Trade, Jobs, and Worker Welfare

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Motivation

- The role of *labor mobility* in quantifying the effect of trade on worker's welfare

- The literature has focused on labor mobility *between* labor markets
  - Artuc, Chaudhuri, and McLaren (2010, **ACM**), Dix-Carneiro (2014), Caliendo, Dvorkin, and Parro (2019, **CDP**)
  - Labor markets are typically aggregate, e.g., sectors, states, etc

- In data, *within-market mobility* is much larger than between-market mobility

- **Our contribution**:
  - A new dynamic GE trade model with within- and between-market labor mobility
  - New channel: **job opportunities**
  - Comprehensive yet fully tractable; clean identification of structural parameters

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Job Opportunities

- What makes workers move?
  - Wage differentials (endogenous)
    - (Exogenous) mobility frictions, idiosyncratic preference to explain residual mobility
  - *Job opportunities* (endogenous)
- We provide a micro-foundation for *endogenous non-wage factor* of labor mobility
- Why job opportunities matter for worker welfare
  - If a worker chooses the best job out of more potential jobs, it is more likely that the chosen one gives the worker higher welfare
  - Future opportunity in a dynamic setting

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Main Quantitative Findings

- Data: the matched employer-employee data from Brazil (RAIS) for 2003-2015
- Quantify trade-induced changes in worker welfare
  1. A positive mfg export shock increases aggregate worker welfare
     - equivalent to a one-time increase of wage by 120.43% of the average annual wage
  2. Trade shocks generate both between- and within-market mobility
  3. Workers in a better-connected labor market benefit more
  4. The job opportunity channel magnifies welfare gains from trade by 30%
  5. Lower mobility frictions magnify welfare gains from trade (20% $\downarrow \Rightarrow$ 16.5% $\uparrow$)
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Related Research

- **Local labor market approach on the effect of trade on labor market outcomes**
  - Topalova (2010), Kovak (2013), Autor, Dorn, and Hanson (2013), Autor, Dorn, and Hanson (2015), McLaren and Hakobyan (2016), Dix-Carneiro and Kovak (2015), Dix-Carneiro and Kovak (2017) and Dix-Carneiro and Kovak (2019)
  - We estimate the mobility friction and quantify welfare consequence of trade
- **Dynamic labor market adjustment to trade shocks**
  - Artuc, Chaudhuri, and McLaren (2010, **ACM**), Dix-Carneiro (2014), Caliendo, Dvorkin, and Parro (2018, **CDP**), and Traiberman (2019)
  - We capture both between- and within-labor-market labor mobility
  - Search-based approach: Cosar et al. (2016), Fajgelbaum (2020)
- **(Modified) welfare consequences**
  - Arkolakis, Costinot, and Rodriguez-Clare (2012), CDP (2018), Galle, Rodriguez-Clare, and Yi (2018)
  - We derive welfare consequences of trade in a dynamic setting

Outline

1. Introduction
2. Empirical Analysis
3. Model
4. Estimation
5. Quantification and Counterfactuals
6. Model Validation
7. Conclusion

Outline

Data Description

- *Relação Anual de Informações Sociais* (RAIS) 2003-2015
  - Census of the Brazilian formal labor market from the Brazilian Ministry of Labor
  - A high-quality matched employer-employee administrative database
  - Establishment-level information
  - Detailed worker-level information on demographics, job characteristics, tenure, etc
  - Focus on workers of age 16-64 in the private sector
- Merged with the customs data on export transactions by microregion, industry and destination in each year
- Definition of labor market: region $\times$ sector
  - 558 microregions by grouping 5571 municipalities
  - 3 sectors by grouping 5-digit industries

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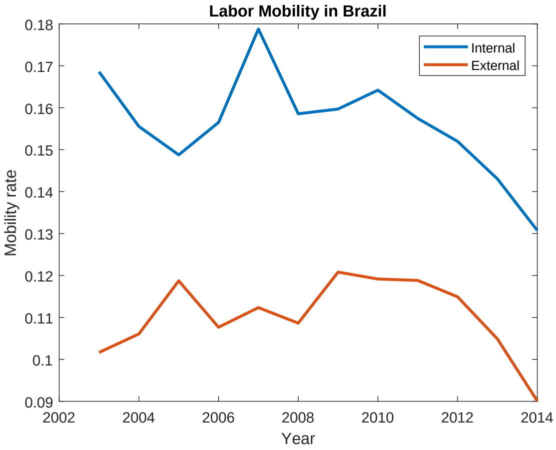
Between- vs. Within-labor-market Mobility

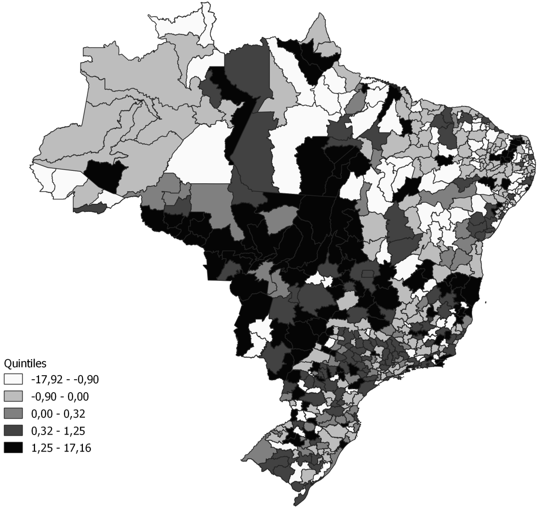
- Within-labor-market mobility is much larger than between-labor-market mobility



  - Within-labor market mobility is measured based on the # of workers who switch either 6-digit occupation or firm within the same labor market

Changes in Export Revenues by Microregion

- Changes in log export revenues 2004-2014



Empirical Specification

- What is the effect of export shocks on labor market outcomes?

$$\Delta y_t^k = \alpha + \beta \Delta Z_t^k + \lambda_t + \epsilon_t^k$$

  - y_t^k: labor market outcomes of interest (in log)
  - Z_t^k: log export revenue originated from labor market k

- IV strategy using the exogenous variation in change of import demand directed to each labor market

$$\Delta \bar{Z}_t^k = \sum_d \beta_{d,k,2003} \Delta IM_{dI_k t}$$

  - $IM_{dI_k t}$: each destination d's total imports (excluding Brazil) in sector I_k Variation
  - $\beta_{d,k,2003}$: export share of destination d in labor market k in 2003

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IV Regression Result (Second Stage)

	ΔEmployment	ΔResidual wage	
ΔExport value	0.2276	0.3187	All variables in logs
(s.e.)	(0.0372)	(0.0322)	S.E. clusterd by microreagion×year
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	between-market		
	Δ# entering	Δ# leaving	
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First Stage Table

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	between-market		*within-market*
	$\Delta\#$ entering	$\Delta\#$ leaving	$\Delta\#$ switching jobs (internally)
ΔExport value	0.3459	-0.9162	0.4275
(s.e.)	(0.0806)	(0.1335)	(0.1015)
Time FE	Y	Y	Y
N	4008	4008	4008

First Stage Table

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Overview

1. **International trade**
   - Building on Eaton and Kortum (2002)
   - New elements: multiple sectors with IO linkages, multiple regions
   - Producers have *love for variety of tasks*: more tasks are operated by producers in a larger region/sector
2. **Labor mobility**
   - Workers endogenously choose the best job after comparing all job opportunities across all labor markets
   - Each labor market offers a different # of job opportunities

- **General equilibrium**: trade patterns determine wages and the # of job opportunities which then affect labor allocation decision of workers

Labor Mobility Model: Basic Setup

- Definition of **labor market**: a pair of **region** and **sector**
- One additional *residual* labor market (informal labor + unemployment)
  - Assume no production in the residual labor market
- Each labor market k offers a different **wage** w_t^k and a different number of **job opportunities** N_t^k
- Idiosyncratic preference for each job opportunity $\sim Gumbel(-0.5772\nu, \nu)$
- At each period t, each worker chooses the job j which gives her the highest expected utility
  - Rational expectation for future wage process
  - Labor market affiliation is an *outcome* of this job choice, K_j
- Two types of mobility friction
  - Between labor markets $C_t(k, l)$ [*estimated structurally*]
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Equilibrium Between-market Labor Mobility

- The equilibrium probability of moving ***conditional on*** switching a job

$$\widetilde{m}_t^{kl} = \frac{N_t^l \exp\left(\frac{E_t \beta V_{t+1}^l - \delta - C_t(k,l)}{\nu}\right)}{N_t^k \exp\left(\frac{E_t \beta V_{t+1}^k - \delta}{\nu}\right) + \sum_{l' \neq k} N_t^{l'} \exp\left(\frac{\beta E_t V_{t+1}^{l'} - \delta - C_t(k,l')}{\nu}\right)}$$

- Re-write the labor-market-specific value (= average welfare for workers in k)

$$V_t^k = w_t^k + \beta E_t V_{t+1}^k \underbrace{-\nu \log(\mu_{0,t}^k)}_{\text{option value}}$$

  - $\mu_{0,t}^k$: the probability of keeping the same job

- Decomposition of the option value
  - *Internal* option value: $-\nu \log\left(1 - \mu_{1,t}^k\right)$
  - *External* option value: $-\nu \log\left(\mu_{0,t}^k\right) + \nu \log\left(1 - \mu_{1,t}^k\right)$
    - $\mu_{1,t}^k$: the probability of changing jobs but not labor market

Detail

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Detail

Love for Variety of Tasks

- Producers decide
  1. $\widetilde{l}^k_{1,t}$: total demand for aggregate labor units
  2. O^k_t: how many tasks to operate for the desired level of labor aggregate
- The total demand for labor is a CES aggregate of all tasks, with $\tilde{\sigma} > 1$
- More diversified production structure is more costly: marginal cost $\tilde{c}$
- Workers are equally productive for each task within the same labor market

$$\widetilde{l}^k_{1,t} = L^k_{1,t}(O^k_t)^{\frac{1}{\tilde{\sigma}-1}}$$

- The number of job opportunities workers can sample

$$N^k_t = \rho(O^k_t),$$

where $\rho(\cdot)$ is a monotonically increasing function

- International trade: EK (2002) + multiple sectors, IO linkages
  - Iceberg trade costs for international trade, no domestic trade cost Detail

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Timing

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2. Producers allocate workers across O_t^k tasks for production and pay wage w_t^k
3. Producers decide how many tasks to operate in the next period, O_{t+1}^k, based on
   - workers' expected mobility decisions
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4. Workers sample $N_{t+1}^k = \rho(O_{t+1}^k)$ job opportunities from each labor market k
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6. Workers choose a new job at the end of period t subject to mobility frictions

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Timing

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Equilibrium Trade Flows and Market Clearing

- The model delivers equilibrium gravity relationship for trade flows as in EK
  - Between region r of country 1 and country $n \neq 1$: $\lambda^{i}_{(1,r),n,t}$ and $\lambda^{i}_{n,(1,r),t}$
    - ★ $\lambda^{i}_{n,1,t} = \bar{R}\lambda^{i}_{n,(1,r),t}$ for aggregate imports of country 1
  - Between country $n \neq 1$ and country $n' \neq 1$: $\lambda_{n,n'',t}$

- The exact price index for each sector and country also follows EK

- Labor market clearing: for $R^k = r$ and $I^k = i$ ($\widetilde{w}$: nominal wage)

$$\widetilde{w}^{k}_{1,t} L^{k}_{1,t} = \gamma_l \left(\sum_{r'} \lambda^{S_k}_{(1,R_k),(1,r'),t} X^{S_k}_{(1,r'),t} + \sum_{n' \neq 1} \lambda^{S_k}_{(1,R_k),n',t} X^{S_k}_{n',t} \right),$$

$$\widetilde{w}_{n,t} \bar{L}_{n,t} = \bar{\gamma}_l \sum_{s'} \left(\sum_{r'} \lambda^{s'}_{n,(1,r'),t} X^{s'}_{(1,r'),t} + \sum_{n' \neq 1} \lambda^{s'}_{n,n',t} X^{s'}_{n',t} \right) \quad \text{s.t. } n' \neq 1$$

Trade flows | Price index | Expenditure

Outline

Outline

Estimation Overview

- Data: RAIS from Brazil
  - The data covers only the formal labor market of Brazil
- Labor market: 558 microregions and 3 sectors
- An additional residual sector
  - Further assumption: no job switch within the residual sector
- Estimation process:
  1. Estimate moving probabilities $\widetilde{m}_t^{kl}$ along with $C_t(k,l)$ Detail Results
  2. Estimate the (inverse) labor supply elasticity $\nu = 0.484$ Result detail

Welfare Effects of Export Shocks

- Model-implied changes in relative welfare and the number of job opportunities

$$\Delta\left(V_t^k - V_t^l\right) = \Delta\nu\left[\log \widetilde{m}_t^{lk} - \log \widetilde{m}_t^{kk} - \log(\mu_{1,t}^k + \mu_{2,t}^k) + \log(\mu_{1,t}^l + \mu_{2,t}^l)\right]$$

$$\Delta \log N_t^k = \Delta\nu\left[\log \mu_{1,t}^k - \log \mu_{0,t}^k\right]$$

- The same regression equation used for the reduced-form analysis

$$\Delta y_t^k = \alpha + \beta \Delta Z_t^k + \lambda_t + \epsilon_t^k$$

  - The same IV strategy for the export shock
  - Δy_t^k: model-implied welfare outcomes

	Coefficients	s.e.	Implied elasticities with $\nu = 0.484$
ΔWelfare	0.700	(0.150)	0.339
ΔExternal option values	-0.147	(0.048)	-0.071
ΔInternal option values	0.146	(0.022)	0.071
$\Delta\#$ job opportunities	0.6217	(0.131)	0.301

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Outline

Outline

1. Introduction
2. Empirical Analysis
3. Model
4. Estimation
5. Quantification and Counterfactuals
6. Model Validation
7. Conclusion

Quantification of the Model

- *Flexible dynamic hat algebra*: rewrite the model using the following operators

$$\ddot{X}_t \equiv \exp\left(\frac{\beta E_{t-1} X_t - \beta X_0}{\nu}\right) \qquad \dot{X}_t \equiv \exp\left(\frac{X_t - X_0}{\nu}\right) \qquad \widehat{X}_t \equiv \frac{X_t}{X_0}$$

- Taking model to the data (Base year: 2003)
  - 21 countries including Brazil + ROW
  - 3 sectors, microregions to define labor markets
  - Assume no international trade in service
  - Main data sources: RAIS, WIOD
- Estimated structural parameters: $C(k,l)$ and ν
- Calibrated parameters to the base year: Cobb-Douglas cost shares
- Parameters assigned or taken from existing works: $\beta = 0.95$ and $\theta = 4$ (Simonovska and Waugh (2014))

Solution Algorithm

Quantification of the Model

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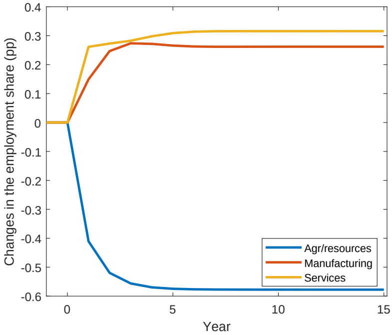
Solution Algorithm

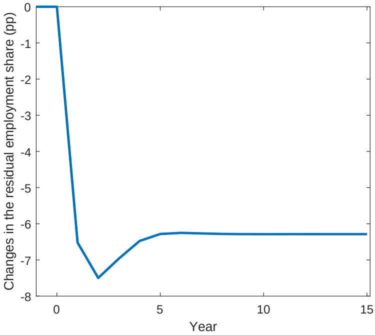
Baseline Results: Labor Allocation

- **Benchmark counterfactual shock**: a 30% permanent decline of trade costs in the manufacturing sector from Brazil to each of its trading partner

- Between labor markets (aggregated to the sector level)



(a) within formal

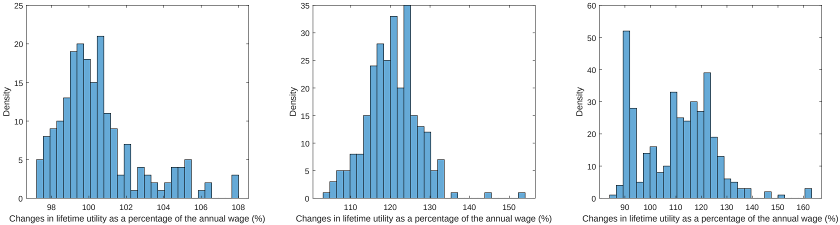


(b) residual share

- Within labor markets (internal churning): AGR (+5.22%); MFG (+17.79%); SVC (+18.24%)

Welfare Effects between and within Sectors

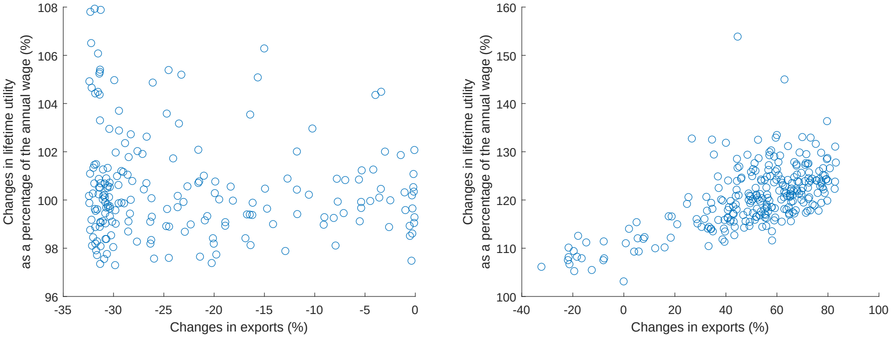
- Average lifetime utility of workers increase; equivalent to a one-time 120.43% increase of annual wage
- Sector-level average welfare gains:
  - MFG (124.39%) > SVC (120.21%) > AGR (100.78%)



(a) Agriculture (b) Manufacturing (c) Service

Welfare Changes vs. Export Changes

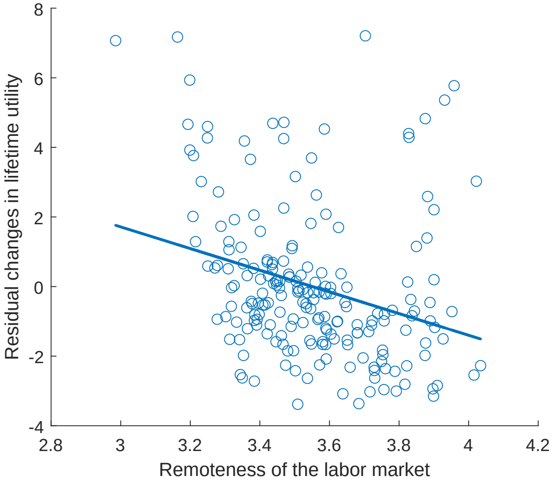
- How much of the welfare change is explained by changes in exports induced by the counterfactual shock?



(a) Agriculture (b) Manufacturing

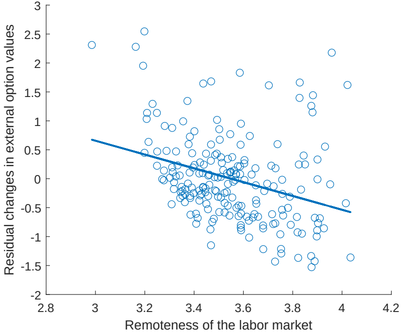
Residual Welfare Changes vs. Remoteness

- Residual welfare changes not explained by export changes are negatively associated with the remoteness of each agricultural labor market



Residual Changes in Option Values vs. Remoteness

- Residual changes in external (internal) option values are negatively (positively) associated with the remoteness of the labor market



(a) External

(b) Internal

External vs. exports Internal vs. exports

Model Comparisons and Policy Experiments

- The effective degree of mobility frictions is important for worker's welfare

- Alternative model specifications:
  - a model without the job opportunity channel: $\widehat{N}_t = 1$
  - a model with 20% lower moving costs between labor markets: both across regions and sectors; only across regions; only across sectors

- Comparison of the welfare effect of the same benchmark trade shock

	Baseline
Aggregate	120.43
Agriculture	100.78
Manufacturing	124.39
Service	120.21

Model fits

Model Comparisons and Policy Experiments

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	Baseline	No job
Aggregate	120.43	92.64
Agriculture	100.78	71.75
Manufacturing	124.39	96.83
Service	120.21	92.42

Model fits

Model Comparisons and Policy Experiments

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- Comparison of the welfare effect of the same benchmark trade shock

	Baseline	No job	Lower C (both)
Aggregate	120.43	92.64	140.39
Agriculture	100.78	71.75	121.83
Manufacturing	124.39	96.83	144.07
Service	120.21	92.42	140.20

Model fits

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- Comparison of the welfare effect of the same benchmark trade shock

	Baseline	No job	Lower C (both)	Lower C (region)
Aggregate	120.43	92.64	140.39	136.81
Agriculture	100.78	71.75	121.83	117.45
Manufacturing	124.39	96.83	144.07	140.61
Service	120.21	92.42	140.20	136.63

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	Baseline	No job	Lower C (both)	Lower C (region)	Lower C (sector)
Aggregate	120.43	92.64	140.39	136.81	123.19
Agriculture	100.78	71.75	121.83	117.45	104.18
Manufacturing	124.39	96.83	144.07	140.61	127.05
Service	120.21	92.42	140.20	136.63	122.97

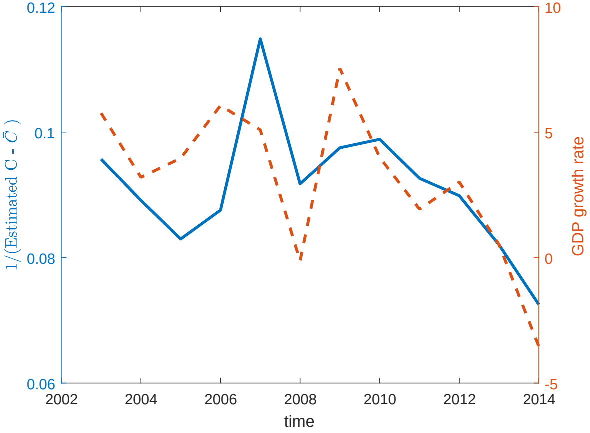
Model fits

Outline

Outline

Estimated Moving Costs and Business Cycle

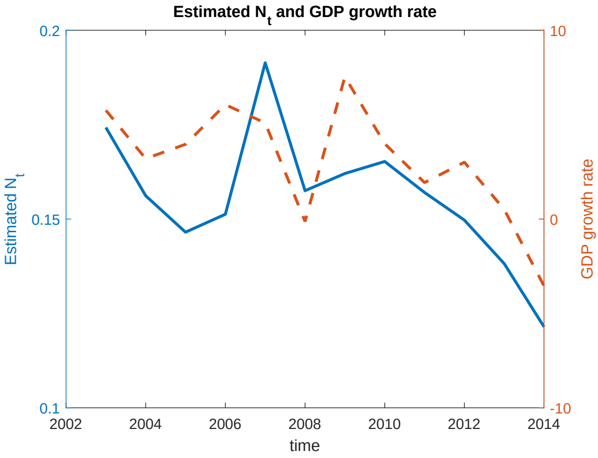
- Moving costs without taking into account the number of job opportunities (ACM and CDP) are negatively correlated with positive shocks



US case

Estimated Job Opportunities and Business Cycle

- This correlation is from the positive correlation between changes in the number of job opportunities and positive shocks



Outline

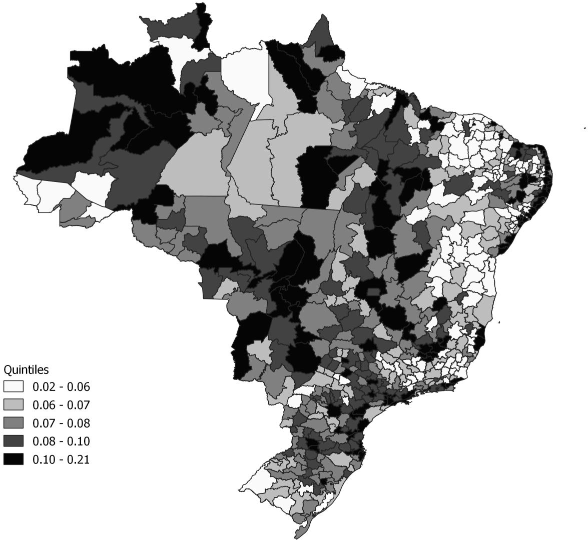
Outline

Conclusion

- A new dynamic labor mobility model with trade featuring the endogenous number of job opportunities
- Trade shocks generate not only between-market but also within-market mobility
- A positive mfg export shock increases aggregate welfare but has distributional consequences between and within labor markets
- Workers initially in a better-connected market benefits more
- The job opportunity channel magnifies welfare gains from trade by 30%
- Lower between-market mobility frictions, especially across regions, increase welfare gains

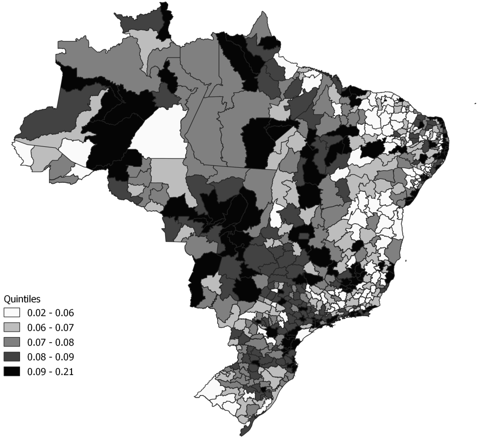
Gross Flow Rates

- Gross outflow rates by microregion 2004-2014



Gross Flow Rates

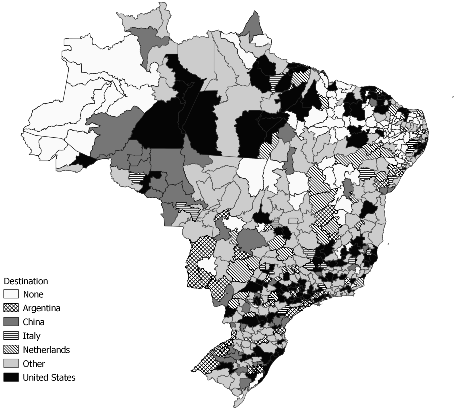
- Gross inflow rates by microregion 2004-2014



Back

Variation across Export Destinations

- Top export destination from each microregion in 2003



Back

First-stage Result

- First-stage result between the export shock and the import demand

	ΔZ_t^k	s.e.	F-stat	# obs
$\Delta \bar{Z}_t^k$	0.7927	(0.0928)	29.8696	4008

- All variables are in log
- Standard errors are clustered by microregion$\times$year

Back

Production: Detail

- Production of variety ω in labor market k of country 1 at time t

$$Q^k_{1,t}(\omega) = z^k_1(\omega)(\widetilde{l}^k_{1,t})^{\gamma_l}(M^k_{1,t})^{\gamma_m}(B^k_1)^{\gamma_b}$$

  - $\tilde{l}^k_{1,t}$: aggregate efficiency units of labor (CES aggregate of tasks)
  - $M^k_{1,t}$: composite intermediate goods
  - B^k_1: fixed factor

- Production in all other countries ($n \neq 1$)

$$Q^k_{n,t}(\omega) = z^k_n(\omega)(\bar{L}^k_{n,t})^{\bar{\gamma}_{n,l}}(M^k_{n,t})^{1-\bar{\gamma}_{n,l}}$$

- Fréchet distribution for productivity with the scale parameter T^k_n and the shape parameter θ

Back

Labor Mobility Model: Details

- **Cell-specific *expected* present discounted utility** at the beginning of t

$$V_t^{s,K_j} = w_t^{K_j} + E_\varepsilon \max_{j'} \left\{ \beta E_t V_{t+1}^{K_{j'}} - (C_t(K_j, K_{j'}) + \delta_t) \mathbf{1}(j \neq j') + \varepsilon_t^{j',h} \right\}$$

- The equilibrium probability of type s workers moving from k to l

$$m_t^{kl} = \frac{\mathbf{1}_{l=k}\lambda_{0,t}^k + \mathbf{1}_{l\neq k \wedge l \neq I}\lambda_{1,t}^l \exp\left(-\frac{C_t(k,l)}{\nu}\right) + \mathbf{1}_{l=I}\lambda_{I,t}^k}{\lambda_{0,t}^k + \lambda_{1,t}^k + \lambda_{2,t}^k + \lambda_{I,t}^k},$$

$$\lambda_{0,t}^k \equiv \exp\left(\frac{\beta}{\nu} E_t V_{t+1}^k\right)$$

$$\lambda_{1,t}^k \equiv N_t^k \exp\left(\frac{E_t \beta V_{t+1}^k - \delta_t}{\nu}\right)$$

$$\lambda_{2,t}^k \equiv \sum_{l' \neq k} N_t^{l'} \exp\left(\frac{\beta E_t V_{t+1}^{l'} - \delta_t - C_t(k, l')}{\nu}\right)$$

$$\lambda_{I,t}^k \equiv \exp\left(\frac{\beta E_t V_{t+1}^{I} - \delta_t - C_t(k, I)}{\nu}\right)$$

Back

Equilibrium Trade Flows

- Equilibrium trade flows

$$\lambda^s_{(1,r),(1,r'),t} = \frac{T^{(r,s)}_{1,t}(c^{(r,s)}_{1,t})^{-\theta}}{\sum_{r''} T^{(r'',s)}_{1,t}(c^{(r'',s)}_{1,t})^{-\theta} + \sum_{n'\neq 1} T^s_{n',t}(c_{n',t}d^s_{n'1,t})^{-\theta}} = \frac{X^s_{(1,r),(1,r'),t}}{X^s_{(1,r'),t}}$$

$$\lambda^s_{n,(1,r),t} = \frac{T^s_{n,t}(c_{n,t}d^s_{n1,t})^{-\theta}}{\sum_{r''} T^{(r'',s)}_{1,t}(c^{(r'',s)}_{1,t})^{-\theta} + \sum_{n'\neq 1} T^s_{n',t}(c_{n',t}d^s_{n'1,t})^{-\theta}} = \frac{X^s_{n,(1,r),t}}{X^s_{(1,r),t}}$$

$$\lambda^s_{(1,r),n,t} = \frac{T^{(r,s)}_{1,t}(c^{(r,s)}_{1,t}d^s_{1n,t})^{-\theta}}{\sum_{r'} T^{(r'',s)}_{1,t}(c^{(r'',s)}_{1,t}d^s_{1n,t})^{-\theta} + \sum_{n'\neq 1} T^s_{n',t}(c_{n',t}d^s_{n'n,t})^{-\theta}} = \frac{X^s_{(1,r),n,t}}{X^s_{n,t}}$$

$$\lambda^s_{n,n'',t} = \frac{T^s_{n,t}(c_{n,t}d^s_{nn'',t})^{-\theta}}{\sum_{r'} T^{(r'',s)}_{1,t}(c^{(r'',s)}_{1,t}d^s_{1n'',t})^{-\theta} + \sum_{n'\neq 1} T^s_{n',t}(c_{n',t}d^s_{n'n'',t})^{-\theta}} = \frac{X^s_{n,n'',t}}{X^s_{n'',t}}$$

Back

Exact Price Indices and Expenditure

- Exact price indices

$$P^s_{1,t} = \bar{\Gamma}\left[\sum_{r''} T^{(r'',s)}_{1,t}(c^{(r'',s)}_{1,t})^{-\theta} + \sum_{n'\neq 1} T^s_{n',t}(c_{n',t}d^s_{n'1,t})^{-\theta}\right]^{-\frac{1}{\theta}}$$

$$P^i_{n,t} = \bar{\Gamma}\left[\sum_{r'} T^{(r'',s)}_{1,t}(c^{(r'',s)}_{1,t}d^s_{1n,t})^{-\theta} + \sum_{n'\neq 1} T^s_{n',t}(c_{n',t}d^s_{n'n,t})^{-\theta}\right]^{-\frac{1}{\theta}},$$

where $\bar{\Gamma} \equiv \left[\Gamma(\frac{\theta+1-\sigma}{\theta})\right]^{1/(1-\sigma)}$

- Aggregate price index

$$P_{n,t} = \prod_s \left(\frac{P^s_{n,t}}{\phi^s}\right)^{\phi^s}$$

Back

Expenditures

- For country 1,

$$X^s_{(1,r),t} = \phi^s \gamma_m \sum_{s'} \left(\sum_{r'} \lambda^{s'}_{(1,r),(1,r'),t} X^{s'}_{(1,r'),t} + \sum_{n' \neq 1} \lambda^{s'}_{(1,r),n',t} X^{s'}_{n',t} \right) + \phi^s \left(\sum_{k \in \{k|R_k = r\}} \left(\widetilde{w}^k_{1,t} L^k_{1,t} + D^k_{1,t} \right) \right)$$

- For country $n' \neq 1$,

$$X^s_{n,t} = \phi^s (1 - \bar{\gamma}_l) \sum_{s'} \left(\sum_{r'} \lambda^{s'}_{n,(1,r'),t} X^{s'}_{(1,r'),t} + \sum_{n' \neq 1} \lambda^{s'}_{n,n',t} X^{s'}_{n',t} \right) + \phi^s \left(\widetilde{w}_{n,t} \bar{L}_{n,t} + D_{n,t} \right)$$

Back

Estimation of Moving Probabilities

- A simple bin-estimator for a moving probability works only with a large sample size and a small number of choices
  - Not feasible for $\widetilde{m}_t^{kl}$ in our case

- We estimate $\log \widetilde{m}_t^{kl}$ by imposing a structure on the moving cost

$$\widetilde{C}_t(j,k) = \widetilde{c}_{1,t} D^{jk} + \widetilde{c}_{2,t} \mathbf{1}_{I_j \neq I_k} + \tilde{c}_{3,t} \mathbf{1}_{I_j \neq I_k \& R_j \neq R_k},$$

  - D^{jk}: the log of distance between labor markets j and k
  - $D^{jj} = 0$ for every j and $D^{jk} = 0$ if $R_j = R_k$

- Derive a gravity-like estimating equation from the model

$$\log \widetilde{m}_t^{kl} = \widetilde{V}_t^l - \widetilde{C}_t(k,l) + \widetilde{\Gamma}_t^k - \log \widetilde{L}_t^k$$

and estimate it using PPML Back

Estimation of Moving Probabilities

- First, re-write
$$\log \widetilde{m}_t^{kl} = \widetilde{V}_t^l - \widetilde{C}_t(k,l) + \widetilde{\Gamma}_t^k - \log \widetilde{L}_t^k,$$
where
$$\widetilde{V}_t^l = E_t \frac{\beta}{\nu} V_{t+1}^l - \log \mu_{0,t}^l + \log \mu_{1,t}^l$$
$$\widetilde{C}_t(k,l) = \frac{C_t(k,l)}{\nu}$$
$$\widetilde{\Gamma}_t^k = -\log \sum_{l'} \exp\left(\widetilde{V}_t^{l'} - \widetilde{C}_t(k,l')\right) + \log \widetilde{L}_t^k$$
  - $\widetilde{L}_t^k$: the number of job switchers who were in k at the beginning of t
  - Define $\widetilde{y}_t^{kl} \equiv \widetilde{m}_t^{kl} \widetilde{L}_t^k$
- Maximum likelihood based on the log-likelihood function
$$\log \mathcal{L} = \sum_k \sum_l \widetilde{y}_t^{kl} \left[\widetilde{\Gamma}_t^k + \widetilde{V}_t^l - \widetilde{C}_t(k,l) - \log(\widetilde{L}_t^k)\right]$$
- Result: mobility friction is much larger *across regions* than across sectors

Back

Estimated Moving Costs

Year	$\widetilde{c}_{1,t}$	s.e.	$\widetilde{c}_{2,t}$	s.e.	$\widetilde{c}_{3,t}$	s.e.
2003	1.0775	(0.0008)	1.9983	(0.0048)	-0.2839	(0.0097)
2004	1.0602	(0.0008)	1.9275	(0.0049)	-0.2786	(0.0098)
2005	1.0473	(0.0008)	1.6034	(0.0047)	0.0507	(0.0099)
2006	1.0447	(0.0007)	1.8967	(0.0048)	-0.2808	(0.0093)
2007	1.0667	(0.0007)	2.0184	(0.0048)	-0.4659	(0.0091)
2008	1.0478	(0.0007)	1.9298	(0.0045)	-0.3153	(0.0086)
2009	1.0448	(0.0006)	1.7939	(0.0041)	-0.2755	(0.0079)
2010	1.0355	(0.0006)	1.8190	(0.0042)	-0.2546	(0.0080)
2011	1.0250	(0.0007)	1.8127	(0.0050)	-0.2146	(0.0094)
2012	1.0221	(0.0007)	1.8331	(0.0053)	-0.2194	(0.0098)
2013	1.0290	(0.0006)	1.8491	(0.0044)	-0.2546	(0.0083)
2014	1.0399	(0.0006)	1.9684	(0.0044)	-0.2752	(0.0083)
Average	1.0451		1.8709		-0.2556	

Back

Estimation of the Labor Supply Elasticity

- We estimate ν by using the same IV for equations derived from the model

$$\Delta y_t^k = \alpha + \frac{\beta}{\nu}\Delta Z_t^k + \lambda_t + \epsilon_t^k,$$

$$Z_t^k = w_t^k$$

$$y_t^k = \widetilde{V}_t^k + \left(\log \mu_{0,t}^k - \log \mu_{1,t}^k\right) - \beta\left[\widetilde{V}_{t+1}^k + \log \mu_{1,t+1}^k\right]$$

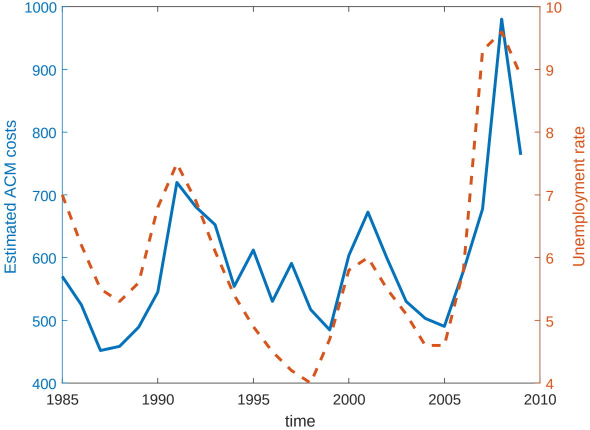
- With $\beta = 0.95$, our estimate is $\nu = 0.484$

I. First stage		II. Second stage	
Δ(import demand)	0.412	ΔZ_t^k	1.962
	(0.028)		(0.757)
F-stat	138.480		

Back

Moving Costs

- Estimated moving costs based on a model without the job opportunity channel (e.g., ACM/CDP) using the U.S. data vs. U.S. unemployment rate



Back

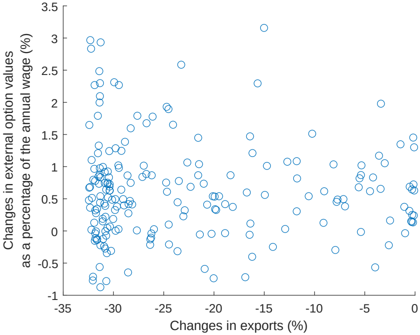
Solution Algorithm

1. Calibrate the model to the base year and the steady state moving probabilities
2. Guess changes in nominal factor prices $\left(\widehat{\widetilde{\mathbf{w}}}_1, \widehat{\widetilde{\mathbf{w}}}_{-1}, \widehat{\mathbf{b}}\right)$
3. Solve for changes in goods prices $\widehat{\mathbf{P}}$ and the number of jobs $\widehat{\mathbf{N}}$
4. Solve for labor allocation $\mathbf{L}$ and value changes $\ddot{\mathbf{V}}$ conditional on price changes
5. Conditional on $\mathbf{L}$, calculate excess demand for each factor
6. Update the guess for factor prices accordingly and repeat 3-5 until the excess demand for each factor becomes sufficiently close to zero

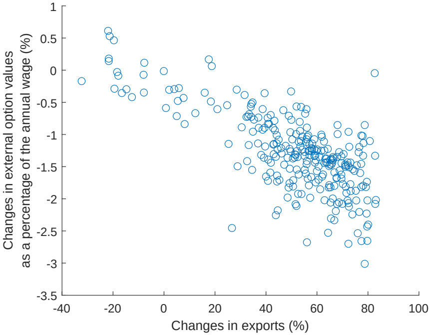
Back

Changes in External Option Values vs. Export Changes

- External option values decrease with an increase of exports



(a) Agriculture

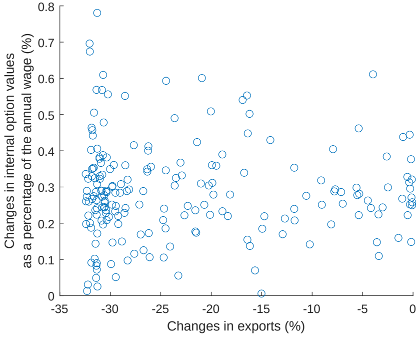


(b) Manufacturing

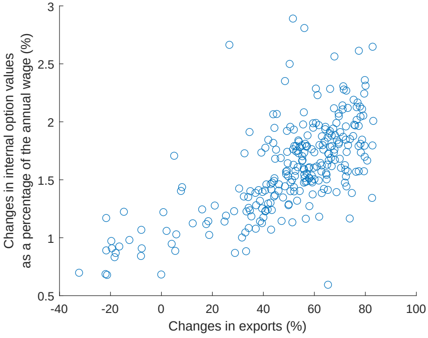
Back

Changes in Internal Option Values vs. Export Changes

- Internal option values increase with an increase of exports



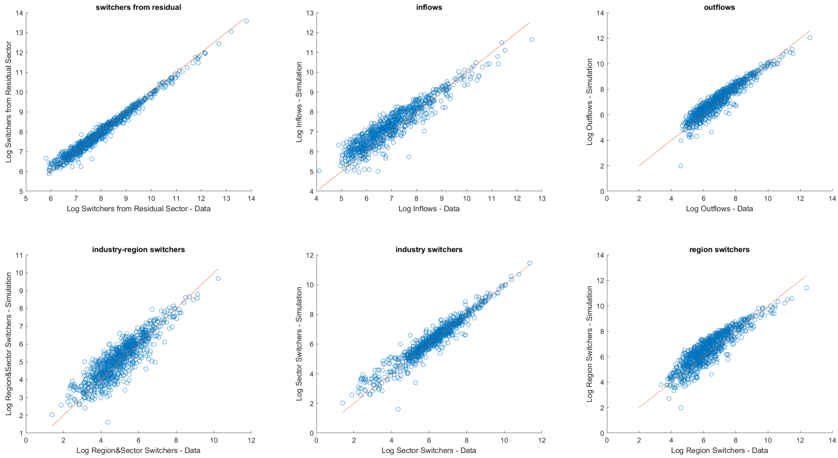
(a) Agriculture



(b) Manufacturing

Back

Model Fit: Mobility



Back