Labor Market Effects of Global Supply Chain Disruptions

Mauricio Ulate[1], Jose P. Vásquez[2], and Román D. Zárate[3]

[1]Federal Reserve Bank of San Francisco, [2]London School of Economics, [3]World Bank Development Research Group

CEBRA Annual Meeting

July 6th 2023

The views expressed in this paper do not necessarily reflect the views of the FRBSF, the Fed System, or the World Bank

Outline of the talk

Motivation

- COVID-19 caused a number of disruptions in global supply chains:
  - Port closures
  - Reduced shipping capacity due to lockdowns
  - Fewer shipping workers
- Huge interest in analyzing the economic effects of these disruptions:
  - How does it affect labor markets?
  - How does it affect sectoral composition?
  - How does it affect welfare?
- We are interested in analyzing these questions at the global level:
  - We first focus on the US economy
  - Then we turn to the effects on other countries

What are the effects on labor markets?

- We examine the labor market consequences of recent global supply chain disruptions:
  - Disruption modelled as an increase in international trade cost that persists for 3 years
  - We use data from OECD's ICIO and other sources

- We use a dynamic quantitative trade model with several features:
  - Forward-looking agent as in ACM (2010)
  - Home production as in CDP (2019)
  - Unemployment from DNWR as in RUV (2022)
  - Dynamic exact hat algebra

- Preview of findings:
  - The impact of the shock varies by sector:
    - For the US there is a temporary increase in manufacturing employment and a decline in the service and agricultural sectors.
  - States with larger service sectors experience larger declines in labor force participation
  - Internationally, the impact of the shock on LFP depends on size and trade openness:
    - China, US, Brazil, and India experience a small decline in labor force participation
    - Small open economies (Ireland, Estonia, Slovakia) experience a larger decline
  - More monetary accommodation can mitigate the unemployment effects of the shock

Related Literature

- COVID-19 and global supply changes:
  - Labelle & Santacreu (2022); Meier & Pinto (2020); Bonadio et al. (2020); Sforza & Steininger (2020)
  - We contribute by analyzing the effects on local labor markets

- Impact of trade shocks on local labor markets:
  - Rodríguez-Clare et al., (2022); Galle et al., (2022); Caliendo et al., (2019); Adao et al., (2020); Artuc et al., (2010); Galle & Lorentzen (2020)
  - We contribute by examining the effects of supply disruptions at the global level

- Downward nominal rigidities in GE models:
  - Galí & Monacelli (2005, 2008); Clarida et al., (2002); Schmitt-Grohe & Uribe (2016); Guerrieri et al., (2021)
  - We contribute by incorporating nominal effects to understand the supply disruption

Outline of the talk

Model Environment: Consumption and Intermediate Inputs

- I regions (M inside US), S market sectors plus home production
- Cobb-Douglas preferences ($\alpha_{i,s}$) across market sectors. Armington assumption within sectors with EoS $\sigma_s > 1$. All income devoted to consumption
- Cobb-Douglas production using labor ($\phi_{i,s}$) and intermediate inputs ($\phi_{i,ks}$)
- Perfect competition with iceberg trade costs $\tau_{ij,s,t} \geq 1$

$$P_{i,t} = \prod_{s=1}^{S} P_{i,s,t}^{\alpha_{i,s}}, \qquad P_{j,k,t}^{1-\sigma_k} = \sum_{i=1}^{I} p_{ij,k,t}^{1-\sigma_k}$$

where $p_{ij,k,t} = \tau_{ij,k,t} A_{i,k,t}^{-1} W_{i,k,t}^{\phi_{i,k}} \prod_{s=1}^{S} P_{i,s,t}^{\phi_{i,sk}}$

- All sectors and final consumers face the same price index in a given destination

Market Clearing Conditions in the Static Equilibrium

- Exogenous trade imbalances: $P_{i,t}C_{i,t} = \sum_{s=1}^{S} W_{i,s,t}L_{i,s,t} + D_{i,t}$
- Equilibrium in sector s, region i, at time t:

$$R_{i,s,t} = \sum_{j=1}^{I} \lambda_{ij,s,t} \left(\alpha_{j,s} P_{j,t} C_{j,t} + \sum_{k=1}^{S} \phi_{j,sk} R_{j,k,t} \right)$$

  with trade shares $\lambda_{ij,k,t} = \frac{p_{ij,k,t}^{1-\sigma_k}}{\sum_{r=1}^{I} p_{rj,k,t}^{1-\sigma_k}}$

- Labor market clearing: $W_{i,k,t}L_{i,k,t} = \phi_{i,k}R_{i,k,t}$
- Standard model: free mobility and $\sum_{k=1}^{S} L_{i,k,t} = \bar{L}_{i,t}$

Labor Supply: Dynamic Decisions

- As in CDP and ACM:
  - Agents can move across sectors and regions within U.S., only across sectors in other countries
  - Forward-looking agents (with perfect foresight) move subject to relocation costs
  - In region i, time t, home production yields μ_i and sector s yields $\omega_{i,s,t}$
- Different elasticities across sectors ($\frac{1}{\nu}$) and regions ($\frac{1}{\kappa}$)
  - Nested Gumbel for amenity shocks across regions and sectors

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

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

- In CDP: $\omega_{i,s,t} \equiv \frac{W_{i,s,t}}{P_{i,t}}$. With DNWR: $\omega_{i,s,t} \equiv \frac{W_{i,s,t}}{P_{i,t}} \frac{L_{i,s,t}}{\ell_{i,s,t}}$
- This block determines labor supply $\ell_{i,s,t}$

Nominal Wage Rigidity

- DNWR: $W^{LCU}_{i,s,t} \geq \delta_s W^{LCU}_{i,s,t-1}$
- Maximum employment: $L_{i,s,t} \leq \ell_{i,s,t}$
- Complementary slackness:

$$(\ell_{i,s,t} - L_{i,s,t})(W^{LCU}_{i,s,t} - \delta_s W^{LCU}_{i,s,t-1}) = 0$$

- For regions outside of the U.S., with exchange rate $E_{i,t}$ given in dollars per LCU, DNWR implies

$$W_{i,s,t} \geq \frac{E_{i,t}}{E_{i,t-1}} \delta_s W_{i,s,t-1}$$

- **Nominal anchor**: nominal world GDP in dollars grows at rate γ

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

Outline of the talk

We use data from several sources

87 regions: 50 U.S. states, 36 other countries, aggregate RoW

15 sectors: home production, 12 manufacturing sectors, services, agriculture

- 2018 OECD's ICIO database: sector-level bilateral trade between countries
- 2017 CFS: manufacturing trade flows across U.S. States
- 2018 U.S. Census: trade between U.S. states and other countries
- 2018 BEA: state-level production and consumption in serv. and agric.
- 2018 BLS and OECD: labor force participation
- 2018 CPS + ACS: sector-level bilateral migration flows between U.S. states
- We match the initial equilibrium:
  - Solve the model using dynamic exact hat algebra

Model Parameters and Calibration

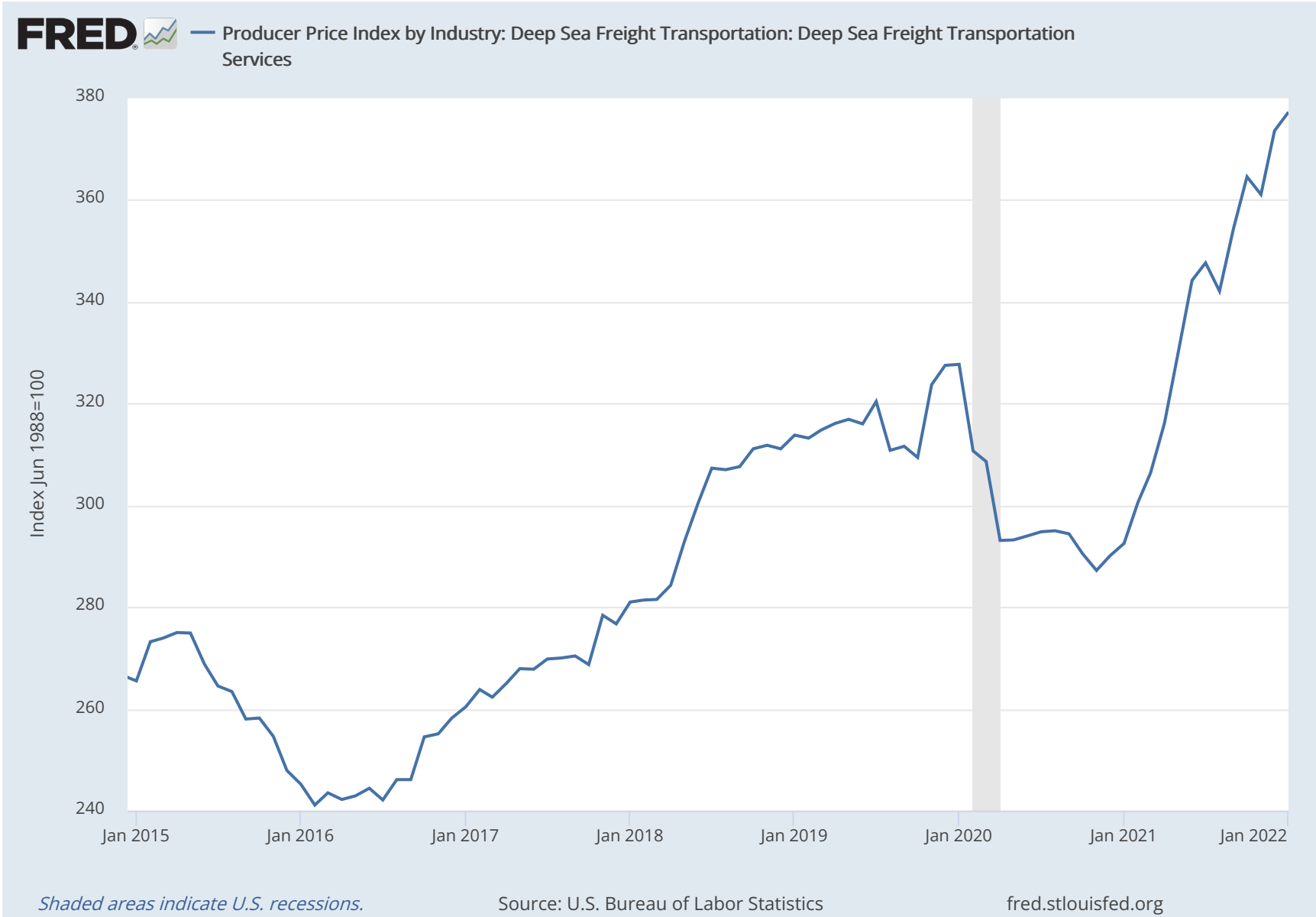
- We assume an increase in international trade costs of **12%** for **3** years
- We also examine how the effects depend on several choices:
  - size: 6%, 18%, 24%
  - persistence: 2, 4, 5, or 6 years
  - nominal growth rate: 2% to 6%

Table: **Parameter values used**

Parameter	Value	Description	Source
δ	1	Lower bound in DNWR	Normalization
γ	4%	Growth rate of world nominal GDP in \$	Suggestive
ν	0.55	Inverse elasticity of moving across sectors	RUV
σ	6	Trade elasticity	Trade Literature

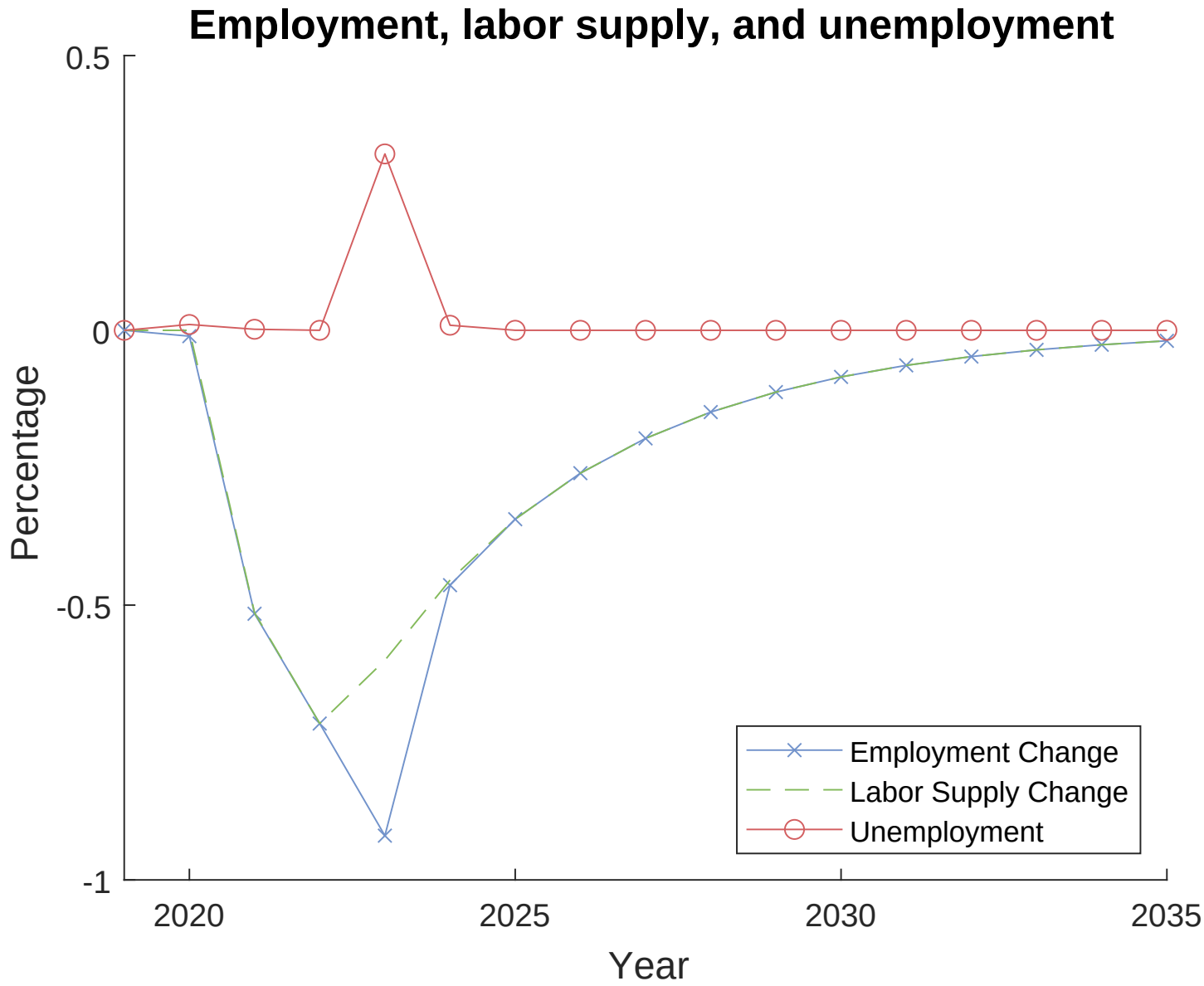
Notes: This table contains the parameter values used in the baseline specification, together with their description and the source where they are taken from.

Why are we using an increase of 12%?

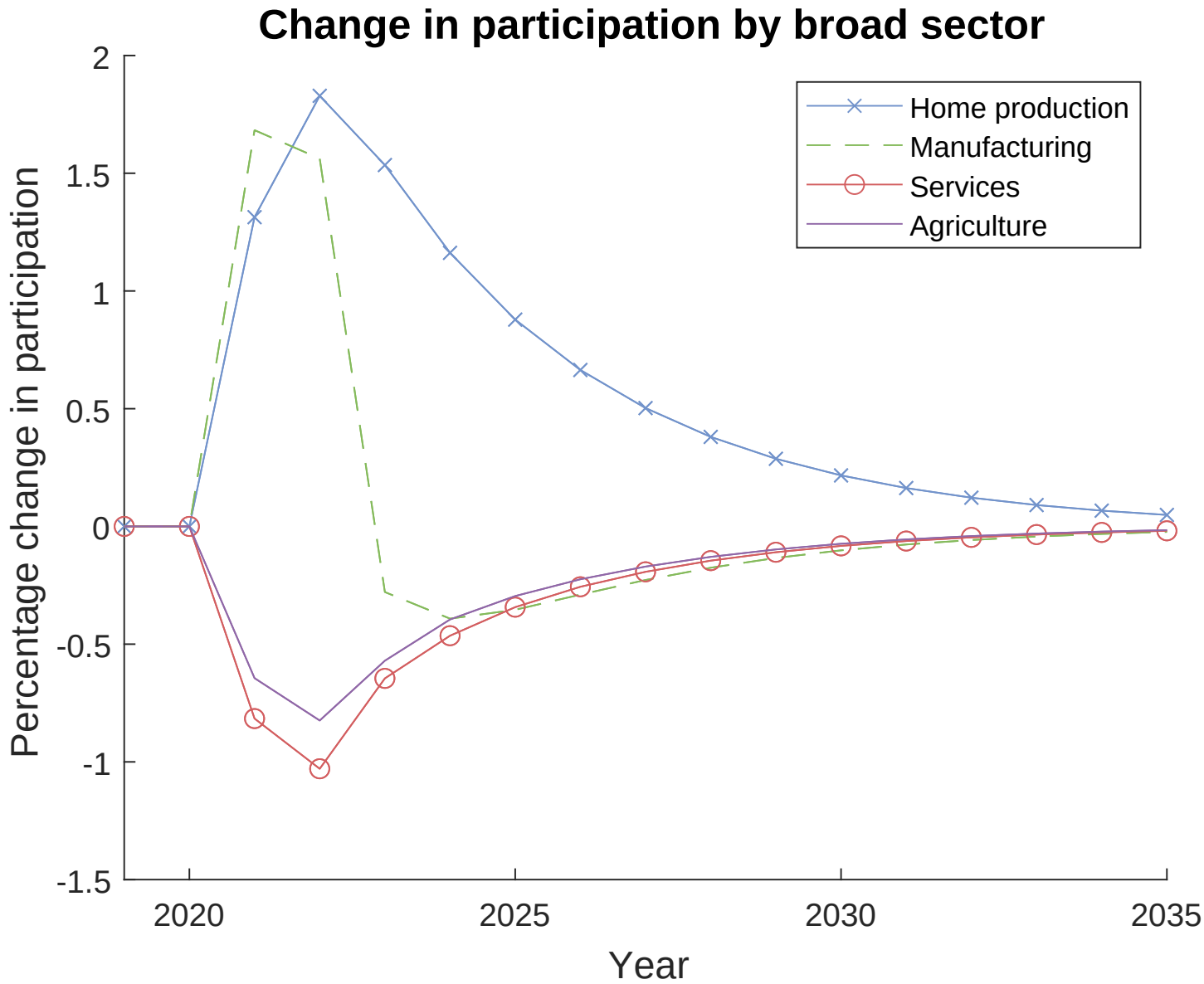


Outline of the talk

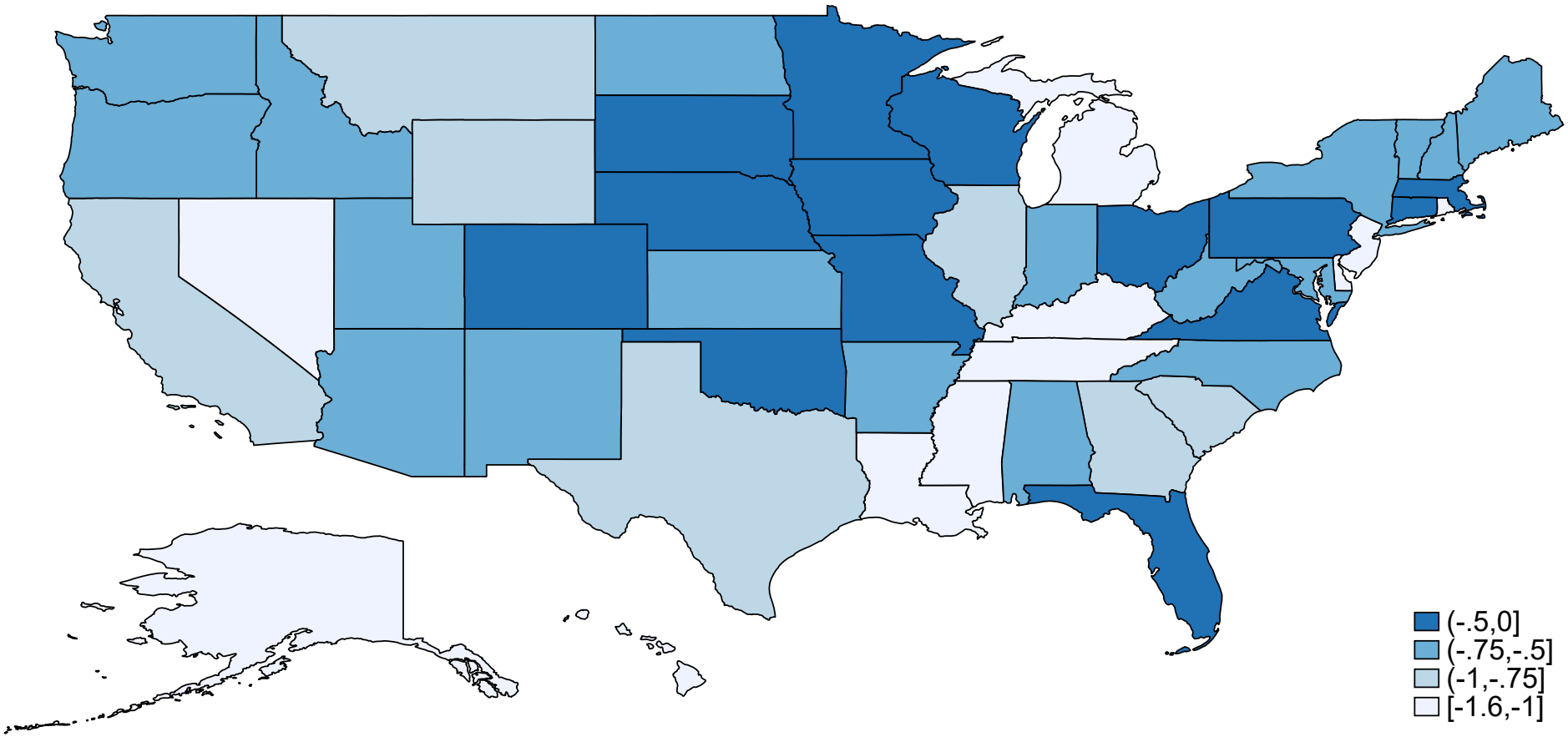
Baseline results at the aggregate level in the US



Baseline results at the sectoral level in the US



Change in labor force participation across states in the US



Exposure to the shock at the country level

- Following AAE we construct a measure of exposure to the shock:
  - This formula is based on a first-order approximation:

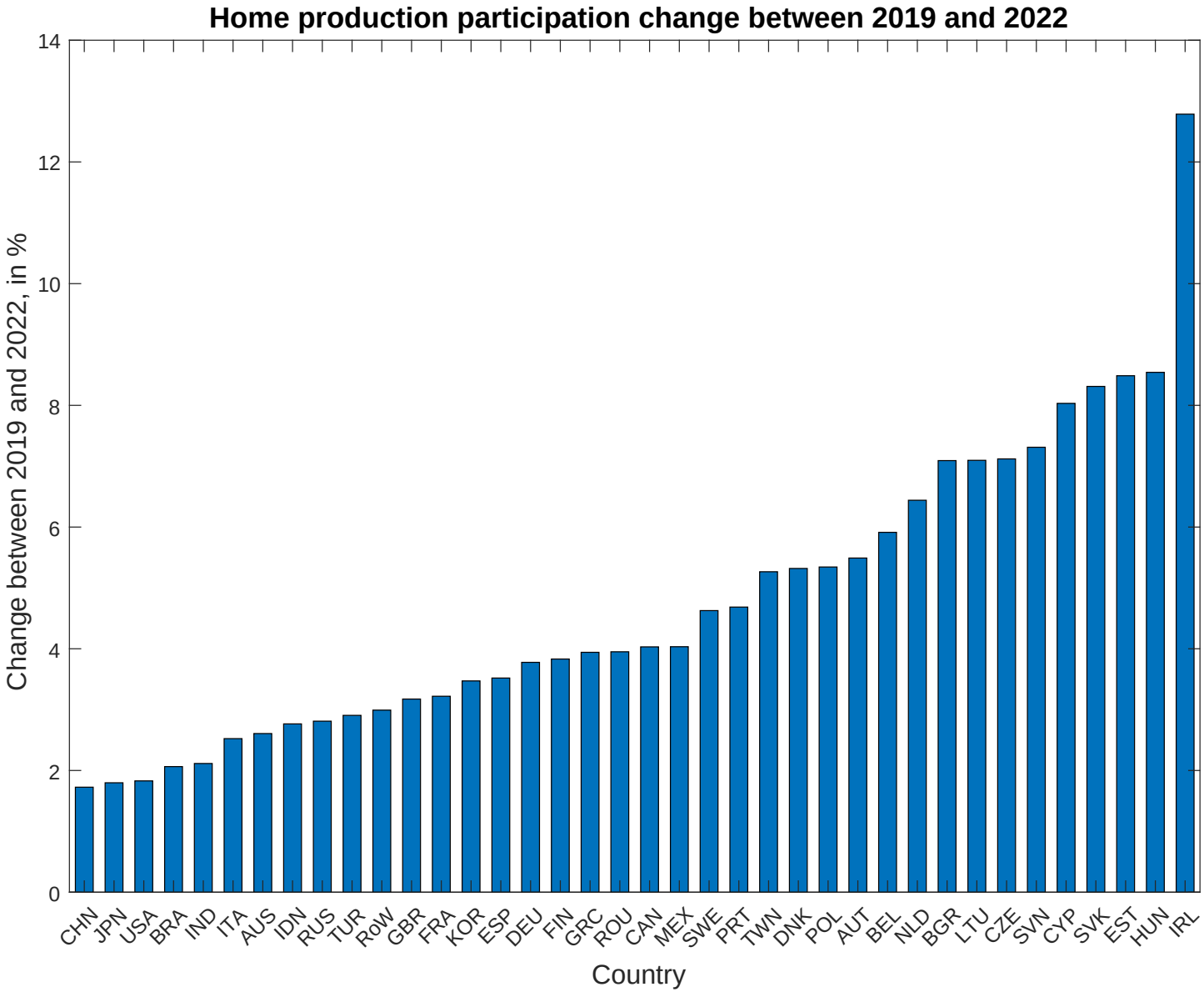
$$\hat{\eta}_i(\hat{\tau}) = (1-\sigma)\sum_{s=1}^{S} \ell_{i,s,0}\theta_{i,s}(\hat{\tau})$$

$$\theta_{i,s}(\hat{\tau}) = \sum_{j=1}^{I} r_{ij,s,0}\left(\hat{\tau}_{ij,s} - \sum_{q=1}^{I}\lambda_{qj,s,0}\hat{\tau}_{qj,s}\right)$$

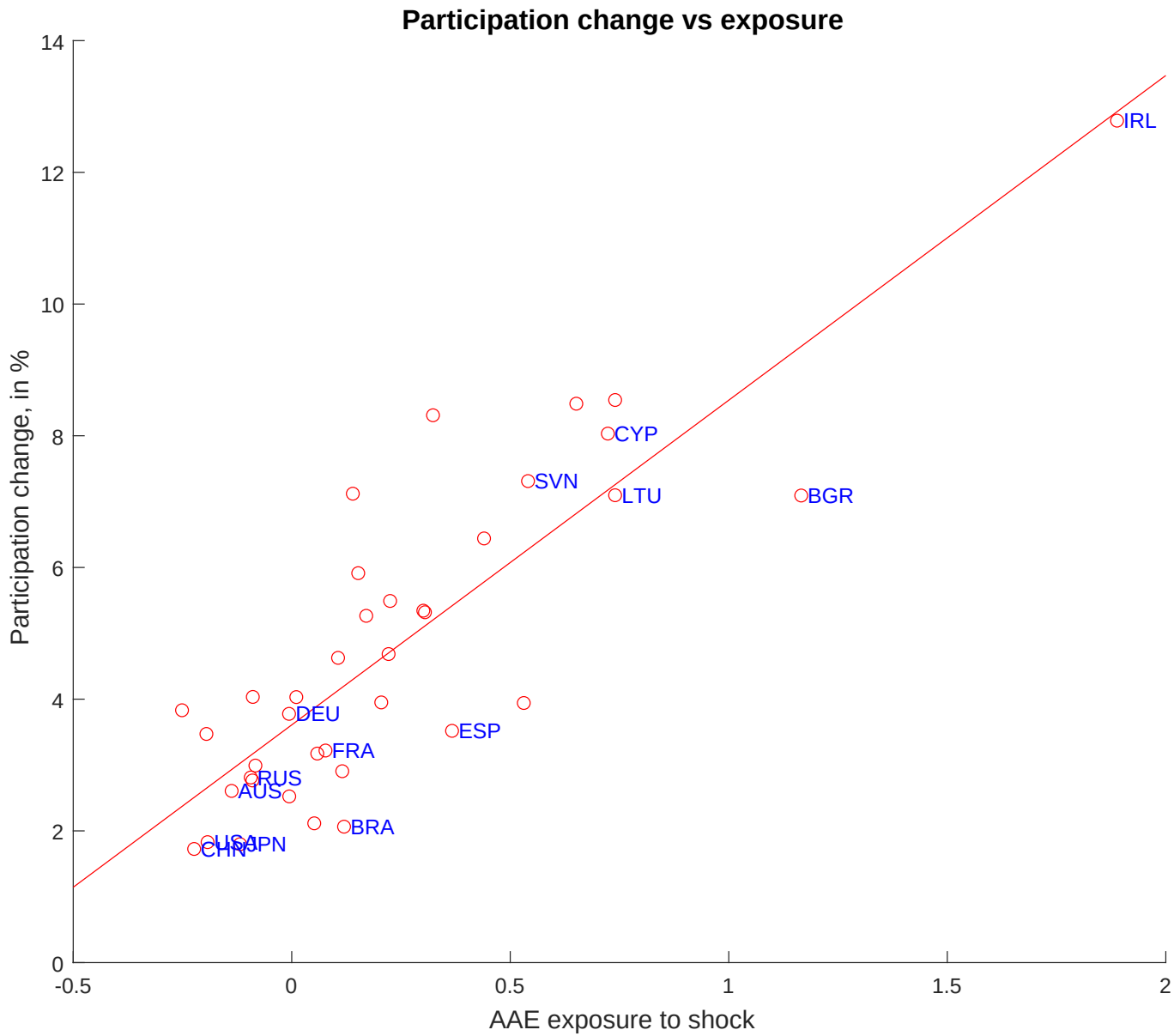
  - $1-\sigma$ corresponds to the trade elasticity
  - $\ell_{i,s,0}$ initial employment share in sector s
  - $r_{ij,s,0}$ how important are sales from is in location j
  - $\sum_{q=1}^{I}\lambda_{qjs,0}$ how much is affected location j from changes in trade cost

- We correlate this measure with changes in labor force participation

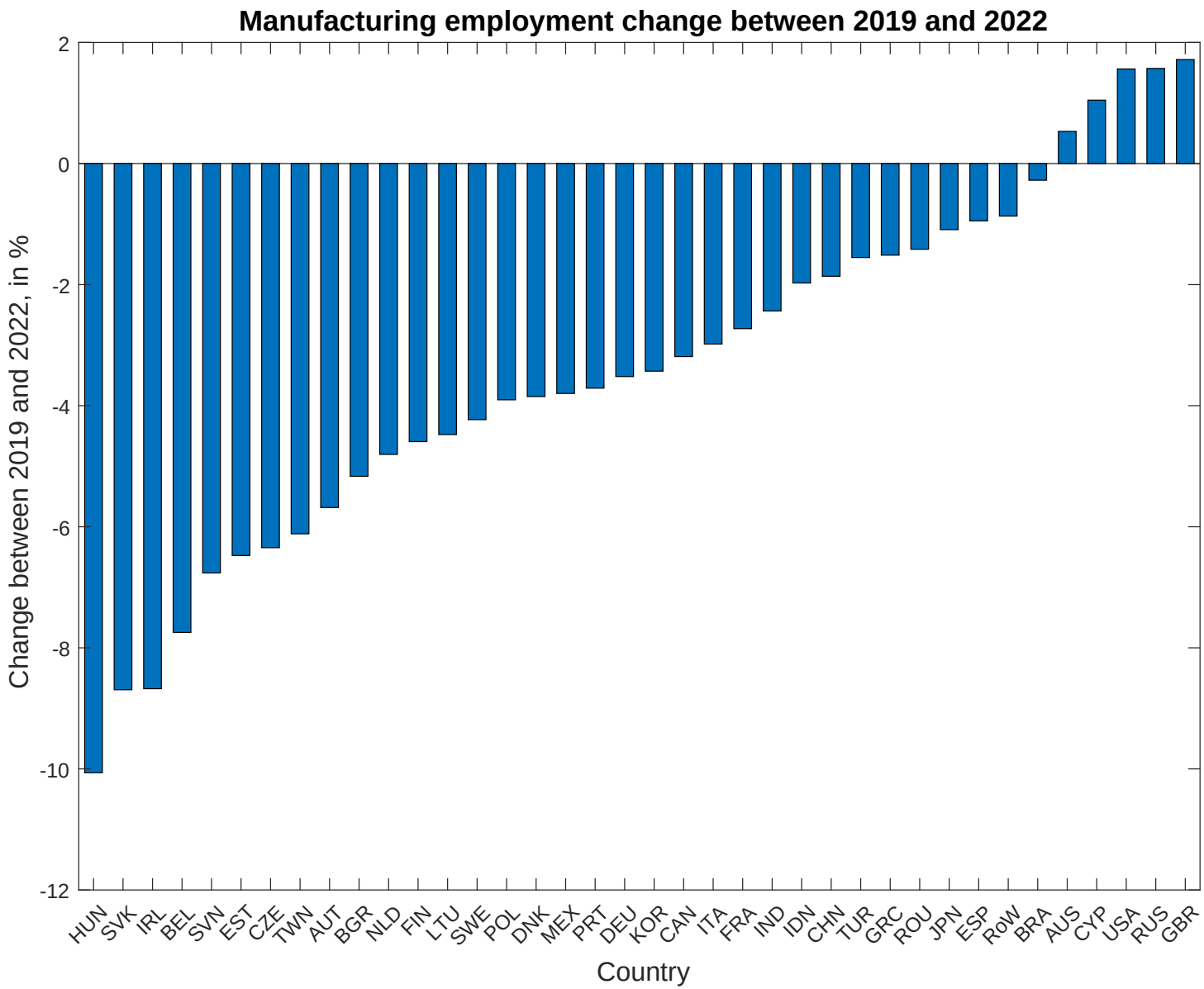
Home production changes across countries



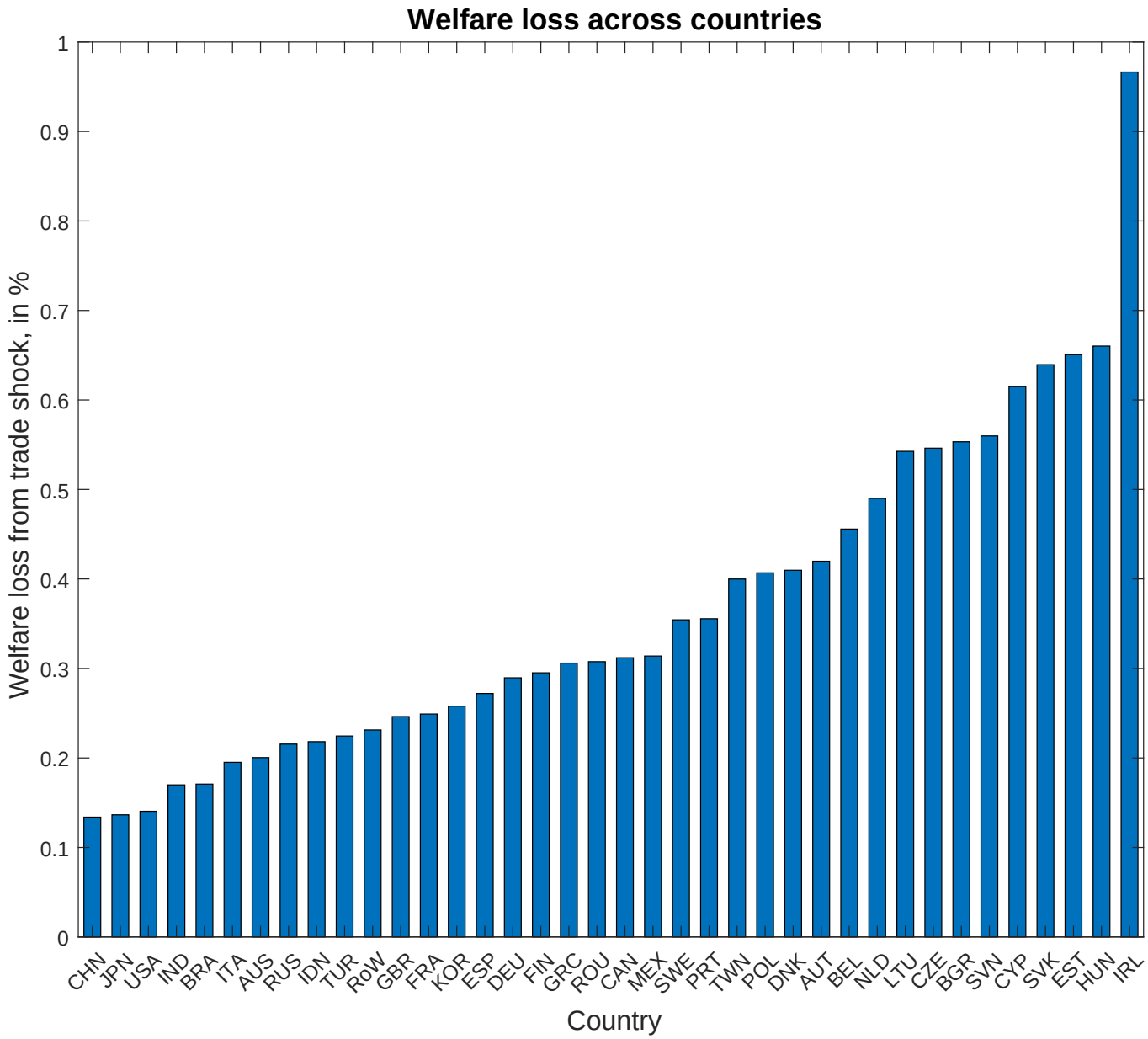
Participation changes vs exposure



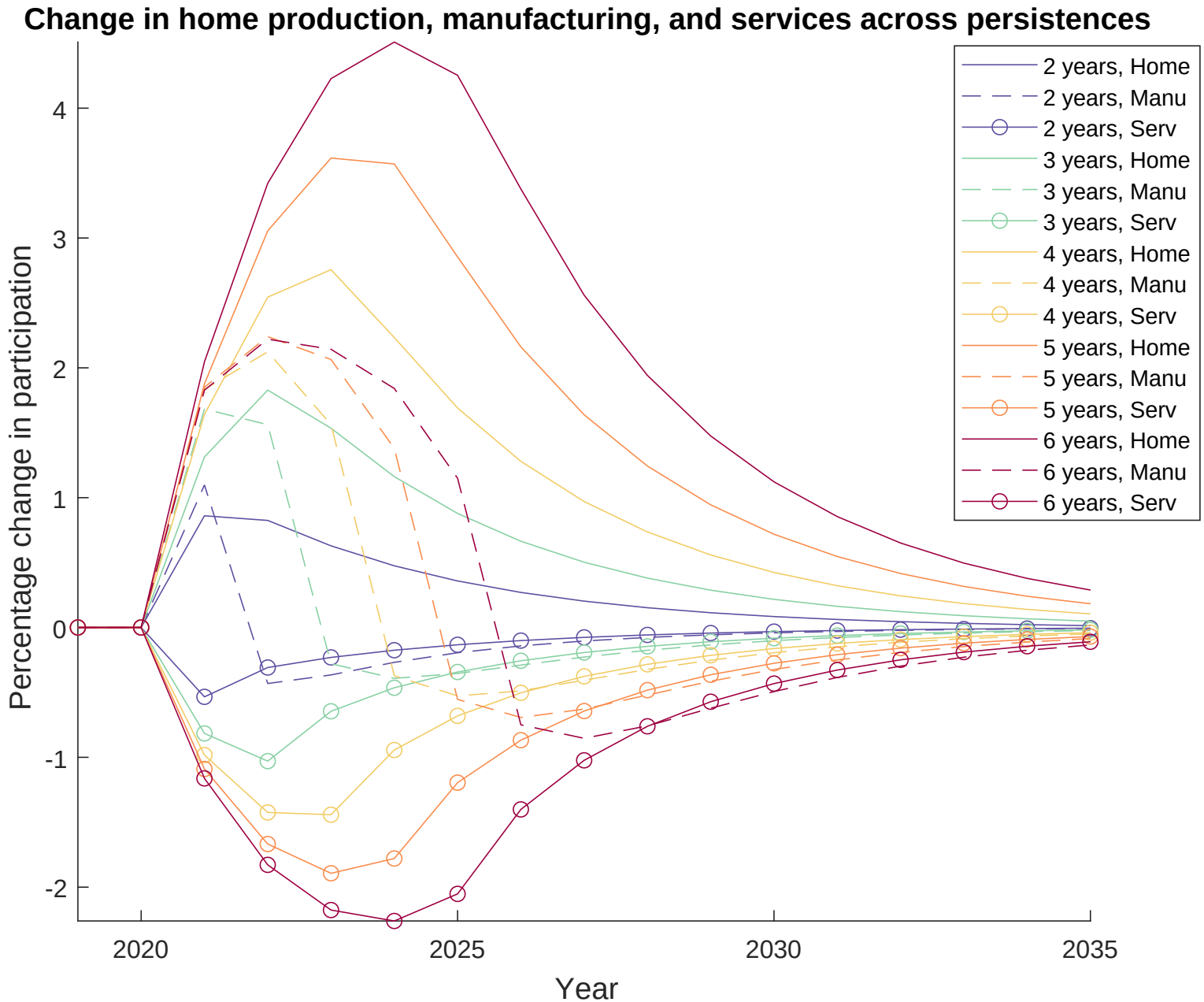
Manufacturing employment changes across countries



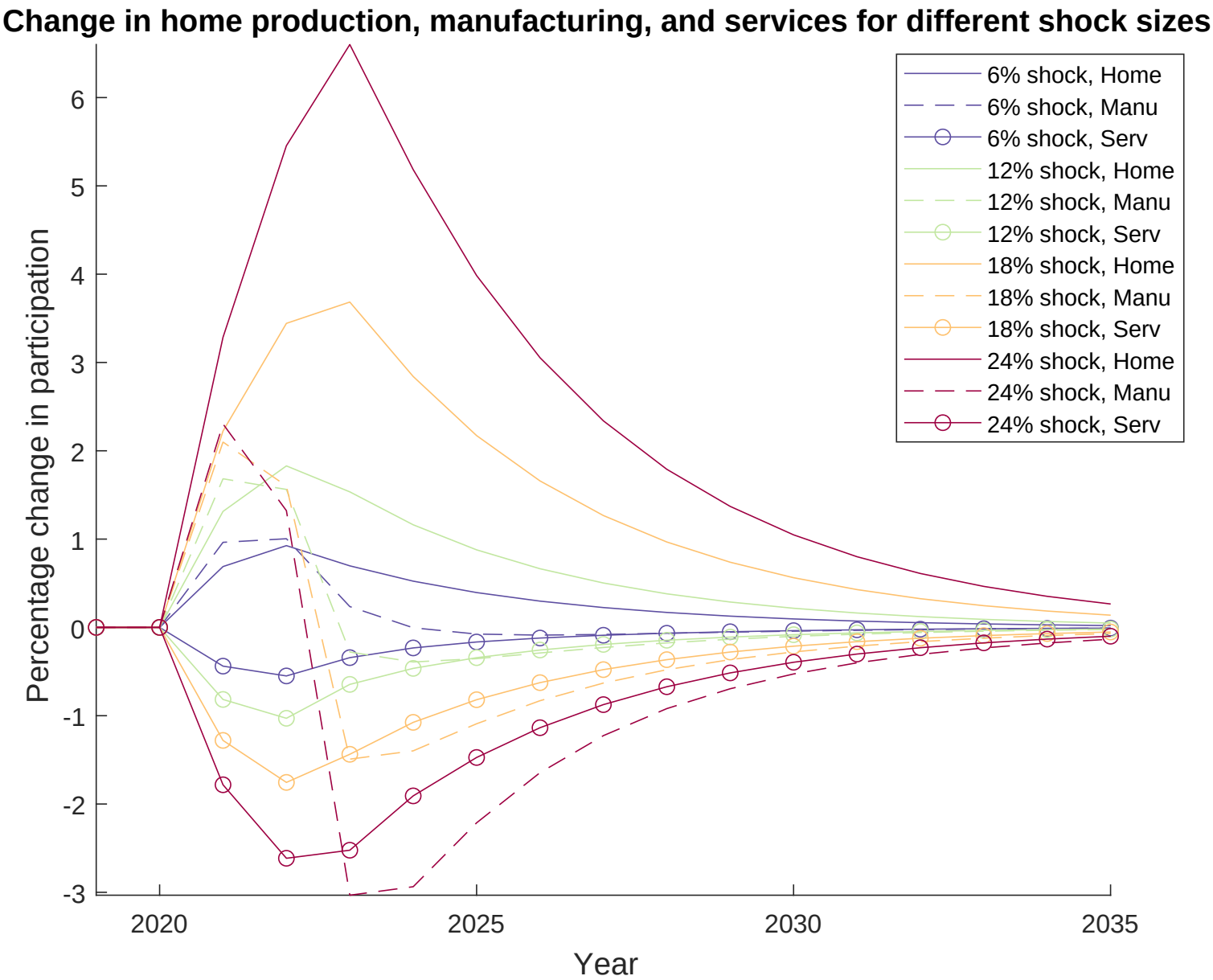
Effects on welfare across countries



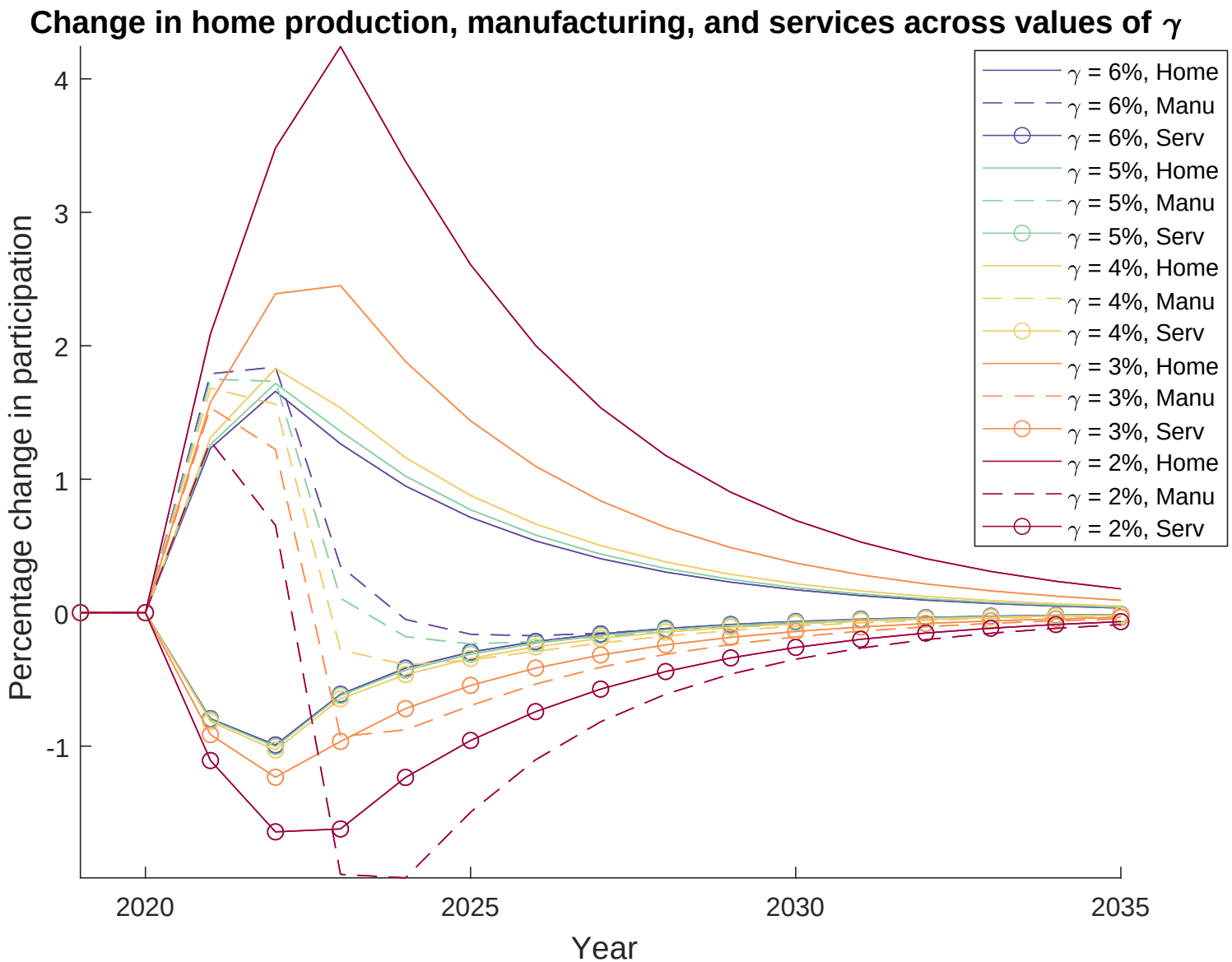
What are the effects for different persistence levels



What are the effects for different sizes of the shock



How does monetary accommodation affect the results?



Outline of the talk

Conclusions

- We study the labor market effects of global supply disruptions using a DQSM:
  - The model incorporates multiple sectors, home production, and unemployment
  - We calibrate the model using data from ICIO and other sources
  - We simulate a 12% increase in the iceberg trade costs that last for 3 years

- We find three main results for the US economy:
  - There is a temporary but persistent decline in labor force participation
  - There is a temporary increase in manufacturing employment
    - The US is a net importer
  - Unemployment increases when the shock dissipates due to the DNWR

- For the RoW, our findings suggest:
  - Small or open economies experience larger declines in labor force participation
  - Manufacturing employment mostly increases in the countries that are net importers