Trade with Nominal Rigidities:
Understanding the Unemployment and Welfare Effects of the China Shock

Andrés Rodríguez-Clare, Mauricio Ulate, Jose P. Vasquez

October, 2024

Motivation

- Autor, Dorn, and Hanson (2013) results

Table: Effects of Exposure to China

Unemployment	0.221**
Not In Labor Force (NILF)	0.553**
Population	-0.050
Manufacturing Employment	-0.596**
Non-Manufacturing Employment	-0.178
Manufacturing Wage	0.150
Non-Manufacturing Wage	-0.761**

Motivation

- Standard model: Full employment $\rightarrow$ all effects on wages
- Add upward sloping labor supply $\rightarrow$ employment effects
  - Need labor supply to be extremely elastic
  - No unemployment; different welfare implications
- **Our approach:** Consider downward-nominal wage rigidity (DNWR) to generate temporary unemployment effects
  - Show DNWR is consistent with the empirical effects of the China Shock
  - Add DNWR to a dynamic quantitative trade model

This paper

1. **New suggestive evidence that DNWR is consistent with China Shock effects**
   - Builds on and extends ADH in the spirit of ADH 2021 (persistence)

2. **A Dynamic Spatial Trade and Migration Model with DNWR**
   - CDP + nest (EoS $1/\nu$ across sectors and $1/\kappa$ across regions)
     - Dynamic exact hat algebra for counterfactual analysis
   - Add DNWR as in Schmitt-Grohe and Uribe (2016)
     - Wage can fall by no more than 100(1-δ)% per year

3. **Quantification**
   - Combined database: 87 regions, 15 sectors
   - Calibrate China shock to match predicted change in US imports from China
   - Calibrate ν, κ, δ to match ADH on unemployment, participation, population
   - Study implications for employment and welfare

Outline

- A Case for DNWR
- Model
- Data and Calibration
- Results

A Case for DNWR

1. Support for DNWR in the recent literature
    - Skip for today, but check: Grigsby et al. (2021), Hazell and Taska (2023), Jo (2022), Fallick et al. (2020), Fadinger et al. (2024), Costinot et al. (2022)
2. DNWR and the persistence in the employment effects of the China Shock
3. Cross-sectional evidence for DNWR in the adjustment to the China Shock

Is DNWR Inconsistent with the Employment Effects of the China Shock?

- Recent evidence (e.g., Dix-Carneiro and Kovak, 2017; ADH 2021) found that increased exposure to import competition led to persistent ↓ employment
- However, persistent ↓ employment could be due to long-run declines in LFP with no long-lasting effects on unemployment
- We take the analysis in ADH and extend it in the spirit of ADH (2021)

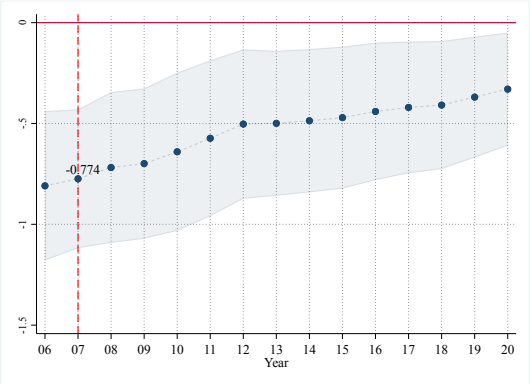
$$\Delta Y_{i,t+h} = \alpha_t + \beta_{1h} \Delta IP^{cu}_{i,\tau} + X'_{i,t} \beta_2 + \varepsilon_{i,t+h},$$

  - Same IV as ADH
  - Exercise mimics ADH for the ending year 2007 and extends it up to 2020

Persistent Employment Effects of the China Shock

$$\Delta Y_{i,t+h} = \alpha_t + \beta_{1h} \Delta IP^{cu}_{i,\tau} + X'_{i,t} \beta_2 + \varepsilon_{i,t+h},$$

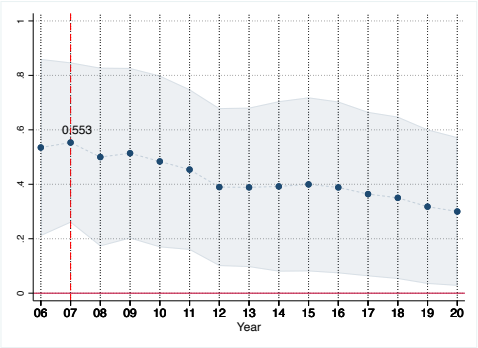
Figure: Tot. employment/Pop.



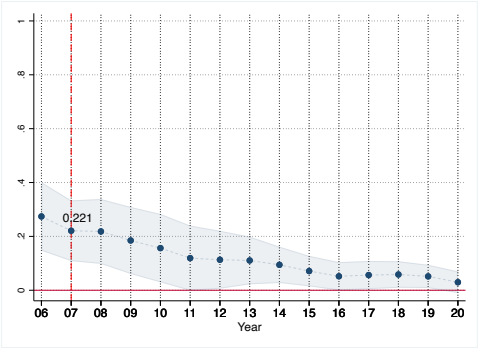
Note: Vertical red line shows ADH coefficient for 2007

Persistence Driven by Not-in-the-Labor-Force

(a) NILF/Pop.



(b) Unemployment/Pop.



Note: Vertical red line shows ADH coefficient for 2007

Evidence for DNWR in the Adjustment to the China Shock

- We enrich the previous regression specification to add a differential effect depending on the degree of DNWR:

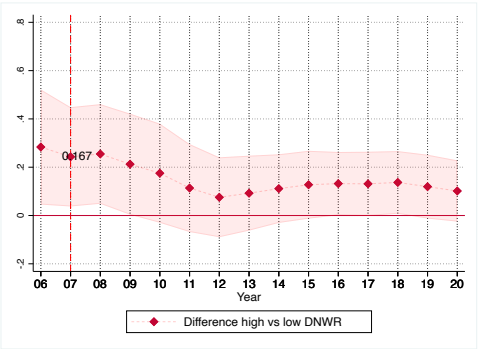
$$\Delta U_{i,t+h} = \gamma_t + \beta_{1,h}\Delta IP^{cu}_{i,\tau} + \beta_{2,h}Rig_{s(i),\tau} + \beta_{3,h}Rig_{s(i),\tau} \times \Delta IP^{cu}_{i,\tau} + X'_{i,t}\beta_4 + \varepsilon_{i,t+h},$$

- $Rig_{s(i),\tau}$ is a state-level proxy for the DNWR in state s to which CZ i belongs
- Following the macro literature (e.g. Jo 2023), use two proxies for DNWR
  1. % of workers with negative yearly hourly Δwage among all workers
  2. % of workers with negative Δwage to total workers with Δwage$\neq 0$
- We then define $Rig_{s(i),\tau}$ as a dummy $= 1$ if s is below the mean share
  - $Rig_{s(i),\tau} = 1$ implies a lower share of negative Δwage, suggesting more DNWR

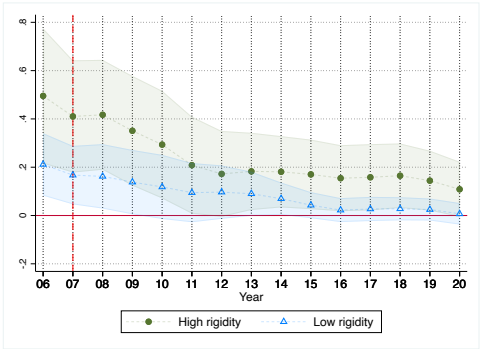
China Shock and unemployment in CZs with high vs. low DNWR

$$\Delta U_{i,t+h} = \gamma_t + \beta_{1,h}\Delta IP^{cu}_{i,\tau} + \beta_{2,h}Rig_{s(i),\tau} + \beta_{3,h}Rig_{s(i),\tau} \times \Delta IP^{cu}_{i,\tau} + X'_{i,t}\beta_4 + \varepsilon_{i,t+h},$$

(a) Estimated $\beta_{3,h}$



(b) $\beta_{1,h}$ vs. $\beta_{1,h} + \beta_{3,h}$



Outline

- A Case for DNWR
- Model
- Data and Calibration
- Results

Basic Assumptions

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

Market Clearing

- 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

- As in CDP:
  - Agents can move across sectors and regions within U.S.
  - 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 $\omega_{i,s,t}$
- **New:** Nested Gumbel for amenity shocks across regions and sectors
  - Different elasticities across sectors $(1/\nu)$ and regions $(1/\kappa)$
- **New:** Unemployed workers receive $z \in (0, 1]$ times average income earned in their sector-region, funded by a tax on employed workers (Rogerson, 1988)
- In CDP: $\omega_{i,s,t} \equiv \frac{W_{i,s,t}}{P_{i,t}}$. With unemployment: $\omega_{i,s,t} \equiv \frac{W_{i,s,t}}{P_{i,t}} \times \frac{L_{i,s,t}}{\ell_{i,s,t}} \times \Delta_{i,s,t}$
- 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

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

Exchange Rate and Nominal Anchor

Exchange rate (options for third countries):

1. ER flexibility: $E_{i,t}$ can adjust enough so that DNWR never binds
   - Implies $L_{i,s,t} = \ell_{i,s,t}\ \forall i > M$, unemployment only in US states
   - This will be our baseline
2. Fixed exchange rate: $E_{i,t} = E_{i,t-1}$
   - Implies that DNWR takes same form in other countries as in US

Nominal anchor: World aggregate demand in \$ grows at γ

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

Dynamic Hat Algebra

- Assume agents did not expect China shock but then in 2001 learn how it will unfold (with perfect foresight)
- Match data from year 2000 ($t = 0$) assuming this year has no unemployment
- This implicitly disciplines many of the model's underlying parameters like productivities, trade costs, relocation costs, etc.
- Goal is to compute relative changes only due to the China shock modeled as a sequence of shocks starting in 2001

Outline

- A Case for DNWR
- Model
- Data and Calibration
- Results

Data, Exposure, and the China Shock

- Combine many data sources (WIOD, CFS, Census, ACS, CPS, IRS, etc.)
- **87 regions:** 50 U.S. states, 36 other countries, aggregate RoW
- **15 sectors:** home production, 12 manufacturing sectors, services, agriculture
- Measure of exposure as in ADH:

$$\text{Exposure}_i \equiv \sum_{s=1}^{S} \frac{L_{i,s,2000}}{L_{i,2000}} \frac{\widehat{\Delta X_{C,US,s}^{2007-2000}}}{R_{US,s,2000}}$$

- Pick productivity changes in China to match $\{\widehat{\Delta X_{C,US,s}^{2007-2000}}\}, \{\widehat{\Delta X_{C,US,t}}\}$

$$\begin{aligned} \Delta X_{C,US,s}^{2007-2000} &= b_2 \Delta X_{C,OC,s}^{2007-2000} + \varepsilon_s \\ \Delta X_{C,US,t} &= a + b_1 \Delta X_{C,OC,t} + \varepsilon_t \end{aligned}$$

Parameters

- $\sigma_s = \sigma = 6$ (trade elasticity of 5 in all sectors)
- Set $\gamma = 1$, put burden on δ
- Match ADH on unemployment, participation, and population:
  - 0.22 $\uparrow$ in unemp., 0.55 $\downarrow$ in LFP, and 0.05% fall in population for each \$1000 of exposure to China shock
- Result is $\delta \approx 0.99$, $\nu \approx 0.54$, and $\kappa \approx 6$
  - Wages can fall $\approx$ 1%/year $\approx$ Schmitt-Grohe and Uribe
  - $\nu \neq \kappa$ key to match NILF and population effects: CDP's $\nu = \kappa = 2.02$ implies too little NILF and too large population effects

Outline

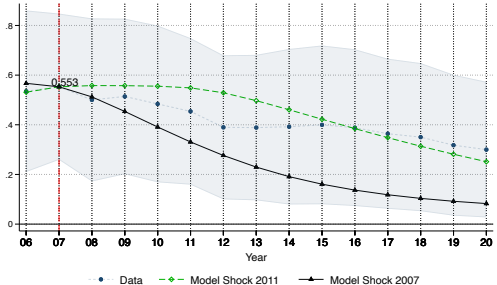
- A Case for DNWR
- Model
- Data and Calibration
- Results

Baseline and Extensions

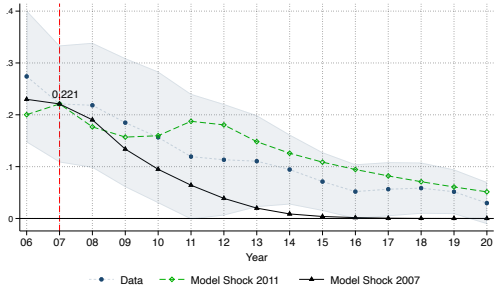
	ADH (1)	Baseline (2)	Longer (3)	NM (4)	$\nu = \kappa$ (5)	DNWRA (6)
Change in Population Shares						
Unemployment **(targeted)**	0.221**	0.221	0.221	0.221	0.221	0.221
NILF **(targeted)**	0.553**	0.553	0.553	0.553	0.553	0.553
Mfg Employment	-0.596**	-0.608	-0.580	-0.602	-0.613	-0.329
Non-mfg Employment	-0.178	-0.166	-0.193	-0.172	-0.161	-0.445
Percentage Changes						
Population **(targeted)**	-0.050	-0.050	-0.050	0.000	-0.170	-0.050
Mfg Wage	0.150	0.023	0.205	-0.016	0.033	-0.362
Non-mfg Wage	-0.761**	-1.181	-0.969	-1.204	-1.187	-0.735
Welfare						
Welfare vs exposure		-0.093	-0.142	-0.081	-0.100	-0.108
Mean welfare change		0.124	0.006	0.138	0.124	0.197
Mean welf. change no DNWR		0.312	0.450	0.314	0.313	0.324
Parameters						
ν		0.539	0.712	0.611	0.604	0.549
κ		5.790	12.27		0.604	0.946
δ		0.991	0.994	0.990	0.991	0.981

Persistence: Data vs. Model

NILF/Pop.

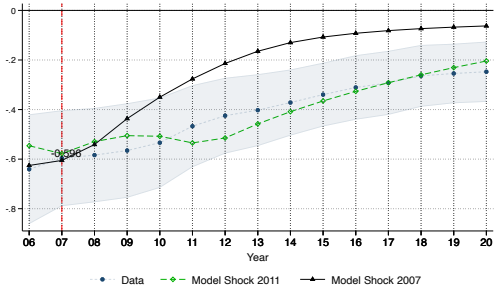


Unemployment/Pop.

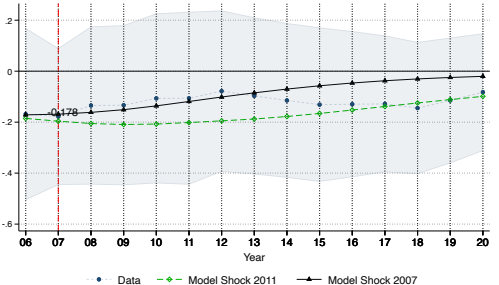


Persistence: Data vs. Model (continued)

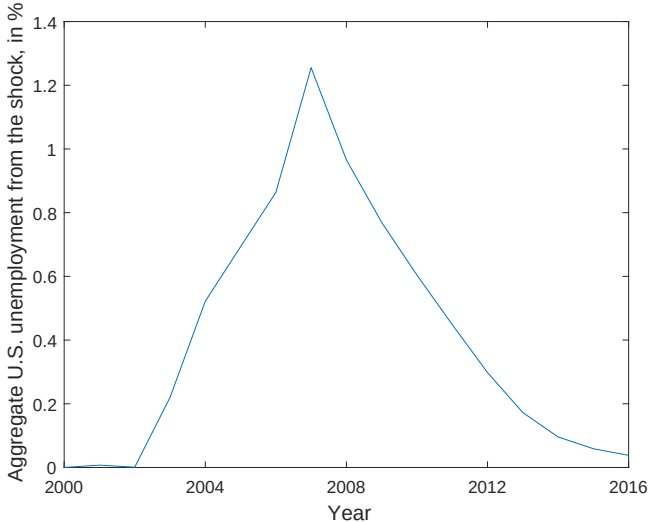
Manuf employment/Pop.



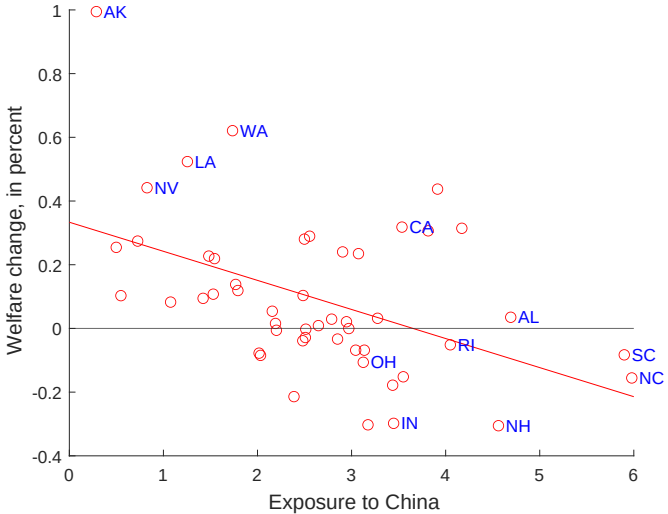
Non-Manuf employment/Pop.



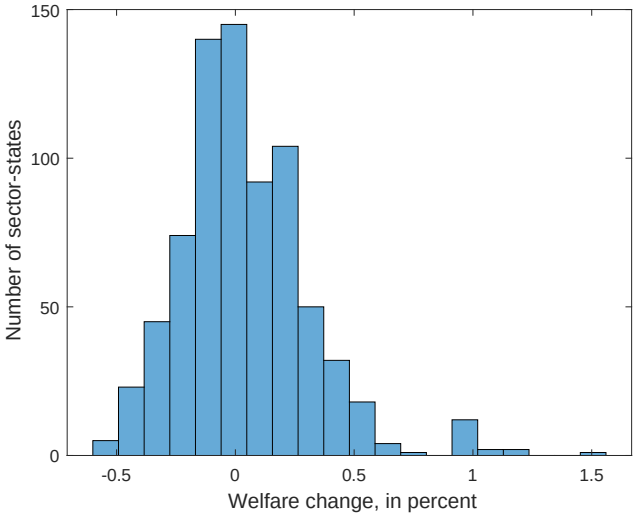
Aggregate Unemployment



Higher Exposure Decreases Welfare



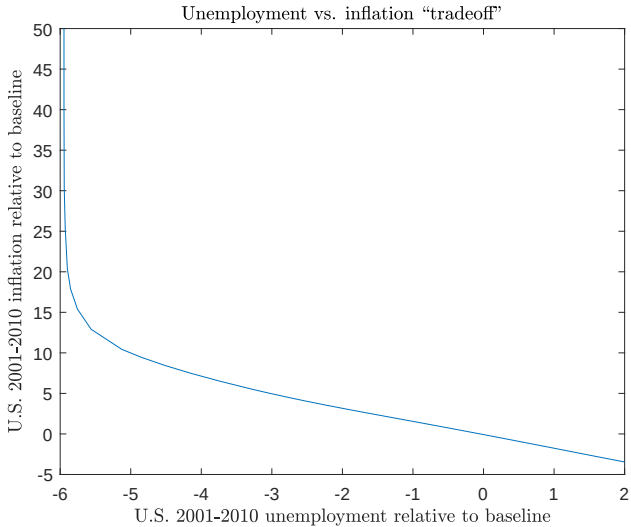
Dispersion in Sector-State Welfare



Effects Across States

	Number of States			
	2	18	25	5
ToT & L in S.S.	↓	↑	↑	↑
Welfare	↓	↓	↑	↑
L in transition	↓	↓	↓	↑

Trade-off Between the Unemployment Effects and Inflation



Conclusion

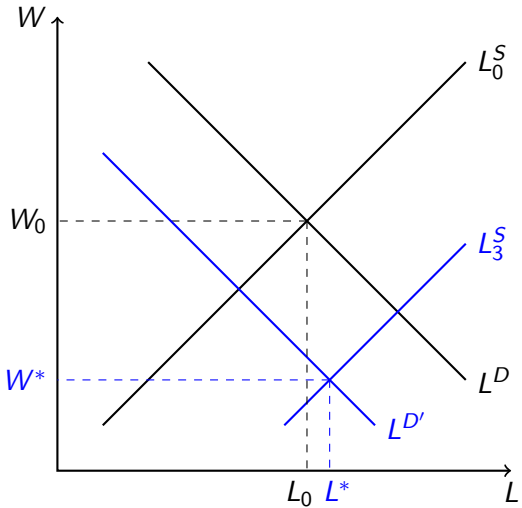
- We have proposed a trade model with DNWR consistent with ADH's cross-sectional unemployment and participation effects
- Model leads to realistic dispersion of income and employment effects and rationalizes the importance of ADH-style exposure
- Relevant implications for welfare
- Caveat: simplistic macro rules (no Euler equation, simple nominal anchor)

Additional Slides

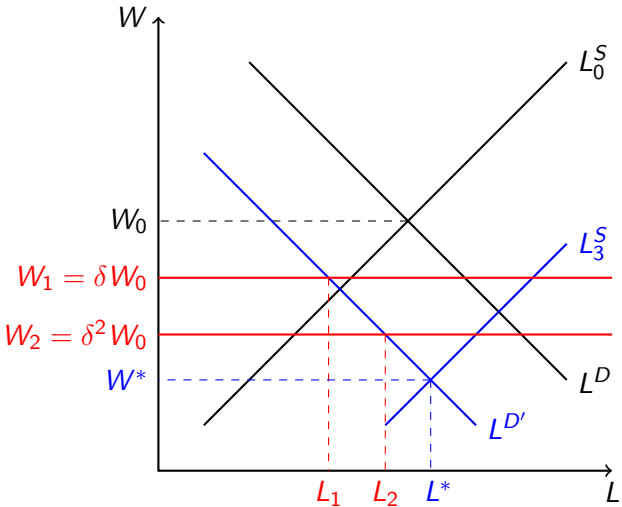
Literature

- Aggregate and dist. effects of China Shock: ADH'13, CDP'19, GRY'23, AAE'23
- Trade + Search and matching frictions: Dix-Carneiro et al.'23, Kim & Vogel'20
- Trade + Wage rigidities: EK + Neiman'14, Costinot et al'22
- Nominal rigidities in macro: NS'18, Shimer'04, Schmitt-Grohe & Uribe'16
- Microeconomic evidence for DNWR: Dickens et al.'07, Hazell-Taska'23

Some Intuition, Flexibility



Some Intuition, DNWR



Dispersion in Employment and Income Effects

- ADH 2021 and AAE 2021 show that standard quantitative models deliver too little dispersion in employment or income effects of China shock
- For example, CDP or Galle et al. (2021) struggle to match the spatial het. of the employment and income effects in ADH
- Model with DNWR leads to much larger declines in employment in the most exposed regions
  - S.D. for effects on employment/pop $= 1.35$ (vs 1.18 in ADH)
  - S.D. for effects on income/pop $= 2.5$ (vs 1.9 in ADH)