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

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First version: April 22, 2025

This version: April 22, 2025

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We use a dynamic trade and reallocation model with downward nominal wage rigidities to quantitatively assess the economic consequences of the recent increase in the U.S. tariffs on imports from Mexico, Canada, and China, as well as the "reciprocal" tariff changes announced on "Liberation Day" and retaliatory measures by other countries. Higher tariffs trigger an expansion in U.S. manufacturing employment, but this comes at the expense of declines in service and agricultural employment, with overall employment declining as lower real wages reduce labor-force participation. For the United States as a whole, real income falls around 1% by 2028, the last year we assume the high tariffs are in effect. Importantly, our analysis disaggregates the U.S. into its 50 states, while incorporating cross-state redistribution of the tariff-generated fiscal revenue, allowing us to analyze which states gain or lose more from the shock. Around half of the states lose, with some states experiencing real income declines of more than 3%. Turning to cross-country results, some close U.S. trading partners—like Canada, Mexico, China, and Ireland—suffer the largest real income losses.

JEL codes: F10, F11, F13, F16, F40, F42.

Keywords: Tariff Changes, U.S. Tariffs, Liberation Day, Canada, Mexico, China.

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1 Introduction

The U.S. government has recently announced a series of substantial tariff hikes, including a new 25 percent duty on aluminum, steel, automobiles, and auto parts, and new tariffs on goods from Canada, Mexico, and China. Additionally, a set of "reciprocal tariffs" was introduced on "Liberation Day," April 2, 2025, with rates varying by exporting country and ranging from 10 to 50 percent. As a result, the average implied tariff has risen above 20 percent—a level not seen since the 1930s.[1] This substantial increase in tariffs could have significant economic implications.

This paper studies the quantitative consequences of these tariff increases, focusing on total and sector-level employment, wages, and real income across U.S. states and other countries. The model incorporates the tariff revenue generated by the tariff increases, and allows for flexible patterns of redistribution of this revenue within the United States. Our baseline exercise assumes that the tariffs revert to their 2024 levels after fours years and that other countries retaliate by imposing mirror tariffs on the United States, but we also study how the effects of the shock depend on its persistence or on the extent of retaliation by other countries. We place special emphasis on how the shock impacts outcomes within the United States, but turn to cross-country results towards the end of the paper.

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

[1] For now, we do not incorporate the 90-day pause in tariffs to most countries announced on April 9th, or the further increase in tariffs towards China announced on April 8th-11th. We acknowledge that current U.S. trade policy operates in a rapidly shifting and uncertain environment. Crucially, 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, states of the U.S., and other countries.

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 a home-production sector. Trade takes place between regions (either U.S. states or other countries), and workers can move across sectors in a region subject to mobility costs. As in Caliendo et al. (2019), workers draw idiosyncratic shocks to the utility of working in each sector in each period. Based on these shocks, the costs of switching sectors, and expected real income in future periods (including tariff revenues rebated by the government), workers choose which sector to participate 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.[2] Given the presence of DNWR, the model requires a nominal anchor that prevents nominal wages from increasing enough as to make the DNWR never bind.[3] 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. Even though this nominal anchor may not capture the subtleties of real-world monetary policy, it 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.[4]

Our quantitative analysis requires sector-level input-output flows as well as trade flows between all pairs of U.S. states and other countries included in our sample. We leverage multiple data sources, a set of proportionality assumptions to make all datasets

[2]See Section 2 of RUV for a discussion of the evidence in favor of DNWR and the advantages of using such a feature in trade models. As in RUV, we only apply the DNWR constraint in the sectors of manufacturing, treating the service and agricultural sectors as if they operated under wage flexibility. Results in the case where DNWR applies to all sectors are available upon request.

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

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

internally consistent, and implications from a gravity model to construct sector-level trade flows among all region pairs in our sample. The final dataset encompasses 87 regions (50 U.S. states, 36 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 studies—enables us to offer a more comprehensive cross-sector understanding of the implications of the recent tariff changes.

We quantify the impact of the shock using the "dynamic exact-hat algebra" approach introduced by 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 parameters implicitly calibrated by the exact hat algebra methodology using data from the base year (2024), we require an explicit calibration of four parameters. These are the DNWR parameter, δ, the growth rate of world nominal GDP in dollars, γ, the inverse elasticity of mobility across sectors, ν, 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 from RUV.

Our analysis implies that U.S. employment falls by approximately 1.1% relative to the pre-shock baseline. During the high tariff period, engaging in the home-production sector (which provides a constant utility flow) becomes more appealing, resulting in lower labor force participation. The impact of the tariff shock on the labor market varies by sector. There is a temporary employment increase in manufacturing, a sector where the United States is a net importer. By contrast, the services and agricultural sectors experience temporary employment reductions. Once the shock dissipates, manufacturing wages face downward pressure as the economy adjusts to the lower tariffs, generating involuntary unemployment in the presence of DNWR.

For the U.S. as a whole, we find a decrease in the real wage of around 1.4% in 2028, the last year the elevated tariffs are active in our baseline specification. The decline in the real wage is partially offset by an increase in tariff revenue rebates, resulting in a smaller decline in real income for agents in the labor force. Specifically, the cumulative percentage decline in U.S. real income between 2024 and 2028 is around 1%.

The effect of the tariff shock varies significantly by state. States that lose the most, such as California, Michigan, and Texas, allocate a lot 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, or the extent of retaliation by other countries. The main lesson from these exercises is that the trade elasticity has a pronounced impact on the results. If the trade elasticity is low enough, overall labor force participation can increase when tariffs are high and the United States can even experience a real income gain. When the trade elasticity is low, the United States has stronger market power relative to its smaller trading partners, allowing it to benefit from imposing tariffs, even under retaliation. However, perhaps surprisingly, manufacturing employment experiences a less pronounced boost from the tariffs, and may even decrease.

Turning to cross-country results, the effects of the shock vary internationally and depend on trade openness and the new tariffs imposed on a given country. The United States and its close trading partners—like Canada, Mexico, China, and Ireland—suffer the largest real income losses. By contrast, some countries subject to the smallest possible "Liberation Day" tariff increase of 10%, such as Turkey and Great Britain, experience real income increases due to reduced competition in their export markets.

We emphasize that our model is designed to analyze the direct consequences of a tariff shock in a general equilibrium trade 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. As discussed further in the Conclusion, the model also does not incorporate endogenous trade deficits, capital accumulation, non-unitary elasticity of substitution across production inputs, or the potential response of monetary-policy authorities to the effects of the tariff shock. Nevertheless, the framework provides valuable insights into the 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. using a framework that holds wages in other countries fixed. They find 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—resulting in an estimated $1.4 billion monthly decline in U.S. real income. Feenstra and Hong (2024) use a translog expenditure system to show that the welfare losses may have been smaller than previously estimated, due in part to product exclusions that reduce the effective increase in import prices.

Flaaen and Pierce (2019) study the employment effects on the U.S. manufacturing sector, finding that industries more exposed to tariff increases experienced relative declines in employment and output, as any protective gains were offset by higher input costs and retaliatory measures. Additional work by Peake and Santacreu (2020) reinforces these results, showing that U.S. states more exposed to international trade experienced weaker employment and output growth in the aftermath of the trade war. Our contribution to this literature relies on extending the model developed by RUV to incorporate import tariffs and their associated fiscal revenue, allowing us to study the dynamic effects of the new round of U.S. tariff increases in April 2025 and to explore the consequences under different duration, retaliation, and trade-elasticity scenarios.

Our research also connects to the literature on trade wars and optimal tariff responses in a global context. For example, Ossa (2014) and Lashkaripour (2021) analyze the design of optimal tariffs under trade conflict and highlight the potential gains from more cooperative trade policies. More recently, Itskhoki and Mukhin (2025) study optimal tariffs in the presence of global imbalances, showing that the optimal tariff is negatively related to a country's trade deficit and Baqaee and Malmberg (2025) further show that incorporating capital adjustments could amplify the long-run costs of trade wars.

Our model also offers insights into the potential global consequences of the 2025 tariff hike. In this context, our work relates to studies examining third-country effects of earlier trade wars. For instance, Fajgelbaum et al. (2024) analyzes how countries responded globally to the U.S.-China trade tensions, highlighting the role of scale economies and noting that global trade volumes were largely unaffected due to complementarity with U.S. products and substitution with Chinese exports. Similarly, Heise et al. (2024) study how the anticipation of trade conflicts can alter long-term trading relationships, estimating welfare losses equal to roughly one-third of the gains from trade.

Recent studies have examined the implications of rising trade uncertainty and the tariff increases announced in April 2025. For instance, Ignatenko et al. (2025) analyze the impact of these tariffs on U.S. trade deficits and welfare, showing that while tariffs may help reduce the deficit, retaliatory measures by trade partners can reduce U.S. welfare by up to 0.1%. Lab (2025) estimates that the average household stands to lose approximately $4,800 due to the new tariffs, and Evenett and Muendler (2025) highlight how import displacement limits the government's ability to raise revenue. Related work by Flach and Scheckenhofer (2025) investigates the consequences of retaliatory tariffs. Our contribution is to study the 2025 tariff increases within a framework that incorporates dynamic effects, wage rigidities, and distributional implications across states.

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

2 A Dynamic Spatial Trade Model with Tariffs

We use a dynamic multi-sector quantitative trade and reallocation model featuring nominal wage rigidities and input-output linkages akin to the one in RUV and UVZ to examine the recent tariff increases imposed by the U.S. Importantly, we extend the model to incorporate tariff changes and their associated fiscal revenue. In this section, we outline the main features of the model, deferring further mathematical details to Appendix A. The model incorporates a total of I regions ($I = 87$: the 50 U.S. states, 36 other countries, and an aggregate rest of the world region) and S sectors ($S = 15$: home production, 12 manufacturing sectors, services, and agriculture). Since allowing for cross-state migration does not significantly affect our results, we simplify the analysis by assuming away labor mobility across U.S. states.

Preferences and production Total consumption in a region is a Cobb-Douglas aggregate of consumption across all the market sectors with given time-invariant expenditure shares denoted by $\alpha_{j,s}$ (where j denotes the region and s the sector). As in a multi-sector Armington model, consumption within a market sector is a CES aggregate of the variety produced by each region, with an elasticity of substitution σ_s. We denote the region i, sector s, and time t triad as (i, s, t).

Production uses two factors: labor and intermediate inputs. Specifically, the technology for producing the (i, s, t) good takes the following 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. $\phi_{i,s} + \sum_k \phi_{i,ks} = 1$. There are also iceberg trade costs $\tau_{ij,s,t} \geq 1$ for shipping the sector s good from region i to region j at time t.

Tariffs, trade shares, and revenues There are ad-valorem tariffs $t_{ij,s,t}$ imposed by country j on imports that come from country i in sector s at time t. These tariffs will 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.[5]

There is perfect competition in production. Letting $W_{i,s,t}$ denote the wage in dollars in (i, s, t) and $P_{i,k,t}$ denote the dollar price of the composite good of sector k, in region i, at time t, the dollar price in region j of the (i, s, t) good is then equal to its unit cost,

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

with corresponding trade shares given by

$$\lambda_{ij,s,t} \equiv \frac{p_{ij,s,t}^{1-\sigma_s}}{\sum_{r=1}^{I} p_{rj,s,t}^{1-\sigma_s}}.$$

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—potentially in a manner that is not proportional to the revenue each state initially contributed. To flexibly capture this feature, we assume that the total tariff revenue received (TRR) by region i at time t is

$$TRR_{i,t} = \sum_{j} \theta_{ji} TRC_{j,t}, \tag{1}$$

[5] Caliendo and Parro (2015) also incorporates 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 allocation of tariff revenues across U.S. states.

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-sender region when summing across all the tariff-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 disproportionately allocated to certain states (e.g., those that voted for a given political party in the last election) or sectors. Tariff revenues in countries other than the United States simply stay in that country (as we do not disaggregate other countries into smaller regions).

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

$$TRC_{j,t} \quad = \quad \sum_s \sum_i \frac{t_{ij,s,t}}{1+t_{ij,s,t}} \lambda_{ij,s,t} EXP_{j,s,t} = \sum_s \psi_{j,s,t} EXP_{j,s,t}, \tag{2}$$

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 industry k of region j of 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

$$EXP_{j,s,t} \quad = \quad \alpha_{j,s} \left(\sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + D_{j,t} + TRR_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t}. \tag{3}$$

Introducing equations (2) and (3) into (1) and rearranging, we get

$$TRR_{i,t} = \sum_j \theta_{ji} \sum_s \psi_{j,s,t} \left[\alpha_{j,s} \left(\sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + D_{j,t} + TRR_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t} \right]. \quad (4)$$

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

$$R_{i,s,t} = \sum_{j=1}^{I} \frac{\lambda_{ij,s,t}}{1+t_{ij,s,t}} \left(\alpha_{j,s} \left(\sum_{s=1}^{S} W_{j,s,t} L_{j,s,t} + D_{j,t} + TRR_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t} \right). \quad (5)$$

Appendix A details how to combine equations (4) and (5) into a computationally efficient matrix equation that can be used to solve for period-by-period sectorial revenues while accounting for flexible tariff revenue redistribution through the θ coefficients.

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 indicates that the nominal wage in (i, s, t) has to be greater than δ times the nominal wage in $(i, s, t-1)$, $W_{i,s,t} \geq \delta W_{i,s,t-1}$.[6] As a consequence of this rigidity, employment does not have to equal labor supply, leading to the following weak inequality, $L_{i,s,t} \leq \ell_{i,s,t}$.

Unemployment only occurs if the wage is at its lower bound. Hence, the previous inequalities are augmented by a complementary slackness condition, indicating that at least one of them has to hold with equality,

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

The previous condition says that employment and wages are determined by supply and demand when the wage is unconstrained. By contrast, when the wage is at its lower

[6]The DNWR applies in the local currency of region i, which needs to be converted into U.S. dollars using an exchange rate. This is described in more depth in Appendix A.

bound, the labor market does not clear, and there is rationing (i.e., unemployment) as labor supply exceeds labor demand.

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 which does not depend on economic conditions. By contrast, a given market sector $s > 0$ offers an endogenous level of real consumption $c_{i,s,t}$.

Given the presence of downward nominal wage rigidity, agents must take into account the possibility of unemployment when selecting which sector to participate in. To simplify the analysis, we assume a representative agent in each region-sector.[7] Additionally, the income for agents is not only given by their wage income, but it also includes the tariff revenue received by the region where agents 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

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

where $P_{i,t}$ is the aggregate price index in region i.

Agents choose their sector of employment while facing idiosyncratic amenity shocks and switching costs, and they take into account the expected future income across all sectors (i.e., the $c_{i,s,t}$'s) with perfect foresight. The idiosyncratic preference shocks follow a Gumbel distribution, making the participation decision tractable and allowing for closed-form expressions (see Appendix A for additional details). A key parameter in the model is the elasticity of switching across sectors within a region, given by $1/\nu$.

[7] This is equivalent to assuming that the income generated in a sector-region is equally shared between all agents in that sector-region. We refer the interested reader to RUV for details on how to implement a more general type of insurance than the one modeled here.

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 enough for our quantification.[8] Specifically, we assume that world nominal GDP measured in U.S. dollars grows at a constant rate γ each year,

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

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.

Dynamic hat algebra The main objective of the paper is to examine the effects of an unanticipated tariff shock. To achieve this in a computationally tractable way, we use "dynamic exact hat algebra" (Caliendo et al., 2019), which allows us to match production, trade, and reallocation patterns in the base year. We can then introduce a change in the level of tariffs, without knowing the initial levels of fundamentals (like technology and iceberg trade costs), and study the economy's adjustment to such a shock.

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 real-world production, trade, and sectoral flow patterns perfectly. 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.

[8] 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.

3 Data, Calibration, and Shocks

3.1 Data for the Quantitative Exercise

Our quantitative exercise requires trade and employment data from 50 U.S. states, 36 other countries, and a rest of the world region. We incorporate 14 market sectors—12 manufacturing subsectors, services, and agriculture—plus a home production sector. We collect data on initial tariffs prior to 2025 and the tariff adjustments around the time of "Liberation Day." The remaining steps of the data construction closely follow UVZ but use 2024 as the base year in the quantification. We summarize the data construction below, with additional details in Appendix B.

Initial tariffs To compute the tariff level in the baseline year, we start with the bilateral product-level tariff dataset constructed by Teti (2024). This dataset contains pairwise tariff data between countries at the 6-digit HS code level. We first calculate the weighted average (weighted by bilateral trade value) of the tariffs at the 4-digit HS level and map them to 3-digit NAICS codes, following Liao et al. (2021). Then, we assign each NAICS code to the 13 non-services market sectors described in Appendix B.1 and compute the weighted average (again, weighted by bilateral trade value) for the tariffs at the importer-sector level for our 13 non-services market sectors.

Labor, consumption, and input shares We use data from the BEA and the OECD's Inter Country Input-Output Database (ICIO) to compute value-added shares (equated to the labor share in the model) 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 between 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 up or down 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. Census 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 keep internal consistency with ICIO. Fourth, we construct trade flows in services and agriculture among all regions inferred from two gravity structures. To do so, we obtain U.S. state-level services production 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 across all regions, following a gravity approach. We apply a similar methodology for agriculture, integrating data from the Agriculture Census with ICIO and the National Marine Fisheries Service Census to obtain state-level production data for crops, livestock, and seafood. Further details can be found in Appendix B.2.

Labor supply and mobility Employment data by sector comes from the WIOD Socio-Economic Accounts (SEA) and ILO for countries, and the BLS for U.S. states. Labor force participation represents the share of individuals aged 25-65 who are employed or unemployed. The shares of workers moving across the different sectors within U.S. states are computed from the CPS, while frictionless mobility is assumed for other countries.

3.2 Tariff Shock and Parameter Calibration

Tariff shock As indicated in the introduction, the baseline exercise examines an increase in the import tariffs imposed on Canada and Mexico from the low levels prevalent in 2024 to a level of 25%, and those charged to China from their 2024 levels (which differ across products and sectors) to 20%.[9] Additionally, the baseline exercise also incorporates the reciprocal tariffs that the administration announced on April 2nd, 2025, known as "Liberation Day", which further increased tariffs to China and also affected almost all countries in the world.[10]

In our baseline exercise, we analyze a tariff shock that reverts after four years. However, we also examine how the effects of the shock depend on its persistence (i.e., durations of $8, 12$, or 16 years instead of 4) or on the targeted countries' decisions to retaliate against the U.S. We place special emphasis on how the shock impacts outcomes in the U.S., due to the richness of our framework in modeling U.S. states and sectoral mobility patterns, before turning briefly to cross-country results towards the end of the paper.

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 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 the nominal 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

[9]Technically, the new 25% tariff level for Canada and Mexico only applies to those goods that are "not compliant" with the USMCA trade agreement, except for auto exports and steel and aluminum products which fall under separate tariff policies. However, in the model we apply the new 25% tariffs across the board in the absence of detailed data indicating to what extent goods in each sector are compliant with the USMCA trade agreement.

[10]As noted in footnote 1, we do not incorporate the 90-day pause in tariffs to most countries announced on April 9th (our model is at the annual frequency anyway), or the further increase in tariffs towards China announced on April 8th-11th. We emphasize that our framework is able to accommodate any set of tariff changes and therefore serves as a flexible tool to evaluate the economic impacts of any tariff shock.

in the expected direction. The higher the γ, the less binding the DNWR is, and the less unemployment is generated in the model. For a high γ of 5% or higher, the model has essentially the same behavior as the model without DNWR.

We take the inverse elasticity of moving across sectors (ν) directly from RUV, setting $\nu = 0.55$. 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 proposed by Boehm et al. (2023) in Section 5.

4 Baseline Results

We now investigate the effects of the tariff shock described in the previous section. The baseline exercise uses a model where there is no migration across U.S. states, world nominal GDP in dollars grows at 3% per year, the affected countries retaliate by imposing mirror tariffs on the U.S., and the tariff shock lasts for four years (i.e., it is active from 2025 to 2028). We discuss the effects on labor force participation and unemployment, real wages, relative prices (sectoral 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.[11]

Figure 1 summarizes the results by presenting the effects on participation, real wages, relative prices, and the real value added across sectors. Specifically, the cumulative percentage change in labor force participation (i.e., labor supply) since 2024 is in the top left, the one for real 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.[12]

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

[12] 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.

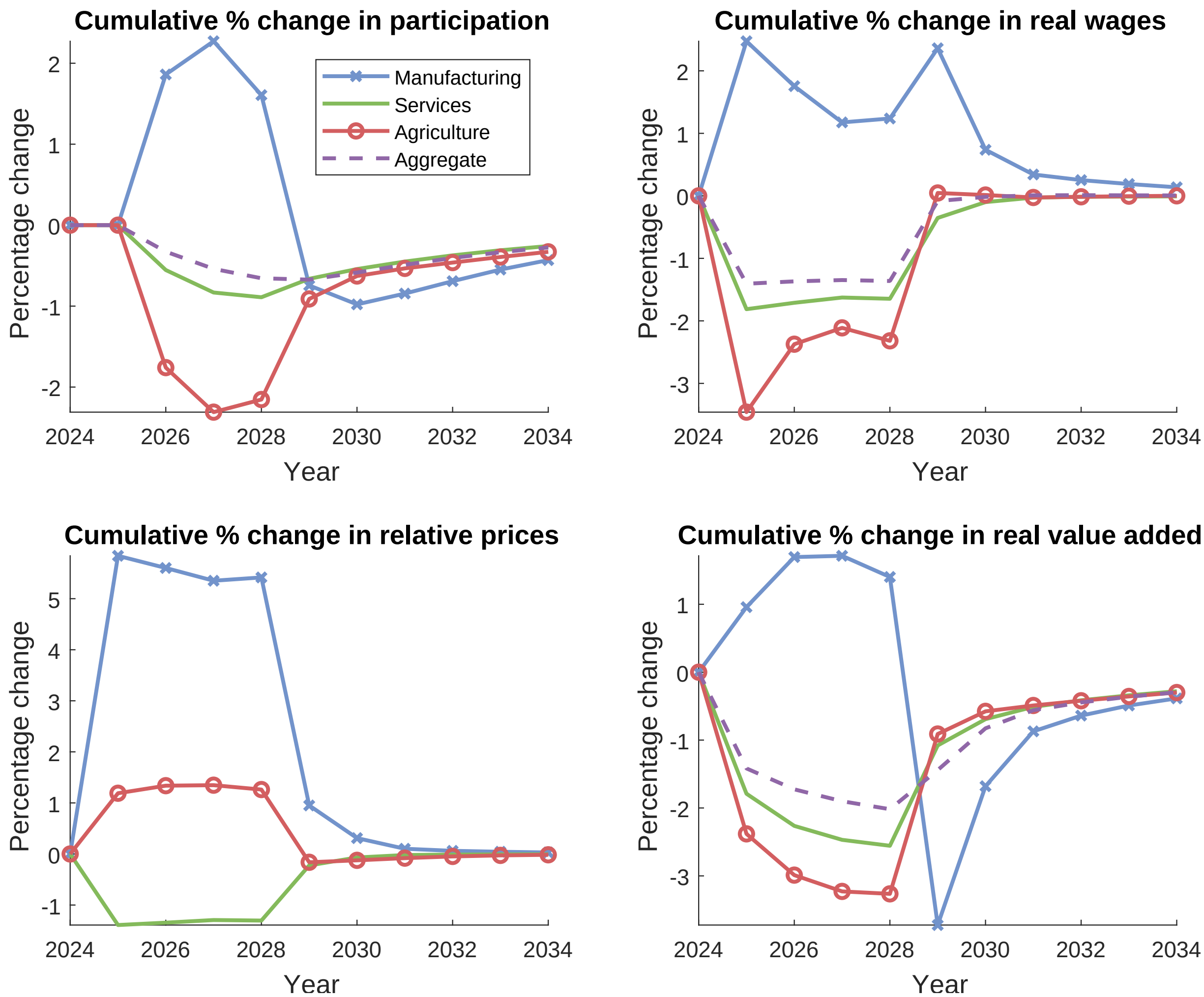

Figure 1: Paths of relevant variables for the U.S. on aggregate. The cumulative percentage change in participation (labor supply) since 2024 is in the top left, the cumulative percentage change in real wages is in the top right, the cumulative percentage change in relative prices is in the bottom left, 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.

The manufacturing sector is depicted by the crossed blue line, services by the solid green line, agriculture by the red line with circles, and the dashed purple line represents the aggregate across sectors.

Changes in participation broadly follow changes in real wages, with slight year-to-year differences arising from lagged and anticipatory effects. In turn, real wages, relative prices, and real value added follow changes in demand triggered by the tariff shock. Since the U.S. is a net importer of manufactures, higher tariffs reallocate demand towards U.S. manufacturing, increasing its relative price and real wage. At the peak, real manufacturing value added increases by 1.7%, while participation increases by more than 2%.

By contrast, participation, the real wage, the relative price, and value added fall for services. This is because the U.S. is a net exporter of services, so the trade war decreases demand for U.S. services, which experience a decrease in value added of around 2.5% in 2028. U.S. agricultural trade is roughly balanced, but here the key mechanism is that tariffs increase input prices, leading to an increase in costs and a decline in real wages, participation, and value added in this sector. By 2028, real value added in agriculture has fallen by more than 3%.

Aggregate U.S. labor force participation (shown by the dashed purple line on the top left panel of Figure 1) decreases by up to 0.65% during the years when the tariff shock is active. This aggregate fall in participation occurs because, while tariffs are high, participating in the home-production sector (which provides a constant real utility flow) temporarily becomes more attractive than participating in the market sectors. This shift is due to the fact that high tariffs make the market sectors less productive, explaining the decline in the real wage shown in the top right of Figure 1, which falls around 1.4% by 2028. This fall in the real wage is amplified by the decline in participation, leading to a fall in real value added of around 2% by 2028.

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 2 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.[13] A small amount of unemployment of around 7 basis points is generated between 2025 and 2026. This happens in a few states whose manufacturing sector is more exposed to

[13]The dashed purple line corresponds to the dashed purple line in the top right panel of Figure 1.

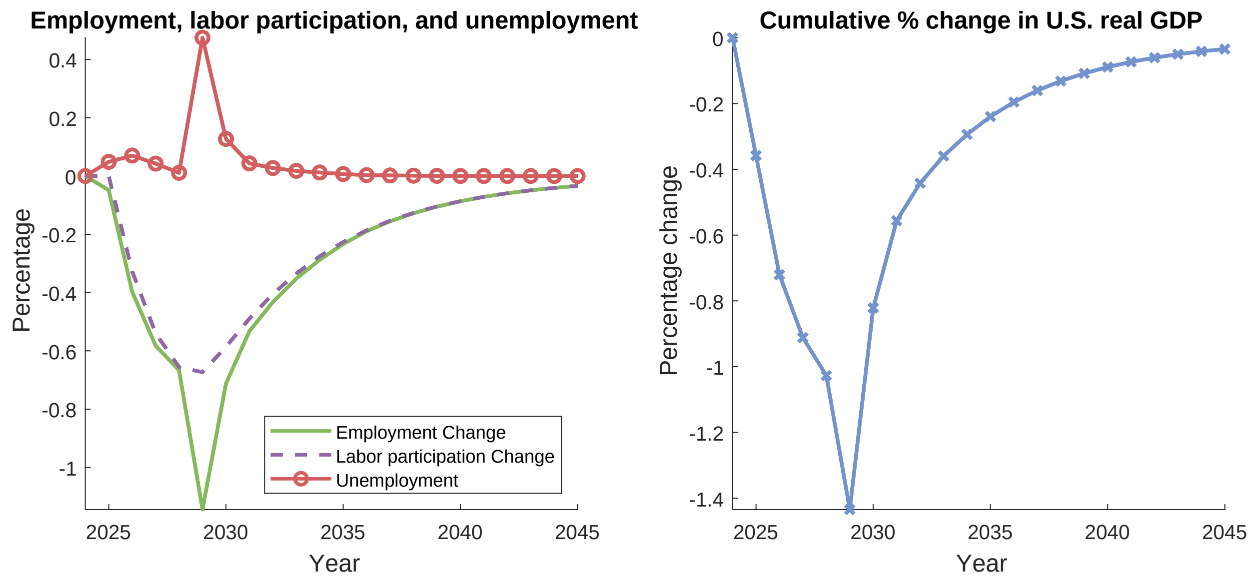

Figure 2: Paths of relevant variables for the U.S. on aggregate. The left panel displays the cumulative percentage change in employment since 2024 (solid green line), the cumulative percentage change in labor supply since 2024 (dashed purple line), and the level of unemployment in percent (red line with circular markers). The right panel displays the cumulative percentage change in real GDP (which coincides with real income) for the U.S. on aggregate since 2024. Notice that real GDP is inclusive of tariff revenues. The years in the x-axis go from 2024 until 2045.

foreign retaliation (i.e., states exporting more to China) or to domestic tariffs on the input side relative to their exposure to the positive protectionist effect of the domestic tariffs on their output. By contrast, when the shock ends in 2029, the U.S. manufacturing sector experiences a negative demand shock, and the DNWR binds in many states, triggering a more significant increase in aggregate unemployment, which reaches 0.5% in 2029. The cumulative change in total U.S. employment, given by the green line in Figure 2, reaches a trough of -1.1% in 2029.

The right panel of Figure 2 presents the cumulative percentage change since 2024 in U.S. real GDP, which is inclusive of tariff revenues and coincides with real income for the U.S. as a whole. The 2% decline in aggregate real value added by 2028 depicted in the bottom right panel of Figure 1 is partially offset by the increase in tariff revenue rebates, so real GDP only falls around 1% by 2028. The unemployment generated in 2029 further lowers real GDP, which declines by 1.4% in 2029 and then recovers gradually back to its

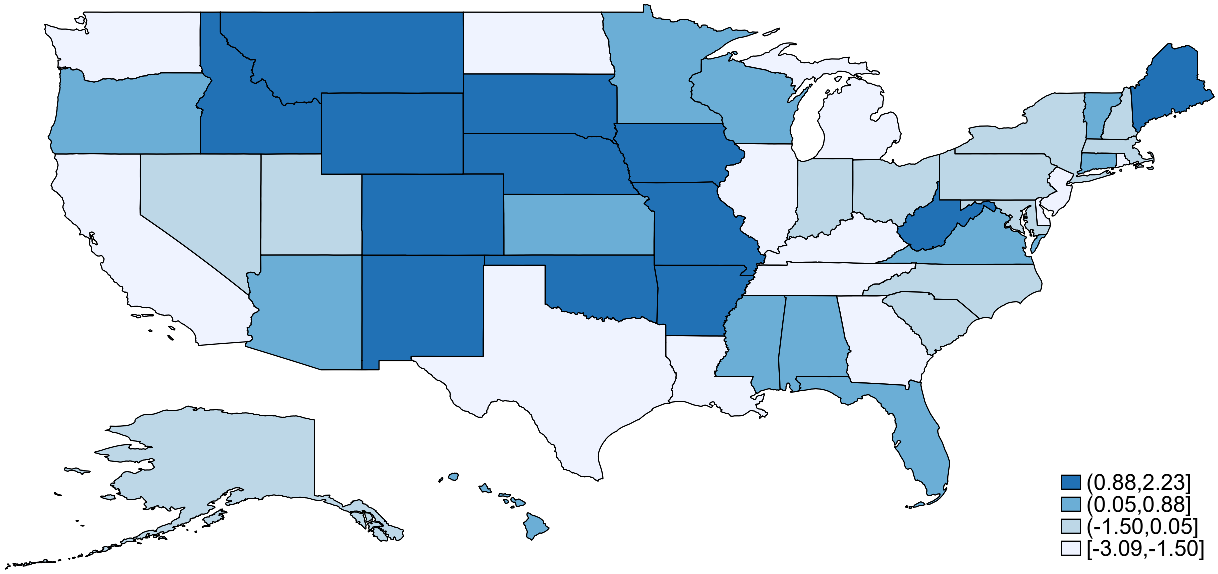

Figure 3: Map of the cumulative change in real income between 2024 and 2028, in percent, across U.S. states. The darker the shade of blue, the smaller the fall in real income (or the bigger the gain).

pre-shock level.[14]

A key advantage of our framework, where the U.S. is disaggregated into its 50 states, is that it allows us to assess how the shock impacts each of these sub-national units. Figure 3 presents a map depicting the cumulative change in real income between 2024 and 2028, in percent, across U.S. states. Some states where real income falls the most are Texas, California, and Michigan, while some states where it falls the least are Colorado, Nebraska, and Oklahoma. While U.S. real income falls around 1% by 2028, this masks large cross-state heterogeneity in real income changes, which range between an increase of 2.2% and a decrease of 3.1%.

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 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

[14]While the trough in U.S. aggregate GDP occurs in 2029 rather than 2028, we highlight the 2028 level of the fall throughout the paper 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 don't suffer unemployment, and therefore generally experience the maximum impact of the shock around 2028.

that solely relies on how each state's expenditures are allocated across region-sectors combined with how tariffs change towards 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 (when the high tariffs are assumed to be in effect), we construct a measure of exposure for a given region as follows:

$$Exposure_i = \sum_{s=1}^{S} \sum_{j=1}^{I} \frac{EXP_{ji,s,0}}{EXP_{i,0}} \frac{t_{ji,s,1} - t_{ji,s,0}}{1 + t_{ji,s,0}}. \tag{6}$$

For example, if a state allocates 3% of its expenditure on 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 4 plots the exposure measure in equation (6), in percent, on the x axis, against the real income loss from the tariff shock, in percent, on the y axis, across the 50 U.S. states. The correlation between the variables is over 81%, 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.[15]

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. The formula, given in RUV, is a present value sum where we use an annual discount factor of $\beta = 0.95$.

[15]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), then the cross-state distribution of the real income change is largely unaffected by this tariff revenue.

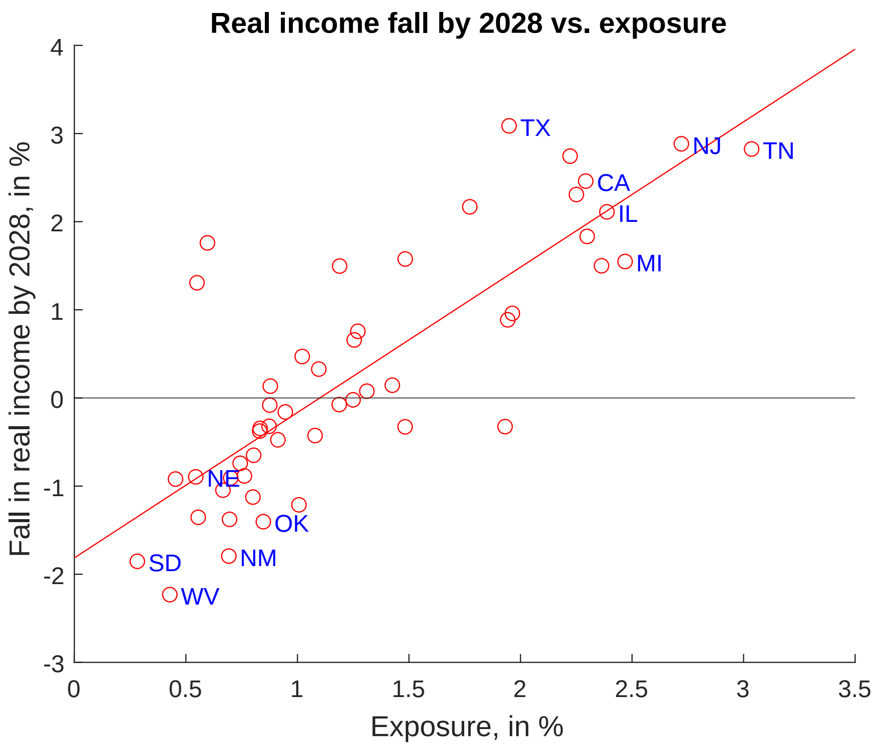

Figure 4: This figure presents a scatter plot of the exposure measure defined in equation (6), in percent, in the x axis, against the real income fall by 2028, in percent, in the y axis, across the 50 U.S. states. Some of the states that gain or lose the most from the shock are labeled with the usual two-letter abbreviations.

The U.S. suffers an aggregate welfare loss of around 5.6 basis points. Recall that this welfare loss is for a shock that lasts only four years. If the shock lasted longer or the discount factor was lower, the welfare losses would naturally be larger. Additionally, our model contains a home production sector, which provides a constant utility flow that is unaffected by the tariff shock and serves as a protection mechanism for agents in all sectors against the effects of the shock. For details on how mobility between sectors affects welfare, see Section 3.6 of RUV.

5 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, or retaliation by the

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

Panel A: Trade Elasticity		Panel B: Duration		Panel C: Retaliation	
Sigma	Income gain	Years	Income gain	Retaliation	Income gain
1.76	0.4099	4*	-1.0270*	0%	-0.5143
2.44	0.0093	8	-1.4812	50%	-0.8198
3.12	-0.2723	12	-1.6920	100%*	-1.0270*
6.00*	-1.0270*	16	-1.7827	150%	-1.1585

Notes: This table displays the aggregate U.S. cumulative real income gains (real income losses are therefore represented as negative numbers) from 2024 to the last year that the high tariffs are active, in percent, across our three alternative specification exercises. Panel A varies the σ parameter governing the trade elasticity, Panel B varies the duration of the shock in years, and Panel C varies the extent of retaliation by other countries. An asterisk denotes the values under the baseline specification, which are $\sigma = 6$, a duration of 4 years, and a retaliation of 100%.

affected countries. Throughout this section, we will refer to Table 1 which contains the aggregate U.S. cumulative real income gains (real income losses are then represented as negative numbers) between 2024 and the last year the high tariffs are active, in percent, from the tariff shock across our three alternative-specification exercises. Panel A varies the σ parameter governing the trade elasticity, Panel B varies the duration of the shock in years, and Panel C varies the extent of retaliation by other countries.

In our baseline, we use a value of the trade elasticity parameter of $\sigma = 6$, a standard 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 median 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 relative market power the United States has against its smaller trading partners, and the less it suffers from the tariff shock (even if the other countries retaliate). In fact, if the value of σ is low enough, the United States as a whole benefits from the imposition of tariffs. This can be seen in Panel A of Table 1. For our baseline value of $\sigma = 6$, the United States suffers aggregate real income losses of around 1% by 2028, for $\sigma = 3.12$ the real income loses are much closer to zero, while for the lowest value of $\sigma = 1.76$ the U.S. experiences a real income gain of 40 basis points. We emphasize that values of sigma below three are low relative to those commonly used in the literature, and not necessarily the most realistic for this exercise, but we present them here in order to illustrate the impact of the trade elasticity on the effects of the tariff shock.[16]

Figure 5 displays the 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 percentage (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 our baseline value of $\sigma = 2.44$, the orange line with circular markers $\sigma = 3.12$, and the burgundy line with crosses $\sigma = 6$.

As σ decreases from 6 to 1.76, the change in aggregate labor force participation reverses direction. With a lower elasticity of substitution, individuals are more likely to enter the labor force to capitalize on the increased profitability of market sector employment. Similarly, participation in manufacturing also reverses direction at 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. Consequently, 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 elasticity of substitution limits the ability to replace foreign with domestic inputs and amplifies the impact of the input cost channel, making it more likely that the net employment effect is negative.

We now turn to discussing the impact of the shock's duration. Figure 6 displays the same four outcomes as Figure 5, but now across different values for the duration of the

[16] If the value of the trade elasticity is one, i.e., $\sigma = 2$, then even extremely small countries have optimal unilateral tariffs of 100% (see Costinot and Rodriguez-Clare, 2014), which seems unrealistic.

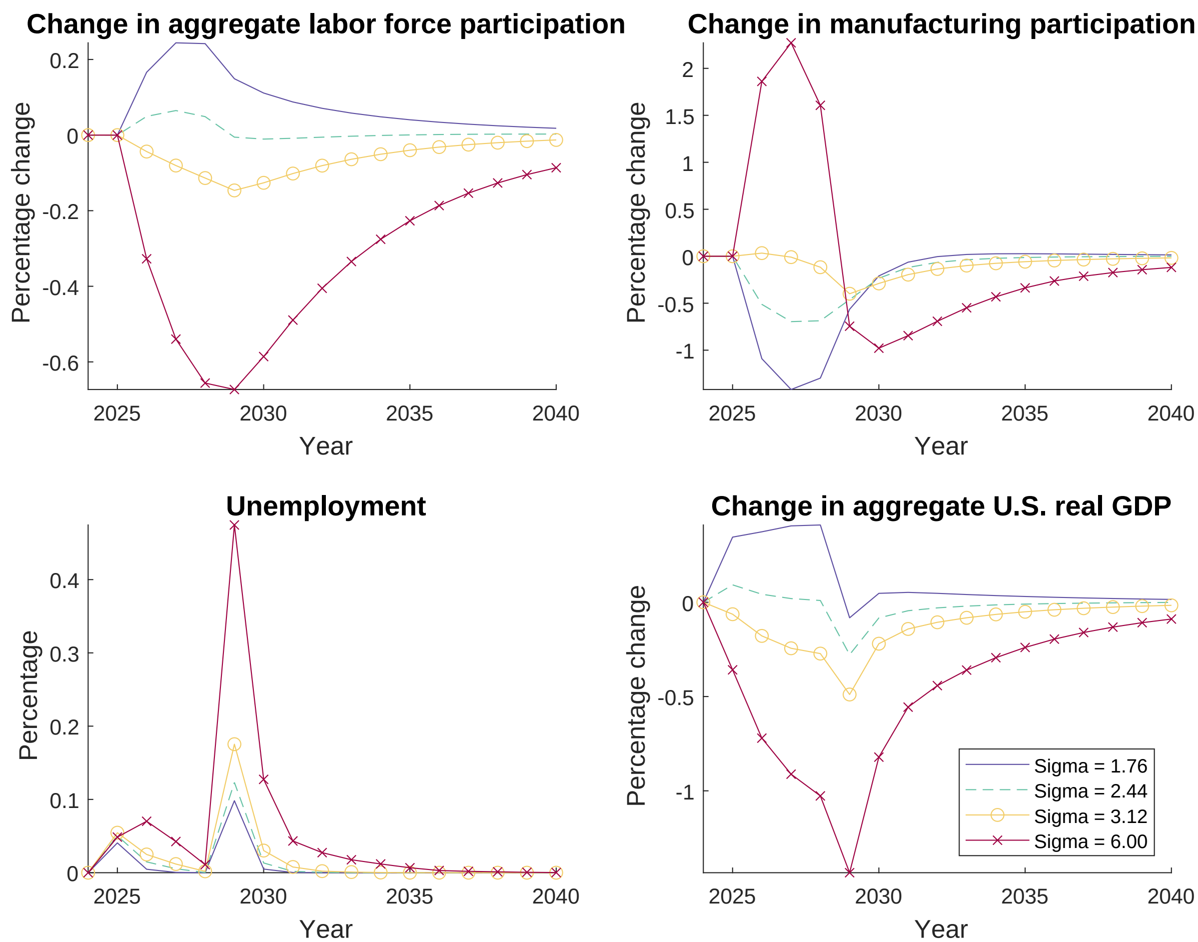

Figure 5: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percentage (bottom left), and the cumulative 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 a sigma of 1.76, the dashed green line a sigma of 2.44, the orange line with circles a sigma of 3.12, and the burgundy line with crosses a sigma of 6.

shock (recall that we have solved the model under perfect foresight, so the agents in the model know the size of the shock and when it will disappear). A higher persistence leads to a greater decrease in aggregate participation. Manufacturing, however, has a more complicated reaction to changes in persistence. The increase in manufacturing participation becomes greater when duration goes from four to eight years, but from then on stays roughly constant when the duration increases to 12 or 16 years. Interestingly, the decline in manufacturing participation overshoots its lower steady-state value as tariffs revert to

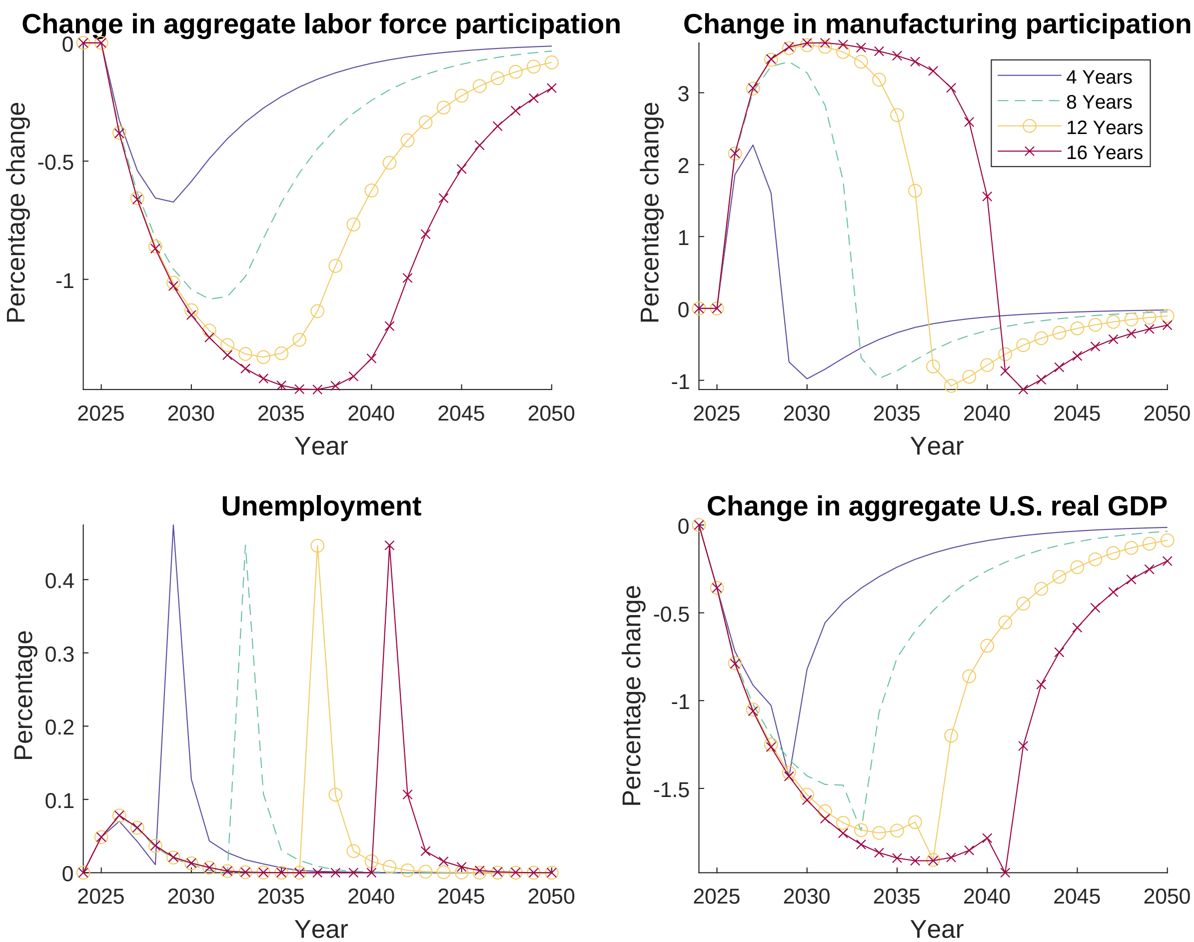

Figure 6: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percentage (bottom left), and the cumulative percentage change since 2024 in real GDP for the U.S. 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.

the baseline. This is a result of DNWR, which leads to unemployment in the years immediately following the tariff reversal, and this in turn dissuades agents from supplying labor to the sector.

Next, we consider the effects of retaliation by the other countries. Figure 7 displays the same four outcomes as Figure 5, but now across different retaliation intensities by the affected countries. The solid blue line depicts a retaliation of 0% (i.e., the affected countries do not change their tariffs at all), the dashed green line a retaliation of 50%

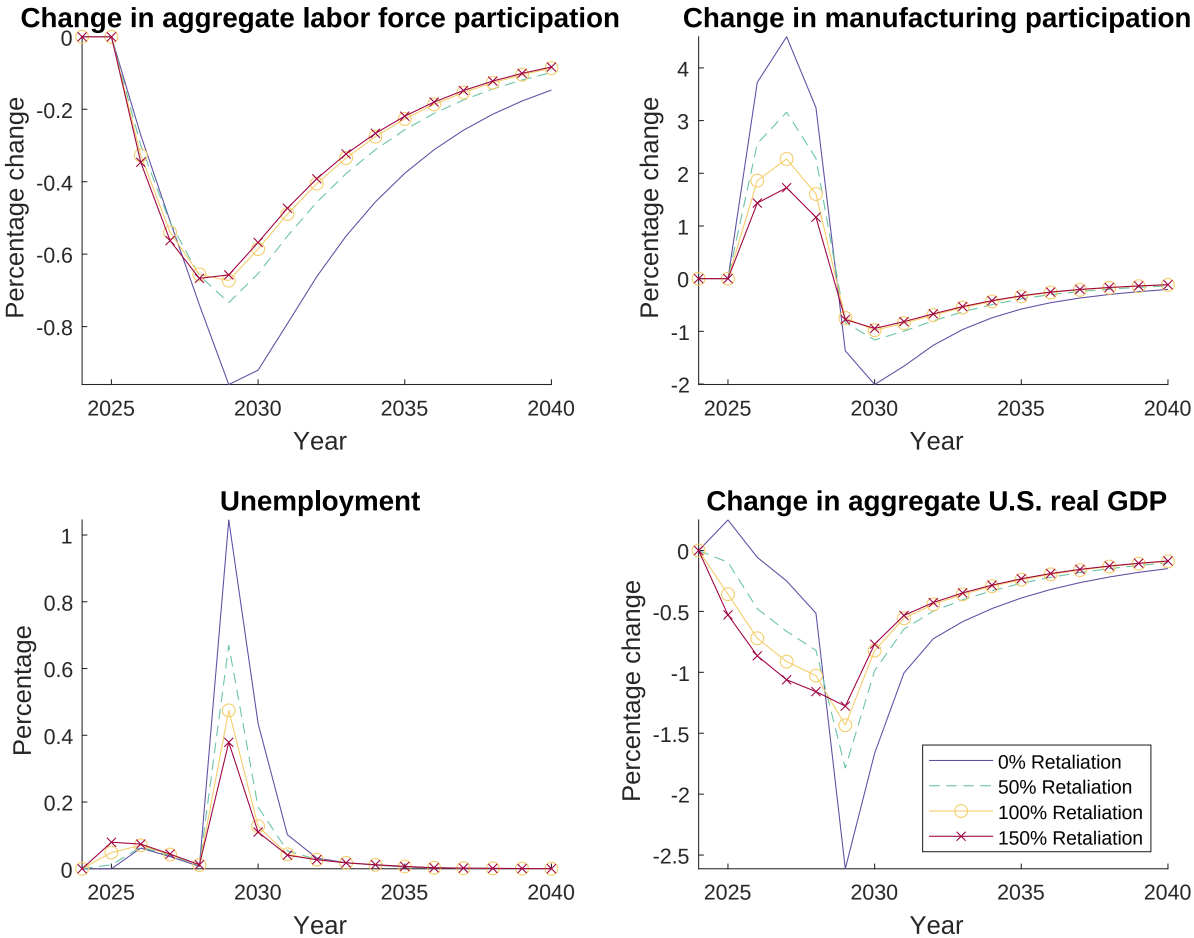

Figure 7: This figure presents the cumulative percentage change since 2024 in aggregate labor force participation (top left), the cumulative percentage change since 2024 in manufacturing participation (top right), the unemployment generated by the shock in percentage (bottom left), and the cumulative percentage change since 2024 in real GDP for the United States as a whole across different values for the percent retaliation by other countries. The solid blue line depicts a retaliation of 0% (i.e., other countries do not change their tariff at all), the dashed green line a retaliation of 50% (i.e., other countries impose on the U.S. half the tariff increase that they have suffered), the orange line with circular markers a retaliation of 100% (other countries mirror the U.S. increase), and the burgundy line with crosses a retaliation of 150% (other countries impose a tariff on the United States that is 50% bigger than the one they have received).

(i.e., the affected countries impose on the United States half the tariff increase that they have suffered), the orange line with circular markers a retaliation of 100% (the affected countries mirror the U.S. increase), and the burgundy line with crosses a retaliation of 150% (affected countries impose a tariff on the United States that is 50% bigger than the one they have received).

The higher the retaliation, the less beneficial is the shock for the United States (as indicated in Panel C of Table 1). Higher retaliation also dampens the boost to manufacturing demand due to domestic protection, weakening the increase in manufacturing participation. Remarkably, the larger the extent of retaliation by other countries, the lower is the amount of unemployment generated when the tariff shock disappears. Under no retaliation, 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 substantially when the shock disappears, at which point the manufacturing sectors in many U.S. states hit the DNWR, leading to unemployment. A tariff-generated unemployment of 0.5% in 2029 under the baseline specification turns into a level of more than 1% under the no-retaliation scenario. Thus, perhaps surprisingly, foreign retaliation ameliorates the unemployment effects of the U.S. tariffs.

We finish this section by briefly discussing the implications of other changes to the model's assumptions. Modifying the annual growth rate of world nominal GDP from 3% to higher values lowers the amount of unemployment generated when the shock dissipates, dampening the real income losses from the shock (without accounting for the unmodeled cost of higher inflation). Allowing for migration across U.S. states does not change the results substantially, as the migration elasticities typically estimated for the United States tend to be fairly low (see, e.g., RUV). 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.[17]

[17] Essentially, 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.

6 International Results

In this section, we focus on how the impact of the tariff shock varies across countries.[18] 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 8 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 U.S. lose the most, while some countries can gain by having less competition in their export markets, for example, if they are charged the minimum tariff by the United States (examples of this are Turkey and Great Britain).

As discussed earlier, the real income loss for the United States in 2028 is around 1%. Canada loses 2%, Mexico loses 2.7%, Ireland loses 3%, Taiwan loses 1.4%, and China loses 0.5%.

Canada and Mexico suffer more than China and the U.S. because they are smaller countries with a more limited ability to use tariffs to change the price of their goods to exert their market power on their trading partners. Nevertheless, the U.S. suffers more than most other countries because it experiences a significant change in tariffs vis-à-vis all trading partners, while other countries are only facing changes with respect to the United States.

7 Conclusion

In this paper, we use a dynamic trade model with an input-output structure and DNWR to assess the effects of temporary tariff increases. We propose a general method

[18] So far, we have focused on the U.S. implications of the shock because our framework models the U.S. 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.

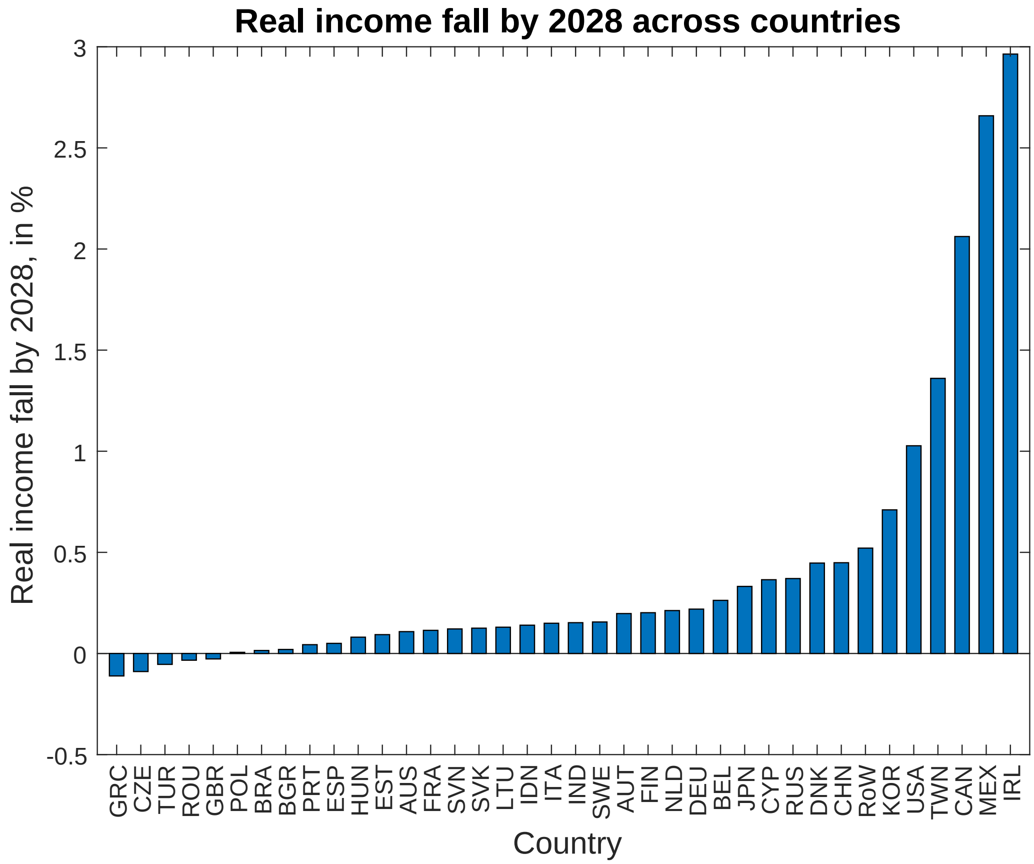

Figure 8: This figure displays the cumulative real income (which coincides with real GDP) fall by 2028, in percent, across countries. For country abbreviation codes, see Appendix B.1.

to solve quantitative trade models when the tariff revenue 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 U.S. First, there is a temporary but persistent decline in labor force participation as the market sector becomes less efficient and home production becomes comparatively more appealing. Second, there is a temporary increase in manufacturing employment, a sector for which the United States is a net importer. By contrast, there are temporary reductions in service and agricultural employment. Third, states highly exposed to trade with the countries most affected by the new tariffs (like Michigan, Texas, and California) see bigger real income losses. Fourth, the impacts of the shock depend on the trade elasticity. If the trade elasticity is low enough, the U.S. as a whole benefits from the tariff shock, but this comes with a decline in employment in the manufacturing sector.

At the country level, we find that the real income loss from the shock for the United States by 2028 is around 1%. Close trading partners of the U.S., like Canada, Mexico, China, and Ireland also suffer substantial real income losses. The overall U.S. real income loss masks huge heterogeneity across states, with certain states suffering real income losses greater than 3%. Importantly, our model does not capture any effects of tariff increases that might come from uncertainty, heightened geopolitical tensions, interactions with pre-existing distortions (such as income taxes), or central bank reactions to the shock, among many others.

Finally, we want to highlight some assumptions that might make our model underestimate the very 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.[19] 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 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).

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

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Appendix

A Model Equations

The model economy comprises multiple regions (indexed by i or j). There are M regions inside the U.S. (the 50 U.S. states), plus $I - M$ regions (countries) outside of the U.S. (for a total of I regions). We assume that there is no labor mobility across different countries but can allow for mobility across different states of the U.S. There are $S + 1$ sectors in the economy (indexed by s or k), with sector zero denoting the home-production sector and the remaining S sectors being productive market sectors. In each region j and period t, a representative consumer participating in the market economy devotes all income to expenditure $P_{j,t}C_{j,t}$, where $C_{j,t}$ and $P_{j,t}$ are aggregate consumption and the price index respectively. Aggregate consumption is a Cobb-Douglas aggregate of consumption across the S different market sectors with expenditure shares $\alpha_{j,s}$. As in a multi-sector Armington trade model, consumption in each market sector is a CES aggregate of consumption of the good of each of the I regions, with an elasticity of substitution $\sigma_s > 1$ in sector s.

Each region produces the good in sector s with a Cobb-Douglas production function, using labor with share $\phi_{j,s}$ and intermediate inputs with shares $\phi_{j,ks}$, where $\phi_{j,s} + \sum_k \phi_{j,ks} = 1$. TFP in region j, sector s, and time t is $A_{j,s,t}$. There is perfect competition and iceberg trade costs $\tau_{ij,s,t} \geq 1$ for exports from i to j in sector s. Additionally, there are ad-valorem tariffs $t_{ij,s,t}$ imposed by country j on imports from country i in sector s at time t. Intermediates from different origins are aggregated in the same way as consumption goods. Letting $W_{i,s,t}$ denote the wage in region i, sector s, at time t, the price in region j of good s produced by region i at time t is then

$$p_{ij,s,t} = \tau_{ij,s,t}(1 + t_{ij,s,t}) A_{i,s,t}^{-1} W_{i,s,t}^{\phi_{i,s}} \prod_k P_{i,k,t}^{\phi_{i,ks}}, \tag{A1}$$

where $P_{i,k,t}$ is the price index of sector k in region i at time t. Given our Armington assumption, these price indices satisfy

$$P_{j,s,t}^{1-\sigma_s} = \sum_{i=1}^{I} p_{ij,s,t}^{1-\sigma_s}, \tag{A2}$$

with corresponding trade shares

$$\lambda_{ij,s,t} \equiv \frac{p_{ij,s,t}^{1-\sigma_s}}{\sum_{r=1}^{I} p_{rj,s,t}^{1-\sigma_s}}. \tag{A3}$$

As mentioned in the main text, it is important to keep track of the revenue that different regions obtain from tariffs. Within the United States, we have the added problem that the tariff revenue collected by a U.S. state might not stay in that state, but might instead be transferred to the federal government that later redistributes that income to other states (in a way that is not necessarily proportional to the amount of tariff revenue they collect themselves). In order to flexibly model this, we assume that the total tariff revenue received by region i at time t is given by:

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

where $TRC_{j,t}$ is 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 constrain on these shares is that they need to add to one for a giver sender region when summing across all the receiving regions, i.e. $\sum_i \theta_{ji} = 1 \quad \forall j$. In our quantitative implementation, we will assume that tariff revenue collected is redistributed within the United States according to the share of the population that a given state represents.

In turn, the total revenue collected by region j, $TRC_{j,t}$, is given by:

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

where $EXP_{j,s,t}$ is the 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 $R_{i,s,t}$ and $L_{i,s,t}$ denote total revenues and employment in sector s of country i, respectively. Noting that the demand of industry k of country j of 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 given by:

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

Introducing the last two equations into the equation for TRR as a function of TRC and rearranging, we get:

$$\begin{aligned} TRR_{i,t} &= \sum_j \theta_{ji} \sum_s \psi_{j,s,t}\left[\alpha_{j,s}\left(\sum_{s=1}^{S} W_{j,s,t}L_{j,s,t} + D_{j,t} + TRR_{j,t}\right) + \sum_{k=1}^{S}\phi_{j,sk}R_{j,k,t}\right] \\ &= \sum_j \theta_{ji} \sum_s \psi_{j,s,t}\alpha_{j,s}TRR_{j,t} \\ &+ \sum_j \theta_{ji} \sum_s \psi_{j,s,t}\left[\alpha_{j,s}\left(\sum_{s=1}^{S} W_{j,s,t}L_{j,s,t} + D_{j,t}\right) + \sum_{k=1}^{S}\phi_{j,sk}R_{j,k,t}\right]. \end{aligned} \tag{A4}$$

In matrix notation, we can write this as:

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

where Θ, Ψ, A, and Φ are all matrices whose definitions should be clear from context, Y is a vector that contains as its j-th entry the element:

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

and R is a large vector made up of S sectorial vectors, each of which contains as its j-th entry the value of $R_{j,s,t}$. Therefore, we can finally solve for TRR as:

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

where eye(I) is an identity matrix of size I (i.e., the number of regions).

The market clearing condition for sector s in country i can be written as:

$$R_{i,s,t} = \sum_{j=1}^{I} \frac{\lambda_{ij,s,t}}{1+t_{ij,s,t}} \left(\alpha_{j,s}\left(\sum_{s=1}^{S} W_{j,s,t}L_{j,s,t} + D_{j,t} + TRR_{j,t}\right) + \sum_{k=1}^{S} \phi_{j,sk}R_{j,k,t}\right). \quad \text{(A5)}$$

In matrix notation this becomes:

$$R = \tilde{\Lambda}\left[A\left(Y + TRR\right) + \Phi R\right],$$

where $\tilde{\Lambda}$ is a matrix whose definition should be clear from the context. Multiplying through and introducing the expression for TRR we obtain:

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

So we can finally solve for the revenue vector using the following matrix expression:

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

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

Employment must be compatible with labor demand, which imposes another equilibrium equation given by:

$$W_{i,s,t}L_{i,s,t} = \phi_{i,s}R_{i,s,t}. \tag{A6}$$

Agents can either engage in home production or look for work in the labor market. If they participate in the labor market, they can be employed in any of the S market sectors. We let $c_{i,0,t}$ denote consumption associated with home production in region i, and $c_{i,s,t}$ denote consumption associated with seeking employment in sector s and region i at time t. We assume that $c_{i,0,t}$ is exogenous and does not vary over time, while—as explained further below—$c_{i,s,t}$ is endogenous and depends on real wages, unemployment, and tariff revenue. Additionally, we denote the number of agents participating in region i, sector s, at time t, by $\ell_{i,s,t}$.

Agents are forward looking and face a dynamic problem where they discount the future at rate β. Relocation decisions are subject to sectoral and spatial mobility costs. Specifically, there are costs $\varphi_{ji,sk}$ of moving from region j, sector s to region i, sector k. These costs are time invariant, additive, and measured in terms of utility. Additionally, agents have additive idiosyncratic shocks for each choice of region and sector, denoted by $\epsilon_{i,s,t}$.

An agent that starts in region j and sector s observes the economic conditions in all labor markets and the idiosyncratic shocks, then earns real income $c_{j,s,t}$ and has the option to relocate. The lifetime utility of an agent who is in region j, sector s, at time t, is then:

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

We assume that the joint density of the vector ϵ at time t is a nested Gumbel:

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

where $\kappa > \nu$. This allows us to have different elasticities of moving across regions and sectors. Let $V_{j,s,t} \equiv \mathbb{E}(\mathrm{v}_{j,s,t})$ be the expected lifetime utility of a representative agent in labor market j,s. Then, using γ to denote the Euler-Mascheroni constant, we have

$$V_{j,s,t} = \ln(c_{j,s,t}) + \ln\left(\sum_{i=1}^{I}\left(\sum_{k=0}^{S}\exp\left(\beta V_{i,k,t+1} - \varphi_{ji,sk}\right)^{1/\nu}\right)^{\nu/\kappa}\right)^{\kappa} + \gamma\kappa. \tag{A7}$$

Denote by $\mu_{ji,sk|i,t}$ the number of agents that relocate from market js to ik expressed as a share of the total number of agents that move from js to ik' for any sector k'. Additionally, let $\mu_{ji,s\#,t}$ denote the fraction of agents that relocate from market js to any market in i as a share of all the agents in js. As shown in RUV, these fractions are given by

$$\mu_{ji,sk|i,t} = \frac{\exp\left(\beta V_{i,k,t+1} - \varphi_{ji,sk}\right)^{1/\nu}}{\sum_{h=0}^{S}\exp\left(\beta V_{i,h,t+1} - \varphi_{ji,sh}\right)^{1/\nu}} \tag{A8}$$

$$\mu_{ji,s\#,t} = \frac{\left(\sum_{h=0}^{S}\exp\left(\beta V_{i,h,t+1} - \varphi_{ji,sh}\right)^{1/\nu}\right)^{\nu/\kappa}}{\sum_{m=1}^{I}\left(\sum_{h=0}^{S}\exp\left(\beta V_{m,h,t+1} - \varphi_{jm,sh}\right)^{1/\nu}\right)^{\nu/\kappa}}. \tag{A9}$$

The total number of agents that move from js to ik is given by $\mu_{ji,sk} = \mu_{ji,sk|i,t} \cdot \mu_{ji,s\#,t}$. Participation in the different labor markets evolves according to

$$\ell_{i,k,t+1} = \sum_{j=1}^{I}\sum_{s=0}^{S}\mu_{ji,sk|i,t}\mu_{ji,s\#,t}\ell_{j,s,t} \tag{A10}$$

The aggregate price index in region i at time t is given by:

$$P_{i,t} = \prod_{s=1}^{S} P_{i,s,t}^{\alpha_{i,s}}. \tag{A11}$$

We assume that the income generated in a sector-region is equally shared between all participants in that sector-region. Additionally, the income for agents is not only given by their wage income, but it also includes the tariff revenue received by the region that agents live in. We assume that, within sectors in a region, tariff revenue received (TRR) is split among sectors using labor supply weights. With all of this, the real level of per-capita consumption $c_{i,s,t}$ from participating in market sector s is given by:

$$c_{i,s,t} = \frac{W_{i,s,t} L_{i,s,t} + \frac{\ell_{i,s,t}}{\sum_{k=1}^{S} \ell_{i,k,t}} TRR_{i,t}}{\ell_{i,s,t} P_{i,t}}, \tag{A12}$$

where $P_{i,t}$ is the aggregate price index in region i and $TRR_{i,t}$ is the tariff revenue received by region i at time t.

We denote the number of agents that are actually employed in region i and sector k at time t with $L_{i,k,t}$. In a standard trade model, labor market clearing requires that the labor used in a sector and region be equal to labor supplied to that sector, i.e., $L_{i,k,t} = \ell_{i,k,t}$. We depart from this assumption and instead follow Schmitt-Grohe and Uribe (2016) by allowing for downward nominal wage rigidity, which might lead to an employment level that is strictly below labor supply,

$$L_{i,k,t} \leq \ell_{i,k,t}. \tag{A13}$$

All prices and wages up to now have been expressed in U.S. dollars. In contrast, a given region faces DNWR in terms of its local currency unit. Letting $W_{i,k,t}^{LCU}$ denote nominal wages in local currency units, the DNWR takes the following form:

$$W_{i,k,t}^{LCU} \geq \delta_k W_{i,k,t-1}^{LCU}, \qquad \delta_k \geq 0.$$

Letting $E_{i,t}$ denote the exchange rate between the local currency unit of region i and the local currency unit of region 1 (which is the U.S. dollar) in period t (in units of dollars per

LCU of region i), then $W_{i,k,t} = W^{LCU}_{i,k,t} E_{i,t}$ and so the DNWR for wages in dollars entails

$$W_{i,k,t} \geq \frac{E_{i,t}}{E_{i,t-1}} \delta_k W_{i,k,t-1}.$$

Since all regions within the U.S. share the dollar as their LCU, then $E_{i,t} = 1$ and $W^{LCU}_{i,k,t} = W_{i,k,t} \; \forall \; i \leq M$. This means that the DNWR in states of the U.S. takes the familiar form $W_{i,k,t} \geq \delta_k W_{i,k,t-1}$. For the $I - M$ regions outside of the U.S., the LCU is not the dollar, so the exchange-rate behavior impacts how the DNWR affects the real economy. The DNWR in dollars can then be captured using a country-specific parameter $\delta_{i,k}$, i.e.:

$$W_{i,k,t} \geq \delta_{i,k} W_{i,k,t-1}, \qquad \delta_{i,k} \geq 0. \tag{A14}$$

The baseline model assumes that regions outside of the U.S. have a flexible exchange rate with respect to the U.S. (so the DNWR never binds for other countries).[20] This is captured by setting $\delta_{i,k} = \delta_k \; \forall \; i$. There is also a complementary slackness condition,

$$(\ell_{i,k,t} - L_{i,k,t})(W_{i,k,t} - \delta_{i,k} W_{i,k,t-1}) = 0. \tag{A15}$$

So far, we have introduced nominal elements to the model (i.e., the DNWR), but we have not introduced a nominal anchor that prevents nominal wages from rising so much in each period as to make the DNWR always non-binding. We now want to capture the general idea that central banks are unwilling to allow inflation to be too high because of its related costs. In traditional macro models, this is usually implemented via a Taylor rule, where the policy rate reacts to inflation. Instead, we use a nominal anchor that captures a similar idea in a way that naturally lends itself to quantitative implementation in our trade model. A similar nominal anchor is used in Guerrieri et al. (2021), albeit in the context of a static, closed economy model. In particular, we assume that world nominal

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

GDP in dollars grows at a constant rate γ every year,

$$\sum_{i=1}^{I}\sum_{k=1}^{K} W_{i,k,t}L_{i,k,t} = (1+\gamma)\sum_{i=1}^{I}\sum_{k=1}^{K} W_{i,k,t-1}L_{i,k,t-1}. \tag{A16}$$

The main benefit of this nominal anchor assumption is that it allows us to solve our otherwise-unwieldy model using a fast contraction-mapping algorithm in the spirit of Alvarez and Lucas (2007) that we develop to deal with the complementary slackness condition brought by the DNWR.

Following Caliendo et al. (2019), we can think of the full equilibrium of our model in terms of a temporary equilibrium and a sequential equilibrium. In our environment with DNWR, given last period's nominal world GDP ($\sum_{i=1}^{I}\sum_{s=1}^{S} W_{i,s,t-1}L_{i,s,t-1}$), wages $\{W_{i,s,t-1}\}$, 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 $\{R_{i,s,t}\}$, bilateral trade shares $\{\lambda_{ij,s,t}\}$, tariff revenues received $\{TRR_{i,t}\}$, sectoral aggregate prices $\{P_{i,s,t}\}$, and bilateral prices $\{p_{ij,s,t}\}$ such that equations (A1)-(A6) and (A13)-(A16) hold. In turn, given starting world nominal GDP ($\sum_{i=1}^{I}\sum_{s=1}^{S} W_{i,s,0}L_{i,s,0}$), labor supply $\{\ell_{i,s,0}\}$, and wages $\{W_{i,s,0}\}$, a sequential equilibrium is a sequence for the aforementioned endogenous variables in the temporary equilibrium plus the variables $\{c_{i,s,t},\ V_{i,s,t},\ \mu_{ji,sk|i,t},\ \mu_{ji,s\#,t},\ \ell_{i,s,t},\ P_{i,t}\}_{t=1}^{\infty}$ such that: (i) at every period t $\{W_{i,s,t}, L_{i,s,t}, R_{i,s,t}, \lambda_{ij,s,t}, TRR_{i,t}, P_{i,s,t}, p_{ij,s,t}\}$ constitute a temporary equilibrium given $\sum_{i=1}^{I}\sum_{s=1}^{S} W_{i,s,t-1}L_{i,s,t-1}$, $\{W_{i,s,t-1}\}$, and $\{\ell_{i,s,t}\}$, and (ii) $\{c_{i,s,t}, V_{i,s,t}, \mu_{ji,sk|i,t}, \mu_{ji,s\#,t}, \ell_{i,s,t}, P_{i,t}\}_{t=1}^{\infty}$ satisfy equations (A7)-(A12).

We are interested in obtaining the effects of the tariff shock as it is introduced in an economy that did not previously expect it. In order to do this, we will use the exact hat algebra methodology of Dekle et al. (2007), extended to dynamic settings by Caliendo et al. (2019). Specifically, we use $\hat{x}_t$ to denote the ratio between a relative time difference in the counterfactual economy ($\dot{x}'_t$) and a relative time difference in the baseline economy ($\dot{x}_t$), i.e. $\hat{x}_t = \dot{x}'_t/\dot{x}_t$ for any variable x. Then we compare a counterfactual economy where the knowledge of the tariff shock is unexpectedly introduced in the year 2025 (and agents have perfect foresight about the path of the shock from then on), with a baseline economy where the tariff shock does not occur.

B Additional Details on Data Construction

Our data construction follows steps similar to those in Rodriguez-Clare, Ulate, and Vasquez (2025) (RUV) and Ulate, Vasquez, and Zarate (2025) (UVZ). The most recent data available for calibrating our quantitative model is from 2020. To avoid complications from the COVID-19 shock, we use data from 2019 and assume that the relative sizes of each country, state, and sector closely approximate those in 2024. In this sense is that we consider 2024 as our baseline year. Here we provide a summary of the main features of the data construction and refer the reader to the Online Appendix in RUV for further details.

B.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, and one agriculture sector. We follow RUV and UVZ in the selection of the 12 manufacturing sectors. These are: **1)** Food, beverage, and tobacco products (NAICS 311-312, ICIO sector D10T12); **2)** Textile, textile product mills, apparel, leather, and allied products (NAICS 313-316, ICIO sector D13T15); **3)** Wood products, paper, printing, and related support activities (NAICS 321-323, ICIO sectors D16, D17T18); **4)** Mining, petroleum and coal products (NAICS 211-213, 324, ICIO sectors D05T06, D07T08, D09, D19); **5)** Chemicals (NAICS 325, ICIO sectors D20, D21); **6)** Plastics and rubber products (NAICS 326, ICIO sector D22); **7)** Nonmetallic mineral products (NAICS 327, ICIO sector D23); **8)** Primary metal and fabricated metal products (NAICS 331-332, ICIO sectors D24, D25); **9)** Machinery (NAICS 333, ICIO sector D28);

10) Computer and electronic products, and electrical equipment and appliance (NAICS 334-335, ICIO sectors D26, D27); **11)** Transportation equipment (NAICS 336, ICIO sectors D29, D30); **12)** Furniture and related products, and miscellaneous manufacturing (NAICS 337-339, ICIO sector D31T33). There is a **13)** Services sector which includes Construction (NAICS 23, ICIO sector D41T43); Wholesale and retail trade sectors (NAICS 42-45, ICIO sectors D45T47); Accommodation and Food Services (NAICS 721-722, ICIO sector D55T56); transport services (NAICS 481-488, ICIO sectors D49-D53); Information Services (NAICS 511-518, ICIO sectors D58T60, D61, D62T63); Finance and Insurance (NAICS 521-525, ICIO sector D64T66); Real Estate (NAICS 531-533, ICIO sector D68); Education (NAICS 61, ICIO sector D85); Health Care (NAICS 621-624, ICIO sector D86T88); and Other Services (NAICS 493, 541, 55, 561, 562, 711-713, 811-814, ICIO sectors D69T75, D77T82, D90T93, D94T96, D97T98). Finally, there is an **14)** agriculture sector (ICIO sectors D01T02, D03).

List of countries: As in RUV and UVZ, we use data for 50 U.S. states, 36 other countries and a constructed rest of the world. The list of countries is: Australia (AUS), Austria (AUT), Belgium (BEL), Bulgaria (BGR), Brazil (BRA), Canada (CAN), China (CHN), Cyprus (CYP), Czechia (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), India (IND), Indonesia (IDN), Italy (ITA), Ireland (IRL), Japan (JPN), Lithuania (LTU), Mexico (MEX), the Netherlands (NLD), Poland (POL), Portugal (PRT), Romania (ROU), Russia (RUS), Spain (ESP), the Slovak Republic (SVK), Slovenia (SVN), South Korea (KOR), Sweden (SWE), Taiwan (TWN), Turkey (TUR), the United Kingdom (GBR), and the rest of the world (RoW). We plan to extend the list of countries very soon.

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

For bilateral trade between countries, we use the OECD's Inter Country Input Output (ICIO) Database. For data on bilateral trade in manufacturing between U.S. states, we combine 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 rest of the countries, we follow RUV and obtain sector-level imports and exports between the 50 U.S. states and the list of other 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 BEA and total production and expenditure in services from ICIO (for other countries). We also use the Agricultural Census and 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 and 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. For the list of other countries, we obtain the share of value added in gross output using data on value added and gross output data from ICIO.

B.3 Data on Employment and Labor Flows

For the case of countries, we take data on employment by country and sector from the WIOD Socio Economic Accounts (WIOD-SEA) and the International Labor Organization (ILO). For the case of U.S. states, we take sector-level employment (including unemployment and non-participation) from a combination of the Census and the American Community Survey (ACS). As in RUV and UVZ, we only keep observations with ages between 25 and 65, who are either employed, unemployed, or out of the labor force. We construct a matrix of migration flows between sectors within each U.S. state using the Current Population Survey (CPS). Finally, we abstract from international migration and migration between U.S. states.