# Appendix

### 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 $s$. 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

$$p_{ij,s,t} = \tau_{ij,s,t} A_{i,s,t}^{-1} W_{i,s,t}^{\phi_{i,s}} \prod_k P_{i,k,t}^{\phi_{i,ks}}, \tag{A.1}$$

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

$$P_{j,s,t}^{1-\sigma_s} = \sum_{i=1}^{I} p_{ij,s,t}^{1-\sigma_s}, \tag{A.2}$$

with corresponding trade shares

$$\lambda_{ij,s,t} \equiv \frac{p_{ij,s,t}^{1-\sigma_s}}{\sum_{r=1}^{I} p_{rj,s,t}^{1-\sigma_s}}. \tag{A.3}$$

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, the market clearing condition for sector $s$ in country $i$ can be written as

$$R_{i,s,t} = \sum_{j=1}^{I} \lambda_{ij,s,t} \left( \alpha_{j,s} \left( \sum_{k=1}^{S} W_{j,k,t} L_{j,k,t} + D_{j,t} \right) + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t} \right), \tag{A.4}$$

where $D_{j,t}$ are transfers received by region $j$, with $\sum_j D_{j,t} = 0$. In turn, employment must be compatible with labor demand,

$$W_{i,s,t} L_{i,s,t} = \phi_{i,s} R_{i,s,t}. \tag{A.5}$$

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 and unemployment. 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 $\beta$. 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:

$$\Omega_{j,s,t} = \ln(c_{j,s,t}) + \max_{\{i,k\}_{i=1,k=0}^{I,S}} \{\beta \mathbb{E}(\Omega_{i,k,t+1}) - \varphi_{ji,sk} + \epsilon_{i,k,t}\}. \tag{A.6}$$

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

$$F(\boldsymbol{\epsilon}) = \exp\left(-\sum_{i=1}^{I}\left(\sum_{k=0}^{S} \exp\left(-\epsilon_{i,k,t}/\nu\right)\right)^{\nu/\kappa}\right), \tag{A.7}$$

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

$$V_{j,s,t} = \ln(c_{j,s,t}) + \ln\left(\sum_{i=1}^{I}\left(\sum_{k=0}^{S} \exp\left(\beta V_{i,k,t+1} - \varphi_{ji,sk}\right)^{1/\nu}\right)^{\nu/\kappa}\right)^{\kappa} + \gamma\kappa. \tag{A.8}$$

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

$$\mu_{ji,sk|i,t} = \frac{\exp\left(\beta V_{i,k,t+1} - \varphi_{ji,sk}\right)^{1/\nu}}{\sum_{h=0}^{S} \exp\left(\beta V_{i,h,t+1} - \varphi_{ji,sh}\right)^{1/\nu}} \tag{A.9}$$

$$\mu_{ji,s\#,t} = \frac{\left(\sum_{h=0}^{S} \exp\left(\beta V_{i,h,t+1} - \varphi_{ji,sh}\right)^{1/\nu}\right)^{\nu/\kappa}}{\sum_{m=1}^{I}\left(\sum_{h=0}^{S} \exp\left(\beta V_{m,h,t+1} - \varphi_{jm,sh}\right)^{1/\nu}\right)^{\nu/\kappa}}. \tag{A.10}$$

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

$$\ell_{i,k,t+1} = \sum_{j=1}^{I}\sum_{s=0}^{S} \mu_{ji,sk|i,t}\mu_{ji,s\#,t}\ell_{j,s,t} \tag{A.11}$$

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

$$P_{i,t} = \prod_{s=1}^{S} P_{i,s,t}^{\alpha_{i,s}}. \tag{A.12}$$

We assume that the income generated in a sector-region is equally shared between all participants in that sector-region. Since agents get real wage $W_{i,s,t}/P_{i,t}$ with probability $L_{i,s,t}/\ell_{i,s,t}$ if they seek employment in sector $s$ of region $i$ at time $t$, we have

$$c_{i,k,t} = \frac{W_{i,k,t}}{P_{i,t}} \cdot \frac{L_{i,k,t}}{\ell_{i,k,t}}. \tag{A.13}$$

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,

$$L_{i,k,t} \leq \ell_{i,k,t}. \tag{A.14}$$

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:

$$W_{i,k,t}^{LCU} \geq \delta_k W_{i,k,t-1}^{LCU}, \qquad \delta_k \geq 0. \tag{A.15}$$

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 $W_{i,k,t} = W_{i,k,t}^{LCU} E_{i,t}$ and so the DNWR for wages in dollars entails

$$W_{i,k,t} \quad \geq \quad \frac{E_{i,t}}{E_{i,t-1}} \delta_k W_{i,k,t-1}. \tag{A.16}$$

Since all regions within the U.S. share the dollar as their LCU, then $E_{i,t} = 1$ and $W_{i,k,t}^{LCU} = W_{i,k,t} \; \forall \; i \leq M$. 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.:

$$W_{i,k,t} \geq \delta_{i,k} W_{i,k,t-1}, \qquad \delta_{i,k} \geq 0. \tag{A.17}$$

The baseline model assumes that regions outside of the U.S. have a fixed exchange rate with respect to the U.S. (so the DNWR takes the same form in other countries as it does in the United States).[25] This is captured by setting $\delta_{i,k} = \delta_k \; \forall \; i$. There is also a complementary slackness condition,

$$(\ell_{i,k,t} - L_{i,k,t})(W_{i,k,t} - \delta_{i,k} W_{i,k,t-1}) = 0. \tag{A.18}$$

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 GDP in dollars grows at a constant rate $\gamma$ every year,

$$\sum_{i=1}^{I} \sum_{k=1}^{K} W_{i,k,t} L_{i,k,t} = (1+\gamma) \sum_{i=1}^{I} \sum_{k=1}^{K} W_{i,k,t-1} L_{i,k,t-1}. \tag{A.19}$$

The main benefit of this nominal anchor assumption is that it allows us to solve our other-wise-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.

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

Following CDP, 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 $\{W_{i,s,t}\}$ and employment levels $\{L_{i,s,t}\}$ such that equations (A.1)-(A.5) and (A.14)-(A.19) 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 $\{c_{i,s,t},\ V_{i,s,t},\ \mu_{ji,sk|i,t},\ \mu_{ji,s\#,t},\ \ell_{i,s,t},\ W_{i,s,t},\ L_{i,s,t},\}_{t=1}^{\infty}$ such that: (i) at every period $t$ $\{W_{i,s,t}, L_{i,s,t}\}$ 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) $\{c_{i,s,t}, V_{i,s,t}, \mu_{ji,sk|i,t},\ \mu_{ji,s\#,t}, \ell_{i,s,t}\}_{t=1}^{\infty}$ satisfy equations (A.8)-(A.13).

We are interested in obtaining the effects of the trade cost shock as it is introduced in an economy that did not previously expect this shock. 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 trade shock is unexpectedly introduced in the year 2020 (and agents have perfect foresight about the path of the shock from then on), with a baseline economy where the trade shock does not occur.

## Appendix B. Exposure of a Region to a Trade Shock

One may be interested in assessing how different regions are exposed to trade cost shocks. To this end, one can use the labor demand equation from our model and a first-order approximation to construct a regional exposure measure that tracks how the change in trade costs impacts regional value added (which is equivalent to nominal GDP). This formula can be understood as a comparative-statics exercise that tells us how much demand across regions (and, therefore, countries) shifts in response to trade cost shocks. This measure is somewhat similar to the one in (Adao et al., 2020, henceforth AAE), but it includes new elements due to the presence of intermediate inputs in our model.[26] The exposure formula for region $i$ after a change in the vector of trade costs $\hat{\tau}$ is given by:

$$\hat{\eta}_i(\hat{\tau}) \quad = \quad \sum_{s=1}^{S}(1-\sigma_s)\omega_{i,s,0}\theta_{i,s}(\hat{\tau}). \tag{B.1}$$

In the previous expression, $(1-\sigma_s)$ is the trade elasticity in sector $s$, $\omega_{i,s,0}$ is the share of the wage bill in market $i$ that goes to sector $s$ in the base year (denoted with a zero even though in our implementation it will be the year 2019), and $\theta_{i,s}(\hat{\tau})$ is the shift in demand for the sector $s$ good of region $i$:

$$\theta_{i,s}(\hat{\tau}) \quad = \quad \sum_{j=1}^{I} r_{ij,s,0}\left(\hat{\tau}_{ij,s} + \widehat{mc}_{i,s} - \sum_{q=1}^{I}\lambda_{qj,s,0}(\hat{\tau}_{qj,s} + \widehat{mc}_{q,s})\right). \tag{B.2}$$

The variable $r_{ij,s,0}$ denotes the share of market $i$'s sales in sector $s$ that go to market $j$ in the base year, $\lambda_{qj,s,0}$ denotes the share of market $j$'s purchases in sector $s$ that come from market $q$ in the base year, $\hat{\tau}_{ij,s} = \ln(\tau_{ij,s,2021}) - \ln(\tau_{ij,s,2019})$ denotes the log difference in the iceberg trade costs between the base year and the high-trade-cost years, and $\widehat{mc}_{i,s} = \ln(mc_{i,s,2021}) - \ln(mc_{i,s,2019})$ denotes the log difference in the marginal cost between the base year and the high-trade-cost years.[27] The changes in marginal costs $\widehat{mc}$, can themselves be expressed as a function of the change in trade costs, and they appear in the previous formula

[26] AAE adds labor force participation to a classic trade model but does not incorporate intermediate inputs via an input-output structure.

[27] Recall that in our baseline quantitative implementation the high trade costs will start in 2020, persist during 2021, and revert to their 2019 levels in 2022.

due to the presence of intermediate inputs. If labor was the only factor of production, then the $\widehat{mc}$'s would disappear from the previous expression, and our formula would more closely resemble equation (17) of AAE.

$\hat{\eta}_i(\hat{\tau})$ represents market $i$'s "revenue shock exposure". It is the sum across sectors of the shock to the demand for the good of region $i$ in each sector, $\theta_{i,s}(\hat{\tau})$, weighted by that sector's share in $i$'s wage bill in the base year $\omega_{i,s,0}$. The sector-level demand shock, $\theta_{i,s}(\hat{\tau})$, is itself the sum across destinations $j$ of the impact of market $i$'s own trade shock (including the effects via the marginal cost) on the demand for its good minus the demand shift caused by competitors' trade shocks (including the effects via the marginal cost) in that sector, weighted by the revenue importance of each destination in the base year $r_{ij,s,0}$. Note that all components of $\hat{\eta}_i(\hat{\tau})$ can be computed with information on bilateral trade flows in the base year plus measures of the bilateral trade shocks. In our baseline quantitative implementation, $\hat{\tau}_{ij,s} \approx 12\%$ if $i$ and $j$ are regions located in different countries, while $\hat{\tau}_{ij,s} = 0$ if $i = j$ or if $i$ and $j$ are regions of the same country (e.g., two U.S. states).

The previous exposure measure provides a useful way to assess the impact of shocks on a given region by considering how it competes with all other regions in all possible destination markets, including its own. If a region is in autarky, a change in the $\tau$'s has no effect and $\theta_{i,s}(\hat{\tau}) = 0$ for all $s$, resulting in $\hat{\eta}_i(\hat{\tau}) = 0$. Regions that are more open or have higher wage-bill shares in open sectors are more exposed to trade cost shocks.

In order to derive the exposure measure, notice that, omitting the time subscript and introducing equation (A.4) into it, equation (A.5) can be written as:

$$W_{i,s}L_{i,s} = \phi_{i,s} \sum_{j=1}^{I} \lambda_{ij,s} X_{j,s}, \tag{B.3}$$

where $X_{j,s}$ is the total expenditure of location $j$ in sector $s$ and the trade shares can now be expressed as

$$\lambda_{ij,s} = \frac{(mc_{i,s}\tau_{ij,s})^{1-\sigma_s}}{\sum_{r=1}^{I}(mc_{r,s}\tau_{rj,s})^{1-\sigma_s}}, \tag{B.4}$$

with

$$mc_{i,s} = \frac{W_{i,s}^{\phi_{i,s}} \prod_{k=1}^{S} P_{i,k}^{\phi_{i,ks}}}{A_{i,s}}, \tag{B.5}$$

and

$$P_{i,s} = \left( \sum_{j=1}^{I} (mc_{j,s}\tau_{ji,s})^{1-\sigma_s} \right)^{\frac{1}{1-\sigma_s}}. \tag{B.6}$$

We are interested in constructing an exposure measure for region $i$ to a change in the whole vector of iceberg trade costs $\boldsymbol{\tau}$ (as done, for example, in AAE). We define as our outcome of interest the total wage bill ($WB$) in region $i$:

$$WB_i = \sum_{s=1}^{S} W_{i,s}L_{i,s}. \tag{B.7}$$

Then, we can obtain the exposure measure from a first-order approximation to the previous equation (keeping the $X_{j,s}$ fixed as is commonly done when deriving such exposure measures):

$$\begin{aligned} d\ln WB_i &= \sum_{s=1}^{S}(1-\sigma_s) \underbrace{\frac{W_{i,s}L_{i,s}}{\sum_k W_{i,k}L_{i,k}}}_{\omega_{i,s}} \left( \sum_{j=1}^{I} \underbrace{\frac{\lambda_{ij,s}X_{j,s}}{\sum_n \lambda_{in,s}X_{n,s}}}_{r_{ij,s}} \left[ d\ln \tau_{ij,s} + d\ln mc_{i,s} \right.\right. \\ &\quad \left.\left. - \sum_{q=1}^{I} \lambda_{qj,s}(d\ln \tau_{qj,s} + d\ln mc_{q,s}) \right] \right), \end{aligned} \tag{B.8}$$

where $\omega_{i,s}$ corresponds to the share of wage bill from sector $s$ in the total wage bill of region $i$ and $r_{ij,s}$ corresponds to the share of sales of region $i$-sector $s$ in region $j$. The formula is similar to the one in AAE; the differences are that here the marginal cost is allowed to vary with the trade shock (which is relevant due to the presence of intermediate inputs) and that in AAE $\ell_{i,s}$ corresponds to the share of labor in sector $s$ in region $i$ whereas here $\omega_{i,s}$ is a share of the wage bill.

Taking the partial derivative of (B.5) with respect to trade costs, we get:

$$d \ln mc_{i,s} = \sum_k \phi_{i,ks} d \ln P_{i,k}, \tag{B.9}$$

which we can write as:

$$\widehat{\boldsymbol{mc}} = \boldsymbol{\Phi} \hat{\boldsymbol{P}}, \tag{B.10}$$

where $\widehat{\boldsymbol{mc}}$ is a $(I \cdot S) \times 1$ vector of marginal cost changes, $\hat{\boldsymbol{P}}$ is a $(I \cdot S) \times 1$ vector of price changes, and $\Phi$ is a $(I \cdot S) \times (I \cdot S)$ block diagonal matrix that contains as its $i$-th diagonal block the input-output matrix of region $I$.

If we then take derivative with respect to trade costs in (B.6), we get:

$$d \ln P_{i,k} = \sum_{j=1}^{I} \lambda_{ji,k} (d \ln \tau_{ji,k} + d \ln mc_{j,k}), \tag{B.11}$$

which we can write as:

$$\hat{\boldsymbol{P}} = \Lambda_1 \hat{\boldsymbol{\tau}} + \Lambda_2 \widehat{\boldsymbol{mc}}, \tag{B.12}$$

where $\Lambda_1$ is a $(I \cdot S) \times (I \cdot I \cdot S)$ matrix of trade shares, $\hat{\boldsymbol{\tau}}$ is a $(I \cdot I \cdot S) \times 1$ vector of trade cost changes, and $\Lambda_2$ is a $(I \cdot S) \times (I \cdot S)$ different (from $\Lambda_1$) matrix of trade shares. Introducing (B.10) in this last equation, we get:

$$\hat{\boldsymbol{P}} = \Lambda_1 \hat{\boldsymbol{\tau}} + \Lambda_2 \boldsymbol{\Phi} \hat{\boldsymbol{P}} \tag{B.13}$$

$$(I - \Lambda_2 \boldsymbol{\Phi}) \hat{\boldsymbol{P}} = \Lambda_1 \hat{\boldsymbol{\tau}} \tag{B.14}$$

$$\hat{\boldsymbol{P}} = (I - \Lambda_2 \boldsymbol{\Phi})^{-1} \Lambda_1 \hat{\boldsymbol{\tau}}. \tag{B.15}$$

Therefore, we conclude that:

$$\widehat{\boldsymbol{mc}} = \boldsymbol{\Phi} (I - \Lambda_2 \boldsymbol{\Phi})^{-1} \Lambda_1 \hat{\boldsymbol{\tau}}. \tag{B.16}$$

We can use this equation to write (B.8) solely in terms of the trade cost shock.

## Appendix C. Data Construction

Our data construction follows steps that are related to those in Rodriguez-Clare, Ulate and Vasquez (2024) (RUV), but setting the base year to 2019 (as opposed to 2000 as in RUV) requires incorporating new data sources such as the OECD's Inter-Country Input-Output Database (ICIO) since the World Input-Output Database (WIOD) is not available after 2014. 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.

### *Appendix C.1. Data Description and Sources*

**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 (ICIO sectors D01T02, D03). We follow RUV 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).

**List of countries:** As in RUV, 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).

### *Appendix C.2. Data on Bilateral Trade*

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 CDP 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.

### *Appendix C.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, 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 and U.S. states by combining data from the ACS and the Current Population Survey (CPS). Finally, we abstract from international migration.

## Appendix D. Additional Exhibits

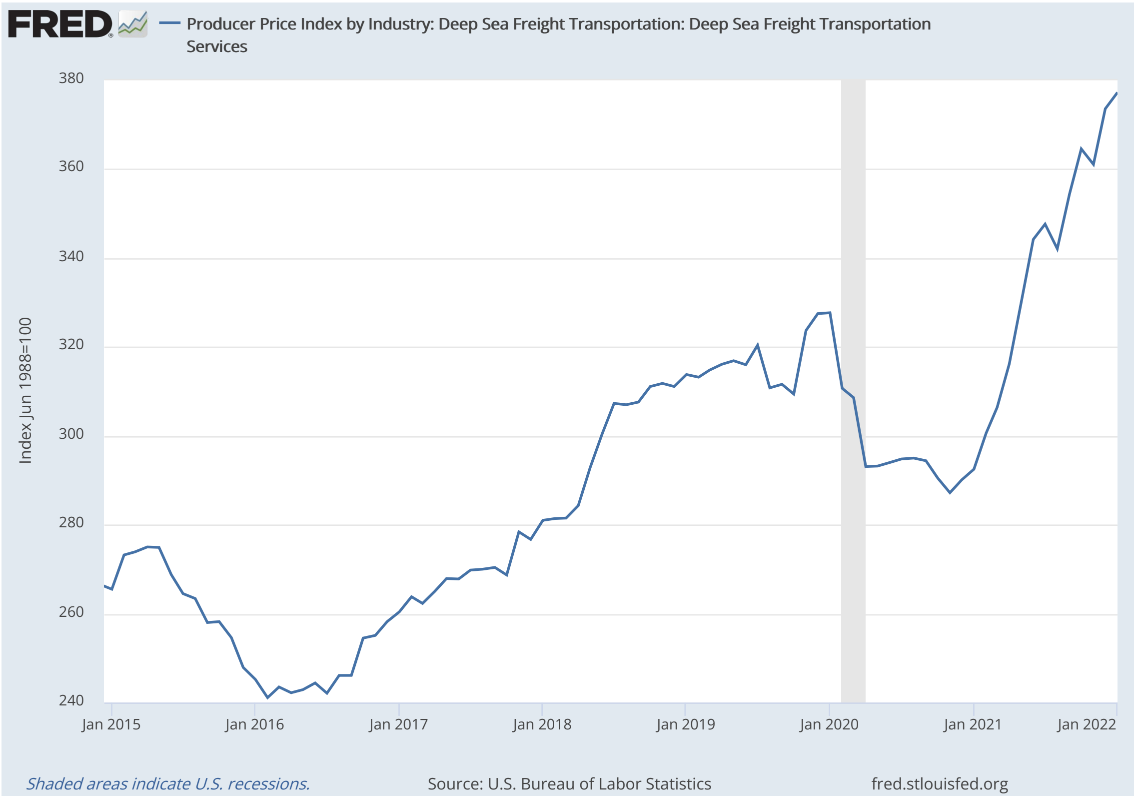


Figure D.1: PPI for deep sea freight transportation services between January 2015 and January 2022, taken directly from FRED.

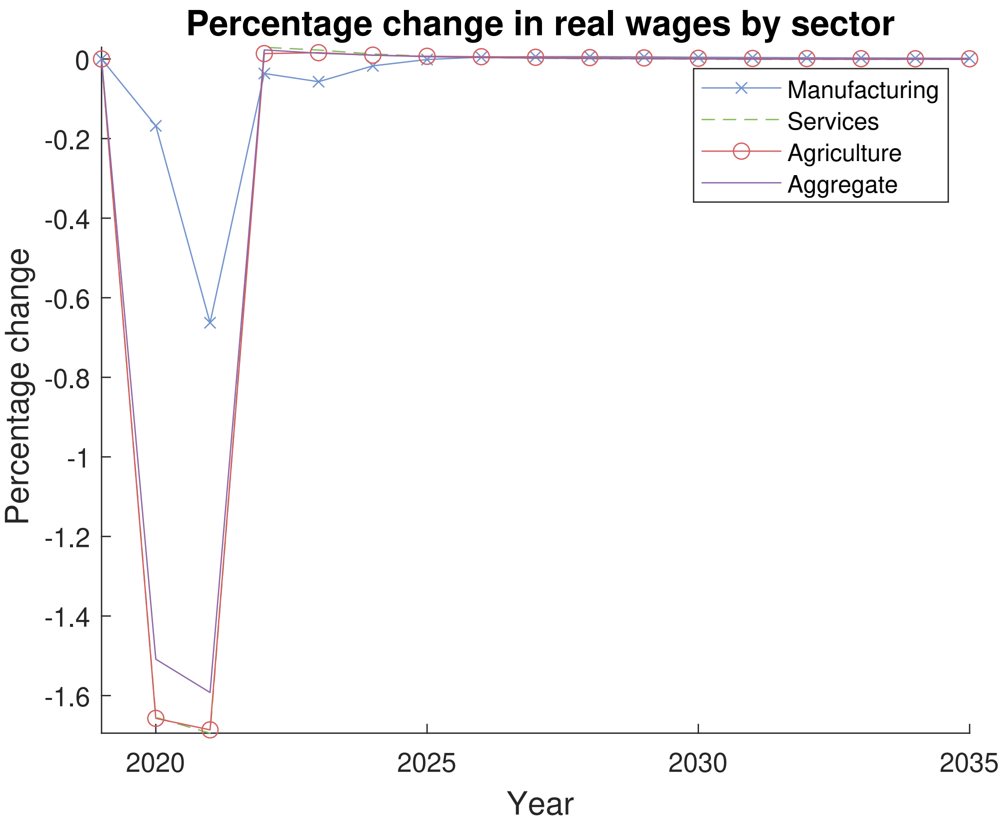


Figure D.2: Paths of cumulative percentage change since 2019 in real wages for manufacturing, services, agriculture, and on aggregate.

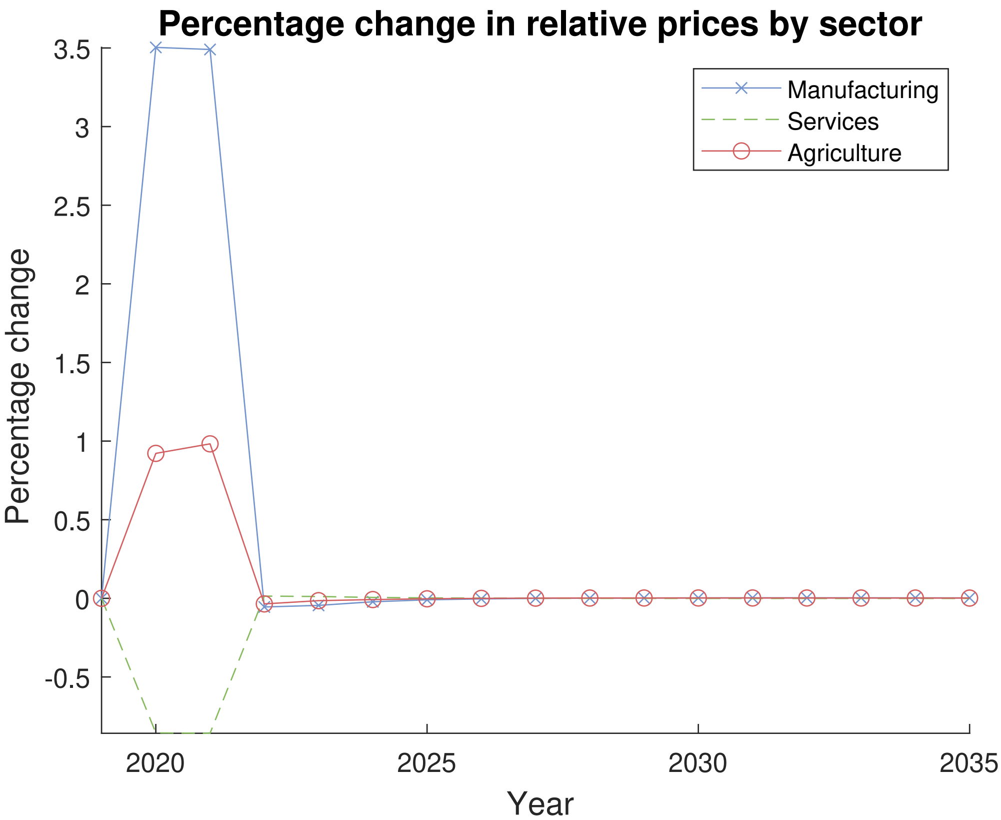


Figure D.3: Paths of cumulative percentage change since 2019 in the relative prices of manufacturing, services, and agriculture.

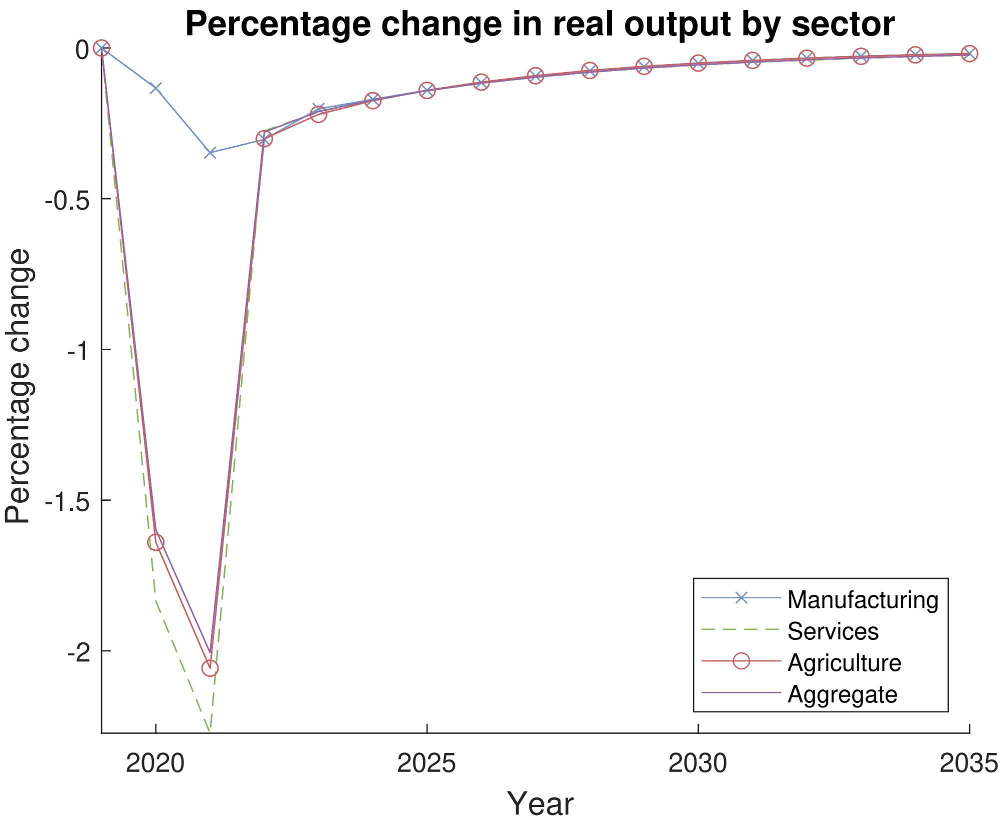


Figure D.4: Paths of cumulative percentage change since 2019 in real output for manufacturing, services, agriculture, and on aggregate.

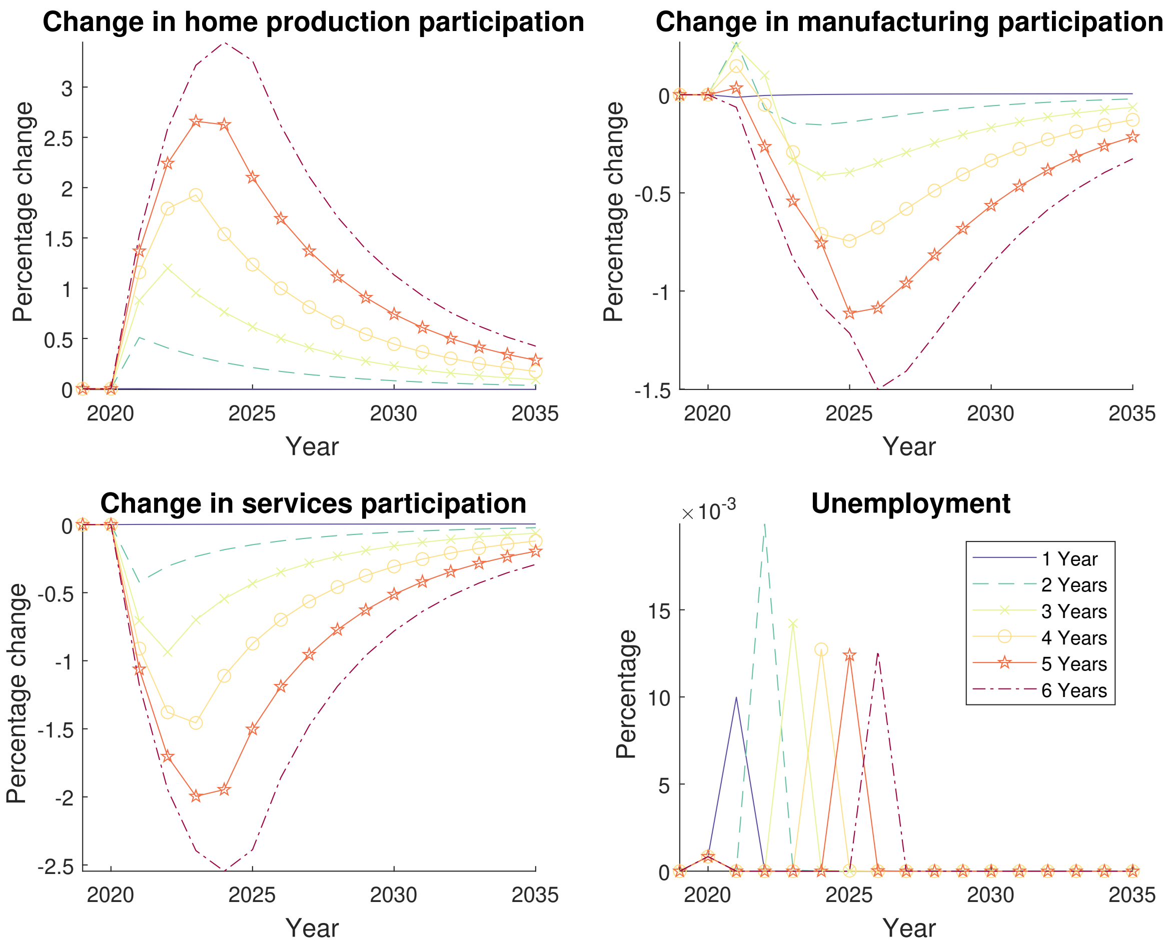


Figure D.5: Paths of percentage changes in participation since 2019 in home production (top left), manufacturing (top right), and services (bottom left), as well as unemployment generated by the shock in percentage (bottom right) for the United States as a whole across different values for the duration of the shock. The solid blue line depicts one year, the dashed turquoise line 2 years, the green starred line 3 years, the apricot circle line 4 years, the orange starred line 5 years, and the red dash dotted line 6 years.

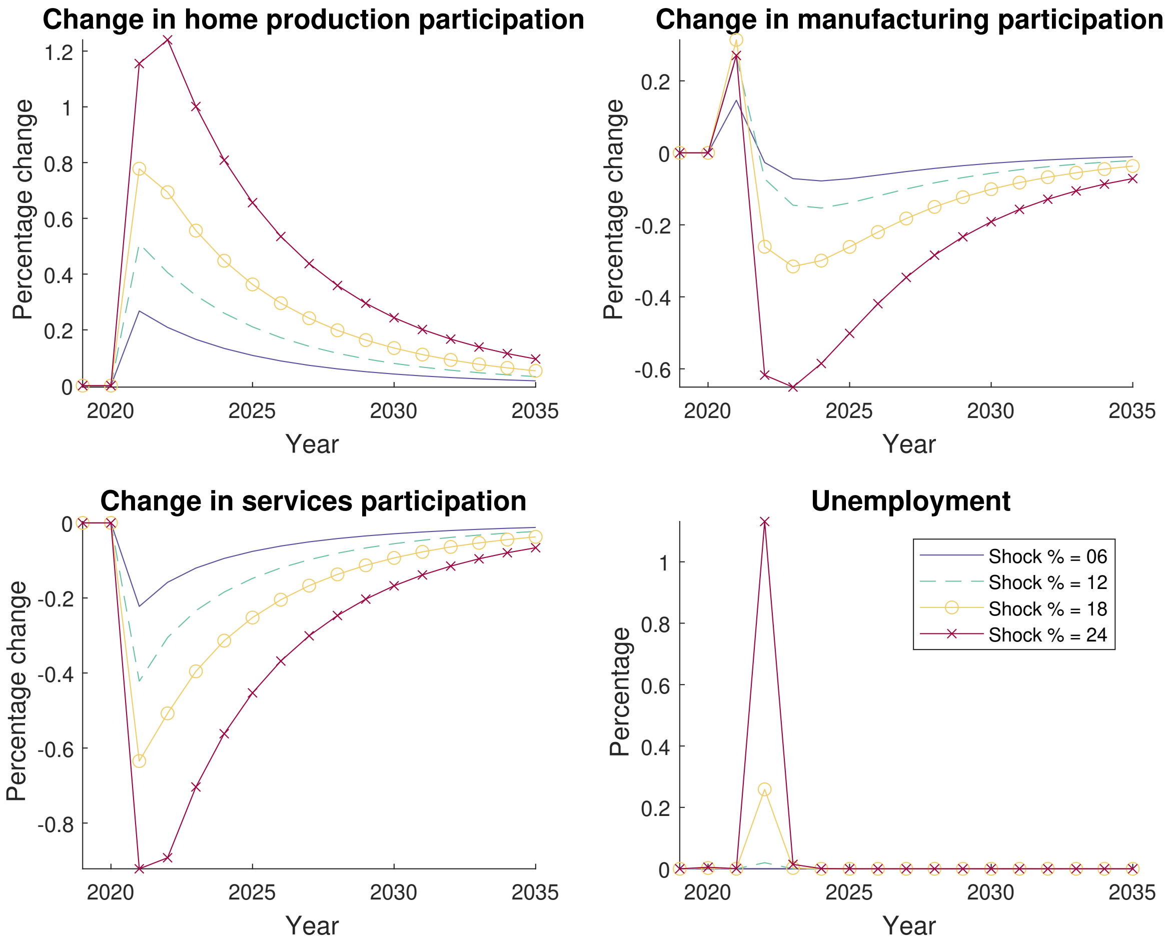


Figure D.6: Paths of percentage changes in participation since 2019 in home production (top left), manufacturing (top right), and services (bottom left), as well as unemployment generated by the shock in percentage (bottom right) for the United States as a whole across different values for the size of the shock. The solid blue line depicts a shock of 6%, the dashed green line 12%, the apricot line with circular markers 18%, and the burgundy line with crosses 24%.

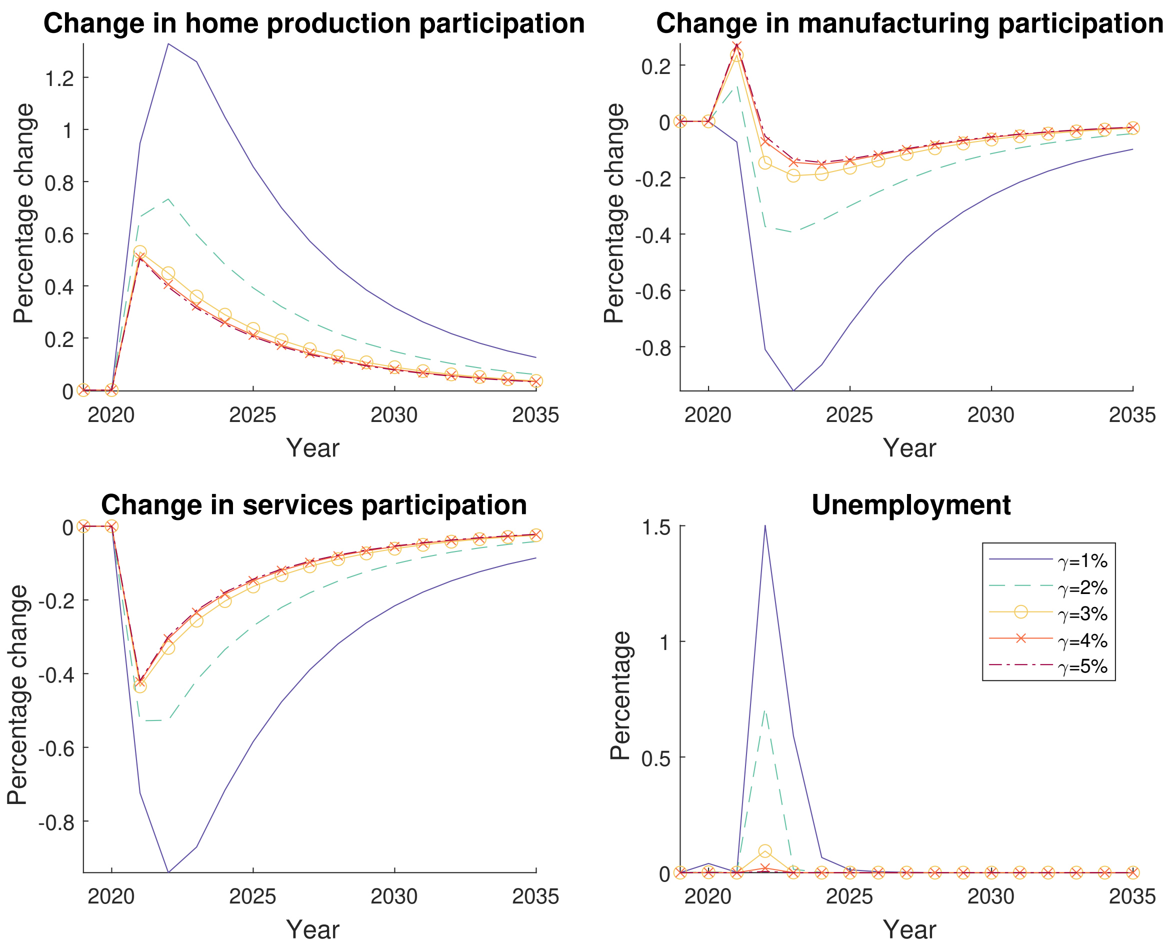


Figure D.7: Paths of percentage changes in participation since 2019 in home production (top left), manufacturing (top right), and services (bottom left), as well as unemployment generated by the shock in percentage (bottom right) for the United States as a whole across different values for growth of world nominal GDP in dollars. The solid blue line depicts a growth rate of 1%, the dashed green line 2%, the apricot line with circular markers 3%, the orange starred line 4%, and the burgundy dash dotted line 5%.

Table D.1: Model vs. Data for U.S. States: Robustness

| | (1) GDP_PC | (2) Manuf | (3) Agric | (4) Services | (5) Non-emp |
|---|---|---|---|---|---|
| **Panel A:** No controls | | | | | |
| $\hat{\rho}^Y$ | 1.38*** | 0.88 | 2.81 | 1.67 | 1.83* |
| | (0.47) | (0.71) | (1.70) | (1.05) | (1.03) |
| P-val Coeff = 1 | 0.43 | 0.87 | 0.29 | 0.53 | 0.43 |
| Partial $R^2$ | 0.12 | 0.015 | 0.023 | 0.071 | 0.093 |
| **Panel B:** + Lockdowns control | | | | | |
| $\hat{\rho}^Y$ | 1.59*** | 0.70 | 2.31 | 1.84* | 2.08** |
| | (0.57) | (0.72) | (1.91) | (0.98) | (0.95) |
| P-val Coeff = 1 | 0.30 | 0.67 | 0.50 | 0.40 | 0.26 |
| Partial $R^2$ | 0.16 | 0.0085 | 0.016 | 0.089 | 0.12 |
| **Panel C:** + Manuf. share control | | | | | |
| $\hat{\rho}^Y$ | 1.58** | 0.72 | 2.56 | 1.39 | 1.80** |
| | (0.63) | (0.69) | (1.68) | (0.89) | (0.90) |
| P-val Coeff = 1 | 0.36 | 0.69 | 0.36 | 0.67 | 0.38 |
| Partial $R^2$ | 0.12 | 0.010 | 0.021 | 0.053 | 0.094 |
| **Panel D:** + Fem. share (Table 1) | | | | | |
| $\hat{\rho}^Y$ | 1.16** | 0.71 | 1.11 | 1.53* | 1.93** |
| | (0.58) | (0.70) | (2.16) | (0.82) | (0.91) |
| P-val Coeff = 1 | 0.78 | 0.69 | 0.96 | 0.53 | 0.32 |
| Partial $R^2$ | 0.073 | 0.011 | 0.0052 | 0.082 | 0.12 |
| **Panel E:** + Fiscal control | | | | | |
| $\hat{\rho}^Y$ | 1.59*** | 0.38 | 1.28 | 1.49* | 1.73* |
| | (0.34) | (1.03) | (1.76) | (0.80) | (0.90) |
| P-val Coeff = 1 | 0.088 | 0.55 | 0.87 | 0.55 | 0.42 |
| Partial $R^2$ | 0.28 | 0.0028 | 0.0075 | 0.073 | 0.093 |
| # Observations | 50 | 50 | 50 | 50 | 50 |

**Notes:** This table presents results for the regression in equation (8) for several outcomes and specifications. The information is presented analogously to Table 1. Panel A shows the regression without controls. Panel B adds the number of lockdown days in 2020 as control. Panel C adds to the previous panel the share of manufacturing employment. Panel D adds the female employment share, thus, presenting our baseline in Table 1. Panel E adds a control variable for fiscal expansion (the change in debt to GDP between 2019 and 2021). Regression specifications are weighted by 2019 population. Standard errors are robust to heteroskedasticity. Asterisks denote statistical significance: *=10%, **=5%, ***=1%.

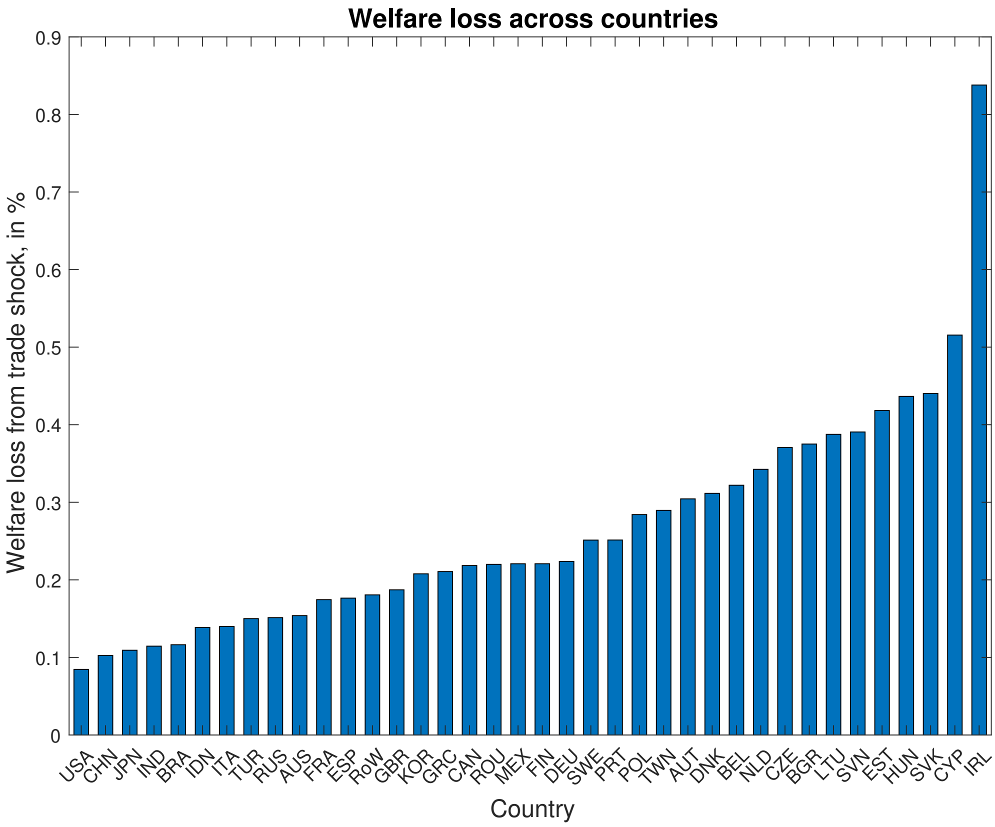


Figure D.8: Welfare loss from the trade shock across countries, in percent. For country abbreviation codes see Appendix C.1.

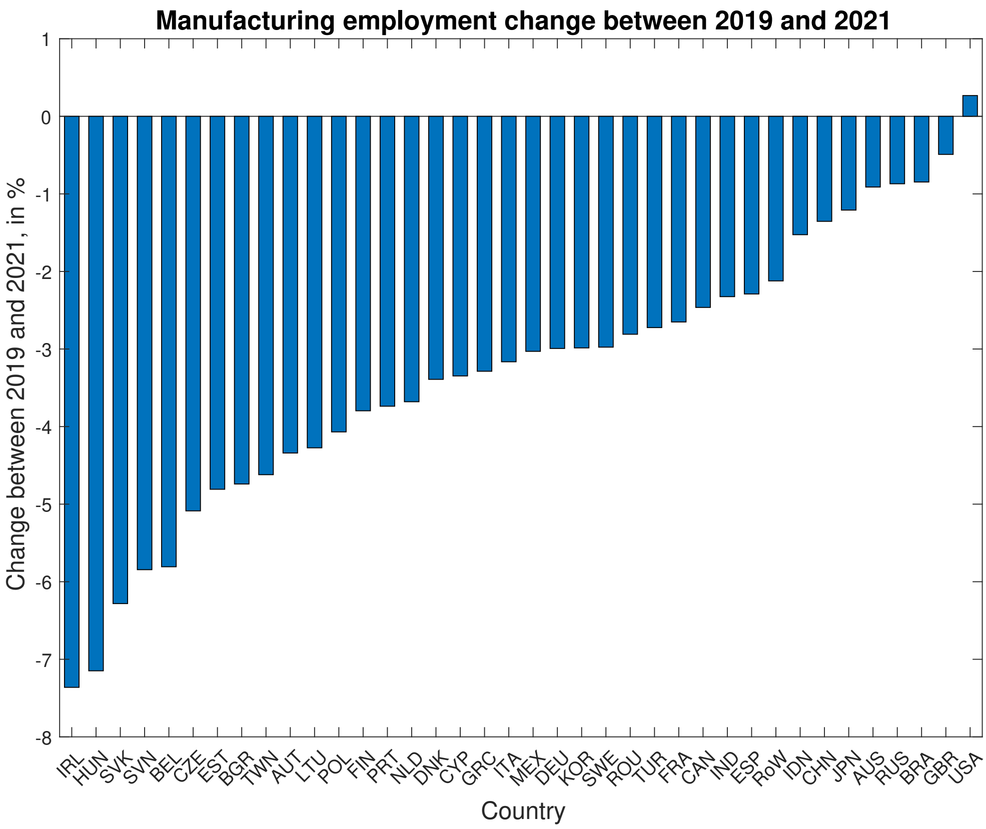


Figure D.9: Percentage change in manufacturing employment between 2019 and 2021 across countries, in percent. See Appendix C.1 for country abbreviation codes.

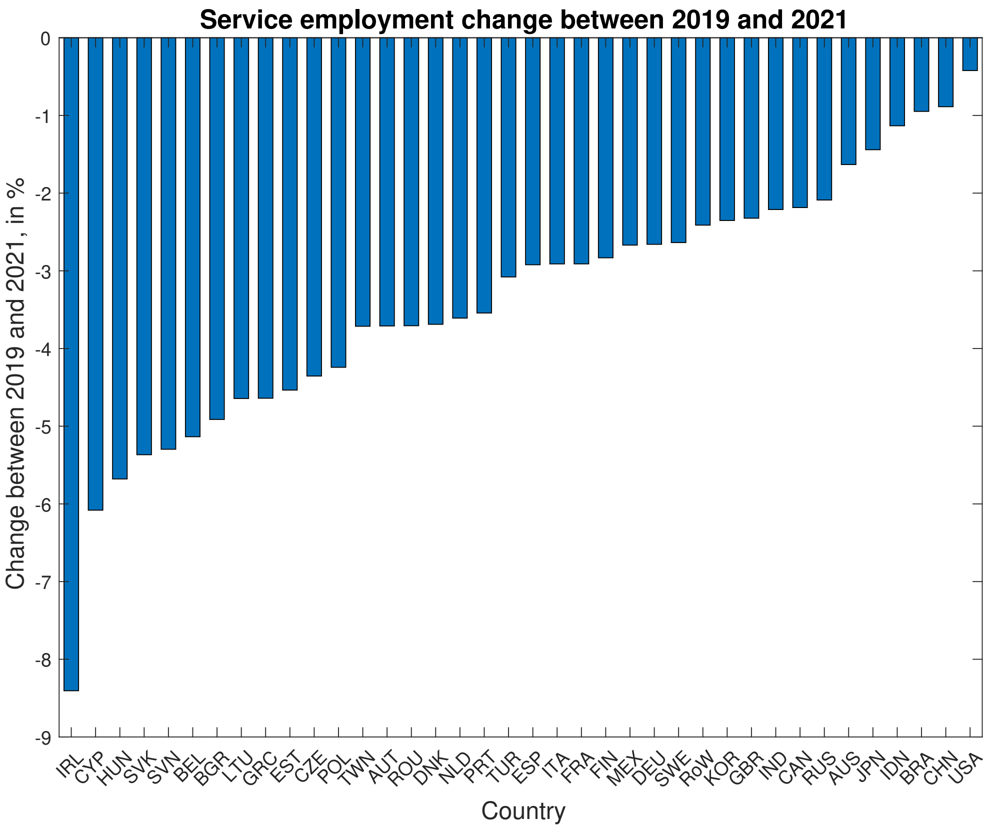


Figure D.10: Percentage change in service employment between 2019 and 2021 across countries, in percent. For country abbreviation codes see Appendix C.1.

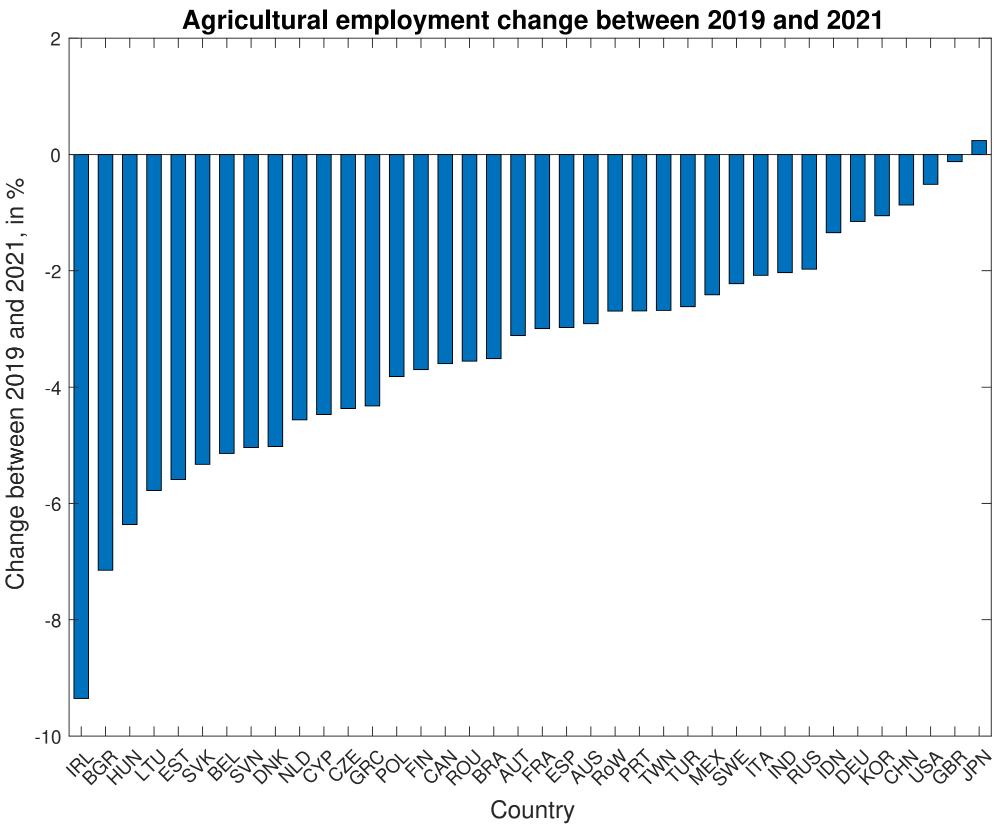


Figure D.11: Percentage change in agricultural employment between 2019 and 2021 across countries, in percent. For country abbreviation codes see Appendix C.1.