Trade and welfare

(across local labor markets)

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Motivation and methodological contribution

- **Empirically**, trade (and other) shocks differentially affect local labor markets along many adjustment margins: wages, prices, participation, unemployment, migration, sector choice
- **Our methodological question: Can we replicate these empirical designs, but aggregate margins into a single welfare statistic under weak restrictions?**

Motivation and methodological contribution

- **Empirically**, trade (and other) shocks differentially affect local labor markets along many adjustment margins: wages, prices, participation, unemployment, migration, sector choice
- **Our methodological question: Can we replicate these empirical designs, but aggregate margins into a single welfare statistic under weak restrictions?**
- Large and growing **quantitative** literature on welfare effects of trade shocks!
  - Often focuses on **few margins** of adjustment; and always...
  - ...**strong functional forms** on active margins (e.g., Fréchet distributed amenity draws)
  - ...**strong assumptions on economic environment** (e.g., unemployment via wage rigidity)
  - ...**welfare measures not invariant to monotonic transformations of utility functions**
- **Our methodology: First-order money-metric welfare for workers initially in a region**
  - Envelope conditions: participation + sector + region choice vs. unemployment
  - Theory-guided measurement of potentially observable shocks

Application

1. **Construct welfare for agents initially in each U.S. CZ btw 2000-2007** (and earlier period)
   - Substantial variation across CZs, mostly driven by productivity-adjusted real wage changes
2. **Project welfare on a CZ measure of exposure to granting China PNTR**
   - 90-10 welfare gap: 1.9% smaller welfare increase in CZ at 90th percentile of exposure
     - ★ ↑ if we incorporate non-pecuniary costs of unemployment
     - ★ ↓ if we assume a national price index (new empirical result: local prices dampen wage effects)
   - Not a continuation of pre-existing differential trends
   - Evidence that results not driven by omitted contemporaneous shocks

Compare results to standard alternative approaches + show how they differ; e.g.,

- comparing wage changes for those initially in different CZs $\approx 1/2$ baseline effect
- comparing wage changes for those in different CZs $\approx 5/4$ baseline effect

Literature

- **Empirical local effects of trade shocks:** Topalova (2010), Autor et al. (2013, 2015, ...), Kovak (2013), Dix-Carneiro and Kovak (2017, 2019), McCaig and Pavcnik (2018), Pierce et al. (2024)...
- **Distributional money-metric / sufficient-statistic approach:** Porto (2006), Atkin et al. (2018), Borusyak and Jaravel (2021), Burstein et al. (2024)...
- **Quantitative local welfare effects of trade shocks:** Adão (2015), Caliendo et al. (2018), Burstein et al. (2019), Lee (2019), Kim and Vogel (2021), Adão et al. (Forthcoming), Galle et al. (2023), Rodriguez-Clare et al. (Forthcoming)...

Outline

1. Theory: welfare sufficient statistic
2. Measurement in U.S. commuting zones
3. Granting China PNTR: shock, design, and results
4. Conclusion

Theory of measurement

Theory: Environment

- Risk-neutral workers who statically optimize
- Worker ω chooses where to live (r) and to which sector to apply (s)
- $s = 0$: home production; $s \geq 1$: employed in (r, s) w/ probability E_{rs} and o.w. unemployed in r
- If in job $j \in \{u, 0, 1, ..., S\}$ in region r, wage per efficiency unit $\widetilde{w}_{rj}$ and price index P_r
- Arbitrary heterogeneity in
  - productivity $\varepsilon^{\omega}_{rj}$ across region-job pairs
  - amenities / compensating differentials η^{ω}_{rj}
- Impose no structure on how wages, prices, or employment probabilities are determined

Payoffs

$$U^{\omega}_{rj} = \frac{\varepsilon^{\omega}_{rj} \widetilde{w}_{rj}}{P_r} + \eta^{\omega}_{rj}$$

$$\mathbb{E}[U^{\omega}(r, s)] = E_{rs} U^{\omega}_{rs} + (1 - E_{rs}) U^{\omega}_{ru}$$

Object of interest

Equivalent/Compensating variation for set of workers who start in r, regardless of where they live or work after shock

Theory: Welfare changes for agents who start in r

- **Welfare**, to a 1^{st}-order approximation, for the set of agents who live in region r in an initial equilibrium, in response to the following changes (which agents treat as exogenous):
  1. incomes per efficiency unit: $\widetilde{w}_{kj}$ for all region-job pairs kj
  2. probabilities of successfully finding employment: E_{ks} for all regions k and sectors $s \geq 1$
  3. price indices, P_k, across all regions k
  4. productivity, ε_{ks} across all regions k and sectors $s \geq 1$
- **Welfare = EV (locally equal to CV)**
  - real transfer received under initial parameters (before realization of unemployment lottery) at which agent is indifferent in expectation btw initial + terminal (shocked) parameters
  - sum this across agents initially in r and divide by expected real income
- EV_r **is a money-metric percentage change in welfare for the initial cohort in region** r
- **Assumption:** set of agents living in r and applying to s is continuous in the shocks

Theory: Two Restrictions

- General formulation in the paper + intuition followed by two additional restrictions used in measurement; here, jump to restrictions

- **Two restrictions**
  1. $E_{rs} = E_r$ **for all** $s \geq 1$**: unemployment equally likely in all sectors within** r
     - ⋆ Why? No data on unemployment conditional on sector of application
  2. $\widetilde{\eta}_r \equiv \frac{1}{|\Omega_{rs}|} \int_{\Omega_{rs}} \eta_{rs}^{\omega} d\omega - \frac{1}{|\Omega_{rs}|} \int_{\Omega_{rs}} \eta_{ru}^{\omega} d\omega$**: dis-amenity of unemployment compared to employment common across sectors** $s \geq 1$ **within** r
     - ⋆ Why? Hard to measure at all, especially so by sector of application

Theory: Sufficient statistic for welfare (under these restrictions)

$$EV_r = \underbrace{\sum_{j \in \mathcal{J}} \frac{l_{rj}}{l_r} \, d \log \left(\frac{w_{rj}}{P_r} \right)}_{\text{real wage}} + \underbrace{(1 + \eta_r) \frac{l_r^e}{l_r} \left(1 - \frac{\bar{l}_r^u}{\bar{l}_r^e} \right) d \log E_r}_{\text{unemployment}}$$

- **Envelope conditions**:
  - Reallocations across regions, sectors, and participation have no first-order welfare effect
  - **But unemployment enters directly because workers do *not* choose unemployment**
- **Weight on real productivity-adjusted wage changes are initial income shares**
  - $d \log w_{rj} = d \log \widetilde{w}_{rj} + d \log \varepsilon_{rj}$ is combo of wage per efficiency unit and rj productivity change
- **If $\eta_r = 0$, second term measures pecuniary cost of changes in unemployment**
  - $\eta_r \equiv \widetilde{\eta}_r / \left(\bar{l}_r^e - \bar{l}_r^u \right)$ average non-pecuniary relative to pecuniary welfare loss of unemployment

Theory: Measurement implications

What the envelope conditions buy us

- No sector or region switching terms
- No need to specify agglomeration, matching, wage-rigidity, etc. mechanisms
- No restrictions on productivities/amenities

What must be measured

- Initial income shares across jobs, replacement rates, and η_r
- Productivity-adjusted wage changes
- Regional price changes
- Employment-rate changes

Key empirical implications of wage component in light of alternative approaches

- Average wages in *rs* don't identify $d \log w_{rs}$ b/c of worker productivity differences
- Average wages among those initially in *rs* don't either b/c of amenity differences

Measurement in U.S. commuting zones

Measurement and data basics

Mapping theory to data

- Regions: mainland commuting zones (roughly 600)
- Jobs: 6-digit NAICS sectors + NILF + unemployment
- Baseline change: 2000–2007
- Placebo change: 1992–2000

Inputs (basics)

- **LBD**: rs income for $s \geq 1$
- **Census/ACS**: unemployment rate, home-production wage
- **Hazell et al. (2022) + BLS**: state inflation
- **DOL**: state unemployment replacement rate
- **Time-use/Census**: home-production income

- Returns to unemployment and NILF are normalized so that $d \log(w_{rj}/P_r) = 0$ for $j \in \{u, 0\}$
- **Missing:** η_r **and** $d \log w_{rs}$

Measurement and data: η_r

- **η_r hard to recover from agent choices b/c agents do not choose to be unemployed**
- **Baseline** $\eta_r = 0$
- **Robustness:** use literature calculating income necessary to compensate an individual for the change in self-reported well-being associated with the loss of job
  - This literature argues unemployment is one of most costly experiences in life and much more so than implied by equal-sized income losses
  - Knabe and Ratzel (2011) provide lower bound in literature of $\eta = 2$
  - Lower bound b/c they incorporate future income loss associated w/ current unemployment

Measurement and data: $d \log w_{rs}$

Why this is hard

- Observed average wages in (r, s) mix
  - changes in wages per efficiency unit
  - changes in worker composition / selection
- Observed average wages for those initially in (r, s) mix in compensating differentials

Our measure

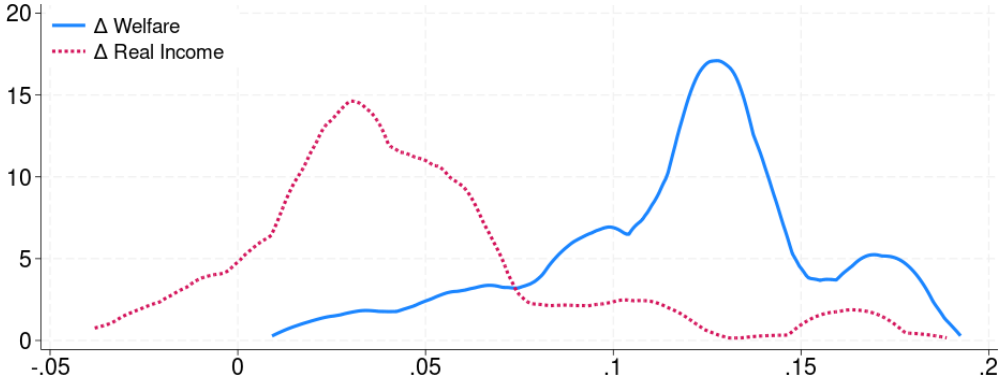
- **LEHD** worker-level panel data on earnings
- Restrict to workers employed in the same (r, s) in both periods

$$d \log w_{rs} = \frac{1}{N_{rs}} \sum_{i=1}^{N_{rs}} \left(\log w_{i,t'} - \log w_{i,t} \right)$$

Implication

- This holds worker composition fixed, so measured changes reflect productivity-adjusted wages rather than selection
- Allows for arbitrary time-invariant worker-level comparative advantage across (r, s), arbitrary (r, s) changes in productivity, but restricts individual-region-sector changes

Unconditional welfare changes across CZs



- Welfare ↑ btw 2000-07 by ≈ 6, 12, and 17% at the 10th, 50th, and 90th percentiles
- $EV_r >$ change in average real income b/c it follows a fixed initial cohort (productivity rises w/ age)
- Decomposing cross-CZ variance: 93% real-wage, 2% unemployment, remainder covariance

Granting China PNTR

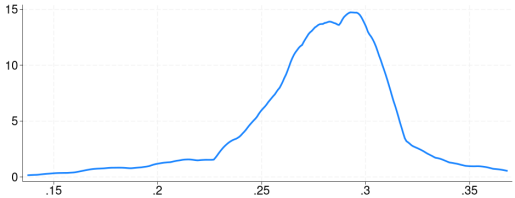
The trade shock: granting China PNTR

- Before China joined WTO, continued access to U.S. NTR tariff rates required annual renewal
- Without renewal, tariffs would have jumped from roughly 6 to 31%, on average
- Sectoral exposure is the 1990 NTR gap from Pierce and Schott (2016)
- Regional exposure is a weighted average of sectoral gaps:

$$\text{NTRG}_r = \sum_{s=1}^{S} \omega_{rs} \, \text{NTR gap}_s$$

- ω_{rs} uses 1980 manuf empl. shares, normalized over sectors w/ defined NTR gaps to avoid incomplete-shares problems of BHJ (2022)

Distribution of NTRG_r across r



Empirical design

$$EV_r = \alpha + \beta\,\mathrm{NTRG}_r + X_r'\gamma + \varepsilon_r$$

- Compare 2000–2007 welfare changes across CZs with different exposure to PNTR
- Controls include initial manufacturing share, missing-NTR-gap sector share, employment-to-population, education, foreign-born share, female employment share, routine share, offshorability, and Census-division fixed effects
- Observations are weighted by each CZ's initial income among the employed; baseline standard errors are clustered by state (BHJ 2022 SE in robustness tend to be smaller)
- We also estimate the same specification separately for the real-wage and unemployment components of EV_r

Baseline empirical results: PNTR and welfare

	(1)	(2)	(3)	(4)	(5)
Panel A: EV					
$NTRG_r$	-0.214*	-0.190	-0.183**	-0.243***	-0.248***
Robust state clustered SE	(0.122)	(0.120)	(0.088)	(0.084)	(0.096)
$\mathbb{E}[EV_r : NTRG_{p90} - NTRG_{p10}]$	-.017	-.015	-.014	-.019	-.019
Panel B: EV Decomposition					
Real wage:					
$NTRG_r$	-0.175	-0.162	-0.162*	-0.211***	-0.224**
Robust state clustered SE	(0.118)	(0.118)	(0.085)	(0.082)	(0.093)
BHJ SE	(0.096)	(0.085)	(0.062)	(0.066)	(0.069)
Unemployment:					
$NTRG_r$	-0.039***	-0.027***	-0.021**	-0.032***	-0.024***
Robust state clustered SE	(0.013)	(0.009)	(0.009)	(0.008)	(0.007)
BHJ SE	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)
Observations	600	600	600	600	600
manufacturing share$_{-1}$		✓	✓	✓	✓
missing NTRG sector share$_{-1}$		✓	✓	✓	✓
employment-to-population$_{-1}$		✓	✓	✓	✓
college share$_{-1}$				✓	✓
foreign born share$_{-1}$				✓	✓
female share$_{-1}$				✓	✓
routine occupation share$_{-1}$					✓
average offshorability$_{-1}$					✓
regional FE			✓	✓	✓

Within-sector wage changes: regional exposure matters

- What explains strong correlation btw real wage component of EV_r and $NTRG_r$? $d \log w_{rs}$...
  1. similar across r w/in s, but some r have higher shares of income earned in more exposed s
  2. **less positive in more exposed r within s**

	$d \log w_{rs}$		
	(1)	(2)	(3)
Sectoral NTR Gap$_s$	-0.056		-0.004
	(0.042)		(0.033)
Regional NTRG$_r$		-0.573***	-0.569***
		(0.146)	(0.137)
Baseline regional controls		✓	✓
$\mathbb{E}[d \log w_{rs} : \text{NTRG}_{p90(r)}\text{-NTRG}_{p10(r)}]$		-.055	-.054
$\mathbb{E}[d \log w_{rs} : \text{NTR Gap}_{p90(s)}\text{-NTR Gap}_{p10(s)}]$	-.015		-.0012
Observations	26500	26500	26500

- Related results in **Pierce et al. (2024)**: Also using LEHD, granting China PNTR lowered incomes of workers **initially** in more exposed r, but not more so in more exposed s

Falsification: not a continuation of pre-trends

	EV_r		
	2000-2007		1992-1999
	(1)	(2)	(3)
$NTRG_r$	-0.248***	-0.314**	0.302
	(0.096)	(0.141)	(0.180)
$\mathbb{E}[EV_r : NTRG_{p90}\text{-}NTRG_{p10}]$	-.019	-.024	.023
Baseline sample	✓		
Placebo sample		✓	✓
Observations	600	80	80

- Column 1 is baseline
- Column 2 restricts to smaller sample available in pre-period and leaves results very similar
- Column 3 is pre-period:
  - If anything, EV_r rising faster in more exposed r $\Rightarrow$ a larger trend break after China joins WTO

Sensitivity

	EV_r					
	(1)	(2)	(3)	(4)	(5)	(6)
$NTRG_r$	-0.248***	-0.296***	-0.254**	-0.248**	-0.290***	-0.314***
	(0.096)	(0.104)	(0.100)	(0.100)	(0.087)	(0.120)
$\mathbb{E}[EV_r : NTRG_{p90}\text{-}NTRG_{p10}]$	-.019	-.023	-.02	-.019	-.022	-.024
Baseline	✓					
Non-pecuniary cost of unemployment		✓				✓
NILF + unemployment, adjusted replacement			✓			✓
NILF + unemployment, baseline replacement				✓		
National price index					✓	
Observations	600	600	600	600	600	600

- Results are broadly robust across alternative mappings from data to welfare, although
  - Column 2: Adding a non-pecuniary unemployment cost makes the effect more negative and raises importance of unemployment, as expected
  - Column 5: Using a national deflator strengthens the effect because local prices fall more in negatively shocked regions

Alternative welfare measures

Sufficient statistic is not just a rescaling; it changes the quantitative interpretation of the shock. Here, omit the unemployment component.

	Alternative Measures of Welfare			
	(1)	(2)	(3)	(4)
$NTRG_r$	-0.266***	-0.332***	-0.169**	-0.127**
	(0.085)	(0.093)	(0.080)	(0.061)
$\mathbb{E}[\Delta Welfare_r : NTRG_{p90}\text{-}NTRG_{p10}]$	-.021	-.026	-.013	-.0098

- Column 1: baseline real wage component using national price index (for comparison)
- Column 2: change in average nominal wages relative to national price index $\times 1.25$
- Column 3: wages constructed in 2000, 2007 on fixed sample who were employed in r in 2000 and remain employed in any location in 2007
- Column 4: same as column 3, but including unemployed in 2007 $\times 0.5$

Conclusions

- Goal: Revisit the empirical trade literature identifying changes in margins of adjustment, but combining margins into welfare without strong restrictions
- Derived a welfare sufficient statistic for local labor markets with unemployment, participation, sectoral choice, migration, local prices, arbitrary heterogeneity
- Measured welfare across U.S. CZs between 2000 and 2007 and showed that granting China PNTR reduced relative welfare growth in more exposed CZs by about 1.9 log points between the 90th and 10th percentiles of exposure
- Methodology can be applied to other well-identified shocks whenever we can observe the relevant wage, price, and employment changes