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

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

NBER SI International Trade & Investment

July 13, 2022

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:** Add downward-nominal wage rigidity (DNWR)

This paper

- CDP + nest (EoS $1/\nu$ across sectors and $1/\kappa$ across regions)
- Add DNWR as in Schmitt-Grohe and Uribe (2016)
  - Wage can fall by no more than 100(1-δ)% per year
- Dynamic exact hat algebra for counterfactual analysis
- Data: WIOD + 50 U.S. states (with migration), 2000-2007
- Calibrate China shock to match predicted change in US imports from China
- Pick ν, κ, δ to match ADH on unemployment, participation, population
- Study implications for employment and welfare

Preview of Findings

- DNWR has important effects at state level:
  - No DNWR $\rightarrow$ 1 state loses and suffers declines in L
  - DNWR $\rightarrow$ 8 states lose, and 31 suffer declines in L
- Aggregate: 1.5 pp $\uparrow$ in unemployment in 2007
- Decent fit to non-targeted moments
- DNWR reduces avg U.S. welfare gain by $1/4$ to $1/3$

Literature

- Aggregate and dist. effects of China Shock: ADH'13, CDP'19, GRY'21, AAE'21
- Trade + Search and matching frictions: Dix-Carneiro et al.'20, 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'20

Outline

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

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

- 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 know how it will unfold with perfect foresight
- Match 2000 data ($t = 0$) assuming this year is at steady state (no unemployment)
- Denote $\dot{x}_t \equiv x_t / x_{t-1}$ and $\hat{x}_t \equiv \dot{x}'_t / \dot{x}_t$
- Goal is to compute relative changes $\hat{x}_t$ only due to the China shock modeled as a sequence of shocks starting in 2001.

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Data

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

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

- WIOD: 35 sectors for 40 countries for 2000
- 2002 CFS: trade flows across U.S. States for 43 commodities
- 2008 U.S. Census: trade between U.S. states and other countries
- BEA: state-level production and consumption in serv. and agric. for 2000
- BLS and OECD: labor force participation for 2000
- CPS + ACS: sector-level bilateral migration flows between U.S. states for 2000

Exposure to China

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

- $L_{i,s,2000} \equiv$ employment in (i, s) in 2000
- $R_{US,s,2000} =$ U.S. sales in s in 2000
- $\Delta \widehat{X_{C,US,s}^{2007-2000}} =$ predicted change in exports from China to the US from 2000 to 2007 in s
- Re-normalize to have the same mean as the measure in ADH

Chinese Technology Changes

- Need $\hat{A}_{China,s,t}$ for $s = 1, ..., 12$ and $t = 2001, ..., 2007$
- Set $\hat{A}_{China,s,t} = \hat{A}^1_{China,t}\hat{A}^2_{China,s}$ (19 parameters instead of 84)
- Predict ΔX in USA using ΔX from other countries:

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

- $\{\hat{A}^1_{China,t}\}, \{\hat{A}^2_{China,s}\}$ to match $\{\widehat{\Delta X^{2007-2000}_{C,US,s}}\}, \{\widehat{\Delta X_{C,US,t}}\}$

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 $\delta \approx 0.98$, $\nu \approx 0.55$, and $\kappa \approx 12$
  - Wages can fall $\approx$ 2%/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

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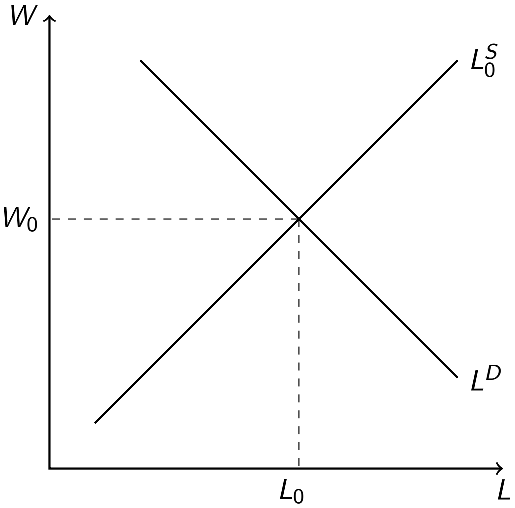
Some Intuition, Flexibility



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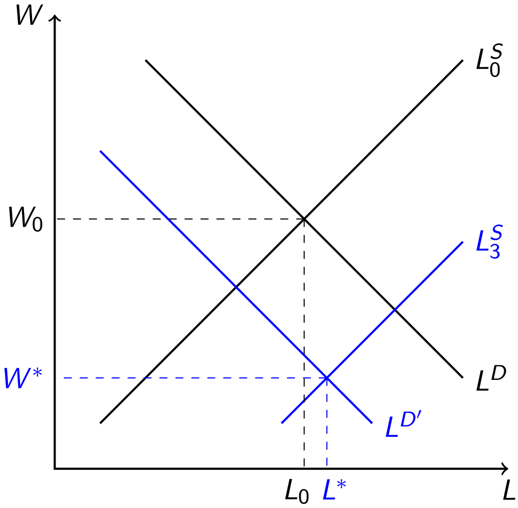
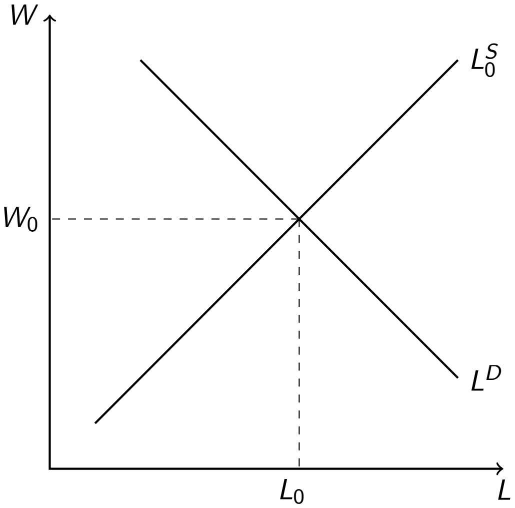


Some Intuition, DNWR



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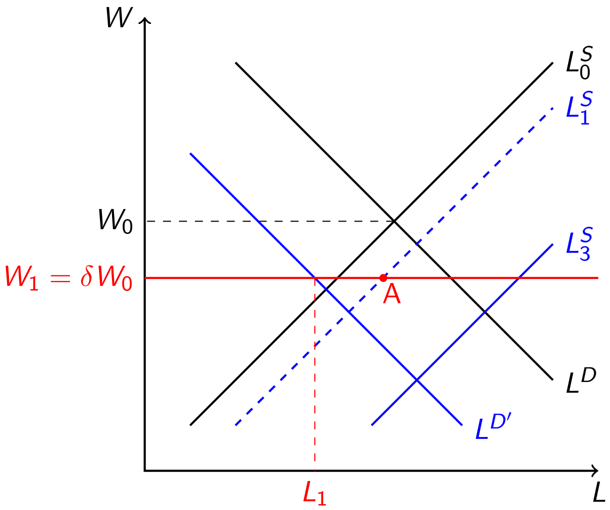

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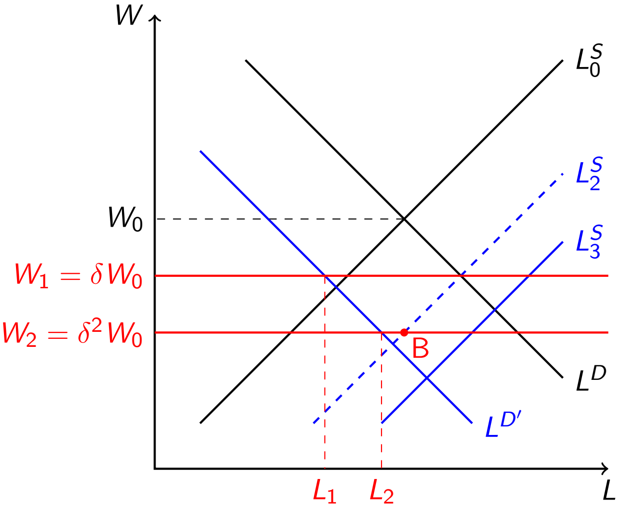

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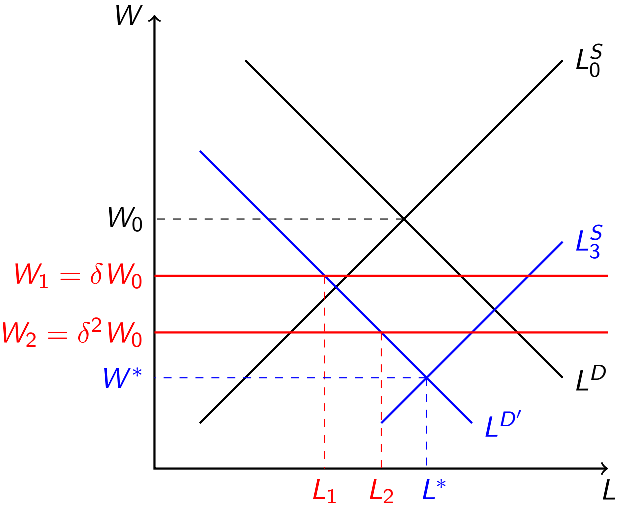
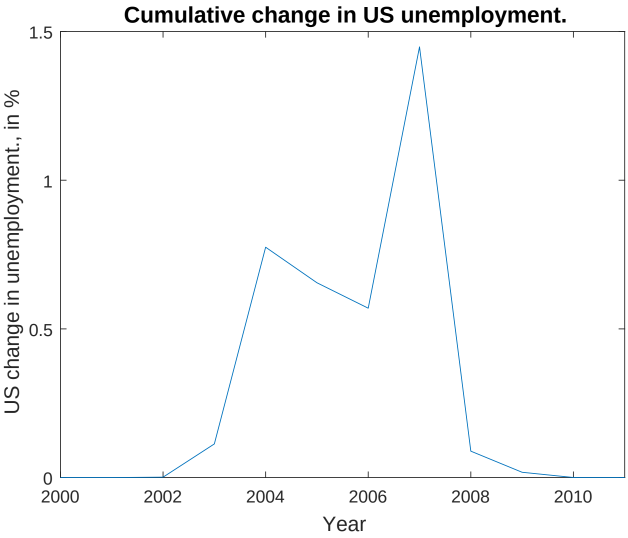


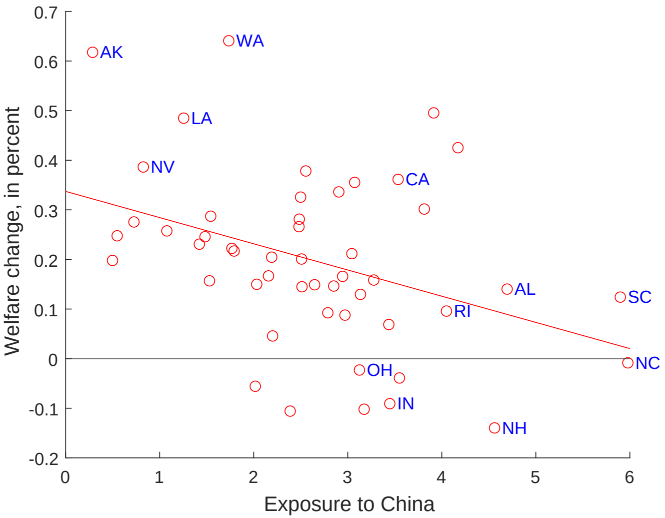
Average Unemployment



Effects Across States

	Number of States			
	1	7	23	19
ToT & L in S.S.	$\downarrow$	$\uparrow$	$\uparrow$	$\uparrow$
Welfare	$\downarrow$	$\downarrow$	$\uparrow$	$\uparrow$
L in transition	$\downarrow$	$\downarrow$	$\downarrow$	$\uparrow$

Higher Exposure Decreases Welfare



Net Exports Exposure vs. ADH Exposure

Table: "Horse race" between exp. measures with and without DNWR

	(1)	(2)	(3)	(4)
	Welf. Flex	Welf. DNWR	Emp. Flex	Emp. DNWR
Constant	0.513**	0.522**	3.204**	4.732**
ADH Exp.	-0.016	-0.031*	-0.168	-0.944**
NX Exp.	-0.076**	-0.092**	-0.537**	-1.168**
N	50	50	50	50
R squared	0.491	0.554	0.460	0.503
Mean d.v.	0.269	0.198	1.351	-0.821

Baseline and Extensions

	ADH (1)	Base. (2)	NoMo (3)	DNWRM (4)
Change in Population Shares				
Unemployment **(targeted)**	0.221**	0.221	0.221	0.221
NILF **(targeted)**	0.553**	0.553	0.553	0.553
Mfg Employment	-0.596**	-0.331	-0.337	-0.543
Non-mfg Employment	-0.178	-0.442	-0.437	-0.230
Percentage Changes				
Population **(targeted)**	-0.050	-0.050	0.000	-0.050
Mfg. Wage	0.150	-0.214	-0.182	0.152
Non-mfg. Wage	-0.761**	-0.689	-0.717	-1.065
Welfare				
Mean welfare change		0.229	0.235	0.197
Mean welfare change no DNWR		0.310	0.313	0.298
ν		0.551	0.594	0.496
κ		12.30		11.21
δ		0.980	0.980	0.987

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)

Conclusion

- DNWR can explain $\uparrow$ in unemployment, and larger $\uparrow$ in NiLF
- Model leads to realistic dispersion and rationalizes importance of ADH exposure
- Relevant implications for welfare
- Caveats: macro rules, risk sharing

Additional Slides

More Extensions

	ADH (1)	Base. (2)	Def. Low (5)	Def. High (6)	Fixed ER (7)
Change in Population Shares					
Unemployment **(targeted)**	0.221**	0.221	0.221	0.221	0.221
NILF **(targeted)**	0.553**	0.553	0.553	0.553	0.553
Mfg Employment	-0.596**	-0.331	-0.340	-0.400	-0.299
Non-mfg Employment	-0.178	-0.442	-0.434	-0.374	-0.475
Percentage Changes					
Population **(targeted)**	-0.050	-0.050	-0.050	-0.050	-0.050
Mfg. Wage	0.150	-0.214	-0.180	0.015	-0.165
Non-mfg. Wage	-0.761**	-0.689	-0.661	-0.541	-0.574
Welfare					
Mean welfare change		0.229	0.232	0.221	0.185
Mean welfare change no DNWR		0.310	0.323	0.386	0.284
ν		0.551	0.548	0.571	0.521
κ		12.30	11.87	10.38	10.37
δ		0.980	0.981	0.986	0.987

Welfare and Discounting

Table: Welfare gains for different discount factors

	Weighted			Unweighted		
β	$\delta = 0$	cal. δ	% dec.	$\delta = 0$	cal. δ	% dec.
0.99	0.382	0.362	5.33	0.332	0.315	5.23
0.95	0.310	0.228	26.22	0.269	0.198	26.36
0.91	0.250	0.134	46.42	0.217	0.114	47.46

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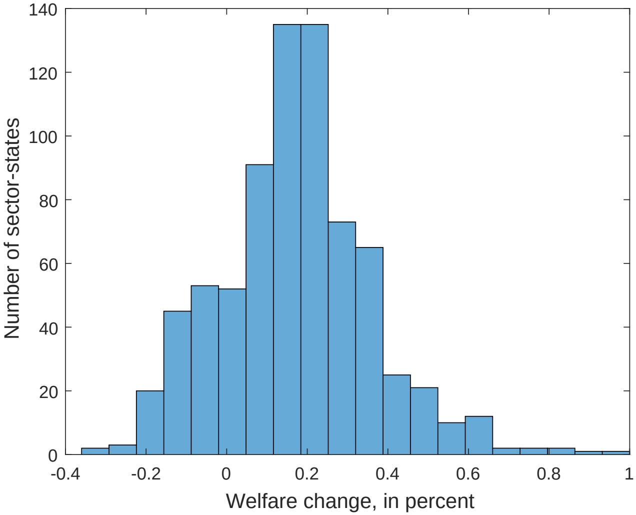
Dispersion in Sector-State Welfare



Job Losses and the "Missing Intercept" Problem

- ADH: a \$1k/worker $\uparrow$ exposure $\Rightarrow$ emp/pop $\downarrow$ 77 bp (22 from unemp + 55 LFP)
- These effects are relative (more exposure vs less exposure)
- A naive calculation that assumes zero exposure $\rightarrow$ zero effect
  - Cross-sectional regression with zero intercept
  - Job losses $= 0.77 \times 2.63 \times 220$ mill $= 4.4$ million jobs, where 2.63 is mean exposure
- Model implies an intercept = -1.75
  - Back-of-the-envelope comp. $\Rightarrow (-1.75 + 0.77 \times 2.63) \times 220 = 0.55$ mill jobs lost
  - Full GE model implies 0.47 million jobs lost
- We stop counting job losses in 2007. Long-term effect are net gains