: Timeline and Data

The return of the Trump administration in January 2025 marked the third and most severe phase of the U.S. tariff escalation that began in 2018. Tariffs rose under the first Trump administration, were largely maintained under the Biden administration, and in 2025 rose more steeply than at any time since the Smoot–Hawley Tariff Act of 1930. We document this evolution with a new tariff dataset.

Our dataset records every U.S. tariff change and every retaliatory tariff on U.S. exports at a daily frequency from January 2018 through May 31, 2026, both at the national tariff-line level and at the internationally comparable HS6 level. On the import side, it covers all changes under Sections 122, 201, 232, and 301, the International Emergency Economic Powers Act (IEEPA), the suspension of normal trade relations with Russia and Belarus, and preference programs such as GSP and AGOA, including the bilateral "deals" implemented through executive action. On the export side, it covers the retaliatory tariffs of the seven partners that retaliated—China, the European Union, India, Canada, Mexico, Russia, and Turkey—coded from their official legal gazettes.[7] We use a frontier large language model to identify tariff events in primary legal sources and extract their content. We cross-check the results against publicly available U.S. tariff trackers and an earlier, manually coded version of the dataset.[8] The dataset applies the stacking rules that determine effective rates when measures overlap and includes only measures with a legal basis that can be translated into product-level tariff changes. MFN and preferential baseline tariffs are updated to the latest available year using the filling algorithm of Teti (2024).

Three features of the 2025 tariffs require assumptions, because the tariff owed depends on shipment features that we do not observe: exemptions that apply only to qualifying imports, tariffs on the non-U.S. content of cars, and tariffs on the metal content of derivatives. The fentanyl tariffs on Canada and Mexico exempt products that qualify for duty-free entry under the USMCA, so we apply them only to the share of imports

[7] We do not code antidumping and countervailing duties, which are firm- and product-specific, or changes to the de minimis threshold. Chinese retaliatory tariffs for 2018–2021 are taken from Bown (2021).

[8] Appendix A.4 lists the trackers and describes the identification and coding of tariff events in more detail.

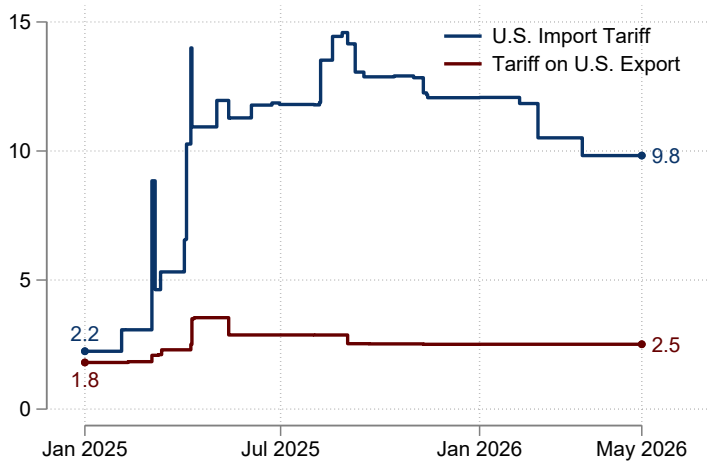
not claiming USMCA preferences, measured by product–country preference utilization rates (PURs);[9] we treat the civil aircraft exemptions analogously. For USMCA-compliant cars, the Section 232 tariff applies only to non-U.S. content, which we set to 62% for Mexico and 50% for Canada (Canadian Vehicle Manufacturers' Association, 2025; Contreras, 2024). For steel, aluminum, and copper derivatives, which were taxed only on their metal content until April 2026, we assume a 50% metal share.

Figure 1 plots the average tariffs implied by the dataset from January 2025 to May 2026: on U.S. imports and exports (panel a) and on U.S. imports from China and the rest of the world (panel b). The average U.S. import tariff jumped from 2.2% in January 2025 to a peak of 14.6% in late August 2025, before falling back to 12.1% by the end of the year and 9.8% by May 31, 2026.[10] The average tariff on U.S. exports rose only from 1.8% to 2.5% over the same period. Until 2025, U.S. tariff increases mainly targeted China, while the rest of the world was largely spared, facing only the global Section 232 duties on steel (25%) and aluminum (10%) and the safeguards on washing machines and solar panels. President Biden left the Chinese tariffs intact, added duties on Chinese electric vehicles and other strategic products in September 2024, and replaced the steel and aluminum duties on the European Union, Japan, and the U.K. with tariff-rate quotas. By January 2025, the average tariff on China was more than ten times that on the rest of the world.

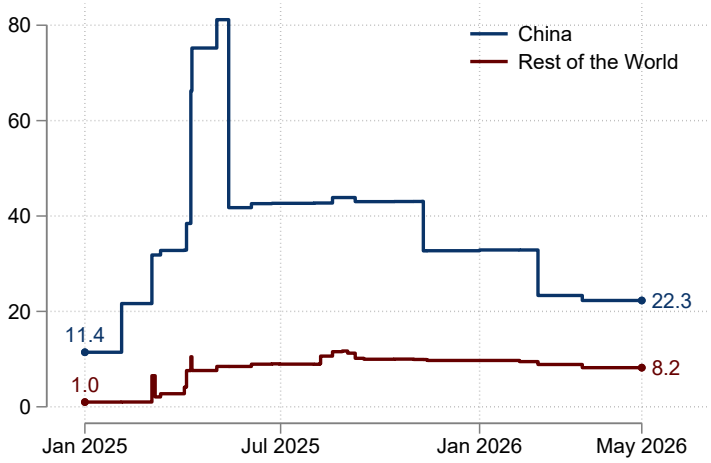
In 2025, U.S. tariff policy turned against all trading partners, relying initially on two legal authorities: IEEPA and Section 232. Under IEEPA, the administration first imposed "fentanyl" tariffs of 20% on China and 25% on Canada and Mexico in February and March, exempting USMCA-qualifying imports within days. On "Liberation Day" (April 2), it then announced "reciprocal" tariffs: a 10% baseline on all imports and country-

[9] We compute PURs from U.S. Census Bureau monthly import data, which record the tariff program under which each shipment entered, over May to December 2025, after importers began claiming preferences on duty-free products. For products without imports from a given country, we use the PUR of the closest product group with trade (8-, 6-, 4-, then 2-digit), and otherwise the country average. PURs average close to 90%. Appendix A.4 presents how they enter the tariff coding.

[10] We report CES-equivalent tariffs: the uniform tariff that generates the same change in the CES price index of U.S. imports as the detailed tariff schedule, using 2024 trade weights, an elasticity of 6 across products and origins within each sector, and Cobb–Douglas across sectors. Because it allows buyers to substitute toward products with smaller tariff increases, it lies below the average weighted by fixed 2024 imports, which stands at 12.8% in May 2026. See Appendix B for details.



(a) Tariffs on U.S. imports and exports



(b) Tariffs on U.S. imports by trading partner (China vs. RoW)

Figure 1: CES-aggregated daily tariffs (in percent) imposed and faced by the U.S., January 1, 2025 to May 31, 2026. MFN and preferential tariff rates are from Teti (2024); Chinese retaliatory tariffs imposed in 2018–2021 are from Bown (2021). All other tariff changes are coded from U.S. Federal Register notices and partners' legal texts. Tariffs are aggregated using 2024 bilateral trade flows from CEPII's BACI (Gaulier and Zignago, 2010). Appendices A and B describe the data and the aggregation.

specific rates of up to 50%, set at half the U.S. trade deficit with each partner relative to U.S. imports from that partner.[11] Under Section 232, the administration raised steel and aluminum tariffs to 50% by June and added tariffs on autos, copper, lumber, heavy trucks, and semiconductors.[12]

[11] Pharmaceuticals, semiconductors, energy, critical minerals, and products subject to Section 232 were exempt. Canada and Mexico were not covered.

[12] Steel and aluminum tariffs were unified at 25% in March and doubled to 50% in June (25% for the U.K.).

The reciprocal tariffs took effect in stages, and U.S. tariffs peaked only in August. The 10% baseline applied to all partners from April 5. The country-specific rates took effect on April 9 but were suspended the next day for all partners except China, whose rate escalated to 125% before a bilateral agreement in May lowered it to the baseline. For other partners, country-specific rates of 10% to 41% took effect only on August 7, alongside a 40% IEEPA tariff on Brazil and an increase of the fentanyl tariff on Canada to 35%.

After the August peak, bilateral deals, a second agreement with China, and the Supreme Court's ruling against the IEEPA tariffs brought U.S. tariffs back down. The deals with the U.K., the European Union, Japan, South Korea, Switzerland, and Taiwan mostly capped the combined tariff at 15%, MFN included, and most also capped the Section 232 tariffs on autos and parts, but none lowered those on steel and aluminum.[13] In November, a second agreement with China cut its fentanyl tariff from 20% to 10%, and broad agricultural exemptions were added to the reciprocal and Brazil tariffs. On February 24, 2026, after the Supreme Court ruled that IEEPA does not authorize tariffs, all IEEPA tariffs were replaced by a temporary 10% surcharge under Section 122 of the Trade Act of 1974.[14] The Section 232 tariffs remained in force.

Whereas many trading partners retaliated during the first Trump administration, most notably China and the European Union, in 2025 only China and, to a lesser extent, Canada did so. The average tariff on U.S. exports to China rose from 12.7% in January 2025 to 141.1% in May 2025 and was 23.7% in May 2026 (see Appendix Figure B.2). Canada imposed counter-tariffs of 25% on U.S. goods in March 2025 but removed almost all of them in September, keeping only those on steel, aluminum, and autos; the European Union reactivated its steel and aluminum countermeasures only briefly. Partner commitments under the deals have rarely been written into law: the European Union eliminated its tariffs on U.S. industrial goods only in July 2026. We return to the lack of retaliation and its implications in Section 6.

[13] Under the 15% cap, goods with higher MFN rates paid no additional duty. The U.K. deal (June 2025) instead kept the 10% baseline on top of MFN and capped the auto tariffs at 10%; Taiwan's deal (May 2026) capped only auto parts and wood; Switzerland's deal did not cover autos. Deals announced with other partners had not been implemented by May 2026.

[14] The Court of International Trade ruled the Section 122 surcharge unauthorized on May 7, 2026. We keep the surcharge in place through May 31, 2026.

3 A Dynamic Spatial Trade Model with Tariffs

We use a dynamic multi-sector quantitative trade and migration model featuring nominal wage rigidities and input-output linkages akin to the one in RUV and UVZ to examine the recent U.S. tariff increases. Importantly, we extend the model to incorporate tariff changes and their associated fiscal revenue. In this section, we present the model and its equilibrium (Appendix D gives more details). The model incorporates a total of I regions ($I = 110$: the 50 U.S. states, 59 other countries, and an aggregate rest of the world region), indexed by i or j, and 15 sectors (home production, which is sector 0, and 14 market sectors: 12 manufacturing sectors, services, and agriculture), indexed by s or k. Workers can move across sectors within a region and, in the United States, across states, while we abstract from international migration. Time is discrete, with periods corresponding to years, and we denote the region i, sector s, and time t triad as (i, s, t).

Preferences and production In each region j and period t, agents participating in the market economy devote all of their income to expenditure $P_{j,t}C_{j,t}$, where $C_{j,t}$ is aggregate consumption and $P_{j,t}$ is its price index. Aggregate consumption is a Cobb–Douglas aggregate of consumption across the S market sectors with time-invariant expenditure shares $\alpha_{j,s}$, where $\sum_{s=1}^{S} \alpha_{j,s} = 1$, so the aggregate price index is

$$P_{j,t} = \prod_{s=1}^{S} P_{j,s,t}^{\alpha_{j,s}}, \tag{1}$$

where $P_{j,s,t}$ is the price index of sector s in region j at time t. As in a multi-sector Armington model, consumption within a market sector is a CES aggregate of the varieties produced by each of the I regions, with an elasticity of substitution $\sigma_s > 1$.

The technology for producing the (i, s, t) good takes the Cobb–Douglas form:

$$Y_{i,s,t} = A_{i,s,t} L_{i,s,t}^{\phi_{i,s}} \prod_{k=1}^{S} M_{i,ks,t}^{\phi_{i,ks}},$$

where $A_{i,s,t}$ is total factor productivity in (i, s, t), $L_{i,s,t}$ is employment in (i, s, t), $M_{i,ks,t}$ is

the quantity of intermediate inputs of sector k used in (i, s, t), $\phi_{i,s}$ is the time-invariant labor share in (i, s), and $\phi_{i,ks}$ is the share of inputs that sector s uses from sector k in region i. Production has constant returns to scale, i.e., $\phi_{i,s} + \sum_k \phi_{i,ks} = 1$. Intermediate inputs from different origins are aggregated in the same way as consumption goods, so the price of the sector-k input in region i is $P_{i,k,t}$. There is perfect competition in production, and there are iceberg trade costs $\tau_{ij,s,t} \geq 1$ for shipping the sector s good from i to j at time t.

Tariffs, trade shares, and revenues There are ad valorem tariffs $t_{ij,s,t}$ imposed by region j on imports from region i in sector s at time t. These tariffs play a crucial role as they are the object being shocked in our main quantitative exercise. Furthermore, these tariffs will also generate revenue for the country that imposes them, which is an important aspect to keep track of. The presence of these tariffs and their associated fiscal revenue is the main difference between our model here and the one in RUV and UVZ.[15]

Letting $W_{i,s,t}$ denote the wage in dollars in (i, s, t), perfect competition implies that the dollar price in region j of the (i, s, t) good is equal to its unit cost, inclusive of trade costs and tariffs,

$$p_{ij,s,t} = \tau_{ij,s,t}(1 + t_{ij,s,t}) A_{i,s,t}^{-1} W_{i,s,t}^{\phi_{i,s}} \prod_{k=1}^{S} P_{i,k,t}^{\phi_{i,ks}}. \tag{2}$$

Given the CES structure, the sectoral price indices and the trade shares are

$$P_{j,s,t}^{1-\sigma_s} = \sum_{i=1}^{I} p_{ij,s,t}^{1-\sigma_s}, \qquad \lambda_{ij,s,t} = \frac{p_{ij,s,t}^{1-\sigma_s}}{P_{j,s,t}^{1-\sigma_s}}, \tag{3}$$

where $\lambda_{ij,s,t}$ is the share of region j's expenditure in sector s that is spent on goods from region i, valued at the prices paid by buyers (i.e., inclusive of tariffs).

We assume that tariff revenue collected on imports by any U.S. state is transferred to the federal government, which subsequently redistributes it across states—not necessarily proportionally to the revenue each state initially contributed. To flexibly capture this

[15] Caliendo and Parro (2015) also incorporate tariff revenue when evaluating the effect of NAFTA. However, they treat the United States as a single region. Our framework allows for a more flexible redistribution schedule that incorporates internal redistribution of tariff revenues across U.S. states.

feature, we assume that the total tariff revenue received (TRR) by region i at time t is

$$TRR_{i,t} = \sum_j \theta_{ji} TRC_{j,t}, \tag{4}$$

where $TRC_{j,t}$ corresponds to the tariff revenue collected by region j at time t and θ_{ji} is the (time-invariant) share of its tariff revenue that region j sends to region i. The only constraint on these shares is that they must sum to one for a given tariff-revenue-sender region when summing across all the tariff-revenue-receiving regions, i.e., $\sum_i \theta_{ji} = 1 \ \ \forall j$.

In our quantitative implementation, we assume that tariff revenue collected is redistributed within the United States according to the share of the population that a given state represents, but our framework can easily accommodate extensions where tariff revenue is not redistributed across states (i.e., it stays in the state where the import happened), or where it is disproportionately allocated to certain states (e.g., those that voted for a given political party) or sectors. Tariff revenues in countries other than the U.S. simply stay in that country (as we do not disaggregate other countries into smaller regions).

The total tariff revenue collected by region j, $TRC_{j,t}$, is

$$TRC_{j,t} \quad = \quad \sum_s \sum_i \frac{t_{ij,s,t}}{1 + t_{ij,s,t}} \lambda_{ij,s,t} EXP_{j,s,t} = \sum_s \psi_{j,s,t} EXP_{j,s,t}, \tag{5}$$

where $EXP_{j,s,t}$ is total expenditure of region j in sector s at time t, including purchases by final consumers and intermediate good purchases, and $\psi_{j,s,t}$ is the share of expenditure in (j, s, t) that is collected as tariff revenue, defined as $\psi_{j,s,t} \equiv \sum_i t_{ij,s,t}/(1 + t_{ij,s,t})\lambda_{ij,s,t}$.

Let $R_{i,s,t}$ denote total revenues in sector s of region i. Noting that demand of sector k in region j for intermediates from sector s is $\phi_{j,sk} R_{j,k,t}$ and allowing for exogenous deficits (where $D_{j,t}$ is used to denote the transfers received by region j at time t, with $\sum_j D_{j,t} = 0$), we know that total expenditure by region j in sector s at time t is

$$EXP_{j,s,t} \quad = \quad \alpha_{j,s} \left(\sum_{r=1}^{S} W_{j,r,t} L_{j,r,t} + D_{j,t} + TRR_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t}. \tag{6}$$

Introducing equations (5) and (6) into (4) and rearranging, we get

$$TRR_{i,t} = \sum_j \theta_{ji} \sum_s \psi_{j,s,t} \left[\alpha_{j,s} \left(\sum_{r=1}^{S} W_{j,r,t} L_{j,r,t} + D_{j,t} + TRR_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t} \right]. \quad (7)$$

Additionally, the market-clearing condition for sector s in region i can be written as

$$R_{i,s,t} = \sum_{j=1}^{I} \frac{\lambda_{ij,s,t}}{1 + t_{ij,s,t}} \left(\alpha_{j,s} \left(\sum_{r=1}^{S} W_{j,r,t} L_{j,r,t} + D_{j,t} + TRR_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t} \right), \quad (8)$$

since producers in region i receive only the fraction $1/(1 + t_{ij,s,t})$ of what buyers in region j spend on their goods, the rest being collected as tariff revenue by region j. Given wages and employment, equations (7) and (8) form a linear system in revenues and tariff revenues received. Appendix D.1 shows how to combine them into a novel, computationally efficient matrix equation that can be used to solve for period-by-period sectoral revenues while allowing for flexible tariff-revenue redistribution through the θ coefficients. Finally, since production is Cobb–Douglas, the wage bill in (i, s, t) is a constant share of revenues,

$$W_{i,s,t} L_{i,s,t} = \phi_{i,s} R_{i,s,t}. \quad (9)$$

Downward nominal wage rigidity We denote the number of agents participating in (i, s, t) by $\ell_{i,s,t}$. In a typical trade model, employment in a sector-region has to equal labor supply in that same sector-region ($L_{i,s,t} = \ell_{i,s,t}$). By contrast, we follow Schmitt-Grohe and Uribe (2016), allowing for a downward nominal wage rigidity (DNWR), which limits how much nominal wages can fall from one period to the next. Letting $W^{LCU}_{i,s,t}$ denote the nominal wage in (i, s, t) in the local currency of region i, the DNWR takes the form

$$W^{LCU}_{i,s,t} \geq \delta_s W^{LCU}_{i,s,t-1}, \qquad \delta_s \geq 0.$$

Letting $E_{i,t}$ denote the exchange rate of region i's currency at time t (in dollars per unit of local currency), we have $W_{i,s,t} = E_{i,t} W^{LCU}_{i,s,t}$, so the DNWR for wages in dollars entails $W_{i,s,t} \geq (E_{i,t}/E_{i,t-1})\, \delta_s W_{i,s,t-1}$. Since all U.S. states share the dollar, $E_{i,t} = 1$ for every U.S.

state i, and the DNWR in the U.S. is $W_{i,s,t} \geq \delta_s W_{i,s,t-1}$. For countries outside the U.S., the exchange rate determines how the DNWR affects unemployment: with a fixed exchange rate with respect to the dollar, the DNWR can bind just as in the U.S., whereas with a flexible exchange rate the currency can depreciate enough to deliver any required fall in dollar wages without a fall in LCU wages, so the DNWR never binds. We capture all of these cases with a region- and sector-specific parameter $\delta_{i,s} \geq 0$ for the DNWR in dollars,

$$W_{i,s,t} \geq \delta_{i,s} W_{i,s,t-1}. \tag{10}$$

As a consequence of this rigidity, employment does not have to equal labor supply:

$$L_{i,s,t} \leq \ell_{i,s,t}. \tag{11}$$

The previous inequalities are combined into a complementary slackness condition:

$$(\ell_{i,s,t} - L_{i,s,t})(W_{i,s,t} - \delta_{i,s} W_{i,s,t-1}) = 0. \tag{12}$$

The previous condition states that employment and wages are determined by supply and demand when the wage is unconstrained. By contrast, when the wage is at its lower bound, the labor market does not clear, and there is rationing (i.e., unemployment) as labor supply exceeds labor demand. There is ample evidence of downward nominal wage rigidity in U.S. labor markets. Using administrative payroll data, Grigsby, Hurst, and Yildirmaz (2021) find that nominal wage cuts are rare among workers who stay with their employer, and Hazell and Taska (2025) find that the wages of new hires are also rigid downward. There is also evidence that DNWR shapes how labor markets adjust to trade shocks: Costinot, Sarvimäki, and Vogel (2022) find that the collapse of Finnish–Soviet trade led to employment declines that were larger in the short run than in the long run, while Fadinger, Herkenhoff, and Schymik (2024) find that German export competition led to employment losses but not to nominal wage cuts in other Eurozone countries.

Labor supply Agents in the model can either engage in home production (sector zero) or seek work in the labor market (sectors 1 through S). Participating in home production yields a time-invariant level of real consumption, $c_{i,0,t} = c_{i,0}$. By contrast, a given market sector $s > 0$ offers an endogenous level of real consumption $c_{i,s,t}$.

Given the DNWR, agents must take into account the possibility of unemployment when selecting a sector. To simplify the analysis, we assume a representative agent in each region-sector.[16] Additionally, the income of agents includes not only their wage income but also the tariff revenue received by the region where they live. We assume that, across workers in a region, tariff revenue received is distributed among market sectors according to labor supply weights. With all these ingredients, the real per-capita consumption level $c_{i,s,t}$ resulting from participating in market sector s is

$$c_{i,s,t} = \frac{W_{i,s,t}L_{i,s,t} + \frac{\ell_{i,s,t}}{\sum_{k=1}^{S}\ell_{i,k,t}}TRR_{i,t}}{\ell_{i,s,t}P_{i,t}}, \tag{13}$$

where $P_{i,t}$ is the aggregate price index in region i, given by equation (1).[17]

Agents are forward looking, have perfect foresight about future economic conditions, and discount the future with discount factor β. An agent in region j and sector s at time t obtains real consumption $c_{j,s,t}$ and then chooses the region i and sector k in which to be at $t+1$. Moving from (j,s) to (i,k) entails a time-invariant mobility cost $\varphi_{ji,sk}$, measured in utils, and agents receive additive idiosyncratic region-sector preference shocks $\epsilon_{i,k,t}$. Agents can switch sectors within their region and, in the United States, move across states, but they cannot move across countries (the corresponding mobility costs are infinite). The lifetime utility of an agent in region j and sector s at time t is then

$$\nu_{j,s,t} = \ln(c_{j,s,t}) + \max_{\{i,k\}_{i=1,k=0}^{I,S}} \{\beta\mathbb{E}(\nu_{i,k,t+1}) - \varphi_{ji,sk} + \epsilon_{i,k,t}\}.$$

[16] This is equivalent to assuming that income in a region-sector is equally shared among all agents there.

[17] As in Costinot and Rodriguez-Clare (2014) and RUV, we avoid attributing a positive direct gain to the foreign transfer (i.e., the deficits). Taking into consideration the direct gain from the deficits would risk treating them as a gift and assuming away their future costs. Appendix D.3 describes a way in which this can be implemented and interpreted more formally.

The idiosyncratic shocks follow a nested Gumbel distribution, with the choice of region in the upper nest and the choice of sector in the lower nest,

$$F(\boldsymbol{\epsilon}) = \exp\left(-\sum_{i=1}^{I}\left(\sum_{k=0}^{S}\exp\left(-\epsilon_{i,k,t}/\nu\right)\right)^{\nu/\kappa}\right),$$

where $1/\nu$ is the elasticity of switching sectors within a region and $1/\kappa$ is the elasticity of moving across U.S. states, with $\kappa > \nu$. Letting $V_{j,s,t} \equiv \mathbb{E}(\mathrm{v}_{j,s,t})$ denote the expected lifetime utility of an agent in (j,s,t) and γ_e the Euler–Mascheroni constant, the nested Gumbel structure delivers

$$V_{j,s,t} = \ln(c_{j,s,t}) + \kappa \ln\left(\sum_{i=1}^{I}\left(\sum_{k=0}^{S}\exp\left(\beta V_{i,k,t+1} - \varphi_{ji,sk}\right)^{1/\nu}\right)^{\nu/\kappa}\right) + \gamma_e\kappa. \tag{14}$$

As shown in RUV, the fraction of agents in (j,s) that move to region i, $\mu_{ji,s\#,t}$, and the fraction of those that choose sector k in region i, $\mu_{ji,sk|i,t}$, are

$$\mu_{ji,sk|i,t} = \frac{\exp\left(\beta V_{i,k,t+1} - \varphi_{ji,sk}\right)^{1/\nu}}{\sum_{h=0}^{S}\exp\left(\beta V_{i,h,t+1} - \varphi_{ji,sh}\right)^{1/\nu}}, \tag{15}$$

$$\mu_{ji,s\#,t} = \frac{\left(\sum_{h=0}^{S}\exp\left(\beta V_{i,h,t+1} - \varphi_{ji,sh}\right)^{1/\nu}\right)^{\nu/\kappa}}{\sum_{m=1}^{I}\left(\sum_{h=0}^{S}\exp\left(\beta V_{m,h,t+1} - \varphi_{jm,sh}\right)^{1/\nu}\right)^{\nu/\kappa}}, \tag{16}$$

so the fraction of agents in (j,s) that move to (i,k) is $\mu_{ji,sk|i,t}\,\mu_{ji,s\#,t}$, and the number of agents participating in each labor market evolves according to

$$\ell_{i,k,t+1} = \sum_{j=1}^{I}\sum_{s=0}^{S}\mu_{ji,sk|i,t}\,\mu_{ji,s\#,t}\,\ell_{j,s,t}. \tag{17}$$

Within a period, labor supply $\ell_{i,s,t}$ is given, and prices, trade, revenues, wages, and employment adjust as in a static trade model. Across periods, labor supply reallocates gradually because of mobility costs, and it does so in anticipation of future conditions. The DNWR adds a second link between periods, since it ties current wages to past wages.

Nominal anchor Since the model incorporates nominal rigidities, it is necessary to introduce a "nominal anchor" to prevent nominal wages from increasing so rapidly each period as to make the DNWR constraint always non-binding. We adopt a nominal rule that captures the idea that central banks are unwilling to tolerate persistently high inflation or unemployment, while also being tractable for our quantification.[18] Specifically, we assume that world nominal GDP in U.S. dollars grows at a constant rate γ each year,

$$\sum_{i=1}^{I}\sum_{s=1}^{S} W_{i,s,t}L_{i,s,t} = (1+\gamma)\sum_{i=1}^{I}\sum_{s=1}^{S} W_{i,s,t-1}L_{i,s,t-1}. \tag{18}$$

While this assumption is useful for solving the model, it has limitations as it does not reflect the optimal monetary policy of any particular country. Thus, we abstract from discussing the implications of the tariff shock for aggregate inflation, since the model is not designed to study this aspect. Nevertheless, the model remains informative about the behavior of relative prices, which we discuss in the results section.

Equilibrium Following Caliendo et al. (2019), we define the equilibrium in two steps. A temporary equilibrium determines the allocation within a period, taking labor supply as given. Given last period's wages and employment, $\{W_{i,s,t-1}, L_{i,s,t-1}\}$, which determine last period's world nominal GDP, and the current period's labor supply $\{\ell_{i,s,t}\}$, a temporary equilibrium at time t is a set of nominal wages $\{W_{i,s,t}\}$, employment levels $\{L_{i,s,t}\}$, revenues $\{R_{i,s,t}\}$, tariff revenues received $\{TRR_{i,t}\}$, trade shares $\{\lambda_{ij,s,t}\}$, sectoral price indices $\{P_{i,s,t}\}$, and bilateral prices $\{p_{ij,s,t}\}$ that satisfy equations (2)–(3), (7)–(12), and (18). In turn, given initial labor supply, wages, and employment, $\{\ell_{i,s,0}, W_{i,s,0}, L_{i,s,0}\}$, a sequential equilibrium is a sequence of the temporary-equilibrium variables together with aggregate price indices $\{P_{i,t}\}$, real consumption levels $\{c_{i,s,t}\}$, expected lifetime utilities $\{V_{i,s,t}\}$, and labor supplies $\{\ell_{i,s,t}\}$ for $t \geq 1$, and mobility shares $\{\mu_{ji,sk|i,t}, \mu_{ji,s\#,t}\}$ for $t \geq 0$, such that (i) in every period $t \geq 1$, the temporary-equilibrium variables constitute a temporary equilibrium given $\{\ell_{i,s,t}\}$ and the previous period's wages and employment, and (ii) aggregate price indices, real consumption, expected lifetime utilities, mobility

[18] This nominal anchor allows us to solve our model using a fast algorithm in the spirit of Alvarez and Lucas (2007) developed in RUV to deal with the complementary slackness condition implied by the DNWR.

shares, and labor supplies satisfy equations (1) and (13)–(17).

Dynamic hat algebra The main objective of the paper is to examine the effects of an unanticipated tariff shock. To do so, we use "dynamic exact hat algebra" (Caliendo et al., 2019): we write the equilibrium conditions in terms of time changes, $\dot{x}_t \equiv x_t / x_{t-1}$, and compare a counterfactual economy, in which tariffs change, to a baseline economy, in which they do not, through $\hat{x}_t \equiv \dot{x}'_t / \dot{x}_t$, where a prime denotes the counterfactual economy. In this form, the equilibrium conditions do not involve the levels of unobserved fundamentals such as technology, iceberg trade costs, and mobility costs. Instead, they are conditioned on base-year data and on the parameters σ_s, β, ν, κ, $\delta_{i,s}$, and γ.

To study the effects of the tariff shock, we assume the base year is 2024. At that point, new tariffs have not been implemented yet, and the model matches the base-year production, trade, and sectoral flow data by construction. Then, the shock is introduced in 2025, and the agents in the model learn the full path of the shock. As the new tariffs are implemented, employment, prices, production, and trade respond accordingly.

Welfare We measure the welfare effect of the shock on agents in (j, s) in the base year by the equivalent variation in consumption: the permanent proportional change in consumption, $\zeta_{j,s}$, that would make these agents indifferent between the baseline economy and the counterfactual economy with the tariff shock (see Appendix D.2 for details). We obtain the welfare change of a region by averaging $\ln \zeta_{j,s}$ across all of its agents, including those in home production, and the welfare change of the United States by averaging the welfare changes of the states using their populations as weights.

4 Data, Calibration, and Shocks

4.1 Data for the Quantitative Exercise

Our quantitative exercise requires trade and employment data from 50 U.S. states, 59 other countries, and a rest of the world region. We incorporate 14 market sectors—12 manufacturing sectors, services, and agriculture—plus a home-production sector. We

collect data on initial tariffs for our base year, 2024, and then introduce the changes in tariffs from 2024 to 2025 and from 2025 to 2026 as our "tariff shock" (see Section 4.2).[19] The remaining data-construction steps closely follow UVZ but use 2024 as the base year for quantification, drawing on the most recent available data for each source. We summarize the data construction below, with additional details in Appendix C.

Initial tariffs We construct the initial tariff levels as described in Section 2. To account for multiple changes in tariffs during the base year, we compute a weighted average based on the number of days each tariff was in force. We first map the tariffs at the six-digit HS level to three-digit NAICS codes, following Liao et al. (2021). Then, we assign each NAICS code to the 13 non-services market sectors described in Appendix C.1 and compute the CES average of gross tariffs (with an elasticity of substitution of 6), weighted by 2024 bilateral trade value, at the importer-exporter-sector level.

Labor, consumption, and input shares We use data from the Bureau of Economic Analysis (BEA) and the OECD's Inter-Country Input-Output (ICIO) Database to compute value-added shares and input-output coefficients across regions. Consumption shares can be backed out from trade flows, labor shares, and input shares.

Bilateral trade flows We build a matrix of bilateral trade flows for all sectors and regions following the four steps below. First, we take sector-level bilateral trade data among countries from ICIO. Second, we calculate the bilateral trade flows in manufacturing between U.S. states by combining ICIO and the Commodity Flow Survey (CFS). Because some CFS industry aggregates (summed across all states) may not match the amounts that the United States trades with itself according to ICIO, we multiply the CFS flows by a "proportionality" constant that adjusts the CFS values so that the total of U.S. internal flows across all states equals the total U.S. internal trade from ICIO. This procedure retains the relative significance of each state in each industry as reflected in the CFS.

Third, we use the Import and Export Merchandise Trade Statistics from the U.S. Cen-

[19] Because our base year is 2024, the tariffs introduced during the first Trump administration (most of which were maintained during the Biden administration) are part of the initial tariffs, and the tariff shock contains only the changes after 2024.

sus Bureau to calculate sector-level trade flows in manufacturing and agriculture between each U.S. state and other countries. We also apply the corresponding proportionality constant to maintain internal consistency with ICIO. Fourth, we construct trade flows in services between U.S. states and all regions, and in agriculture between U.S. states, inferred from two gravity structures. To do so, we obtain U.S. state-level services GDP from the Regional Economic Accounts of the BEA and state-level services expenditure from the Personal Consumption Expenditures (PCE) database of the BEA. We combine these with ICIO data and data on bilateral distances to construct service trade flows, following a gravity approach. We apply a similar methodology for agriculture, integrating data from the Census of Agriculture with ICIO and the National Marine Fisheries Service Census to obtain state-level production. Further details can be found in Appendix C.2 and in RUV.

Labor supply and mobility Employment data by sector come from the World Input-Output Database (WIOD) Socio-Economic Accounts (SEA) and the ILO for countries, and the Bureau of Labor Statistics (BLS) for U.S. states. Labor force participation represents the share of individuals aged 15 and over (16 and over for U.S. states) who are employed or unemployed. The shares of workers moving across sectors and U.S. states are computed from the Current Population Survey (CPS), the American Community Survey (ACS), and the state-to-state migration data of the Internal Revenue Service (IRS), while frictionless mobility across sectors is assumed for other countries.

4.2 Tariff Shock and Parameter Calibration

Tariff shock To quantify the tariff changes implemented by the Trump administration, we compute day-weighted annual averages of the tariff rates in the GTD–U.S. Trade War for 2024, 2025, and 2026, where 2026 covers January 1 to May 31. We aggregate them to the sector level using 2024 trade weights (as for the initial tariffs) and feed two shocks into the model: the change from 2024 to 2025 and the change from 2025 to 2026, after which the 2026 tariffs stay in place through 2028 (in the baseline specification). We apply the same procedure to the tariffs faced by U.S. exporters in foreign markets, which stayed largely the same due to the lack of retaliation. For trade relationships not involving the

United States, we assume there is no change in tariffs.

Figure 2 plots the change in U.S. import tariffs from 2024 to 2026 by sector, showing the mean across trading partners and the 10th and 90th percentiles. The shock is large, with increases of over 10 percentage points in several sectors. On average across the 13 non-services sectors, China is hit hardest, followed by India and Brazil, while Canada and Mexico are partly shielded by the USMCA exemption. In contrast to the large U.S. import tariff increases, few countries retaliated. Only Canada and, much more substantially, China raised duties on U.S. exports, by 3 and 19 percentage points, respectively, on average across manufacturing sectors in 2025, and both partly reversed these increases by 2026. All other partners left their tariffs essentially unchanged.

Parameter calibration Regarding the parameters used in the baseline specification, note that for a given δ (the DNWR parameter), if γ (the nominal growth rate of world GDP in U.S. dollars) is higher, then the DNWR is less likely to bind. Likewise, for a given γ, if δ

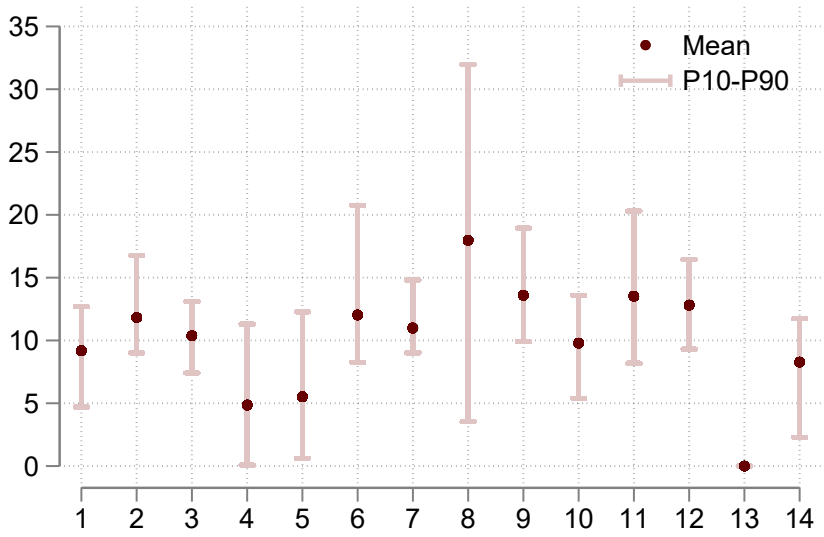


Figure 2: This figure shows the mean change in tariffs (in percentage points) on U.S. imports from 2024 to 2026 by sector across trading partners, along with the 10th and 90th percentiles. Tariffs are day-weighted annual averages, with 2026 covering January 1 to May 31. The sectors are: **(1)** Food & Tobacco; **(2)** Textiles & Apparel; **(3)** Wood & Paper; **(4)** Mining & Petroleum; **(5)** Chemicals; **(6)** Plastics & Rubber; **(7)** Non-metallic Minerals; **(8)** Metals; **(9)** Machinery; **(10)** Electronics & Electrical; **(11)** Transport Equipment; **(12)** Furniture & Misc.; **(13)** Services; and **(14)** Agriculture.

is lower, then the DNWR is less likely to bind. Therefore, we require a normalization and set $\delta = 1$ (as in UVZ), indicating that nominal wages in dollars cannot fall, and putting the burden of adjustment on γ. We set $\gamma = 3\%$ due to the relatively high nominal growth rate in the post-pandemic period. The implications of altering this γ go in the expected direction. As discussed in Section 6 (see Panel D of Table 1), the higher the γ, the less binding the DNWR is, and the less unemployment is generated in the model. For a high γ of 7% or higher, the model has essentially the same behavior as the one without DNWR.

We take the inverse elasticity of moving across sectors (ν) and the inverse elasticity of moving across U.S. states (κ) directly from RUV, setting $\nu = 0.55$ and $\kappa = 12$. Finally, we assume that $\sigma_s = \sigma \; \forall s$, which implies that the trade elasticity ($\sigma_s - 1$ in absolute value) is the same in all sectors. In our baseline, we use $\sigma = 6$ (as is standard in the trade literature, see Costinot and Rodriguez-Clare, 2014), but we discuss robustness to alternative values of σ, like the ones found by Boehm et al. (2023), in Section 6.

5 Baseline Results

We now investigate the effects of the tariff shock described in the previous section. The tariff increases and the limited retaliation in our baseline are those observed in the data for 2025 and 2026. By contrast, how long the higher tariffs will remain in place is unknown, so the four-year duration in the baseline is an assumption; Section 6 varies the final year of the high-tariff regime and also considers retaliation beyond what has been observed so far. We discuss the effects on labor force participation and unemployment, real wages, relative prices (sectoral producer prices divided by the aggregate price index), real value added, and welfare. We consider the effects for the U.S. as a whole and at the level of broad sectors (manufacturing, services, and agriculture) and U.S. states.[20]

Figure 3 summarizes the results by presenting the effects on participation, real wages, relative prices, and real value added across sectors. The cumulative percentage change in labor force participation (i.e., labor supply) since 2024 is in the top left, the one for real

[20]The broad manufacturing sector is an aggregate of the 12 individual manufacturing sectors in our model, described in detail in Appendix C.1.

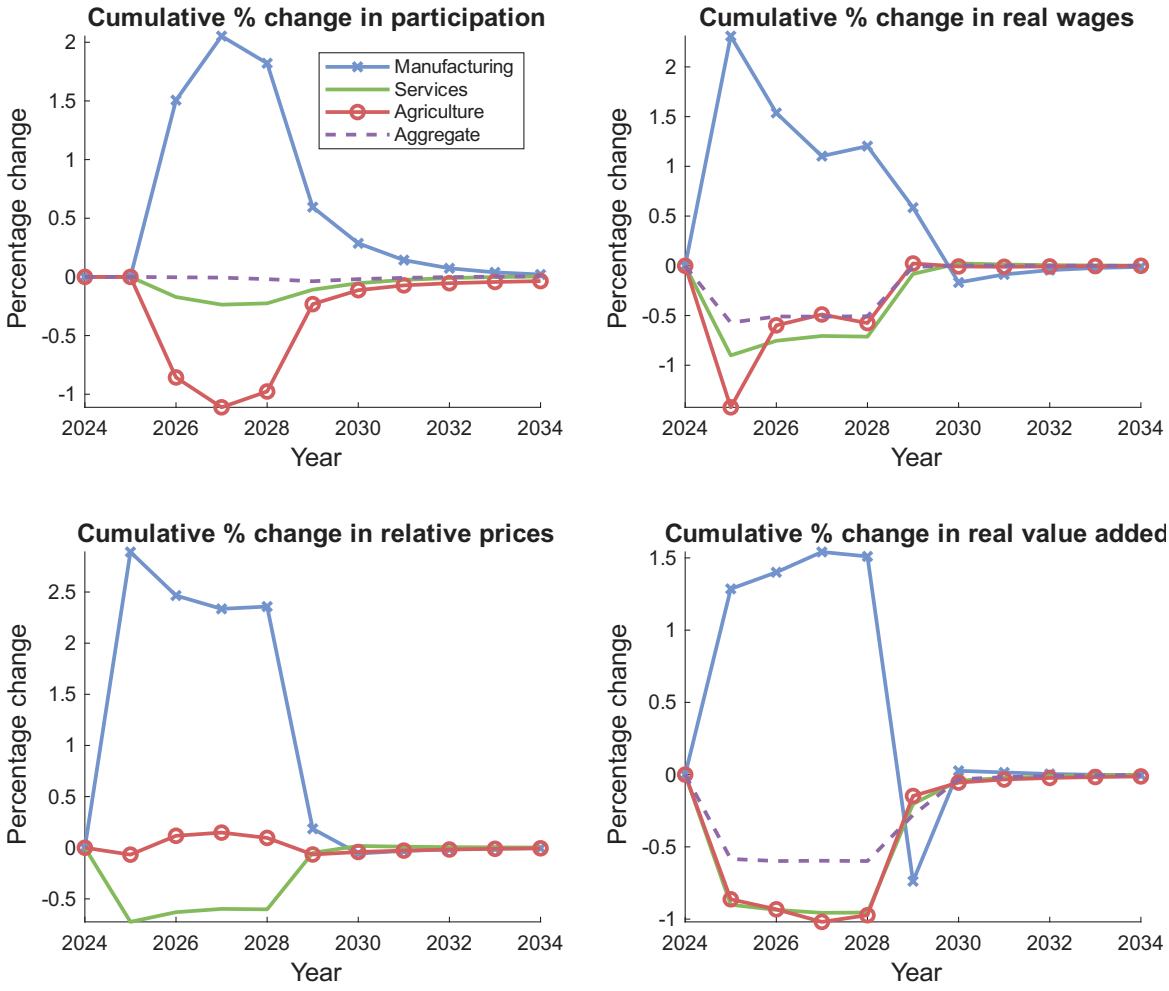


Figure 3: Paths of relevant variables for the United States as a whole. The cumulative percentage change in participation (labor supply) since 2024 is in the top left, the cumulative percentage change in real wages is in the top right, the cumulative percentage change in relative prices is in the bottom left, and the cumulative percentage change in real value added is in the bottom right. Manufacturing is the crossed blue line, services is the solid green line, agriculture is the red line with circular markers, and the dashed purple line represents the aggregate across sectors.

wages is in the top right, the one for relative prices is in the bottom left, and the one for real value added (excluding tariff revenue) is in the bottom right.[21] The manufacturing sector is depicted by the crossed blue line, services by the green line, agriculture by the red line with circles, and the dashed purple line represents the aggregate across sectors.

At the sector level, changes in participation broadly follow changes in real wages,

[21] All U.S. aggregate variables that need to be deflated by a U.S. aggregate price index, such as real wages, relative prices, and real value added, are deflated with the weighted average of the regional price index, $P_{i,t}$, across the 50 U.S. states using population shares as weights.

with slight year-to-year differences arising from lagged and anticipatory effects. In turn, sector-level real wages, relative prices, and real value added follow changes in demand triggered by the tariff shock. Higher U.S. import tariffs reallocate demand toward U.S. manufacturing (especially given the lack of meaningful retaliation by other countries), increasing its relative price and real wage. At the peak, in 2027, real manufacturing value added increases by about 1.5%, while participation increases by about 2.1%.

By contrast, participation, the real wage, the relative price, and value added fall for services. This sector is not protected by the higher tariffs and experiences a decrease in value added of around 1% in 2028. Agriculture behaves similarly to services: participation, the real wage, and value added fall, while its relative price barely changes. Participation in agriculture falls by about 1.1% at its trough in 2027, and by 2028 real value added in agriculture has fallen by around 1%.[22]

In the aggregate, rising intermediate-input costs and tariff-induced misallocation reduce productivity in the market sectors. This generates the decline in the aggregate real wage—about 0.5% by 2028—and a reduction in real value added of roughly 0.6% by 2028. Nevertheless, aggregate U.S. labor force participation barely changes: it falls by at most 0.04%, in 2029. Workers in the market sectors receive the tariff revenue, which offsets the fall in the real wage, so the market sectors become less attractive relative to home production—which provides a constant real utility flow—but only barely so.

DNWR is relevant for the effects of tariffs because tariff policy is volatile: tariffs that raise the demand for the protected sectors can later be lowered, as happened for several sectors in 2026, or removed altogether, and each such reduction is a negative demand shock for these sectors that requires their nominal wages to fall. The presence of DNWR implies that labor supply and demand might not coincide in our model, leading to the possibility of unemployment. The left panel of Figure 4 displays the cumulative percentage change in employment since 2024 in the solid green line, the cumulative percentage change in participation since 2024 in the dashed purple line, and the level of unemployment (in percent) in the red line with circular markers.[23]

[22] See Appendix E for more insights into why agricultural participation falls.
[23] The dashed purple line corresponds to the dashed purple line in the top left panel of Figure 3.

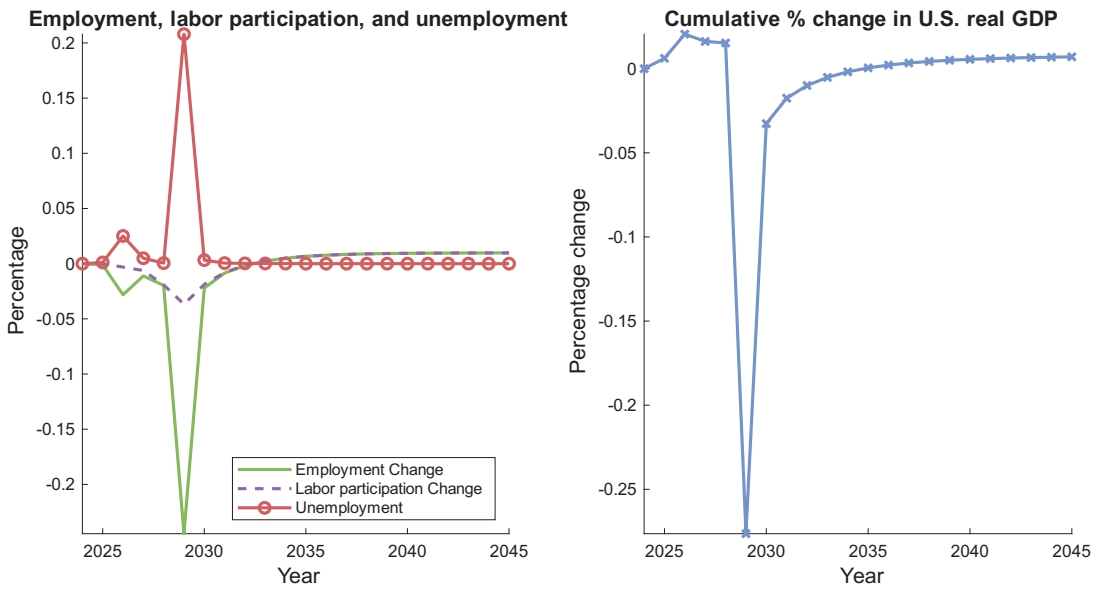


Figure 4: Paths of relevant variables for the United States as a whole. The left panel displays the cumulative percentage change in employment since 2024 (solid green line), the cumulative percentage change in labor supply since 2024 (dashed purple line), and the level of unemployment in percent (red line with circular markers). The right panel displays the cumulative percentage change in real GDP (which coincides with real income) for the United States as a whole since 2024. Notice that real GDP is inclusive of tariff revenues. The years on the x-axis go from 2024 until 2045.

A minuscule amount of unemployment, about 0.03%, is generated in 2026. It is concentrated in four manufacturing sectors whose tariffs rise sharply in 2025 and then fall back partially in 2026: textiles and apparel; plastics and rubber; nonmetallic minerals; and furniture and miscellaneous manufacturing. Wages in these sectors rise in 2025 and attract workers in 2026, so when their tariffs fall in 2026, the required cut in nominal wages exceeds what the DNWR allows, but only by a small degree and in very few states. By contrast, when the shock ends in 2029, the entire U.S. manufacturing sector experiences a generalized negative demand shock, and the DNWR binds in many states, triggering a more significant increase in unemployment, which reaches 0.21% in 2029. The cumulative change in total U.S. employment reaches a trough of -0.24% in 2029.

The right panel of Figure 4 presents the cumulative percentage change since 2024 in U.S. real GDP, which is inclusive of tariff revenues and therefore coincides with aggregate real income. The 0.6% decline in aggregate real value added by 2028 depicted in the bottom right panel of Figure 3 is more than offset by the increase in tariff revenue rebates,

so real GDP is essentially unchanged (a gain of 1.53 basis points) by 2028. The unemployment generated in 2029 lowers real GDP, which reaches a cumulative decline of 27.64 basis points in 2029 and then recovers gradually.[24]

A key advantage of our framework, where the United States is disaggregated into its 50 states, is that it allows us to assess how the shock impacts each of these sub-national units. Figure 5 presents a map depicting the cumulative change in real income between 2024 and 2028, in percent, across U.S. states.[25] Texas, California, and Michigan are among the states where real income falls the most, while West Virginia, Wyoming, and Oklahoma are among those where it increases the most. While U.S. real income is essentially unchanged by 2028, this masks large cross-state heterogeneity in real income changes, which range between a decrease of about 97 basis points (Texas) and an increase of about 169 basis points (Arkansas), with real income increasing in 36 states.

While the total real income change of a given state depends on several factors, such as the distribution of a state's expenditures across countries and sectors, its exposure to

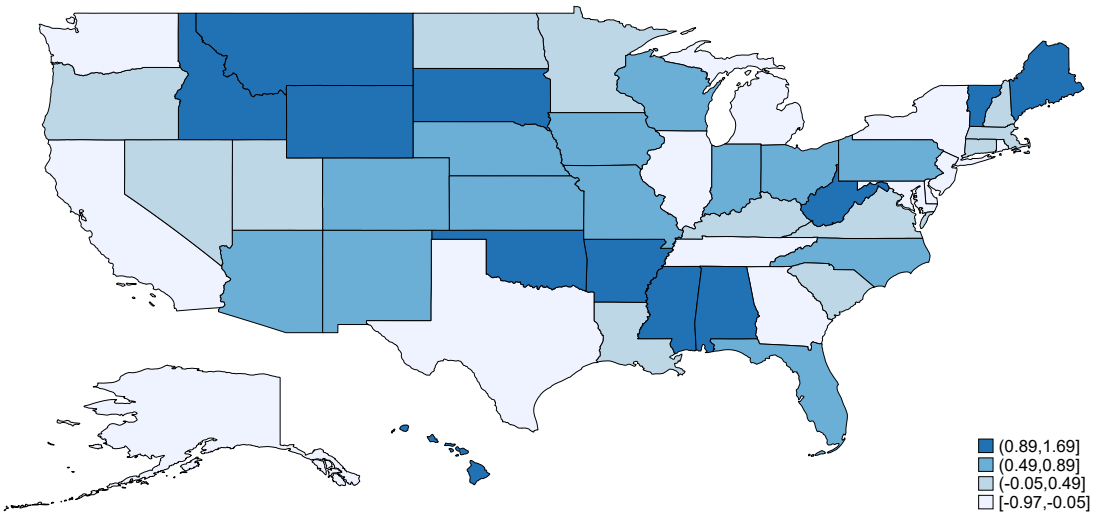


Figure 5: Map of the cumulative change in real income between 2024 and 2028, in percent, across U.S. states. The darker the shade of blue, the smaller the fall in real income (or the bigger the gain).

[24] While the trough in U.S. aggregate real GDP occurs in 2029 rather than 2028, sometimes we highlight the change in 2028 because 2028 is the last year that the tariff shock is active and because it presents an easier point of comparison to the real income changes in other countries. Non-U.S. regions do not suffer unemployment (due to our flexible-exchange-rate assumption), and therefore generally experience the maximum impact of the shock (for good or bad) around 2028.

[25] Appendix Figure G.1 gives an equivalent map but for the welfare change from the shock.

retaliatory tariffs, its deficits, and its indirect exposure to other U.S. states, we abstract away from most of these factors and build a summary measure of exposure to the shock that solely relies on how each state's expenditures are allocated across region-sectors combined with how tariffs change toward each of these region-sectors.

Denote by $EXP_{ji,s,t}$ the expenditure of region i on the sector s good of region j at time t (including both final consumption and intermediate inputs), and by $EXP_{i,t} \equiv \sum_s \sum_j EXP_{ji,s,t}$ the total expenditure of region i at time t. Denoting with 0 the base year and with 1 the year after that (2025, the first year in which the high tariffs are in effect), we construct a measure of exposure for a given region as follows:

$$\text{Exposure}_i = \sum_{s=1}^{S} \sum_{j=1}^{I} \frac{EXP_{ji,s,0}}{EXP_{i,0}} \frac{t_{ji,s,1} - t_{ji,s,0}}{1 + t_{ji,s,0}}. \tag{19}$$

For example, if a state allocates 3% of its expenditure to Chinese manufacturing, and there is a hypothetical tariff shock where the gross tariff rate on Chinese manufacturing increases by 50%, but all other country-sector tariffs are unchanged, then that state would have an exposure to this shock of 1.5%.

Figure 6 plots the exposure measure in equation (19), in percent, on the x-axis, against the real income loss between 2024 and 2028 from the tariff shock, in percent, on the y-axis, across the 50 U.S. states. The correlation between the variables is 0.71, indicating that even though the full real income change depends on many variables and general equilibrium interactions in potentially non-linear ways, the exposure measure already captures most of the ways that the impact varies in the cross-section of U.S. states.[26]

Beyond our exposure measure, which captures how the tariffs affect what each state buys, the effects across states also depend on what each state produces. Santacreu, Sposi, and Zhang (2025) study a uniform increase in U.S. tariffs in a static model of the 50 U.S. states and show that states gain more when their comparative advantage lies in the sectors that the tariffs protect. To assess this channel, we construct a production exposure

[26]The exposure measure does not capture how tariff revenue rebates impact states, but since those are redistributed across U.S. states according to population weights (not based on which states import more), the rebates add roughly the same amount per capita to every state. Section 6 shows how the cross-state distribution changes if each state instead keeps the revenue from its own imports.

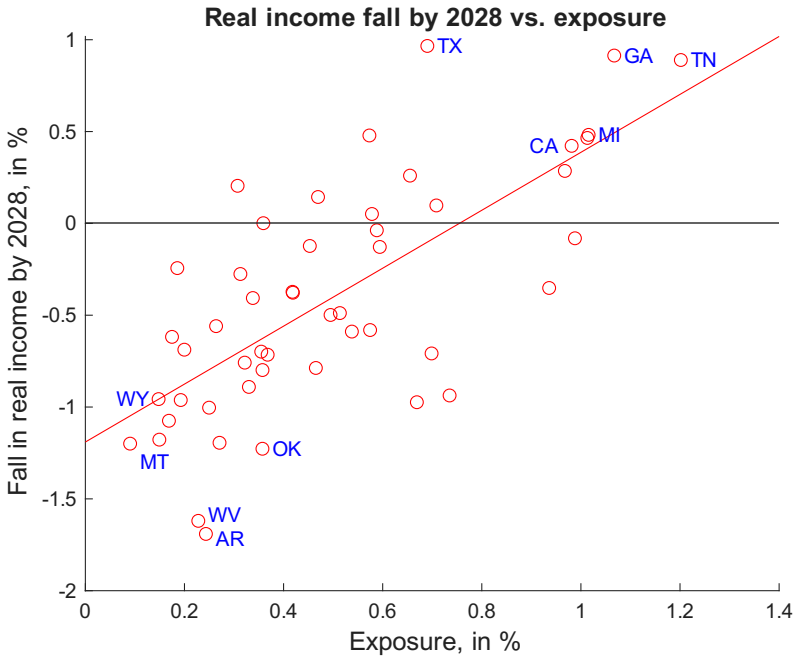


Figure 6: This figure presents a scatter plot of the exposure measure defined in equation (19), in percent, on the x-axis, against the real income fall by 2028, in percent, on the y-axis, across the 50 U.S. states. Some of the states that gain or lose the most from the shock are labeled with the usual two-letter abbreviations.

measure as the average increase in the U.S. import tariff across sectors, weighted by the 2024 shares of each state's workers in each sector. States with higher production exposure also tend to have higher expenditure exposure (the correlation between the two measures is 0.28), but controlling for their expenditure exposure, they gain more. However, adding production exposure to a regression of the real income change on the expenditure exposure measure only raises the R^2 from 0.50 to 0.63. Finally, Section 6 shows that input-output linkages, tariff-revenue redistribution, and migration also shape the distribution of real income changes across states.

The model can also be used to obtain the welfare change due to the shock. The welfare change is measured as the equivalent variation in consumption required by agents in the base year to be indifferent between the economy where tariffs increase and the economy where they do not. We compute it using an annual discount factor of $\beta = 0.95$.

The U.S. experiences an aggregate welfare gain of just 0.61 basis points. This gain hinges on the limited retaliation observed so far. As emphasized by the literature on

optimal tariffs (Johnson, 1953), a country can gain from raising its tariffs, through an improvement in its terms of trade and the resulting tariff revenue, as long as its trading partners do not retaliate. Quantitative work suggests that retaliation is costly: in a global trade war, all countries lose in Ossa (2014), and nearly all do in Lashkaripour (2021). Section 6 shows that the U.S. welfare gain turns into a loss once the weight on mirror retaliation exceeds about 0.45. Recall that this welfare gain is for a shock that lasts only four years. If the shock lasted longer or the discount factor were different, the welfare change would naturally be different; Section 6 shows that the welfare gain rises with the duration of the shock. Additionally, our model includes a home-production sector, which provides a constant utility flow that is unaffected by the tariff shock and dampens the welfare effects of the shock. For details on how mobility between sectors affects welfare, see Section 2.6 of RUV.

6 Alternative Assumptions

This section explores how our results change if we make different assumptions regarding the value of the trade elasticity, the duration of the shock, the extent of retaliation by other countries, or the tightness of the DNWR, and how they change if we shut down, one at a time, three features of our model: the redistribution of tariff revenue across U.S. states, input-output linkages, and migration across U.S. states. Throughout this section, we will refer to Table 1, which contains the aggregate U.S. cumulative real income gains (real income losses are represented as negative numbers) between 2024 and the last year the high tariffs are active, in basis points, from the tariff shock across these five alternative-specification exercises.[27] Panel A varies σ, Panel B varies shock duration, Panel C varies the extent of retaliation by other countries, Panel D varies the growth rate of world nominal GDP in dollars, γ, which governs how binding the DNWR is, and Panel E shuts down model features. Each panel includes our baseline specification as one of its rows.

In our baseline, we use a value of the trade elasticity parameter of $\sigma = 6$, a standard

[27] Appendix Table G.1 gives an equivalent table, but for the welfare change from the shock.

Table 1: U.S. aggregate real income change (in basis points) across specifications

Panel A: Trade Elasticity		Panel B: Duration		Panel C: Retaliation	
σ	Income gain	Years	Income gain	Mirror	Income gain
1.76	79.19	4*	1.53*	0%*	1.53*
2.44	59.66	8	16.78	33%	−9.76
3.12	45.07	12	27.66	66%	−19.86
6.00*	1.53*	16	33.55	100%	−29.20

Panel D: DNWR		Panel E: Model Features	
Setting	Income gain	Model	Income gain
No DNWR	9.29	Baseline*	1.53*
$\gamma = 4\%$	6.30	No redistribution	2.33
$\gamma = 3\%$*	1.53*	No input-output	−1.78
$\gamma = 2\%$	−7.16	No migration	8.81

Notes: This table displays the aggregate U.S. cumulative real income gains (with losses represented as negative numbers) from 2024 to the last year that the high tariffs are active, in basis points, across our five alternative specification exercises. Panel A varies the σ parameter governing the trade elasticity, Panel B varies the duration of the shock, Panel C varies the weight put on mirror retaliation, Panel D varies the growth rate of world nominal GDP in dollars (γ), which governs how binding the DNWR is, and Panel E shuts down, one at a time, the redistribution of tariff revenue across U.S. states, input-output linkages, and migration across U.S. states. An asterisk denotes the values under the baseline specification.

level in the trade literature (see, for example, Costinot and Rodriguez-Clare, 2014). However, Boehm et al. (2023) have recently estimated lower values of the trade elasticity. We now discuss the consequences of assuming $\sigma = 1.76$ (the estimate of Boehm et al. for the short run), $\sigma = 2.44$ (the midpoint of the estimates in Boehm et al.), or $\sigma = 3.12$ (the estimate of Boehm et al. for the long run).

The value of σ has very noticeable implications for the effects of the shock. The lower the value of σ, the more market power the United States has against its trading partners, and the more it gains from the tariff shock. This can be seen in Panel A of Table 1. For our baseline value of $\sigma = 6$, U.S. aggregate real income in 2028 is essentially unchanged (a gain of 1.53 basis points), for $\sigma = 3.12$ the real income gain is roughly 45 basis points, while for the lowest value of $\sigma = 1.76$ the United States experiences a real income gain of almost 80 basis points.

Figure 7 displays the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the U.S. as a whole across different values of the trade elasticity. The solid blue line depicts $\sigma = 1.76$, the dashed green line $\sigma = 2.44$, the orange line with circular markers $\sigma = 3.12$, and the burgundy line with crosses depicts our baseline value of $\sigma = 6$.

As σ decreases from 6 to 1.76, the change in aggregate labor force participation re-

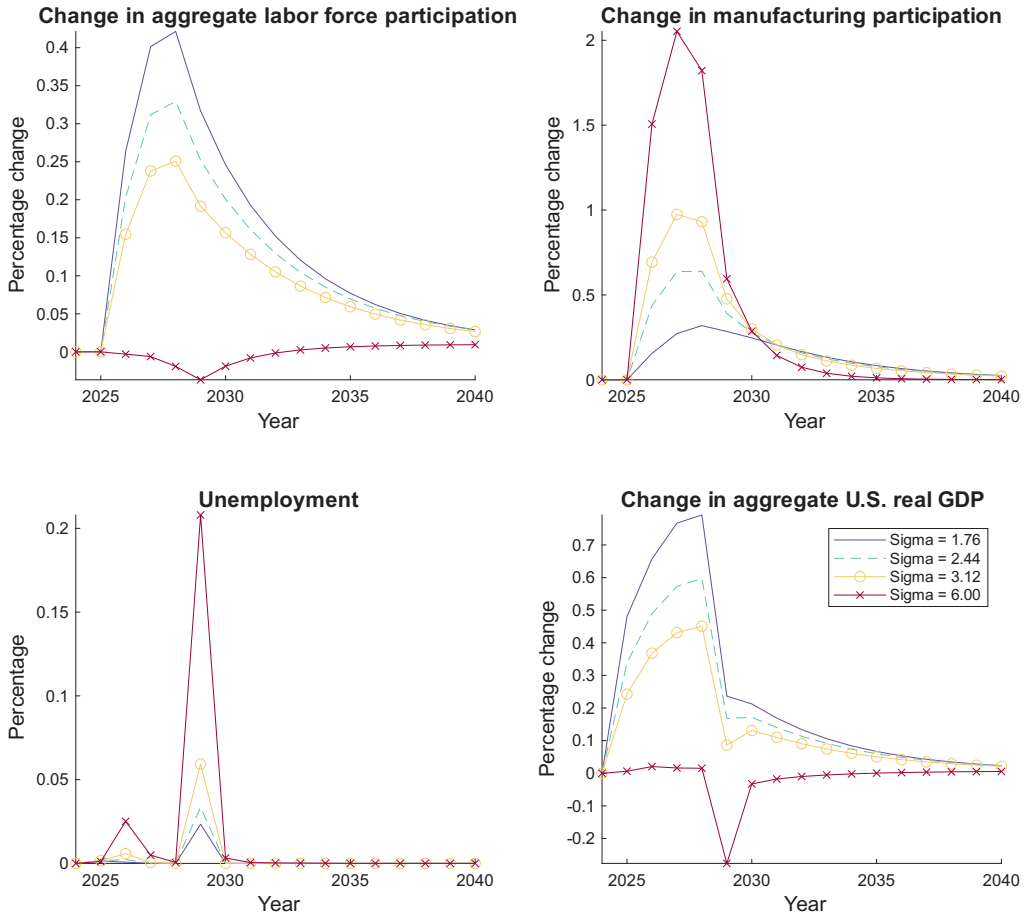


Figure 7: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole across different values of the trade elasticity. The solid blue line depicts $\sigma = 1.76$, the dashed green line $\sigma = 2.44$, the orange line with circular markers $\sigma = 3.12$, and the burgundy line with crosses $\sigma = 6$.

verses direction. A lower trade elasticity implies a larger improvement in the U.S. terms of trade, leading to higher gains in real GDP. Such gains dominate the anticipated losses from higher unemployment when tariffs are removed, leading to higher participation.

However, participation in manufacturing increases less for low values of σ. This shift is tied to the effect of tariffs on the cost of imported inputs. As highlighted by Flaaen and Pierce (2019), such imports are essential for the competitiveness of U.S. manufacturing, so tariffs that raise input costs undermine U.S. comparative advantage in manufacturing, reducing labor demand in that sector. While tariffs do lessen import competition in manufacturing, a lower trade elasticity limits the ability to replace foreign with domestic inputs, amplifying the impact of the input cost channel and making it more likely that the net manufacturing employment effect is smaller.

We now turn to discussing the impact of the shock's duration. Figure 8 displays the same four outcomes as Figure 7, but now across different values for the duration of the shock (recall that we have solved the model under perfect foresight, so the agents in the model know the size and duration of the shock). A higher persistence raises aggregate participation. With a duration of four years, participation falls slightly (by at most 0.04%), but with a duration of eight years or more it increases, by up to 0.2% with eight years and 0.55% with sixteen years, as the gains from the high tariffs last longer and the negative impacts of the unemployment generated when the shock dissipates are pushed farther into the future, so they no longer dissuade agents as much from supplying labor soon after the tariffs are introduced. Manufacturing participation increases more as the persistence of the shock increases. Unemployment is mostly generated in the years immediately following the tariff reversal, and it peaks at around 0.2% for all four durations. As shown in Panel B of Table 1, the U.S. real income gain rises with the duration of the shock, from 1.53 basis points with four years to 33.55 basis points with sixteen years.[28]

Next, we consider the effects of retaliation by other countries. Figure 9 displays the same four outcomes as Figure 7, but now across different levels of retaliation by other

[28] Appendix Figure G.2 presents the same outcomes as Figure 8, but for all durations between 1 and 24 years, as well as for the case when the tariff shock is permanent. Shocks that last only one or two years reduce U.S. welfare (by 0.9 and 0.2 basis points, respectively), while longer shocks increase it. The welfare gain grows with the duration of the shock and reaches 6.7 basis points when the shock is permanent.

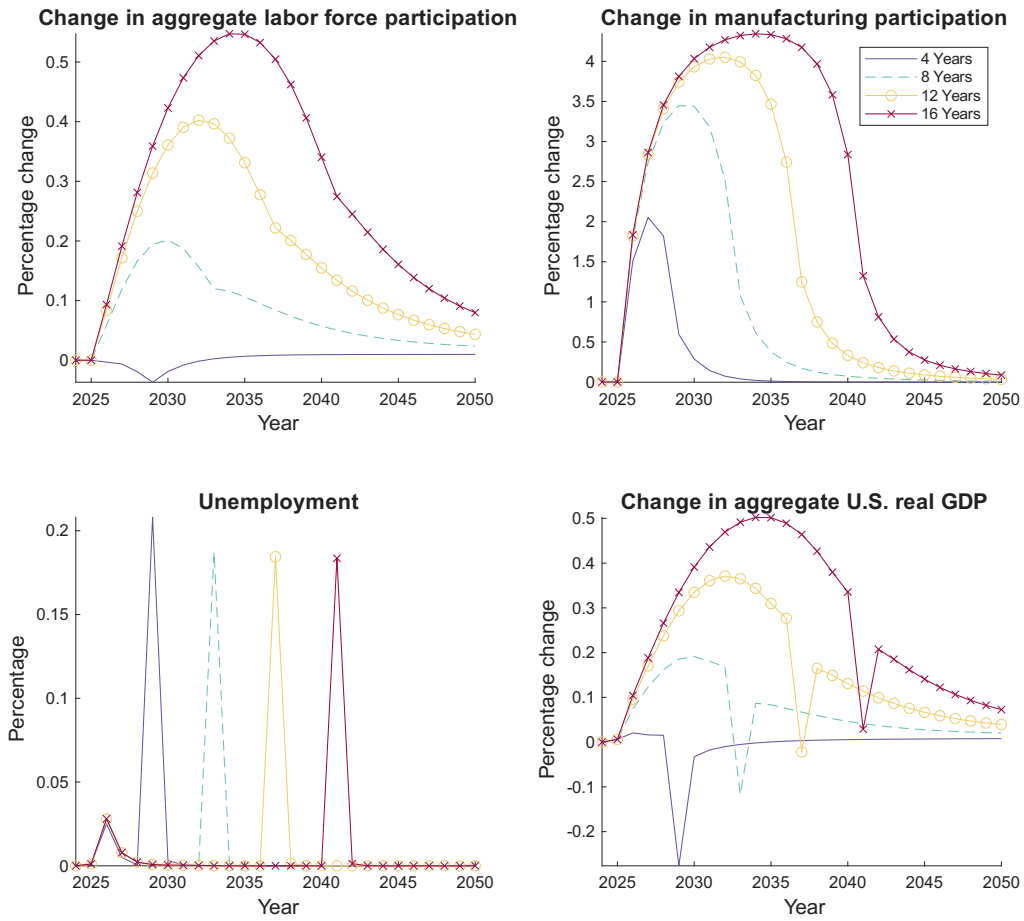


Figure 8: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole across different values for the duration of the shock. The solid blue line depicts a duration of 4 years, the dashed green line 8 years, the orange line with circular markers 12 years, and the burgundy line with crosses 16 years.

countries. For each line, the tariff shock is a convex combination of the amount of retaliation that occurred in the data (which is very small or non-existent, as described in Section 4.2) and mirror retaliation (i.e., other countries impose on the U.S. the same tariff increase that they have suffered). The solid blue line puts 100% weight on actual retaliation (i.e., our baseline), the dashed green line puts 2/3 weight on actual retaliation and 1/3 weight on mirror retaliation, the orange line with circular markers puts 1/3 weight on actual retaliation and 2/3 weight on mirror retaliation, and the burgundy line with crosses puts 100% weight on mirror retaliation.

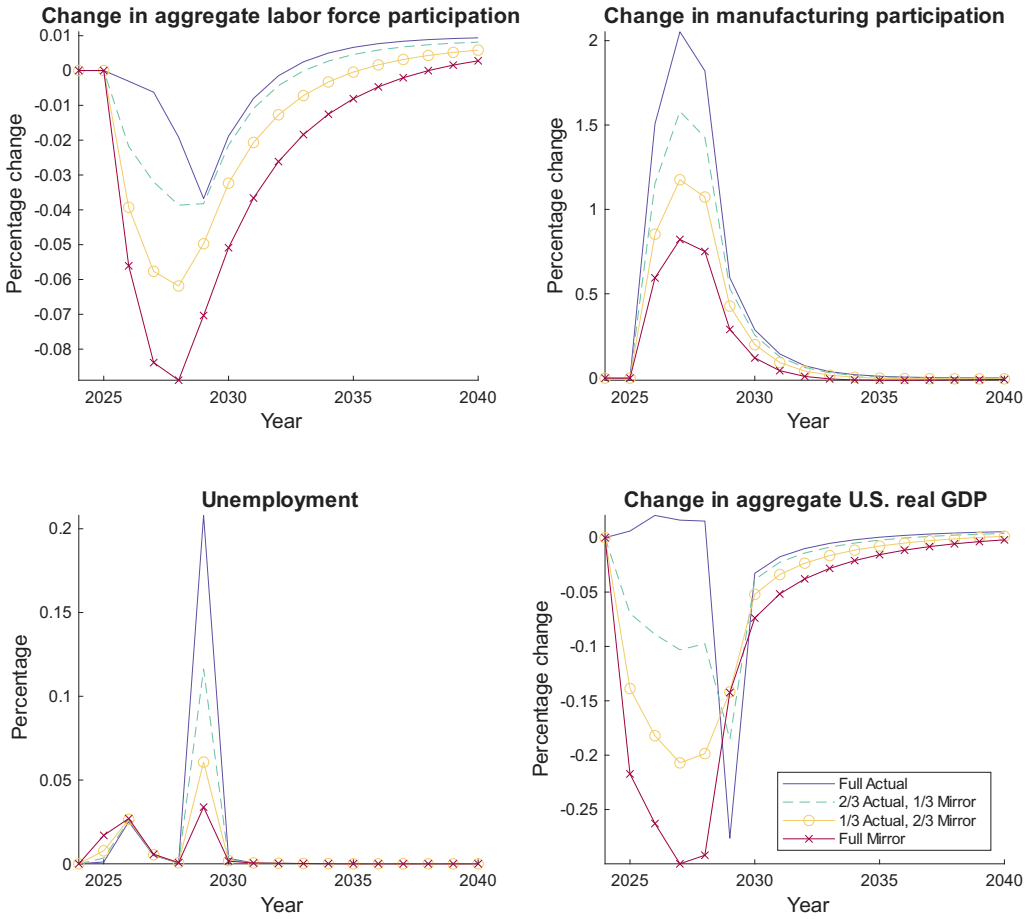


Figure 9: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole across different options for the extent of retaliation by other countries. For each line, the tariff shock is a convex combination of the amount of retaliation that occurred in the data (as described in Section 4.2) and mirror retaliation (i.e., other countries impose on the U.S. the same tariff increase that they have suffered). The solid blue line puts 100% weight on actual retaliation, the dashed green line 2/3 weight, the orange line with circular markers 1/3 weight, and the burgundy line with crosses zero weight (i.e., full weight on mirror retaliation).

The higher the weight put on mirror retaliation, the less beneficial the shock is for the United States (as indicated in Panel C of Table 1): U.S. real income in 2028 falls by 9.76 basis points when one third of the weight is put on mirror retaliation and by 29.20 basis points under full mirror retaliation. Higher weight on mirror retaliation also dampens the boost to manufacturing demand due to domestic protection, weakening the increase in manufacturing participation. Remarkably, the larger the weight on mirror retaliation, the

lower is the amount of unemployment generated when the tariff shock disappears. Under the (limited) retaliation observed so far, manufacturing employment and wages increase sharply during the years with high tariffs, due to the positive protectionist effect. Consequently, the wage in manufacturing needs to fall when the shock disappears, at which point the manufacturing sectors in many U.S. states hit the DNWR, leading to unemployment. These dynamics are much less pronounced under mirror retaliation, explaining why a tariff-generated unemployment of 0.21% in 2029 under the baseline specification falls to just 0.03% under full mirror retaliation. Thus, perhaps surprisingly, foreign mirror retaliation ameliorates the unemployment effects of the U.S. tariffs.

We now turn to the tightness of the DNWR. As discussed in Section 4.2, for a given δ, the DNWR is less likely to bind the higher the growth rate of world nominal GDP in dollars, γ. We therefore vary the tightness of the DNWR by changing γ while keeping $\delta = 1$. Panel D of Table 1 and Figure 10 compare four DNWR scenarios, from the loosest to the tightest: a model without DNWR (in which nominal wages are fully flexible), $\gamma = 4\%$, $\gamma = 3\%$ (our baseline), and $\gamma = 2\%$. The model without DNWR is essentially that of a very high γ: as Figure 11 shows, with $\gamma = 7\%$ the U.S. welfare change is already within about 0.01 basis points of that in the model without DNWR. Figure 10 displays the same four outcomes as Figure 7. The solid blue line depicts the model without DNWR, the dashed green line $\gamma = 4\%$, the orange line with circular markers our baseline of $\gamma = 3\%$, and the burgundy line with crosses $\gamma = 2\%$.

The tighter the DNWR, the more unemployment is generated when the tariffs are removed: unemployment peaks in 2029 at 0.09% with $\gamma = 4\%$, 0.21% in our baseline, and 0.36% with $\gamma = 2\%$, while there is no unemployment without DNWR. Since agents anticipate this unemployment, a tighter DNWR also lowers aggregate participation and the increase in manufacturing participation during the years with high tariffs, and the fall in U.S. real GDP in 2029 reaches 58.27 basis points with $\gamma = 2\%$. As a result, the U.S. gain from the shock shrinks as the DNWR becomes tighter. The real income gain in 2028 falls from 9.29 basis points without DNWR to 1.53 basis points in our baseline and becomes a loss of 7.16 basis points with $\gamma = 2\%$. The effects through 2028 arise before the tariffs are

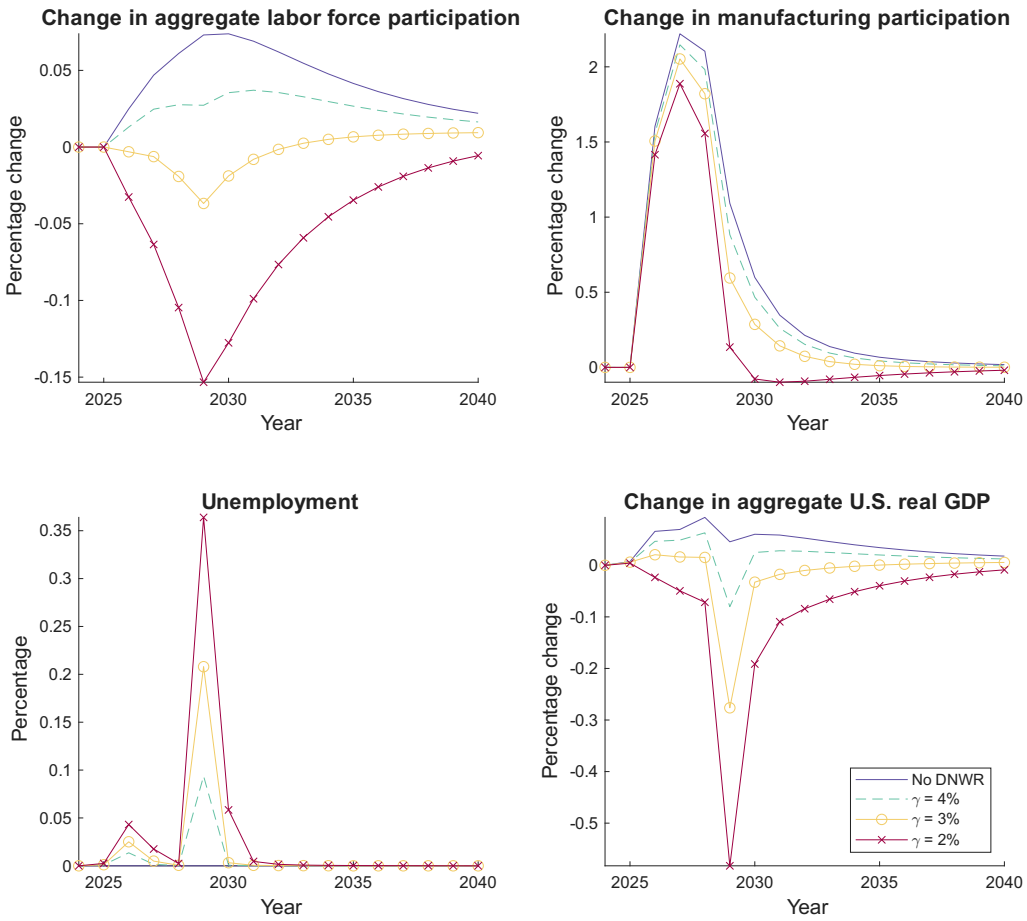


Figure 10: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole for different degrees of DNWR. The solid blue line depicts the model without DNWR, the dashed green line a growth rate of world nominal GDP in dollars of $\gamma = 4\%$, the orange line with circular markers $\gamma = 3\%$ (our baseline), and the burgundy line with crosses $\gamma = 2\%$.

removed and depend on what agents expect rather than on whether the removal actually happens. They would be the same if the tariffs unexpectedly remained in place after 2028.

To study how the DNWR interacts with retaliation, we refer to Figure 11. It shows the welfare change from the shock for the United States as a whole, in basis points, on the y-axis, for different values of the weight put on mirror retaliation (between zero and one), on the x-axis, for seven values of the growth rate of world nominal GDP in dollars (γ) between 2% and 7%, as well as for the case without DNWR, as indicated in the legend.

As expected, the higher the weight put on mirror retaliation, the lower the U.S. welfare gain (counting losses as negative gains). Additionally, the lower the γ, the lower the welfare gain. This happens because a greater γ gives more room for the wage to adjust downward each period, decreasing the amount of manufacturing unemployment generated when the shock dissipates (without accounting for the unmodeled cost of higher inflation). For the low amount of retaliation observed in the data so far, the United States gains from the tariff shock for every value of γ we consider, although the gain is very close to zero (0.04 basis points) with $\gamma = 2\%$. Under full mirror retaliation, by contrast, the United States loses for every value of γ. In our baseline with $\gamma = 3\%$, the U.S. welfare gain turns into a loss once the weight on mirror retaliation exceeds about 0.45.

More subtly, the slope of the lines in Figure 11 becomes more negative with higher γ. Without DNWR, the United States gains 1.14 basis points of welfare from the shock if other countries retaliate as they have done in the data so far, but it loses 0.52 basis points

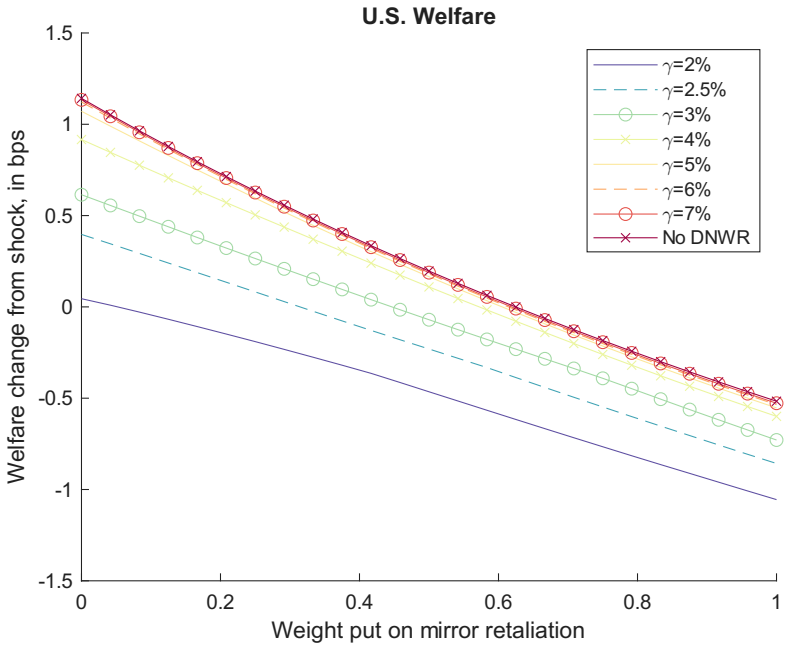


Figure 11: This figure presents the welfare change from the shock for the United States as a whole, in basis points, on the y-axis for different values of the weight put on mirror retaliation (between zero and one), on the x-axis, for seven values of the growth rate of world nominal GDP in dollars (γ), between 2% and 7%, and for the case without DNWR, as indicated in the legend.

if the other countries do mirror retaliation, for a slope of -1.66. By contrast, with $\gamma = 2\%$, the United States gains 0.04 basis points if other countries retaliate as they have done in the data so far, and it loses 1.06 basis points if the other countries do mirror retaliation, for a slope of just -1.10. In other words, the tighter the DNWR, the smaller is the importance of the weight put on mirror retaliation for the welfare impact of the shock. This occurs because, while greater retaliation makes outcomes worse for the United States through the traditional channels, it also dampens the manufacturing expansion that occurs during the high-tariff years and decreases the amount of unemployment generated when the tariff shock disappears.

Finally, Panel E of Table 1 and Figure 12 show the effects of shutting down, one at a time, three features of our model: the redistribution of tariff revenue across U.S. states, input-output linkages, and migration across U.S. states. Without redistribution, each U.S. state keeps the tariff revenue collected on its own imports (i.e., $\theta_{ji} = 1$ if $j = i$ and $\theta_{ji} = 0$ otherwise). Without input-output linkages, we set the labor share to one in every region and sector, so that there are no intermediate inputs, while keeping the same trade flows. Without migration, workers can move across sectors within their state, but not across states. In Figure 12, the solid blue line depicts our baseline, the dashed green line the model without redistribution, the orange line with circular markers the model without input-output linkages, and the burgundy line with crosses the model without migration.

The redistribution of tariff revenue across U.S. states has small effects on U.S. aggregates: without it, the paths in Figure 12 barely change and U.S. welfare falls from a gain of 0.61 basis points to a gain of 0.46 basis points. Its role is mostly distributional. Both the exposure of a state to the tariffs and the revenue collected on its imports increase with its imports, so pooling the revenue across states transfers resources from states that import more to states that import less. Without redistribution, the standard deviation across U.S. states falls from 64 to 46 basis points for the real income change and from 5.8 to 4.1 basis points for the welfare change.

Input-output linkages matter much more. Without them, the U.S. welfare change turns from a gain of 0.61 basis points into a loss of 0.26 basis points, and by 2028 U.S. real

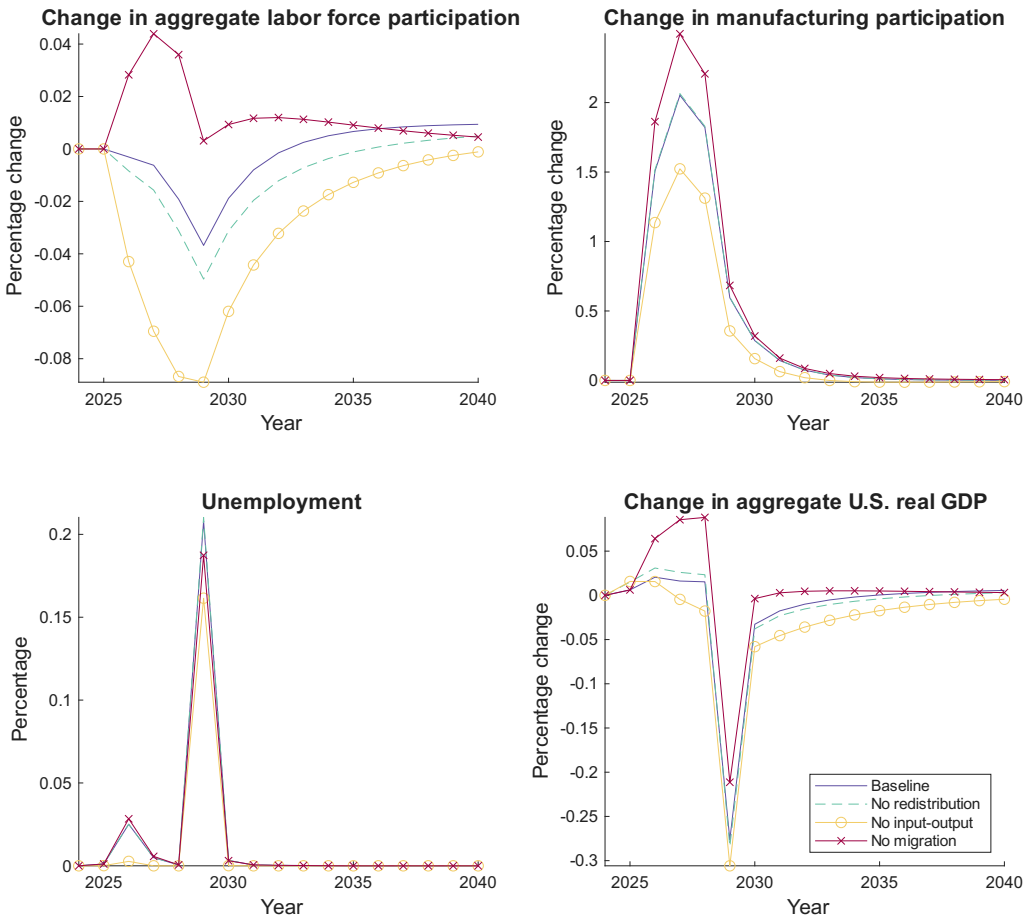


Figure 12: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole when we shut down, one at a time, three features of our model. The solid blue line depicts our baseline, the dashed green line the model without redistribution of tariff revenue across U.S. states, the orange line with circular markers the model without input-output linkages, and the burgundy line with crosses the model without migration across U.S. states.

income falls by 1.78 basis points and manufacturing participation rises by 1.3% rather than 1.8%. Most of these differences reflect a smaller shock relative to income. With the same trade flows and no intermediate inputs, income equals gross output, which is 1.8 times U.S. value added, so imports, tariff revenue, and the tariff shock are all roughly half as large relative to income as in our baseline. Without DNWR, removing input-output linkages would only shrink the welfare gain, not turn it into a loss. With DNWR, however, the shock also causes unemployment, and this unemployment is about as large without

input-output linkages as with them, so the smaller benefits of the shock no longer make up for it and the welfare gain becomes a loss. Input-output linkages also increase the differences across states: without them, the standard deviation across U.S. states falls from 64 to 38 basis points for the real income change and from 5.8 to 3.7 basis points for the welfare change.

Migration across U.S. states matters little for U.S. welfare and unemployment, but more for participation, real income, and the distribution of effects across states. Without migration, the U.S. welfare gain rises slightly, from 0.61 to 0.72 basis points, and unemployment peaks at 0.19% rather than 0.21% in 2029, but the real income gain in 2028 is 8.81 basis points instead of 1.53, and aggregate participation rises rather than falls. The shock makes market work more attractive relative to home production in some states and less attractive in others. Without migration, workers can respond only by switching sectors within their state. With migration, some of the workers pushed out of the market sectors of the states that lose move to other states, where they spread across sectors in proportion to the existing allocation, including home production. If these destination states have lower participation, aggregate participation and real income, which reflect only market activity, fall, while U.S. welfare barely changes. Migration also increases the dispersion of effects across U.S. states: the standard deviation of the real income change rises from 59 to 64 basis points, and that of the welfare change doubles, from 2.9 to 5.8 basis points.

We also consider a scenario in which the tariff revenue is not rebated to workers right away. Specifically, we assume that the additional tariff revenue collected by the United States relative to the baseline economy goes to the "capitalists" described in Appendix D.3—who do not work and whose welfare we do not include in our welfare measure—during the first one, two, or three years of the shock, and that it is rebated to workers afterwards. Since capitalists spend the revenue they receive and have the same preferences as workers, the withheld revenue still enters aggregate expenditure, just as when it is rebated right away. What changes is the income of workers, who forgo the withheld revenue, about 0.6% of U.S. income in each year in which it is withheld.

Withholding the revenue for one year (2025) turns the U.S. welfare gain of 0.61 basis

points into a loss of 1.09 basis points. This is a pure transfer: the allocation of workers across sectors in 2025 is determined before the shock is known, and participation, employment, and real income in the following years are essentially unchanged. Withholding the revenue for two or three years lowers U.S. welfare further, to -2.71 and -4.18 basis points, and now also affects the allocation of labor. Since the tariff revenue is distributed only among workers in the market sectors, it acts as a subsidy to participation, and withholding it lowers participation (by about 0.17% in 2026 with two years and by up to 0.39% with three years), so that U.S. real income in 2028 falls by 7.74 and 25.98 basis points, respectively. By contrast, the delayed rebate barely affects unemployment, which peaks at 0.21% in 2029 in all cases, since the withheld revenue is still spent and therefore does not reduce the demand for U.S. labor.

The results under other potential changes to the model's assumptions, such as fixed exchange rates between the dollar and other currencies, or DNWR applying to all sectors, are available upon request.[29]

7 International Results

In this section, we focus on how the impact of the tariff shock varies across countries.[30] Each country is charged a potentially different tariff. On top of that, countries have differential exposures to the shock determined by their trading patterns and openness to trade. Figure 13 shows the cumulative fall in real income between 2024 and 2028 for all the countries in our sample. Not surprisingly, countries trading more with the United States lose the most, while some countries can gain by having less competition in the U.S. market, for example, if they face relatively small increases in U.S. tariffs (Croatia, Greece, and Cyprus are among the countries that gain slightly).

[29] In a nutshell, other countries having fixed exchange rates against the dollar makes the shock slightly worse for them, since they then experience some unemployment from the shock. When the DNWR applies in all sectors, more unemployment is generated in the United States when the shock first hits.

[30] So far, we have focused on the U.S. implications of the shock because our framework models the United States in great detail. By contrast, our modeling of other countries is more limited; they do not feature internal regions or costs of moving between sectors. We take the U.S. implications of the model more seriously while still thinking that the implications for other countries are worth discussing.

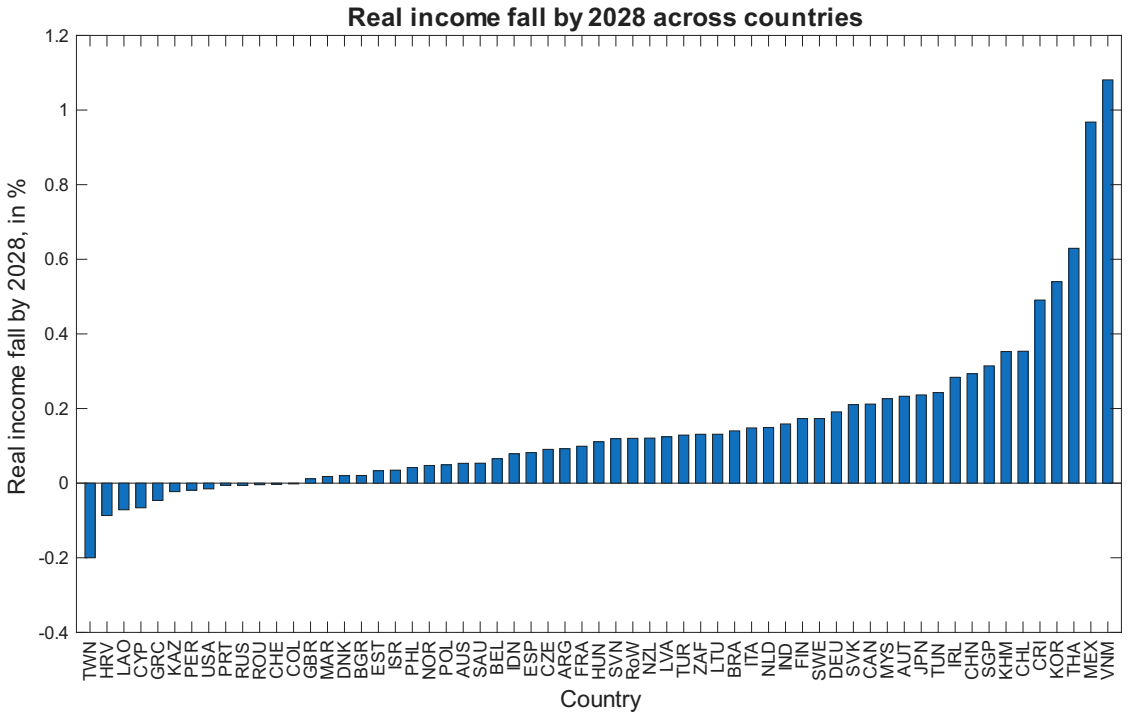


Figure 13: This figure displays the cumulative fall in real income (which coincides with real GDP) by 2028, in percent, across countries. For country abbreviation codes, see Appendix C.1.

As discussed earlier, U.S. real income is essentially unchanged by 2028 (a gain of 1.53 basis points). Vietnam and Mexico are among the countries that lose the most, around 108 and 97 basis points, respectively, while Canada loses 21 basis points, Ireland 28 basis points, and China 29 basis points. Mexico suffers much more than China because a much larger share of its output is sold to the United States, even though China faces a much larger increase in U.S. tariffs.[31] Canada loses much less than Mexico, partly because it faces lower U.S. tariffs and sells a smaller share of its output to the United States.

8 Conclusion

We use detailed tariff data and a dynamic trade and migration model with an input-output structure and DNWR to assess the effects of the recently enacted tariff changes. We propose a general method to solve quantitative trade models when the tariff revenue

[31] See Appendix F for more details on why Mexico loses so much.

received by a given region can be arbitrarily related to the tariff revenue collected on the region's imports due to potential government redistribution.

We find four key results for the United States. First, aggregate labor force participation barely changes, as the tariff revenue offsets the fall in real wages caused by a less efficient market sector. Second, there is a temporary increase in manufacturing employment but temporary reductions in service and agricultural employment. Third, states highly exposed to trade with the countries most affected by the new tariffs (like Texas, California, and Michigan) see bigger real income losses. Fourth, the impacts of the shock depend on the trade elasticity and on retaliation. The lower the trade elasticity, the more the United States as a whole benefits from the tariff shock, but this comes with a much smaller employment increase in the manufacturing sector, while full mirror retaliation by other countries would turn the small U.S. gain into a loss. Close trading partners of the U.S., like Vietnam and Mexico, suffer real income losses of around 100 basis points.

Importantly, our model does not capture any effects of tariff increases stemming from uncertainty, geopolitical tensions, interactions with pre-existing distortions (such as income taxes), or the central bank's reaction to the shock, among others.

Finally, we want to highlight some assumptions that might lead our model to underestimate the short-run consequences of the new tariffs. First, as is standard in quantitative trade models, we assume that technology is Cobb–Douglas, but recent evidence suggests that the elasticity of substitution across inputs is likely to be less than one, especially in the very short run.[32] As shown by Baqaee and Farhi (2019), if factors are not fully mobile across sectors (as is the case in our model due to the costs of moving between sectors), this can lead to significantly larger losses from increases in trade costs. Second, the aggregate nature of our model implies a lot of smoothing of the effects of shocks across different agents. A more granular model could imply larger shocks that could trigger large disruptions, such as bankruptcies that could affect other agents in more granular input-output or credit networks, leading to larger aggregate effects (see, e.g., Acemoglu et al., 2012).

[32] See Boehm et al. (2019) and Atalay (2017).

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Appendix

A Construction of the Global Tariff Database: U.S. Trade War Extension

In this section, we document the construction of the Global Tariff Database: U.S. Trade War Extension underlying our quantitative analysis of the impacts of the recent increases in U.S. tariffs. We begin the coding protocol with an overview of the tariff instruments (Table A.1), describe the rules used to stack them into effective tariff rates, cover tariffs on U.S. exports, detail the data construction, and conclude with illustrative product-country examples. The data are available at Feodora A. Teti's website (https://feodorateti.github.io/) and will be updated regularly.

A.1 Overview of U.S. Tariff Instruments (2018–May 2026)

Tariff Instrument	Details
Tariffs not under IEEPA (unaffected by the Supreme Court ruling)	
Baseline tariff	**Trade relations in normal times**: the baseline tariff equals min(MFN, preferential) or Column 2 if no normal trade relations (Cuba, North Korea; Russia and Belarus since 2022). GSP (including the special scheme for LDCs) lapsed in January 2021 and has not been reauthorized since.
Safeguards (Sec. 201)	**Solar panels** (30%, GSP excl.) and **washers** (20%, GSP+CAN excl.) imposed 07 Feb 2018. Annual reductions; washers expired 07 Feb 2023, solar extended until it expired on 07 Feb 2026.

Tariff Instrument	Details
Unfair Trade Practices (Sec. 301)	**China-specific tariffs** covered about $370bn: Lists 1–3 ($250bn) at 25% (Jul–Sep 2018) and List 4A ($120bn) at 15% (Sep 2019), cut to 7.5% (Feb 2020). Biden maintained the regime and added EVs, batteries, critical minerals, solar inputs (Sep 2024), and tungsten, wafers, and polysilicon (Jan 2025). Further Four-Year Review increases took effect on 01 Jan 2026.
Airbus Dispute (Sec. 301)	**WTO-authorized retaliation** imposed on selected E.U. goods (18 Oct 2019), later adjusted in 2020–21 and suspended in Mar 2021 under Biden's truce with the E.U. and U.K.
National Security (Sec. 232)	**Steel and aluminum** tariffs of 25% on steel and 10% on aluminum imposed 23 Mar 2018. AUS, BRA, ARG, and KOR exempt from the start (quotas); E.U., CAN, MEX exemptions ended 01 Jun 2018. Turkey steel 50% (Aug 2018–May 2019). Scope later extended to certain derivative products 08 Feb 2020, with tariffs applied to the full product value. CAN+MEX re-exempted permanently May 2019; 10% briefly reimposed on one Canadian aluminum product (16 Aug–01 Sep 2020). Biden: TRQs with E.U. (Jan 2022), JPN (Apr 2022), and U.K. (Jun 2022) effectively eliminated tariffs.

Tariff Instrument	Details
	Trump 2.0: all exemptions ended 12 Mar 2025 (aluminum raised to 25%); 04 Jun both steel and aluminum raised to 50%, U.K. capped at 25%; scope extended 23 Jun and 18 Aug 2025, with tariffs applying only to the steel/aluminum content.[33] From 06 Apr 2026, the steel and aluminum tariffs were restructured into product annexes at 50%, 25%, or a top-up to 15% including MFN, applied to the full value of the good.
	Cars faced a 25% tariff imposed 03 Apr 2025 (worldwide), with USMCA-compliant vehicles[34] taxed only on non-U.S. content[35]; the U.K. was later capped at 10% including MFN (30 Jun 2025). Caps of 15% including MFN apply to cars and parts from the E.U. (01 Aug 2025), Japan (16 Sep 2025), and Korea (01 Nov 2025).
	Car parts faced a 25% tariff imposed 03 May 2025 (worldwide), with USMCA-compliant parts exempt.
	Copper faced a 50% tariff imposed 01 Aug 2025 (worldwide), applied only to copper content. From 06 Apr 2026, copper moved to the same product annexes as steel and aluminum, with tariffs applied to the full value of the good.

[33] We assume 50% metal content for all products subject to content-based tariffs.
[34] USMCA-compliant defined using preference utilization rates from May–December 2025 U.S. import data.
[35] About 38% U.S. content for MEX, about 50% for CAN based on PIIE and CVMA sources.

Tariff Instrument	Details
	Timber and furniture faced tariffs of 10% on softwood timber and 25% on furniture and cabinets from 14 Oct 2025.
	Medium- and heavy-duty vehicles and parts faced 25%, and **buses** 10%, from 01 Nov 2025, with USMCA treatment analogous to cars and car parts (except buses). The Sec. 232 tariff on certain semiconductors (15 Jan 2026) is not coded, because it depends on chip specifications and end use.
Tariffs under IEEPA (ended 24 Feb 2026, following the Supreme Court ruling)	
IEEPA: Fentanyl tariffs *Ended 24 Feb 2026 (Supreme Court ruling)*	**China** faced +10% on all imports (04 Feb 2025), raised to 20% (04 Mar 2025), and cut to 10% (10 Nov 2025).
	Canada and Mexico faced 25% on non-USMCA-compliant goods from 04 Mar 2025; the Canadian rate rose to 35% (01 Aug 2025).[36]
IEEPA: Country surcharges *Ended 24 Feb 2026 (Supreme Court ruling)*	**Brazil** was targeted with +40% (06 Aug 2025), with product and sectoral exemptions, including goods covered by the Civil Aircraft Agreement.[37]
	India faced +25% for purchases of Russian oil from 27 Aug 2025, on top of its reciprocal tariff. This surcharge was terminated on 07 Feb 2026, before the ruling.

[36] Compliance determined using preference utilization rates (PURs) from May–December 2025 U.S. import data.

[37] Exemptions identified using preference utilization rates (PURs) for Civil Aircraft Agreement coverage.

Tariff Instrument	Details
IEEPA: Liberation Day *Ended 24 Feb 2026* *(Supreme Court ruling)*	A **flat tariff** of +10% imposed on nearly all imports worldwide (05 Apr 2025), with carve-outs for all Sec. 232 goods, Annex II products (pharma, semiconductors, energy, critical minerals), Column 2 countries (CUB, PRK, RUS, BLR), and humanitarian exemptions. Semiconductors and electronics were exempted with retroactive effect to 05 Apr 2025 (decision announced 11 Apr 2025). Canada and Mexico were excluded, remaining under their original IEEPA tariff regime ("fentanyl tariffs"). Annex II was revised on 08 Sep and 13 Nov 2025, the latter adding agricultural products.
IEEPA: Reciprocal tariffs *Ended 24 Feb 2026* *(Supreme Court ruling)*	**Reciprocal flat tariffs** announced 02 Apr 2025 for 57 partners, with which the U.S. runs bilateral trade deficits.[38] They were designed to **replace** (not stack on) the Liberation Day tariffs. In practice, they took effect on 09 Apr, but for all non-Chinese partners implementation was suspended on 10 Apr, leaving the 10% Liberation Day tariff in place until 07 Aug 2025, when negotiated country-specific reciprocal rates for 69 partners and deals entered into force following the summer talks. Canada and Mexico were excluded, remaining under their IEEPA tariff regime.

[38] The reciprocal tariff rate was defined as $\text{Rate} = \dfrac{\text{U.S. bilateral trade deficit with partner}}{2 \times \text{U.S. imports from that partner}} \times 100$.

Tariff Instrument	Details
	China was subject to reciprocal tariffs starting 09 Apr 2025, escalating to +84% (09 Apr) and +125% (10 Apr); both sides agreed to roll these back to +10% on 14 May 2025.
Import Surcharge (Sec. 122)	A 10% surcharge replaced the IEEPA tariffs on 24 Feb 2026, with exemptions for Annex II goods, goods under Sec. 232 (apart from their non-metal share through 05 Apr 2026), civil aircraft, USMCA-qualifying goods, and CAFTA-DR textiles. Its statutory expiry (24 Jul 2026) falls after our sample ends.
Trade deals in force *Caps on reciprocal tariffs ended with IEEPA on 24 Feb 2026; Sec. 232 caps remain*	**China** (14 May and 10 Nov 2025). U.S. side: reciprocal tariff cut to +10% (14 May) and fentanyl tariff cut to 10% (10 Nov). China side: retaliation against the reciprocal tariff cut from 125% to 10% (14 May) and the March 2025 agricultural measures removed (10 Nov). **United Kingdom** (30 Jun 2025). U.S. side: cars and parts capped at 10% including MFN (quota of 100,000 cars per year), civil aircraft exempt, and timber and furniture at 10% from 14 Oct 2025. U.K. side: quotas for beef and ethanol only, with no rate change.

Tariff Instrument	Details
	European Union (from 01 Aug 2025). U.S. side: a "15–MFN" formula: if MFN $\leq 15\%$, the U.S. reciprocal tariff equals $(15\% - \text{MFN})$; if MFN $> 15\%$, it equals zero. This applies from 07 Aug 2025, with an exemption list from 01 Sep 2025. Cars and parts are capped at 15% including MFN from 01 Aug 2025, wood products at 15% from 14 Oct 2025, and civil aircraft are relieved of the Sec. 232 metal tariffs. E.U. side: duties on five lobster codes fell to zero on 01 Aug 2025; the cut on industrial goods applies only from 01 Jul 2026, after our sample ends.
	Japan (16 Sep 2025). U.S. side: cars, parts, and general reciprocal tariffs capped at 15% including MFN, civil aircraft exempt, and wood products capped at 15% from 14 Oct 2025. Japan side: no tariff-line change coded.
	South Korea (01 and 14 Nov 2025). U.S. side: cars and parts capped at 15% including MFN (01 Nov), general reciprocal tariffs and furniture and cabinets at 15% (14 Nov), and civil aircraft exempt. Korea side: no tariff-line change coded.
	Switzerland and Liechtenstein (14 Nov 2025). U.S. side: general reciprocal tariffs capped at 15% including MFN, with an exemption list. The deal has no Sec. 232 element, so it has no effect after 24 Feb 2026. Partner side: no tariff-line change coded.

Tariff Instrument	Details
	Taiwan (01 May 2026). U.S. side: auto parts and wood products capped at 15% including MFN, and civil aircraft relieved of the Sec. 232 metal tariffs. Taiwan side: no tariff-line change coded.
	Israel unilaterally eliminated tariffs on U.S. exports (government announcement of 01 Apr 2025), which we nevertheless included in our database.
	Cambodia unilaterally reduced tariffs to 5% on 19 specified products (06 Apr 2025); a 0% preferential duty on U.S.-origin goods followed on 01 Aug 2025 (Instruction No. 3724), both as reported by World Trade Organization and International Monetary Fund (2026).
	Zimbabwe unilaterally eliminated tariffs on U.S. exports (announced on 06 Apr 2025, as reported by World Trade Organization and International Monetary Fund (2026); no published instrument), which we nevertheless included in our database.

Table A.1: Overview of U.S. tariff instruments, 2018–May 2026

A.2 Stacking Rules for U.S. Tariffs

Table A.1 lists the individual tariff instruments used by the U.S. from 2018 through May 2026. To determine the *effective tariff* for a given product–country–date observation, the following stacking rules apply:

1. **Apply baseline tariff.** MFN or preferential rate, or Column 2 if no normal trade relations (CUB, PRK; since 2022 RUS and BLR).

2. **Stack additional duties not under IEEPA.** Add safeguards, Sec. 301, and Sec. 232, subject to exclusions, quotas, deal caps, or carve-outs. Safeguards and Sec. 301 add to every other duty.
3. **Add IEEPA fentanyl and country tariffs (Feb 2025 to Feb 2026).** The tariff on China adds to all other duties. The tariffs on Canada and Mexico apply to the non-USMCA share. They give way to each Sec. 232 action from its own date, except on copper, where they apply to the non-copper share. For steel and aluminum, they give way only from 04 Jun 2025; before that, the non-USMCA share paid the IEEPA tariff instead of Sec. 232. The Brazil and India surcharges add to reciprocal tariffs but do not apply at all to goods charged a Sec. 232 duty.
4. **Overlay IEEPA Liberation Day tariffs (Apr 2025).** Flat +10% applied on top of baseline and other duties, subject to exemptions (e.g., selected sectors, Column 2 countries, humanitarian goods); Canada and Mexico are excluded. For Sec. 232 goods, the Liberation Day tariff does not apply. For content-rule goods, from 04 Jun 2025, the Sec. 232 duty applies to the covered material content, while the non-content portion remains subject to Liberation Day tariffs; before that date, the non-content portion paid neither.
5. **Overlay IEEPA Reciprocal tariffs (Aug 2025 to Feb 2026).** Replace Liberation Day for 69 "deficit" partners with country-specific rates. Deal partners pay at most 15% including MFN from the date of their deal. As with Liberation Day, Sec. 232 duties apply to covered products. For content-rule goods, Sec. 232 applies to the steel/aluminum/copper content, while the non-content portion is subject to Reciprocal tariffs.
6. **Replace IEEPA with Section 122 (Feb 2026 onwards).** All IEEPA tariffs end, including the reciprocal deal caps, and the 10% Section 122 surcharge, which is not an IEEPA tariff, applies subject to its own exemptions. It does not apply where Sec. 232 charges full value, and it applies only to the non-metal share of content-rule goods. Sec. 232 and Sec. 301 are unaffected. From 06 Apr 2026, Sec. 232 metal tariffs apply to full value, so the content split ends.

Note: Sec. 232 measures generally do not stack with each other. Goods covered under cars or car parts are subject only to their specific Sec. 232 duty. The exception is steel, aluminum, and copper, which were imposed as distinct measures; goods containing more than one metal can face both the steel (25–50%) and aluminum (10–50%) duties until 05 Apr 2026, after which they pay once.

A.3 Tariffs on U.S. Exports

We describe next the tariffs that U.S. exporters face. We first describe retaliatory tariffs and then discuss how the "deals" reduced tariffs.

A.3.1 Retaliatory Tariffs

Table A.2 lists retaliatory tariffs by the U.S. measure they answer.

Retaliation was broad in the first Trump administration. China, the E.U., Canada, Mexico, Turkey, India, and Russia all raised tariffs. Some of these measures were later lifted: Canada and Mexico removed theirs in May 2019, the E.U. suspended its own in 2021, and Turkey repealed its own in September 2025. India removed its tariffs on eight products in 2023.

Retaliation in the second Trump administration was narrow. Only China and Canada raised tariffs. China hit selected U.S. goods in February and March 2025, then raised its tariff on all U.S. goods to 84% and 125% in April. Canada imposed surtaxes on general goods, steel, aluminum, and autos in March and April 2025, and removed most of them on 01 Sep 2025. The E.U. adopted countermeasures but suspended them before they applied.

U.S. Tariff Instrument	**Retaliatory Measures**
Safeguards (Sec. 201)	No formal retaliation; partners raised concerns in the WTO.

U.S. Tariff Instrument	Retaliatory Measures
Unfair Trade Practices (Sec. 301)	**China** responded symmetrically to Lists 1–3 (2018) and List 4A (2019), covering $\sim$ \$110bn in 2018 and \$75bn in 2019 of U.S. exports (agriculture, autos, chemicals).
Airbus Dispute (Sec. 301)	The **E.U. and the U.K.** received WTO authorization to counter-retaliate in 2020, but suspended measures after the March 2021 truce.
National Security (Sec. 232)	During the **first Trump administration**, China, the E.U., Canada, Mexico, Turkey, India, and Russia imposed countermeasures on steel/aluminum and selected U.S. exports (notably agriculture and consumer goods) in response to the Section 232 steel and aluminum tariffs. Under the **Biden administration**, the E.U. and the U.K. suspended their countermeasures following TRQ arrangements. India removed its tariffs on eight products in 2023. During the **second Trump administration**, the E.U. adopted countermeasures but suspended them before they applied, while Canada imposed new duties on steel, aluminum, and autos (Mar–Apr 2025). Other partners did not retaliate.

U.S. Tariff Instrument	Retaliatory Measures
IEEPA: Fentanyl and country tariffs	During the second Trump administration, **China** imposed additional tariffs of 10–15% on selected U.S. goods (10 Feb and 10 Mar 2025). Canada applied surcharges on selected goods, but withdrew most of them on 1 Sep 2025. Mexico and Brazil did not impose broad countermeasures, although both initiated WTO consultations.
IEEPA: Liberation Day	No dedicated retaliation; most partners waited for reciprocal tariff negotiations.
IEEPA: Reciprocal tariffs	**China** escalated to 125% before rollback.

Table A.2: Overview of retaliatory tariff measures, 2018–May 2026

A.3.2 Deals

Few deals changed tariffs on U.S. goods. We code only cuts that took effect.

- **China**: The May 2025 Geneva deal cut China's tariff on all U.S. goods from 125% to 10%. On 10 Nov 2025, China removed its March 2025 tariffs on agricultural goods.
- **European Union**: Duties on five lobster codes fell to zero on 01 Aug 2025. The cut on industrial goods applies from 01 Jul 2026, after our sample ends.
- **Cambodia**: Tariffs on 19 products fell to 5% on 06 Apr 2025, and U.S.-origin goods became eligible for a 0% duty on 01 Aug 2025 (World Trade Organization and International Monetary Fund, 2026).
- **Israel**: All tariffs on U.S. goods were eliminated on 01 Apr 2025. About 99% of U.S. goods were already duty-free.
- **Zimbabwe**: All duties on U.S. goods were suspended on 06 Apr 2025 (World Trade

Organization and International Monetary Fund, 2026).

The U.K. opened quotas for beef and ethanol but changed no rates. Frameworks with Japan, Korea, and Taiwan contain no tariff-line change on U.S. goods. We exclude deals that were announced or signed but are not in force: Argentina, Ecuador, El Salvador, Guatemala, India, Indonesia, North Macedonia, the Philippines, and Vietnam.

A.4 Data Construction

A.4.1 U.S. Import Tariffs

We build a daily panel of U.S. tariffs for every 10-digit HTS line and origin country from January 2018 through May 2026 in wide format. Each date on which any tariff changed has its own column, and each cell holds the tariff in force from that date. Every tariff equals a normal tariff plus all extra tariffs in force. A large language model (primarily Claude Opus 5, Anthropic, run in July 2026, with later verification on Claude Opus 5.5; henceforth Claude) finds the tariff events and reads their legal texts. All tariff changes are coded in Stata. Each step below is tagged by who carries it out. [CLAUDE] means Claude reads the sources and writes the output. [CLAUDE + SCRIPT] means Claude does the work with help from a fixed script, and the step says what the script does. [STATA] means the step is coded in Stata. We check Claude's output by comparing the final data with our earlier manual build (see Validation below).

Step 1: Reference data We build these once, before coding any event.

- *Panel-ID* HTS10 master lists (2018 and 2022 nomenclatures) crossed with a country list.
- *Normal tariffs* MFN, preferential, and Column 2 rates by year from MacMap, WITS, and the HTS, following Teti (2024), whose algorithm fills missing rates. The normal tariff is Column 2 where it applies and otherwise the lower of MFN and the preferential rate. It changes only on January 1. Extreme rates, which come from converting specific duties to ad valorem equivalents, are winsorized (at the 90th percentile for U.S. MFN rates and 95th percentile of positive rates for U.S. preferential rates).

- *Preference use* The share of imports claiming USMCA (May–December 2025), civil aircraft, or CAFTA-DR treatment (both for all of 2025), from U.S. Census Bureau import data.
- *Deal top-up* For deals that cap the total tariff at 15%: 15% minus MFN, or zero if MFN exceeds 15%.
- *Russia and Belarus* The gap between Column 2 and MFN.
- *Public trackers, for checks only.* Download the trackers provided by the PIIE (Bown, 2026; Bown and Kolb, 2025), the WTO–IMF (World Trade Organization and International Monetary Fund, 2026), and the Congressional Research Service (Hammond and Burkhart, 2026).

Step 2: Identify the tariff events A tariff event is a U.S. policy change that alters the tariff on at least one tariff line for at least one country.

1. *Collect* [CLAUDE] Through the Federal Register API and the GovInfo search, with no keyword filter, Claude downloads every executive order, proclamation, USTR notice, and Public Law from January 2018 through June 2026. For GSP, AGOA, Caribbean Basin, and Nepal, the window starts six months earlier, because some proclamations take effect months later. White House releases cover recent months the Federal Register has not yet published.[39]
2. *Open candidates* [CLAUDE] Claude reads every title and opens the full text if:
   - the title could concern tariffs, duties, imports, customs, or a country-specific emergency (the one judgment call);
   - the title is reused across actions, such as "Adjusting Imports of Steel Into the United States";
   - the document modifies the Harmonized Tariff Schedule or concerns a preference program (read in full, because changes are often buried inside).
3. *Is it an event?* [CLAUDE] A document is a tariff event only if:
   - a signed or published legal text exists (not a press release or social media post);

[39] These lists omit other agencies: Commerce notices adding products to Section 232 need a targeted search, and CBP guidance is not swept. Cross-references in the legal texts and the checks below catch such actions.

- it changes a tariff rate, its product or country coverage, or a country's preference eligibility;
- it imposes the change itself (not an unused authority);
- the change takes effect and is not withdrawn first.

Excluded even if these hold: antidumping and countervailing duties, de minimis changes, import and export bans, technical code corrections, per-shipment customs rules, and changes to quota volumes alone.

4. *Date and log* [CLAUDE] An event is dated when it takes effect, not when it is signed. Documents that jointly define one change are one event. One notice with several future steps is several events. Different remedies from one investigation are judged separately. The event log records the effective date, legal instrument, and source document.
5. *File what fails the test* [CLAUDE] Announced deals go to the deals log. Unused authorities and open investigations go to a watch list, rechecked at each pass.
6. *Search again by instrument, 2018–2024* [CLAUDE + SCRIPT] The WTO–IMF and CRS trackers start in 2025. For earlier years, Claude searches the Federal Register again, one instrument at a time, and confirms that the log contains:
   - Section 301: every list and rate adjustment;
   - Section 232: every proclamation and later exemption, quota, or scope change;
   - Section 201: each safeguard and annual reduction;
   - GSP, AGOA, Caribbean Basin, and Nepal, for the whole sample: every change in a country's eligibility;
   - Section 301 product exclusions, for the whole sample: a script sorts USTR exclusion notices into new grants and mere corrections, and Claude checks the grants against the log. Claude handles the COVID-19 exclusions and the 2022 reinstatement directly.

   Anything missing goes through the event test.
7. *Search for missing events* [CLAUDE + SCRIPT] Four checks look for real events that are

not in the log:

- a script downloads all USTR notices and all Presidential Documents with a trade keyword in the title or abstract, and flags those with no logged event within 14 days; Claude reads the full list and rechecks Public Laws;
- a script lists events in the earlier hand-coded data that are not in the log;
- Claude lists events in the PIIE, WTO–IMF, and CRS trackers that are not in the log;
- Claude searches the news by date for court rulings and reversals absent from the Federal Register.

Each possible gap goes through the event test, and is logged or recorded as a non-event.

8. *Validate logged events* [CLAUDE] Claude looks up each logged event in the PIIE and WTO–IMF trackers, compares its rate, products, countries, effective date, and legal basis, and opens the legal document the tracker links. If they disagree, the legal text decides. Events absent from the trackers stay in the log, because the trackers are coarser.

Step 3: Extract each event [CLAUDE + SCRIPT] In date order, Claude reads the legal text and annexes and writes the HTS codes, countries, and rate change or target rate into a code list. A script checks every code against the master list to double-check that the HTS codes exist (HTS 2018 for events through 2021, HTS 2022 after).

Step 4: Code each event in Stata [CLAUDE + SCRIPT] Claude turns each event into a block of coded tariff changes in Stata, which we review manually. The block adds a column with the tariff change by product and country, given the tariffs in force that day. We set the stacking framework from the legal texts. Claude applies it to each event and records any rule a legal text adds, which we review and feed back into the stacking framework. Each block ends with checks against the tariffs the rules imply. Events through 2021 use the HTS 2018 list (HS 2017) and are mapped to HS 2022 at six digits. Later events use the 2022 list.

Step 5: Verify each event [CLAUDE + SCRIPT] Three checks. First, a script checks each code list's format and codes, and Claude compares the list with the official PDF. Second, Claude compares the Stata code with the log and checks each instrument's running total across events. Third, Claude rereads the legal text clause by clause for missed provisions. Errors go back to Step 3 or 4.

Step 6: Build tariff levels [STATA] Start from the normal tariff and add the running total of changes, resetting the normal tariff each January 1. Take simple means across tariff lines to HS6 in HS 2022, then map to HS 2017 where needed.

Trade deals [CLAUDE] We track the 2025–26 deals in a separate log from announcement to implementation. A deal enters as an event (Steps 2 to 5) only once a legal text implements it.

Assumptions Some tariffs depend on features of a shipment, such as whether the importer claims a trade preference or how much U.S. or metal content the good contains. We do not observe these features, so we make three assumptions to express each rule as a single rate by tariff line and country:

1. *Preference use* The fentanyl tariffs on Canada and Mexico do not apply to products that qualify for duty-free entry under the USMCA, which requires that the good meets the USMCA rules of origin and that the importer claims the preference. We therefore apply the tariff only to the share of imports claiming no USMCA preferences (see footnote 9), measured by preference utilization rates (PURs) computed from U.S. Census Bureau monthly import data, which record the program under which each good entered by origin and tariff line. For every origin and tariff line, the tariff equals the statutory rate times one minus the PUR. Where an origin has no imports in a tariff line, we use the PUR of the 6-digit, then the 4-digit, then the 2-digit HS product group, and otherwise the origin's average PUR. We pool May to December 2025, when importers claimed USMCA preferences even on MFN duty-free goods. Exemptions for civil aircraft and CAFTA-DR textiles work the same way, using the utilization rate of the respective program.
2. *U.S. content of cars* Section 232 tariffs on cars apply to the full value of the car, except

for cars that qualify for preferential treatment under the USMCA, for which only the non-U.S. content is taxed. We set the non-U.S. content at 62% for Mexico and 50% for Canada (Canadian Vehicle Manufacturers' Association, 2025; Contreras, 2024).

3. *Metal content* Until April 2026, Section 232 tariffs on steel, aluminum, and copper derivatives applied only to the value of their metal content rather than to the full value of the good. We assume a metal share of 50% for all derivatives over that period.

Validation For events through August 15, 2025, we compare the event list and coded changes with the previous, manually coded version of the U.S. Trade War Extension (v_2025-10). Where they differed, we reread the legal text and revised the pipeline if it was wrong. This comparison refined the pipeline.

A.4.2 Tariffs on U.S. Exports

Tariffs on U.S. goods imposed by China, the European Union, India, Canada, Mexico, Russia, and Turkey follow the same logic: a baseline tariff from MacMap (MFN or preferential tariff) plus the changes in force. For China, we start from Bown (2021), who provides the retaliatory tariffs of the first Trump administration. We extend these data by hand-coding the missing retaliatory measures of China, the E.U. (including the United Kingdom), Canada, Mexico, Russia, India, and Turkey, harmonized to each country's national tariff-line schedule. Our sources are national gazettes and official announcements, and the WTO–IMF and PIIE trackers help identify the relevant events. From the legal texts, we extract the affected product codes and hand-code the tariff changes.

Of the deals in Table A.1 (China, the United Kingdom, the European Union, Japan, South Korea, Switzerland and Liechtenstein, and Taiwan), only those with China and the E.U. cut tariffs on U.S. goods during our sample. We hand-code these cuts, along with the unilateral cuts by Cambodia, Israel, and Zimbabwe.

Tariffs of all other importers come from the Global Tariff Database (Teti, 2024), held at 2021 rates.

A.5 Examples of U.S. Import Tariffs

This subsection traces the U.S. tariff on three HS6 products from 2018 to May 2026 to show how the instruments stack. Figures A.1, A.2, and A.3 plot the tariff in force on each date for imports from China, Canada, the European Union, and Costa Rica. Each step is one legal change, and the level is the normal tariff plus every additional tariff in force. Because each product is a single tariff line, step sizes equal the legal changes, except where USMCA compliance claims matter.

Tariffs on sunglasses (HS 9004.10) simply add up, because the product falls under neither Section 232 nor a safeguard. Imports from China paid the 2% MFN rate until Section 301 List 4A added 15 percentage points in September 2019, which fell to 7.5 in February 2020. In 2025, the fentanyl tariff under IEEPA added 10 points on February 4 and another 10 on March 4, and the Liberation Day tariff added 10 more on April 5. The reciprocal rate on China then rose to 84% on April 9 and 125% on April 10, taking the total to 154.5%. The Geneva deal of May 14 reset that rate to 10% and the total to 39.5%, and the cut in the fentanyl tariff from 20% to 10% on November 10 left 29.5%. On February 24, 2026, all tariffs imposed under IEEPA, both the fentanyl and the reciprocal tariffs, ended, and a 10% Section 122 surcharge took their place. The final tariff of 19.5% is the sum of the 2% MFN rate, 7.5% under Section 301, and 10% under Section 122.

The other partners faced the same instruments at different rates. The E.U. paid the 10% Liberation Day tariff from April 5, 2025, apart from a single day at its announced reciprocal rate of 20% on April 9. From August 7, its additional duty was set so that the total, including MFN, equals 15%, which added 3 points on sunglasses. Costa Rica enters duty-free under the CAFTA-DR trade agreement and was not among the countries given a higher rate in April, so it paid 10% from April 5 and 15% from August 7. Canada paid no reciprocal tariff, but faced the fentanyl tariff instead, at 25% from March 4, 2025, and 35% from August 1. USMCA-compliant exports are exempt from this tariff, but we observe none for sunglasses in May–December 2025, so the full rate applies. Non-compliant imports would in principle also pay the 2% MFN rate, which the series does not add. Once Section 122 replaced IEEPA, the E.U. stood at 12% and Canada and Costa Rica at

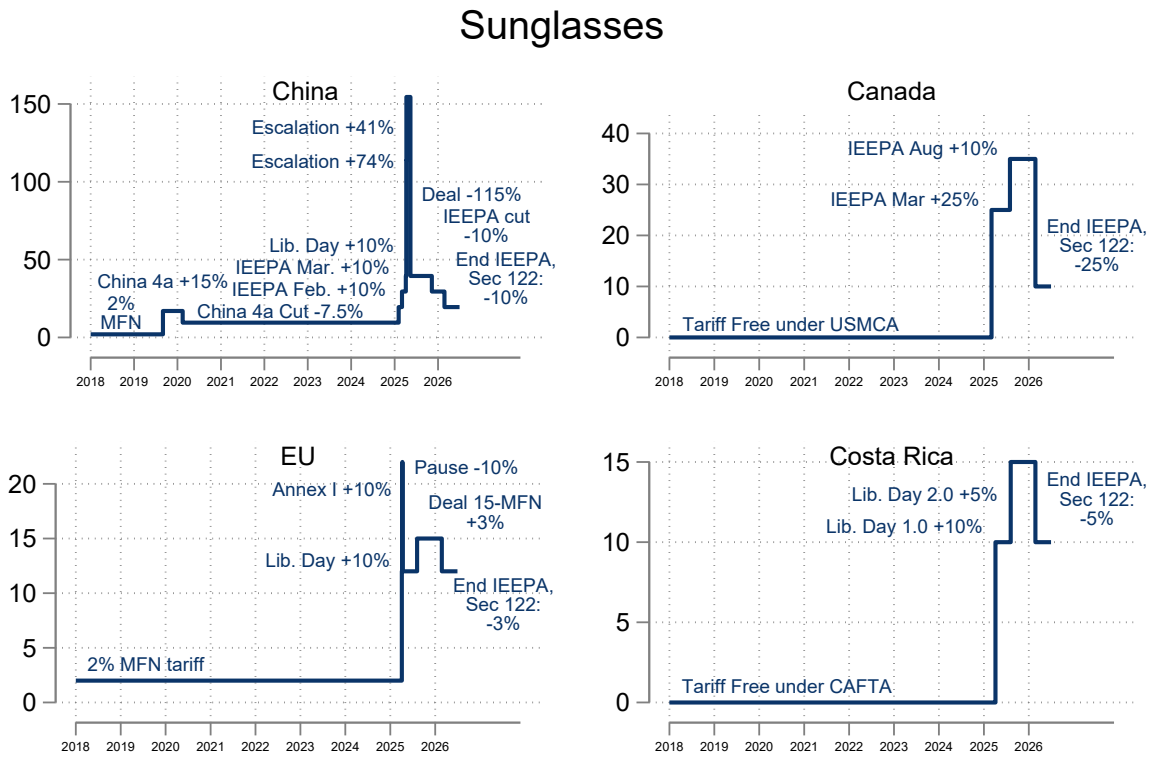


Figure A.1: U.S. import tariffs on sunglasses (HS 9004.10) across selected trading partners, 2018–May 2026. Panels report tariff paths separately for imports from China, Canada, the European Union, and Costa Rica.

10%.

Goods covered by Section 232 pay neither the reciprocal tariffs nor the Section 122 surcharge, but they still pay Section 301 and the fentanyl tariff. Cold-rolled steel coils (HS 7209.15) from China illustrate this. Section 232 imposed 25% in March 2018, and Section 301 added 15% in September 2019. That Section 301 rate fell to 7.5% in February 2020 before the Biden administration raised it by 17.5 points to 25% in September 2024, bringing the total to 50%. In 2025, the fentanyl tariff added 10 points in February and another 10 in March, and the increase of Section 232 to 50% on June 4 lifted the total to 95%. The April 2025 escalation against China left no trace, because Section 232 goods are exempt from the reciprocal tariffs. The cut in the fentanyl tariff in November 2025 and the end of IEEPA in February 2026 brought the tariff down to 75%.

For the E.U. and Costa Rica, Section 232 is the only instrument that reaches steel.

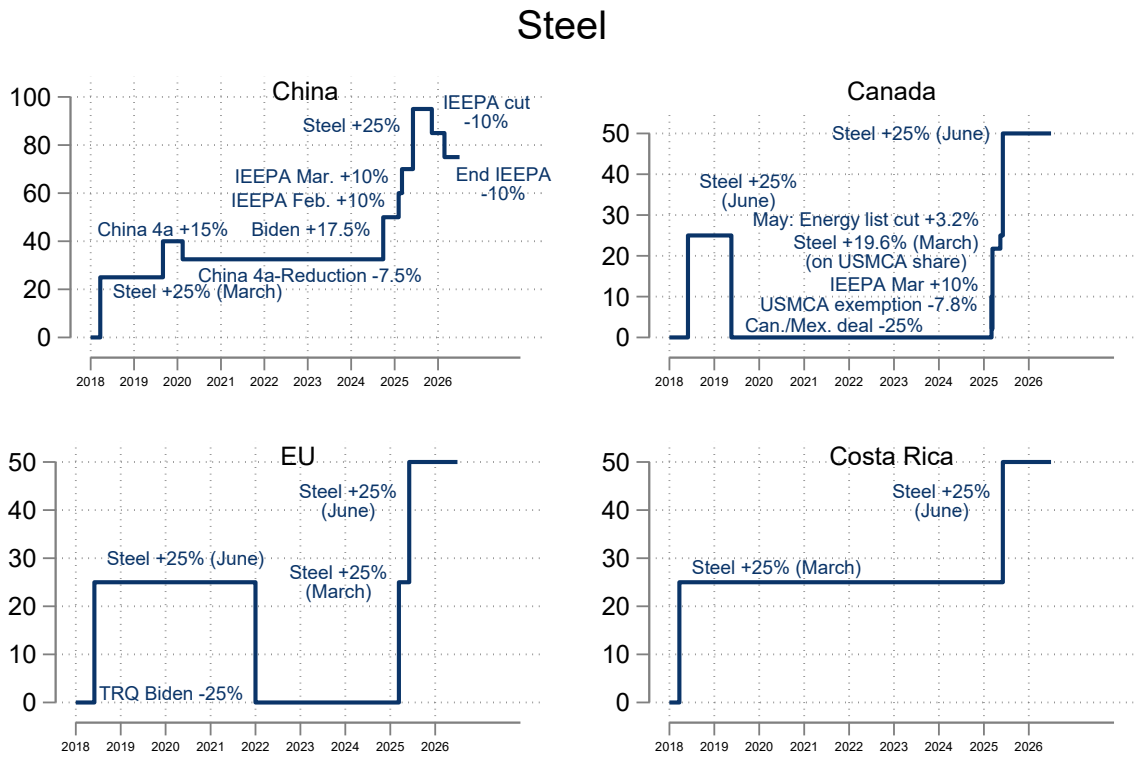


Figure A.2: U.S. import tariffs on cold-rolled steel coils (HS 7209.15: non-alloy steel, 0.5–1 mm thick) across selected trading partners, 2018–May 2026. Panels report tariff paths separately for imports from China, Canada, the European Union, and Costa Rica.

Costa Rica paid 25% from March 2018 and 50% from June 2025. The E.U. was exempt until June 2018 and then paid 25% until a tariff-rate quota replaced the duty in January 2022. We treat all E.U. steel as in-quota. The duty returned when the quota ended on March 12, 2025, and rose to 50% in June. The 15% cap in the E.U. deal does not apply to steel.

For Canada, Section 232 applied at 25% from June 2018 until agreements with Canada and Mexico lifted it in May 2019 (Proclamation 9894). The fentanyl tariff of March 4, 2025, reached this product at only 10% instead of 25%, because the product was on the energy list. USMCA-compliant goods became exempt on March 7, and with 78% of imports USMCA-compliant, the tariff fell to 2.2%. Section 232 returned on March 12 with no USMCA exemption. Executive Order 14289 gave the IEEPA tariff priority, so goods that owed it did not pay Section 232. The USMCA-compliant share therefore paid 25% under

Section 232, the remaining 22% paid 10% under IEEPA, and the average was 21.8%. When the product left the energy list on May 15, the IEEPA rate rose to 25%, and so did the average. On June 4, Proclamation 10947 reversed the priority and raised Section 232 to 50%, which then applied to all imports from Canada, regardless of USMCA compliance.

Chinese cars follow the same logic as Chinese steel. For small passenger cars (HS 8703.22), Section 301 added 25 points to the 2.5% MFN rate in July 2018, the fentanyl tariff added 20 points in two steps in early 2025, and Section 232 added 25 points on April 3, 2025, for a total of 72.5%. The November 2025 cut in the fentanyl tariffs and the end of IEEPA then lowered the total to 62.5% and 52.5%.

Canadian cars benefit from two USMCA provisions that protect the car industry. First, the 25% fentanyl tariff exempts USMCA-compliant goods, and almost all Canadian cars comply, so its effective rate is 0.01% from March 7, 2025. The figure omits the

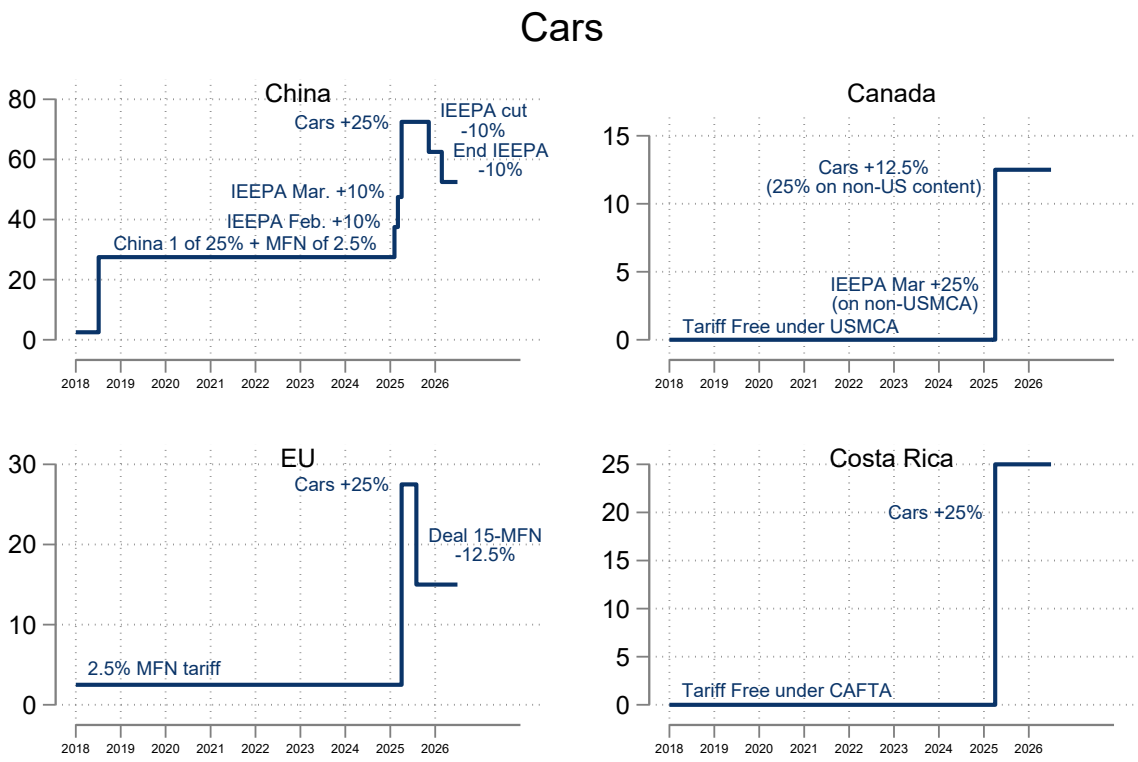


Figure A.3: U.S. import tariffs on passenger cars (HS 8703.22: gasoline cars with 1.0–1.5 liter engines), 2018–May 2026. Panels report tariff paths separately for imports from China, Canada, the European Union, and Costa Rica.

three days from March 4 to 6, when the full 25% applied. Second, Section 232 charges a USMCA-compliant car only on its non-U.S. content. Following industry estimates, we set U.S. content at 50%, so the 25% duty applies to half of the value and amounts to 12.5%, while other partners pay 25% on the full value. Executive Order 14289 places the car tariff ahead of IEEPA, so neither the rise of the Canadian IEEPA rate to 35% in August 2025 nor the end of IEEPA changes the tariff for cars.

The E.U. deal capped the tariff on cars at 15%, while Costa Rica, which has no such deal, still pays the full Section 232 duty. Costa Rica enters duty-free under CAFTA-DR, so its tariff rises from 0 to 25% in April 2025 and stays there. The E.U. starts at the 2.5% MFN rate and rises to 27.5% until the 15% cap, which includes MFN, takes effect on August 1, 2025, applied retroactively by a Federal Register notice of September 25. The deal thus cut the E.U. tariff on cars by 12.5 points, raised the tariff on sunglasses by 3 points, and left steel unchanged.

B Aggregating Tariff Rates

Our tariff data are at the HS6 product level, whereas the model is defined over the S sectors listed in Appendix C.1. This appendix describes how we map product-level tariff changes into the sector-level tariffs $t_{ij,s,t}$ in equation (2). Since the aggregation is the same in every period, we suppress the time subscript.

Let Ω_s denote the set of products in sector s. We assume that the sector-s good that region j buys from region i is a CES aggregate of products $\omega \in \Omega_s$,

$$q_{ij,s} = \left[\sum_{\omega \in \Omega_s} a_{ij,\omega}^{1/\eta_s} \, q_{ij,\omega}^{(\eta_s - 1)/\eta_s} \right]^{\eta_s/(\eta_s - 1)}, \tag{B1}$$

where $\eta_s > 0$ is the elasticity of substitution across products within an origin-sector category and $a_{ij,\omega}$ are demand shifters. The origin-sector composites are then aggregated across origins with elasticity σ_s, as in the main text. It is natural to assume $\eta_s \geq \sigma_s$, but the result below does not require it. The pre-tariff price of product ω is $c_{ij,s}\, z_{i,\omega}$, where $c_{ij,s} \equiv \tau_{ij,s} A_{i,s}^{-1} W_{i,s}^{\phi_{i,s}} \prod_k P_{i,k}^{\phi_{i,ks}}$ is the common unit cost in equation (2) and $z_{i,\omega}$ is a time-

invariant product-specific shifter. Letting $t_{ij,\omega}$ denote the ad valorem tariff on product ω, the price of the composite is then

$$p_{ij,s} = c_{ij,s} \left[\sum_{\omega \in \Omega_s} a_{ij,\omega} \left(z_{i,\omega}(1 + t_{ij,\omega}) \right)^{1-\eta_s} \right]^{1/(1-\eta_s)}. \tag{B2}$$

Consider a change in product-level tariffs from $t_{ij,\omega}$ to $t'_{ij,\omega}$. Because all products in an origin-sector category share the unit cost $c_{ij,s}$, relative pre-tariff prices within the category are unaffected by the shock, and the change in the sector-level tariff is

$$\frac{1 + t'_{ij,s}}{1 + t_{ij,s}} = \left[\sum_{\omega \in \Omega_s} \lambda_{ij,\omega|s} \left(\frac{1 + t'_{ij,\omega}}{1 + t_{ij,\omega}} \right)^{1-\eta_s} \right]^{1/(1-\eta_s)}, \tag{B3}$$

where $\lambda_{ij,\omega|s}$ is the initial share of product ω in region j's imports from region i in sector s. Equation (B3) requires only observed import shares, product-level tariff changes, and η_s; the shifters $a_{ij,\omega}$ and $z_{i,\omega}$ need not be identified. To first order, it coincides with the import-weighted average of product-level tariff changes, but unlike that average it accounts for the reallocation of expenditure away from products facing larger tariff increases. In the limit where $\eta_s \to 0$, it reduces to the import-weighted arithmetic average of $(1 + t'_{ij,\omega})/(1 + t_{ij,\omega})$.

The aggregated tariff is thus the uniform tariff that generates the same change in the price of the origin-sector composite as the detailed tariff schedule. In this respect it is related to the trade restrictiveness index of Anderson and Neary (1996), with the difference that it preserves the price of a given origin-sector composite rather than welfare in general equilibrium.

A single sector-level tariff cannot in general reproduce both this price effect and the tariff revenue of the detailed schedule, $\sum_{\omega \in \Omega_s} t_{ij,\omega}\, c_{ij,s} z_{i,\omega}\, q_{ij,\omega}$. Because tariff revenue in the model, given by equation (5), is computed using the aggregated tariff $t_{ij,s}$, it only approximates the revenue per dollar spent on the origin-sector category implied by the product-level tariffs, $\sum_{\omega \in \Omega_s} \lambda_{ij,\omega|s}\, t_{ij,\omega}/(1 + t_{ij,\omega})$. The approximation is exact when tariffs are uniform within the category, and the error is second order in their dispersion.

The choice of aggregator matters for the measured level of U.S. tariffs in 2025–26. Figure B.1 compares the nested CES aggregate with two common alternatives: the simple mean across tariff lines and the average weighted by fixed 2024 imports. The fixed-weight average measures what the base-year import basket would cost at the new tariffs and so assumes that buyers do not substitute at all; it is the limit of the CES aggregate as all elasticities go to zero and lies above it whenever tariff changes differ across products or origins. The CES aggregate starts from the same weights but lets buyers substitute toward products with smaller tariff increases, and therefore measures the cost of the tariffs to buyers who can adjust, but not costlessly. The simple mean ignores trade flows altogether and weights a minor tariff line as heavily as a major one.

Because the model is annual, we first average the daily tariffs in the GTD–U.S. Trade War within each year, weighting each day equally. For each product and trading partner, we compute the day-weighted average tariff for 2024, 2025, and 2026, where 2026 covers January 1 to May 31, so that a tariff in force for half of the year enters the annual average with half its rate. We then apply equation (B3) to the changes from 2024 to 2025 and from

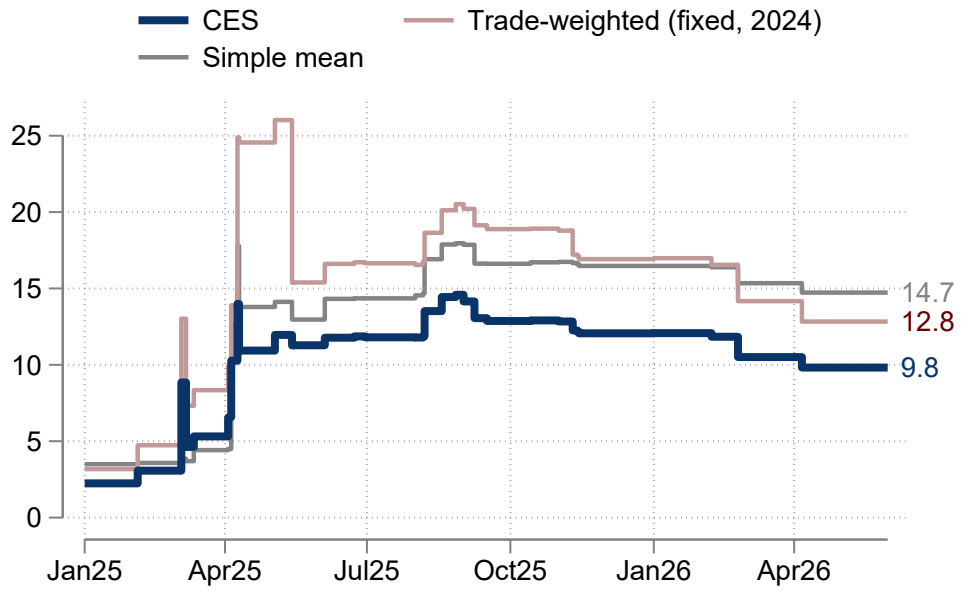


Figure B.1: U.S. import tariffs under three aggregation methods: simple mean, trade-weighted (fixed 2024 imports), and nested CES (2024 weights).

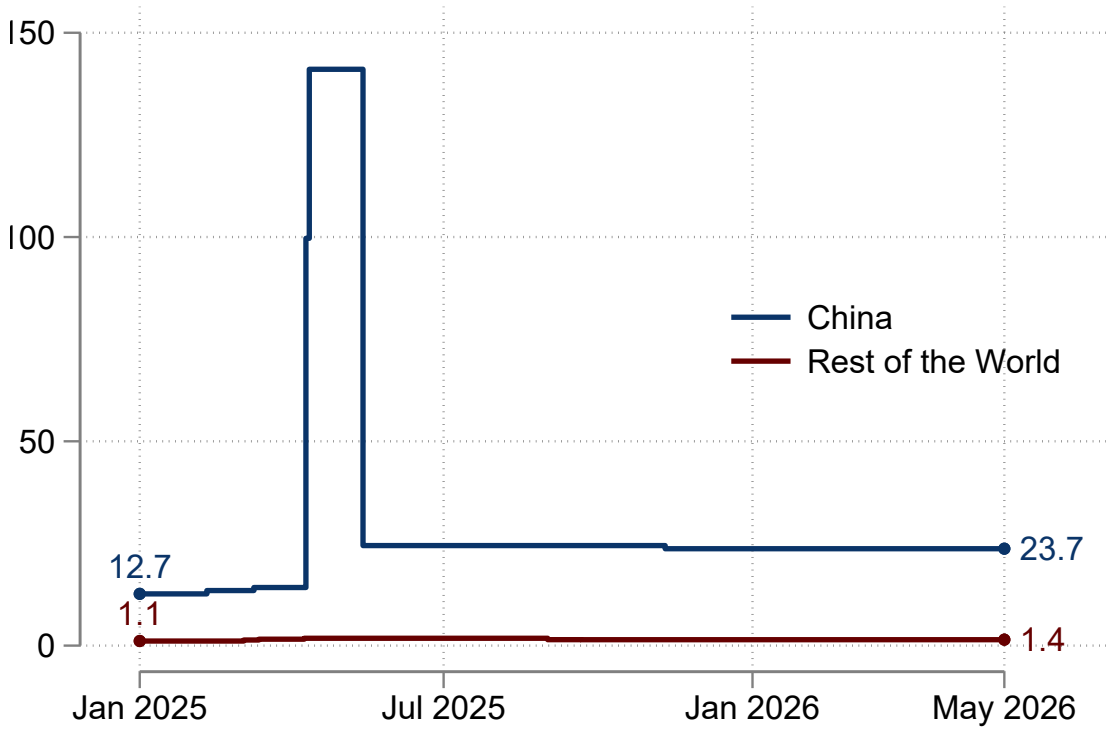


Figure B.2: CES-aggregated daily tariffs (in percent) faced by U.S. exports to China and to the rest of the world, January 1, 2025 to May 31, 2026. MFN and preferential tariff rates are from Teti (2024); Chinese retaliatory tariffs imposed in 2018–2021 are from Bown (2021). All other tariff changes are coded from partners' legal texts. Tariffs are aggregated using 2024 bilateral trade flows from CEPII's BACI (Gaulier and Zignago, 2010).

2025 to 2026, using 2024 trade weights, and proceed in the same way for the tariffs faced by U.S. exporters.

Our tariffs measure the rates that importers owe under the legal texts, not the ratio of duties to imports, a common alternative based on the calculated duty in U.S. Census Bureau import statistics (e.g., Fajgelbaum et al., 2020). The Census Bureau states that calculated duty does not necessarily reflect the duty actually paid and should be used with caution (U.S. Census Bureau, 2026). In addition, the ratio of duties to imports weights each tariff by contemporaneous imports, so it changes with the composition of imports as well as with tariffs.

C Additional Details on Data Construction

Our data construction (for all variables except tariffs) follows steps similar to those in RUV and UVZ, but for an extended list of countries. We use 2024 as the base year and draw on the most recent available data for each source, using the year closest to 2024. For the large majority of inputs, this corresponds to 2024 data; for the few sources whose latest release predates 2024 (most notably the OECD ICIO data, which are currently available through 2022; the Commodity Flow Survey and the Census of Agriculture, both from 2022; and the fisheries landings data, from 2020), we use the latest available vintage. Here we provide a summary of the main features of the data construction and refer the reader to Appendix B of RUV for further details on the general approach.

C.1 Sectors and Countries Used in the Quantitative Analysis

List of sectors. We use a total of 14 market sectors. The list includes 12 manufacturing sectors, one catch-all services sector (excluding utilities and public administration), and one agriculture sector. We follow RUV and UVZ in the selection of the 12 manufacturing sectors. These are (with ICIO sector codes from the 2025 edition): **1)** Food, beverage, and tobacco products (NAICS 311–312, ICIO sector C10T12); **2)** Textile, textile product mills, apparel, leather, and allied products (NAICS 313–316, ICIO sector C13T15); **3)** Wood products, paper, printing, and related support activities (NAICS 321–323, ICIO sectors C16, C17_18); **4)** Mining, petroleum and coal products (NAICS 211–213, 324, ICIO sectors B05, B06, B07, B08, B09, C19); **5)** Chemicals (NAICS 325, ICIO sectors C20, C21); **6)** Plastics and rubber products (NAICS 326, ICIO sector C22); **7)** Nonmetallic mineral products (NAICS 327, ICIO sector C23); **8)** Primary metal and fabricated metal products (NAICS 331–332, ICIO sectors C24A, C24B, C25); **9)** Machinery (NAICS 333, ICIO sector C28); **10)** Computer and electronic products, and electrical equipment and appliances (NAICS 334–335, ICIO sectors C26, C27); **11)** Transportation equipment (NAICS 336, ICIO sectors C29, C301, C302T309); **12)** Furniture and related products, and miscellaneous manufacturing (NAICS 337–339, ICIO sector C31T33). There is a **13)** Services sector, which includes Con-

struction (NAICS 23, ICIO sector F); Wholesale and retail trade (NAICS 42–45, ICIO sector G); Accommodation and food services (NAICS 721–722, ICIO sector I); Transport services (NAICS 481–488, ICIO sectors H49–H53); Information services (NAICS 511–518, ICIO sectors J58T60, J61, J62_63); Finance and insurance (NAICS 521–525, ICIO sector K); Real estate (NAICS 531–533, ICIO sector L); Education (NAICS 61, ICIO sector P); Health care (NAICS 621–624, ICIO sector Q); and Other services (NAICS 493, 541, 55, 561, 562, 711–713, 811–814, ICIO sectors M, N, R, S, T). Finally, there is a **14)** Agriculture sector (NAICS 111–115, ICIO sectors A01, A02, A03).

List of countries. We use data for 50 U.S. states, 59 other countries, and a constructed rest of the world (for a total of 110 regions). The list of countries is: Argentina (ARG), Australia (AUS), Austria (AUT), Belgium (BEL), Brazil (BRA), Bulgaria (BGR), Cambodia (KHM), Canada (CAN), Chile (CHL), China (CHN, including Hong Kong), Colombia (COL), Costa Rica (CRI), Croatia (HRV), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), India (IND), Indonesia (IDN), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Kazakhstan (KAZ), Laos (LAO), Latvia (LVA), Lithuania (LTU), Malaysia (MYS), Mexico (MEX), Morocco (MAR), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Peru (PER), Philippines (PHL), Poland (POL), Portugal (PRT), Romania (ROU), Russia (RUS), Saudi Arabia (SAU), Singapore (SGP), Slovakia (SVK), Slovenia (SVN), South Africa (ZAF), South Korea (KOR), Spain (ESP), Sweden (SWE), Switzerland (CHE), Taiwan (TWN), Thailand (THA), Tunisia (TUN), Turkey (TUR), United Kingdom (GBR), Vietnam (VNM), and the rest of the world (RoW).

C.2 Data for the Construction of the Bilateral Trade Flows

For bilateral trade between countries, we use the 2025 edition of the OECD's Inter-Country Input-Output (ICIO) Database. For data on bilateral trade in manufacturing between U.S. states, we combine the 2022 edition of the Commodity Flow Survey (CFS) with the ICIO database. The CFS records shipments between U.S. states for 43 commodities classified according to the Standard Classification of Transported Goods (SCTG). We

follow Caliendo et al. (2019) and Stumpner (2019) and use CFS tables that cross-tabulate establishments by their assigned NAICS codes against SCTG commodities shipped by establishments within each NAICS code.

For data on bilateral trade in manufacturing and agriculture between U.S. states and the other countries, we follow RUV and obtain sector-level imports and exports between the 50 U.S. states and these countries from the Import and Export Merchandise Trade Statistics database, which is compiled by the U.S. Census Bureau.

For data on services and agriculture expenditure and production, we use U.S. state-level services GDP from the Regional Economic Accounts of the Bureau of Economic Analysis (BEA), U.S. state-level services expenditure from the Personal Consumption Expenditures (PCE) database of the BEA and total production and expenditure in services from ICIO (for other countries). We also use the 2022 edition of the Census of Agriculture and the 2020 edition of the National Marine Fisheries Service Census to get state-level production data on crops, livestock, and seafood. For other countries, we compute production and expenditure in agriculture from ICIO.

For data on sectoral and regional value-added shares in gross output, we use data from the Bureau of Economic Analysis (BEA) by subtracting taxes net of subsidies from GDP data. In the cases when gross output was smaller than value added, we constrain value added to be equal to gross output (43 of the 700 state-sector cells). For other countries, we obtain the share of value added in gross output by computing value added as gross output minus intermediate purchases in ICIO. We set non-positive value-added shares to 0.01 (this binds only for mining in France and Lithuania out of all the sector-region pairs).

C.3 Data on Employment and Labor Flows

For other countries, we take data on employment by country and sector from the WIOD Socio-Economic Accounts (SEA) and the International Labour Organization (ILO). For U.S. states, we use sector-level employment from the Quarterly Census of Employment and Wages (QCEW) of the Bureau of Labor Statistics (BLS) and non-participation

from the BLS Local Area Unemployment Statistics (LAUS). As in RUV and UVZ, we keep only CPS and ACS observations of people aged 25 to 65; we use these observations only to compute the mobility shares, while labor force participation comes from the sources above. Let $L_{ji,sk}$ be the number of workers who move from state j and sector s to state i and sector k between two periods. We combine the CPS, the ACS, and the IRS state-to-state migration data to compute the mobility shares $\mu_{ji,sk}$. The CPS provides flows between sectors within a state, but no moves across states.[40] The ACS provides moves across states by destination sector, but not the sector of origin. The IRS data provide the numbers of people staying in each state and moving between states, regardless of sector. We combine them as follows:

$$\begin{aligned} L_{jj,sk} &= L^{\text{IRS}}_{jj,\#\#} \times \frac{L^{\text{CPS}}_{jj,sk}}{\sum_{s'} \sum_{k'} L^{\text{CPS}}_{jj,s'k'}}, \\ L_{ji,sk} &= \frac{L^{\text{CPS}}_{ii,sk}}{\sum_{s'} L^{\text{CPS}}_{ii,s'k}} \times L^{\text{IRS}}_{ji,\#\#} \times \frac{\sum_{i'} L^{\text{ACS}}_{ji',?k}}{\sum_{i'} \sum_{k'} L^{\text{ACS}}_{ji',?k'}} \quad \text{for } j \neq i, \\ \mu_{ji,sk} &= \frac{L_{ji,sk}}{\sum_{i'} \sum_{k'} L_{ji',sk'}}, \end{aligned}$$

where # denotes a sum over sectors and ? an unknown sector of origin. We abstract from international migration. Since the flows $L_{ji,sk}$ do not imply a steady state, we use the shares $\tilde{\mu}_{ji,sk}$ minimizing the sum of squared differences between the new shares and the original ones subject to (1) 2024 labor supply being stationary, $\ell_{i,k,0} = \sum_j \sum_s \tilde{\mu}_{ji,sk} \, \ell_{j,s,0}$; (2) the new shares being non-negative and summing to one for each origin; (3) shares that are originally zero remaining zero; and (4) each sector-state's share of workers staying in its own state being unchanged. The change in the flows implied by this procedure is very small: the correlation between the original and the new shares is 0.998.

[40] To record annual changes, we match each person's CPS interviews 12 months apart. To avoid noise in our sample, we pool the transitions ending in 2022, 2023, and 2024.

D Model Details and Equilibrium in Changes

Section 3 presents the full model and its equilibrium in levels. This appendix shows how we solve for revenues and tariff revenues received in each period (Appendix D.1), presents the equilibrium conditions in changes, together with the data they are conditioned on, the solution algorithm, and the welfare formula (Appendix D.2), and discusses the allocation of deficits (Appendix D.3).

D.1 Solving for Revenues and Tariff Revenues Received

Given wages and employment, equations (4)–(6) and (8) determine tariff revenues received and collected, expenditures, and revenues in each period. In this appendix, we write each of these equations in matrix notation and then combine them to solve for revenues in closed form. Since all variables refer to the same period, we omit the time subscript t in this subsection. Let R and EXP be vectors of length $I \cdot S$ made up of S sectoral vectors, the s-th of which contains $R_{j,s}$ and $EXP_{j,s}$, respectively, as its j-th entry; we refer to this entry as entry (j,s). Similarly, let TRR, TRC, and Y be vectors of length I that contain as their j-th entries TRR_j, TRC_j, and labor income plus deficits,

$$Y_j = \sum_{s=1}^{S} W_{j,s} L_{j,s} + D_j,$$

respectively.

Expenditure, equation (6), becomes

$$EXP \quad = \quad A\left(Y + TRR\right) + \Phi R, \tag{D1}$$

where A is an $(I \cdot S) \times I$ matrix with $\alpha_{j,s}$ in row (j,s) and column j and zeros elsewhere, so that A distributes the final expenditure of each region across sectors, and Φ is an $(I \cdot S) \times (I \cdot S)$ matrix with $\phi_{j,sk}$ in row (j,s) and column (j,k) and zeros elsewhere, so that ΦR is

the vector of intermediate demand. Tariff revenue collected, equation (5), becomes

$$TRC \quad = \quad \Psi \, EXP, \tag{D2}$$

where Ψ is an $I \times (I \cdot S)$ matrix with $\psi_{j,s}$ in row j and column (j,s) and zeros elsewhere. Tariff revenue received, equation (4), becomes

$$TRR \quad = \quad \Theta \, TRC, \tag{D3}$$

where Θ is an $I \times I$ matrix with θ_{ji} in row i and column j. In turn, the market-clearing condition (8) becomes

$$R \quad = \quad \tilde{\Lambda} \, EXP, \tag{D4}$$

where $\tilde{\Lambda}$ is an $(I \cdot S) \times (I \cdot S)$ matrix with $\lambda_{ij,s}/(1 + t_{ij,s})$ in row (i,s) and column (j,s) and zeros elsewhere.

Combining equations (D1)–(D3) gives the matrix version of equation (7),

$$TRR \quad = \quad \Theta\Psi A \, TRR + \Theta\Psi \left[AY + \Phi R \right],$$

so we can solve for TRR as

$$TRR \quad = \quad (\text{eye}(I) - \Theta\Psi A)^{-1} \Theta\Psi \left[AY + \Phi R \right],$$

where $\text{eye}(I)$ is an identity matrix of size I (i.e., the number of regions). This inverse exists, and equals $\text{eye}(I) + \Theta\Psi A + (\Theta\Psi A)^2 + \ldots$, because each column j of $\Theta\Psi A$ sums to $\sum_s \psi_{j,s}\alpha_{j,s} < 1$, the share of region j's final expenditure that is collected as tariff revenue.

To solve for R, we use the fact that $(\text{eye}(I) - M)^{-1} = \text{eye}(I) + (\text{eye}(I) - M)^{-1} M$ for any $I \times I$ matrix M such that $\text{eye}(I) - M$ is invertible, which follows from writing out the product $(\text{eye}(I) - M)^{-1}(\text{eye}(I) - M) = \text{eye}(I)$ and rearranging. Adding Y to both sides of the expression for TRR and applying this fact with $M = \Theta\Psi A$, total income inclusive

of tariff revenue received is

$$Y + TRR = (\text{eye}(I) - \Theta\Psi A)^{-1} (Y + \Theta\Psi\Phi R). \tag{D5}$$

The matrix $(\text{eye}(I) - \Theta\Psi A)^{-1}$ thus acts as a tariff-revenue multiplier: tariff revenue received raises income, higher income raises final expenditure, part of which is collected as tariff revenue and redistributed again, and so on. Introducing equations (D1) and (D5) into equation (D4), we get

$$\begin{aligned} R &= \tilde{\Lambda} A (\text{eye}(I) - \Theta\Psi A)^{-1} Y \\ &+ \tilde{\Lambda} \left[A (\text{eye}(I) - \Theta\Psi A)^{-1} \Theta\Psi + \text{eye}(I \cdot S) \right] \Phi R, \end{aligned}$$

where $\text{eye}(I \cdot S)$ is an identity matrix of size $I \cdot S$. So we can finally solve for the revenue vector using the following matrix expression:

$$\begin{aligned} R &= \left[\text{eye}(I \cdot S) - \tilde{\Lambda} \left[A (\text{eye}(I) - \Theta\Psi A)^{-1} \Theta\Psi + \text{eye}(I \cdot S) \right] \Phi \right]^{-1} \\ &\cdot \tilde{\Lambda} A (\text{eye}(I) - \Theta\Psi A)^{-1} Y. \end{aligned} \tag{D6}$$

While this is a massive and notationally cumbersome matrix equation, it is linear and allows us to solve our complex trade and migration model with an input-output structure and flexible tariff revenue redistribution in a very computationally efficient manner.

D.2 Equilibrium Conditions in Changes

Notation and timing For any variable x, let $\dot{x}_t \equiv x_t / x_{t-1}$ denote its time change in the baseline economy, without the tariff shock, and $\dot{x}'_t \equiv x'_t / x'_{t-1}$ its time change in the counterfactual economy, with the shock, where a prime denotes the counterfactual economy. Following Caliendo et al. (2019) and RUV, we define $\hat{x}_t \equiv \dot{x}'_t / \dot{x}_t$, so that $\dot{x}'_t = \hat{x}_t \dot{x}_t$. Period 0 is the base year (2024), which is common to both economies, and the shock is revealed unexpectedly at the beginning of period 1 (2025). Since agents choose where to be in period 1 during period 0, before the shock is known, labor supply in period 1 is also common to

both economies, $\ell'_{i,s,1} = \ell_{i,s,1}$. Technology, iceberg trade costs, mobility costs, and deficits as a share of world nominal GDP are the same in both economies, which differ only in their paths of tariffs. We write $\xi_{ij,s,t} \equiv 1 + t_{ij,s,t}$ for the gross tariff, $u_{i,s,t} \equiv \exp(V_{i,s,t})$, and $INC_{i,s,t} \equiv W_{i,s,t}L_{i,s,t} + \frac{\ell_{i,s,t}}{\sum_{k=1}^{S}\ell_{i,k,t}} TRR_{i,t}$ for the total income of market (i,s), the numerator of equation (13).

Temporary equilibrium We write the price and trade-share equations of the counterfactual economy, equations (2)–(3), in time changes and divide them by their baseline counterparts. The unobserved levels of technology and iceberg trade costs drop out, and we obtain, for $t \geq 1$,

$$\hat{P}_{j,s,t}^{1-\sigma_s} = \sum_{i=1}^{I} \lambda'_{ij,s,t-1}\dot{\lambda}_{ij,s,t} \left(\hat{\xi}_{ij,s,t}\hat{W}_{i,s,t}^{\phi_{i,s}} \prod_{k=1}^{S} \hat{P}_{i,k,t}^{\phi_{i,ks}} \right)^{1-\sigma_s}, \tag{D7}$$

$$\lambda'_{ij,s,t} = \lambda'_{ij,s,t-1}\dot{\lambda}_{ij,s,t} \left(\hat{\xi}_{ij,s,t}\hat{W}_{i,s,t}^{\phi_{i,s}} \prod_{k=1}^{S} \hat{P}_{i,k,t}^{\phi_{i,ks}} \right)^{1-\sigma_s} \hat{P}_{j,s,t}^{\sigma_s-1}. \tag{D8}$$

Unlike prices, tariff revenue depends on the level of tariffs and not only on their changes. Hence, the tariff revenue and market-clearing conditions (7)–(8) and labor demand (9) are imposed in levels in the counterfactual economy: they are evaluated at the counterfactual trade shares $\lambda'_{ij,s,t}$, the counterfactual tariffs $t'_{ij,s,t}$ (which determine $\psi'_{j,s,t}$ and the fraction $1/(1 + t'_{ij,s,t})$ of expenditure received by sellers), and the counterfactual wage bills

$$W'_{i,s,t}L'_{i,s,t} = \hat{W}_{i,s,t}\hat{L}_{i,s,t}\dot{W}_{i,s,t}\dot{L}_{i,s,t}W'_{i,s,t-1}L'_{i,s,t-1}. \tag{D9}$$

Since $W'_{i,s,t}/W'_{i,s,t-1} = \hat{W}_{i,s,t}\dot{W}_{i,s,t}$, the DNWR (10), the employment constraint (11), and the complementary slackness condition (12) become

$$\begin{aligned} &\hat{W}_{i,s,t}\dot{W}_{i,s,t} \geq \delta_{i,s}, \qquad L'_{i,s,t} \leq \ell'_{i,s,t}, \\ &\left(\ell'_{i,s,t} - L'_{i,s,t}\right)\left(\hat{W}_{i,s,t}\dot{W}_{i,s,t} - \delta_{i,s}\right) = 0, \end{aligned} \tag{D10}$$

with $L'_{i,s,t} = \hat{L}_{i,s,t}\dot{L}_{i,s,t}L'_{i,s,t-1}$. Letting $y'_{i,s,t-1}$ denote the share of (i,s) in world nominal GDP at $t-1$ in the counterfactual economy, the nominal anchor (18) becomes

$$\sum_{i=1}^{I}\sum_{s=1}^{S} y'_{i,s,t-1}\hat{W}_{i,s,t}\hat{L}_{i,s,t}\dot{W}_{i,s,t}\dot{L}_{i,s,t} = 1+\gamma. \tag{D11}$$

Given labor supply $\ell'_{i,s,t}$, the temporary equilibrium of period t in the counterfactual economy is determined by equations (D7)–(D11), together with the tariff revenue and market-clearing conditions in levels.

Labor supply and mobility By equation (13), the hat of real consumption in market sector $s > 0$ is

$$\hat{c}_{i,s,t} = \frac{\left(INC'_{i,s,t}/INC'_{i,s,t-1}\right) / \left(INC_{i,s,t}/INC_{i,s,t-1}\right)}{\hat{P}_{i,t}\,\hat{\ell}_{i,s,t}}, \qquad \hat{P}_{i,t} = \prod_{s=1}^{S}\hat{P}_{i,s,t}^{\alpha_{i,s}}, \tag{D12}$$

while $\hat{c}_{i,0,t} = 1$ for home production. Because tariff revenue enters income additively, the income hat is computed from the levels of income in both economies rather than as a product of hats. For $t \geq 2$, define

$$\Omega_{ji,s,t} \equiv \sum_{h=0}^{S} \mu'_{ji,sh|i,t-1}\,\dot{\mu}_{ji,sh|i,t}\,\hat{u}_{i,h,t+1}^{\beta/\nu}.$$

When we divide equations (14)–(16) of the counterfactual economy, written in time changes, by their baseline counterparts, the mobility costs drop out, and we obtain (see RUV, Appendix A.5)

$$\hat{u}_{j,s,t} = \hat{c}_{j,s,t}\left(\sum_{i=1}^{I}\mu'_{ji,s\#,t-1}\,\dot{\mu}_{ji,s\#,t}\,\Omega_{ji,s,t}^{\nu/\kappa}\right)^{\kappa}, \tag{D13}$$

$$\mu'_{ji,sk|i,t} = \frac{\mu'_{ji,sk|i,t-1}\,\dot{\mu}_{ji,sk|i,t}\,\hat{u}_{i,k,t+1}^{\beta/\nu}}{\Omega_{ji,s,t}}, \tag{D14}$$

$$\mu'_{ji,s\#,t} = \frac{\mu'_{ji,s\#,t-1}\,\dot{\mu}_{ji,s\#,t}\,\Omega_{ji,s,t}^{\nu/\kappa}}{\sum_{m=1}^{I}\mu'_{jm,s\#,t-1}\,\dot{\mu}_{jm,s\#,t}\,\Omega_{jm,s,t}^{\nu/\kappa}}. \tag{D15}$$

Period 1 is special because the shock is unexpected: the period-0 mobility choices were made under the expectations of the baseline economy, so the counterfactual changes between periods 0 and 1 cannot be written in terms of the period-0 counterfactual shares. Following RUV, we obtain the period-1 equations by replacing, in equations (D13)–(D15) and in $\Omega_{ji,s,1}$, the product $\mu'_{ji,sh|i,0}\,\dot{\mu}_{ji,sh|i,1}$ by $\mu_{ji,sh|i,1}\,\hat{u}_{i,h,1}^{\beta/\nu}$ and the product $\mu'_{ji,s\#,0}\,\dot{\mu}_{ji,s\#,1}$ by $\mu_{ji,s\#,1}$, where $\mu_{ji,sh|i,1}$ and $\mu_{ji,s\#,1}$ are the period-1 shares of the baseline economy. Since $\hat{u}_{i,h,1}$ then appears on both sides of the period-1 value equation, period 1 is a fixed point of its own. Finally, labor supply evolves in levels according to the counterfactual version of equation (17),

$$\ell'_{i,k,t+1} = \sum_{j=1}^{I}\sum_{s=0}^{S} \mu'_{ji,sk|i,t}\,\mu'_{ji,s\#,t}\,\ell'_{j,s,t}, \qquad t \geq 1, \tag{D16}$$

starting from $\ell'_{i,s,1} = \ell_{i,s,1}$.

Data and baseline The equations above require the baseline time changes and the base-year values of the levels that appear in them, which are common to both economies. Let $X_{ij,s,0}$ denote the base-year value of sales of sector-s goods from region i to region j, net of tariffs, and $t_{ij,s,0}$ the base-year tariff. Then the base-year trade shares, revenues, wage bills, tariff revenue collected, and deficits are

$$\begin{aligned}
\lambda_{ij,s,0} &= \frac{(1+t_{ij,s,0})X_{ij,s,0}}{\sum_{m=1}^{I}(1+t_{mj,s,0})X_{mj,s,0}}, \qquad R_{i,s,0} = \sum_{j=1}^{I} X_{ij,s,0}, \qquad W_{i,s,0}L_{i,s,0} = \phi_{i,s}R_{i,s,0}, \\
TRC_{j,0} &= \sum_{s=1}^{S}\sum_{i=1}^{I} t_{ij,s,0}X_{ij,s,0}, \qquad D_{j,0} = \sum_{s=1}^{S}\sum_{i=1}^{I} X_{ij,s,0} - \sum_{s=1}^{S}\sum_{i=1}^{I} X_{ji,s,0} + TRC_{j,0} - TRR_{j,0},
\end{aligned}$$

where tariff revenue received follows from equation (4). The expenditure shares $\alpha_{j,s}$ are the sectoral shares of final expenditure, $\sum_i (1+t_{ij,s,0})X_{ij,s,0} - \sum_k \phi_{j,sk}R_{j,k,0}$. Labor shares and input-output shares come from value-added and input-output data, labor supply $\ell_{i,s,0}$ from employment data, and the base-year mobility shares from data on worker flows across sectors and U.S. states (see Section 4 and Appendix C). We assume that there is no unemployment in the base year, so $L_{i,s,0} = \ell_{i,s,0}$.

With constant fundamentals, these data constitute a steady state of the model: the base-year mobility shares are constructed so that base-year labor supply is stationary, $\ell_{i,k,0} = \sum_j \sum_s \mu_{ji,sk|i,0}\, \mu_{ji,s\#,0}\, \ell_{j,s,0}$, and in the baseline economy the base-year allocation repeats itself in every period, with all nominal variables growing at the rate γ. Hence, the baseline time changes are equal to one for all variables except nominal ones, whose baseline time change is $1 + \gamma$, and the hats of real variables coincide with their time changes in the counterfactual economy. In the baseline economy, tariffs stay at their base-year levels, while in the counterfactual economy they follow the path of the shock described in Section 4.2.

The DNWR in the quantitative implementation In our quantitative implementation, the DNWR applies in the manufacturing sectors of U.S. states, where $\delta_{i,s} = \delta$. Other countries have a flexible exchange rate with respect to the U.S. dollar, so the DNWR never binds for them,[41] and, as in Section 6.2 of RUV, wages are flexible in services and agriculture. We capture these cases by setting $\delta_{i,s}$ low enough that the constraint never binds.

Solution algorithm The equilibrium conditions in changes, equations (D7)–(D16), determine the counterfactual economy given the baseline economy and the paths of tariffs in both economies. We solve them with the nested fixed-point algorithm of RUV. We start from a guess for the path of value hats $\hat{u}_{i,s,t}$. Given this guess, we compute the mobility shares and labor supply forward in time using equations (D14)–(D16). Given labor supply, we solve the temporary equilibrium of each period, using a fast algorithm in the spirit of Alvarez and Lucas (2007) to deal with the DNWR and its complementary slackness condition. Given the temporary equilibria, we update the value hats backward in time using equation (D13), starting from $\hat{u}_{i,s,T} = 1$ in a distant period T (we use $T = 80$), by which time the time changes of the counterfactual economy have converged to those of the baseline. We iterate until the path of value hats converges.

[41] Changing to a specification where other countries have fixed exchange rates with respect to the United States has small implications for U.S. outcomes.

Welfare Normalizing the cost of staying in the same market, $\varphi_{jj,ss}$, to zero, equations (14)–(16) imply

$$V_{j,s,t} = \ln(c_{j,s,t}) - \nu \ln(\mu_{jj,ss|j,t}) - \kappa \ln(\mu_{jj,s\#,t}) + \gamma_e \kappa + \beta V_{j,s,t+1}. \tag{D17}$$

Expected lifetime utility is the discounted sum of log consumption, corrected by the probabilities of staying in the same sector and region, which capture the option value of moving.

Since a permanent change of $\ln \zeta_{j,s}$ in log consumption raises expected lifetime utility by $\ln \zeta_{j,s}/(1-\beta)$, we have that

$$\ln \zeta_{j,s} = (1-\beta)\left(V'_{j,s,0} - V_{j,s,0}\right), \tag{D18}$$

where $V'_{j,s,0}$ and $V_{j,s,0}$ are the expected lifetime utilities in the base year in the counterfactual and baseline economies, respectively.

Iterating equation (D17) forward in both economies and using the fact that period-0 variables are common to both economies, the welfare measure (D18) becomes, as in RUV,

$$\ln \zeta_{j,s} = \sum_{t=1}^{\infty} \beta^t \ln\left(\frac{\hat{c}_{j,s,t}}{\hat{\mu}^{\nu}_{jj,ss|j,t}\,\hat{\mu}^{\kappa}_{jj,s\#,t}}\right). \tag{D19}$$

D.3 Deficit/Surplus Allocation

As described briefly in footnote 17, when considering welfare, we do not include the proceeds from the deficit/surplus that a region might have. To be more explicit, the total final expenditure of a region that enters equation (6) is given by:

$$FEXP_{j,t} \;=\; \sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + D_{j,t} + TRR_{j,t},$$

while the total income that we incorporate in the nominal per-capita consumption level resulting from participating in market sector s (i.e., $P_{j,t} c_{j,s,t}$), described in equation (13),

once added across all agents in the market sectors of a region, is given by:

$$TINC_{j,t} = \sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + TRR_{j,t}.$$

This makes it clear that, as in Costinot and Rodriguez-Clare (2014), we avoid attributing a positive direct gain to the foreign transfer (i.e., the deficit/surplus). Taking into consideration the direct gain from the deficits would risk treating them as a gift and assuming away their future costs. However, it might not be clear what "it means" to have agents spend some amount of money (so that it enters the equilibrium conditions) but not "enjoy" the consumption from this expenditure (so that it does not enter the welfare measure). In this appendix section, we provide a more rigorous characterization that still delivers exactly the same equilibrium conditions as our presentation in the main text.

Imagine that each region has a fixed number of a new class of agents called "capitalists", who do not belong to any given sector, do not work, can never move regions, and have the same Cobb–Douglas preferences across sectors as the workers in their region. Furthermore, imagine that there is a tax $\aleph_j$ in region j that is charged on the income of workers, and whose revenue is given to the "capitalists". The proceeds/debt from the deficits/surpluses are also given to the capitalists. In this case, the total income of workers is

$$TINCW_{j,t} = (1 - \aleph_j) \left(\sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + TRR_{j,t} \right),$$

while the total income of capitalists is

$$TINCC_{j,t} = \aleph_j \left(\sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + TRR_{j,t} \right) + D_{j,t}.$$

Therefore, the total income of region j is given by

$$TINCE_{j,t} = \sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + TRR_{j,t} + D_{j,t},$$

which is the same as the total final expenditure that enters the market-clearing conditions in our main text. Notice that we can always make sure that the income of capitalists is positive by choosing the appropriate $\aleph_j$ for each region. Finally, when computing welfare in region i, we only consider the welfare of workers (the mobile population), and we ignore the welfare of "capitalists", who are immobile. Something similar to this is done in Caliendo et al. (2019) with "rentiers". With this setup, the real per-capita consumption level $c_{i,s,t}$ resulting from participating in market sector s would be given by

$$c_{i,s,t} = (1 - \aleph_i) \frac{W_{i,s,t} L_{i,s,t} + \frac{\ell_{i,s,t}}{\sum_{k=1}^{S} \ell_{i,k,t}} TRR_{i,t}}{\ell_{i,s,t} P_{i,t}},$$

rather than the expression given in equation (13). Still, the $(1 - \aleph_i)$ term would disappear when we compute $\dot{c}_{i,s,t}$ or $\hat{c}_{i,s,t}$, leaving our equilibrium equations from the main text unchanged.

E Why Does Agricultural Participation Fall?

Participation in agriculture falls in our baseline even though U.S. import tariffs also rose on agricultural goods. The reason is that agriculture received much less protection than manufacturing and, at the same time, bore a disproportionate share of the limited retaliation against U.S. exports. On the import side, weighting by 2024 imports, the U.S. tariff on agricultural goods rose by about 6 percentage points in 2025, half the increase of about 12 points in manufacturing, in large part because agricultural imports from Canada and Mexico were mostly exempt under the USMCA. Imports are also a smaller share of the U.S. market in agriculture (about 10% of U.S. spending on agricultural goods, compared with 25% in manufacturing), so a given tariff increase shifts less demand toward U.S. producers. At the same time, higher U.S. import tariffs raise U.S. wages and prices relative to those in the rest of the world, which makes all U.S. exporters less competitive abroad. In manufacturing, the gain in the domestic market far outweighs this loss. In agriculture, the small gain at home only roughly offsets it, so agriculture, unlike manu-

facturing, does not expand.

On the export side, retaliation was limited (Section 4.2), but what there was fell heavily on agriculture, and almost entirely through China. China is the largest market for U.S. agricultural exports, buying about a third of them, and it raised its tariff on U.S. agricultural goods from about 15% in 2024 to about 40% in 2025, a larger increase than on U.S. manufactures. Canada's retaliation, by contrast, fell mostly on steel, aluminum, and autos and barely touched agriculture, and no other partner retaliated. As a result, agriculture accounts for about 6% of U.S. goods exports but for almost a fifth of the increase in duties on U.S. exports in 2025 (evaluated at 2024 trade flows). Losing a large part of its largest export market is a sizable shock for a small sector, and it drives most of the decline in agricultural participation: if China had kept its tariff on U.S. agricultural goods at its 2024 level, with all other tariff changes as in the baseline, participation in agriculture would fall by only about 0.2% at its 2027 trough instead of 1.1%, and real value added in agriculture would be essentially unchanged. Agriculture therefore contracts mainly because of Chinese retaliation, and its weak protection leaves nothing to offset it.

F Why Does Mexico Lose So Much?

Mexico is among the countries that lose the most in our baseline, even though it was not subject to the reciprocal tariffs, the USMCA exempted most of its exports from the fentanyl tariffs and the Section 122 surcharge, and the much larger increase in U.S. tariffs on China should divert U.S. demand toward Mexican goods. Two features explain this result. First, Mexico is very exposed to the U.S. market: it sells about a sixth of its total output to the United States, compared with about 1% for China. Second, the USMCA offers only partial protection against the Section 232 tariffs, which fell precisely on the goods that Mexico sells most to the United States. These tariffs apply to steel, aluminum, and copper and to many metal-intensive products made from them, such as refrigerators and air conditioners, as well as to vehicles and auto parts that do not qualify under the USMCA. Qualifying vehicles pay them on their non-U.S. content, while

qualifying parts are exempt. Vehicles and auto parts alone account for more than a quarter of Mexico's exports to the United States, and since Mexico, unlike Japan, South Korea, or the European Union, has no deal capping the Section 232 tariffs on autos, Mexican cars faced a larger tariff increase than Japanese, Korean, or German cars by 2026. As a result, the increase in Mexico's tariffs is very concentrated: weighting by 2024 trade, the products whose U.S. tariff rose by more than 10 percentage points by 2026, mostly those under Section 232, account for over four fifths of the increase in Mexico's average tariff, while the USMCA kept the increase small for most of its other exports.

The higher U.S. tariffs on China do benefit Mexico, but only modestly. Mexico's main competitor in the U.S. market is not China but U.S. producers, who pay no tariffs: in the sectors in which Mexico sells to the United States, U.S. producers account for 73% of U.S. spending and Chinese goods for only 6%. Since U.S. buyers in our model substitute between domestic and foreign goods with the same elasticity as among foreign goods, most of the demand diverted away from China goes to U.S. producers, and Mexican goods, whose tariffs rose by more than the average across all suppliers to the U.S. market, lose ground relative to them. Moreover, China sells very few vehicles to the United States, so the tariffs on China do little to offset the tariffs in the sectors where Mexico is hit hardest; Mexico gains mostly where China is a large supplier, as in electronics, where Mexican value added expands. Two counterfactuals, each keeping all other tariff changes as in the baseline, quantify these forces. If the United States had not raised its tariffs on China, Mexico's real income in 2028 would be about 37 basis points lower than in the baseline. If instead the United States had not raised its tariffs on Mexico, Mexico would gain about 107 basis points instead of losing 97. Mexico therefore loses not because it gains little from the tariffs on China, but because the tariffs on its own exports, concentrated in its largest export sectors, outweigh that gain by far.

G Additional Exhibits

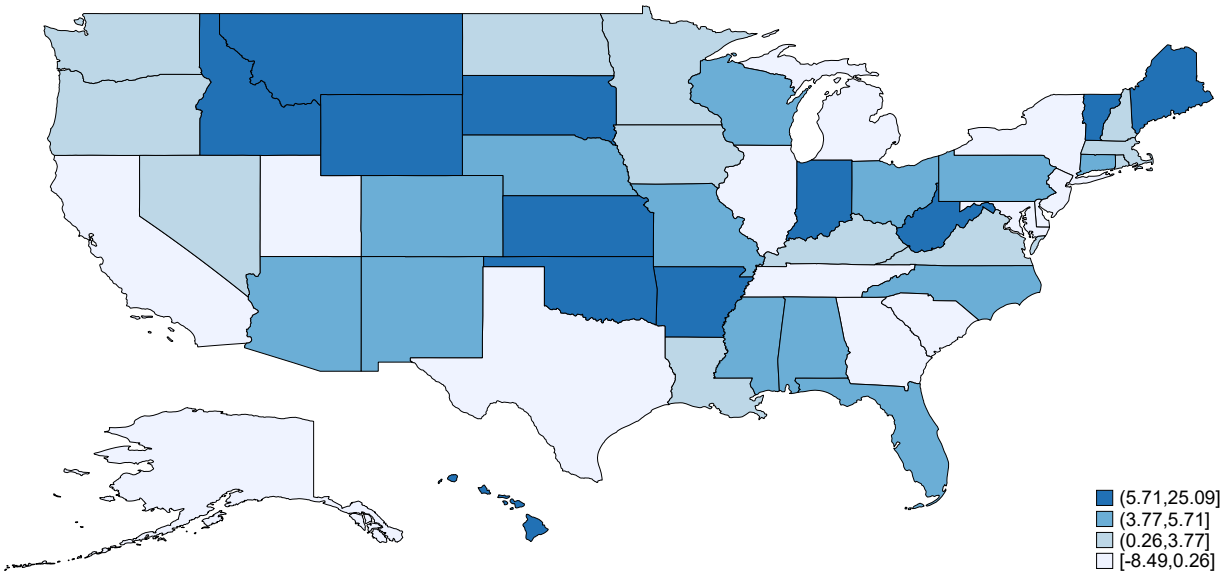


Figure G.1: Map of the welfare change from the shock, in basis points, across U.S. states. The darker the shade of blue, the bigger is the welfare gain (or the smaller is the loss).

Table G.1: U.S. aggregate welfare change (in basis points) across specifications

Panel A: Trade Elasticity		Panel B: Duration		Panel C: Retaliation	
σ	Welfare gain	Years	Welfare gain	Mirror	Welfare gain
1.76	4.53	4*	0.61*	0%*	0.61*
2.44	3.62	8	1.80	33%	0.15
3.12	2.90	12	2.73	66%	-0.28
6.00*	0.61*	16	3.47	100%	-0.73

Panel D: DNWR		Panel E: Model Features	
Setting	Welfare gain	Model	Welfare gain
No DNWR	1.14	Baseline*	0.61*
$\gamma = 4\%$	0.92	No redistribution	0.46
$\gamma = 3\%$*	0.61*	No input-output	-0.26
$\gamma = 2\%$	0.04	No migration	0.72

Notes: This table displays the aggregate U.S. welfare change from the shock, in basis points, across our five alternative specification exercises. Panel A varies the σ parameter governing the trade elasticity, Panel B varies the duration of the shock in years, Panel C varies the weight put on mirror retaliation, Panel D varies the growth rate of world nominal GDP in dollars (γ), which governs how binding the DNWR is, and Panel E shuts down, one at a time, the redistribution of tariff revenue across U.S. states, input-output linkages, and migration across U.S. states, all as explained in the text. An asterisk denotes the values under the baseline specification, which are $\sigma = 6$, a duration of 4 years, 0% weight on mirror retaliation (which implies full weight on the retaliation observed in the data, which is small to non-existent), $\gamma = 3\%$, and all three model features active.

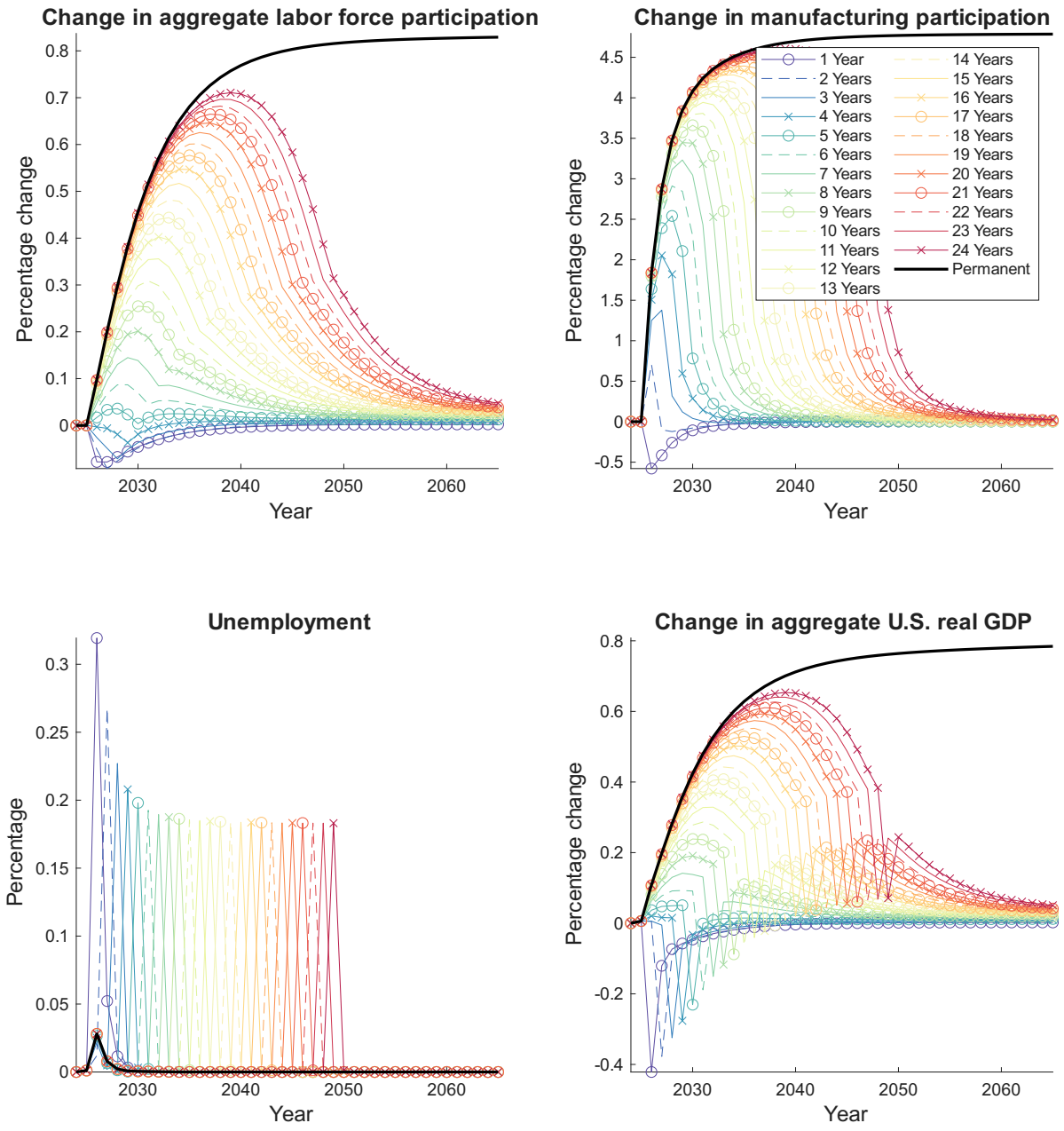


Figure G.2: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percent (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole across different values for the duration of the shock described in the legend.