Migration, Specialization, and Trade: Evidence from the Brazilian March to the West

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Migration and Comparative Advantage

- Comparative Advantage (CA): Differences in relative production costs
  - Determines trade patterns and the gains from trade
  - Evolves over time

- Internal migrations are often tied to large sectoral changes
  - U.S., China, Rural-Urban, Indonesia, Colombia, ...

- This paper: How do migration costs shape regional and aggregate CA?
  - Workers' allocation and regional productivity
  - Land to labor ratio
  - Worker heterogeneity

- Quantitative model + policy-driven episode of *internal migration* in Brazil

What we do

March to the West

- Productivity shocks, int & domestic trade policies, migration policies
- West population ↑ from 7% to 15% (1950-2010)

Facts

1. Big changes in Brazil's agricultural exports, expansion of the West is key
2. Migrants sort disproportionately across agricultural activities (*in the paper*)
3. Migrant productivity relate to region of origin

OLG model of trade and migration

- Heterogeneous workers → acquire productivity in the region of origin
- ⇒ CA: natural advantage + land-labor ratio + worker productivity

Quantification

- Model matches the evolution of the economy (1950-2010)
- Counterfactual: no changes in *migration costs* since the 1950s

Main Findings

Theory

- Impact of reductions in migration costs on CA is ambiguous
- Sufficient statistic for the impact of migration costs on trade patterns

Empirics

- What were the effects of changes in migration costs since the 1950s on Brazil's patterns of trade?
  - Drop in migration costs induces 55% of the migration to the West
  - $\uparrow$ Brazil's specialization in soy, beef and corn in 2010 by 30%
  - Worker heterogeneity increases by up to 1/5 the effects on specialization

- What were the effects on the gains from trade? (*in the paper*)
  - Large heterogeneity across regions, but limited aggregate effect

Related Literature

Trade and economic geography

- **CA and dynamics:** Levchnko & Zhang (2016) Hanson et al (2015) Morrow (2010) Chor (2010) Levchenko (2007) Nunn (2007) Manova (2013) Bombardini et al. (2012) Ohnsorge & Trefler (2007) Bahar & Rapoport (2016)
- **Econ. Geography:** Allen & Arkolakis (2014), Fajgelbaum & Redding (2018), Cosar & Fajgelbaum (2014), Bryan & Morten (2018), Morten & Oliveira (2019), Ramondo, Rodriguez-Clare & Saborio-Rodriguez (2018), Redding & Rossi-Hansberg (2016) Allen Donaldson (2018), Caliendo et al. (2018), Desmet et al (2018)
- **Agricultural trade:** Costinot & Donaldson (2014), Costinot, Donaldson & Smith (2016), Allen & Atkin (2016), Porteous (2018), Pellegrina (2020), Sotelo (2020), Gouel & Laborde (2018), Hertel (2011)

Contribution: migration costs $\rightarrow$ CA

Migration and productivity

- **Migrants and productivity:** Arkolakis et al (2019) Bazzi et al. (2016) De la Roca & Puga (2018)
- **Crop diffusion:** Sabel et al (2012), Crosby (1973), Olmstead & Rhode (2011), Bustos et al. (2019)

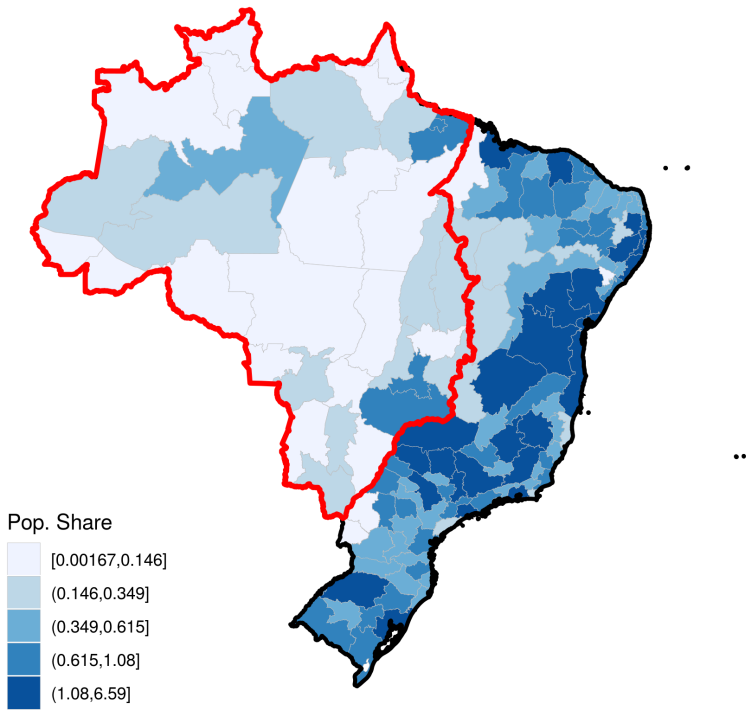
Contribution: migrant productivity and origin influence $\rightarrow$ GE model

The Onset of the March to the West

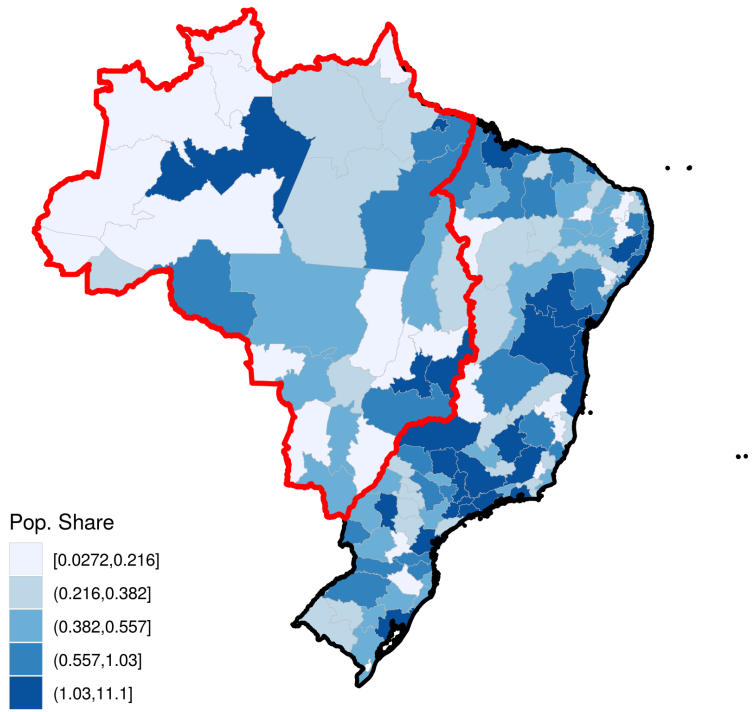
- 1940s: Vargas's Government
  - Rapid urbanization $\rightarrow$ launch campaign to occupy the West
  - "The true sense of Brazilianness is the March to the West"
- 1960s: Kubitschek's government
  - Move federal capital to Brasilia
  - New roads to connect Brasilia to periferal regions
- 1970s and 1980s: Military Government
  - Creation of EMBRAPA
  - Extension of roads to the Amazon

The March in Numbers I

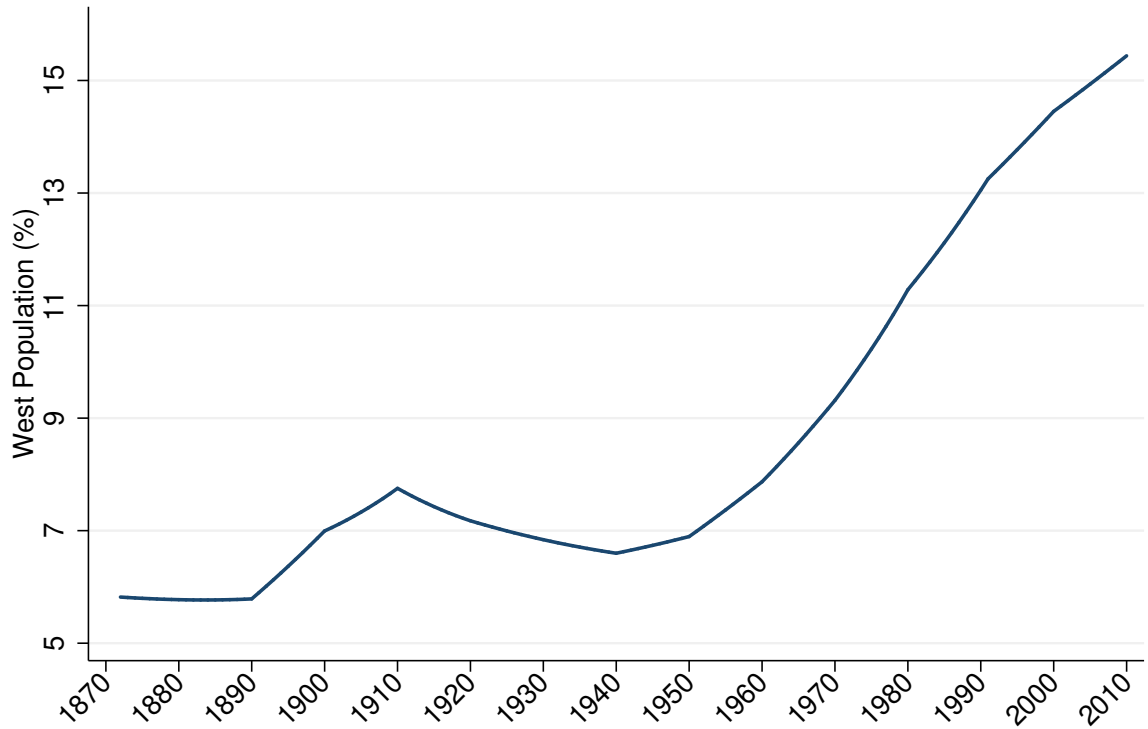
1950



2010



The March in Numbers II



- Fraction of the pop in the West increased 8 p.p.

Migration and Knowledge

- Researchers have documented the role of migrants' knowledge in the West
  - **Soybeans**: "The first movers had some experience with these crops in the southern part of Brazil [...] Such experience and technical capabilities allowed them to experiment with soybean cultivation in other regions of the country [...]." in Export Pioneers in Latin America (IDB, 2012)
  - **Coffee**: "The new amazonian experience with the "black gold" is the result of the entrepreneurship of migrants coming from Paraná, Minas Gerais and Espírito Santo. [...] Farmers from Paraná and Minas Gerais brought arabic coffee to the region and farmers from Espírito Santo brought robusta coffee, which they cultivated in their region of origin." in Coffee in the Amazon (EMBRAPA, 2015)
- What is the main origin of farmers in key agricultural centers in the West?
  - Sorriso (MT) $\rightarrow$ main producer of soy in the West
    - Rio Grande do Sul $\rightarrow$ Main source of migrants + Key producer of soy
  - São Miguel do Guaporé (RO) $\rightarrow$ main producer of coffee in the West
    - Espírito Santo $\rightarrow$ Main source of migrants + Key producer of coffee

Data

Final Sample

- 11 agricultural activities, manufacturing and services
- 133 meso-regions (in 26 states)
- 3 periods (1950, 1980 and 2010)

Sources

- Demographic census microdata: 1970-2010
  - Employment → Income and activity (including crops)
  - Migration → Current and previous meso-region
- Demographic census aggregates (state-level): 1950-2010
  - Interstate migration → State of birth and state of residence
  - Employment by activity
- Municipal Agricultural Production and Value Added: 1950-2010
- State-to-state trade data: Domestic 1950-, International 1990-
- International trade data: 1950-2010

Fact 1: Brazil's Changing Trade Specialization

	RBE (relative to Manufacturing)				Export Shr in Ag	
	Brazil		East	West	Brazil	Brazil
	1950	2010	2010	2010	1950	2010
Corn	**2.1**	**4.6**	**1.5**	**25.4**	**1.3**	**3.9**
Beef	**1.1**	**5.7**	**3.4**	**21.1**	**2.2**	**6.9**
Soy	**0.01**	**69.7**	**44.9**	**237.1**	**0.0**	**29.3**
Coffee	655.6	166.1	190.2	3.9	59.2	8.1
Cacao	273.4	15.0	17.2	0.1	9.0	0.4
Banana	5.1	0.4	0.4	0.0	0.5	0.1
Agriculture	4.9	6.1	2.2	19.2	79.8	31.9
Manufacturing	1.0	1.0	1.0	1.0	20.2	68.1

$$RBE_{BF,kk'} = \frac{X_{BF,k}/X_{BF,k'}}{X_{FF,k}/X_{FF,k'}}$$

where $X_{ij,k}$ is sales of i to j in activity k

Fact 3: Worker productivity and the region of origin

- Estimate with Census:

$$\log\left(income_{ij,kt}\right) = \iota_{j,kt} + \iota_{ij,t} + \alpha_1 \log(workers_{i,kt-1}) + \epsilon_{ij,kt}$$
$$\log\left(workers_{ij,kt}\right) = \iota_{j,kt} + \iota_{ij,t} + \alpha_2 \log(workers_{i,kt-1}) + \epsilon_{ij,kt}$$

  - origin i, destination j, crop k and period t
  - Stack $t = 2000, 2010$, lag $t-1$ equals 30 years
  - Sample: migrants, farmers, head of households, 30 to 60 years old

	OLS	PPML
	(1)	(2)
a. Income (logs)		
Farmers in origin	0.023**	0.045***
	(0.010)	(0.012)
R^2	0.702	-
Obs	6794	6794
b. Farmers in destination (logs)		
Farmers in origin	0.075***	0.120***
	(0.014)	(0.013)
R^2	0.751	-
Obs	7375	7375

Fact 3: Worker productivity and the region of origin

- Non-parametric check
- Robustness check
  - SES controls and age
  - Geographic unit (state, meso and micro region)
  - Different lags
  - Individual data
- Meso-region regressions: yields relate to labor supply composition check

Model: Summary

- Time is discrete $t = 1, ...$
- Regions $i = 1, \ldots, I$ regions + 1 foreign region F
- Activities k: agricultural commodities + manufacturing + services
  - Agriculture: uses land, labor and a composite good
  - Manufacturing and services: uses labor and a composite good
- Trade $\rightarrow$ one variety per region and activity (Armington)
- Agents (overlapping generation) (Allen and Donaldson, 2020)
  - Young: Acquire good specific knowledge $s_{i,kt} = \bar{s} L_{i,kt-1}^{\beta}$
  - Old: migrate and choose destination-activity pair (Fréchet with dispersion κ)
- Trade costs and migration costs: $\tau_{ij,kt}$ and $\mu_{ij,kt}$

Model: Sufficient Statistic

- Recall: Specialization measure

$$RBE_{ij,kk'} = \frac{X_{iF,k}/X_{jF,k}}{X_{iF,k'}/X_{jF,k'}}$$

- Proposition: Let H be a small economy (Alvarez Lucas, 2006). Then the impact of banning migration ($\mu_{ij,k} \to \infty$, $\forall i \neq j$) on specialization is

$$\underbrace{\widehat{RBE_{iF,kk'}}}_{\text{Counterfactual vs Baseline}} = \underbrace{\left(\frac{\mathcal{E}_{ii,k}}{\mathcal{E}_{ii,k'}}\right)^{-\frac{\alpha(1-\eta)}{1+\kappa+\alpha(\eta-1)}}}_{\text{Baseline}}$$

where $\mathcal{E}_{ii,k} \equiv \frac{E_{ii,k}}{E_{i,k}}$, share of efficient labor in i coming from i

Mapping to Data - Identifying κ and β

- Income identifies β

$$income_{ij,kt} = w_{j,kt}\bar{s}L^{\beta}_{i,kt-1}$$

$$\log\left(income_{ij,kt}\right) = \iota_{j,kt} + \iota_{i,t} + \underbrace{\beta}_{\equiv\alpha_1}\log L_{i,kt-1} + u^1_{ij,kt}$$

- Activity-choice identifies $\kappa\beta$

$$L_{ij,kt} = \left[w_{j,kt}\bar{s}L^{\beta}_{i,kt-1}/\left(\mu_{ij,kt}P_{j,t}\right)\right]^{\kappa}\Xi^{-\kappa}_{i,t}L_{i,t-1}.$$

$$\log L_{ij,kt} = \iota_{j,kt} + \iota_{ij,t} + \underbrace{\beta\kappa}_{\equiv\alpha_2}\log L_{i,kt-1} + u^2_{ij,kt}$$

- Pick $\beta \in 0.047$ and $\kappa = 2$ based on Fact 3

- Sensitivity to $\beta \in \{0, 0.08\}$

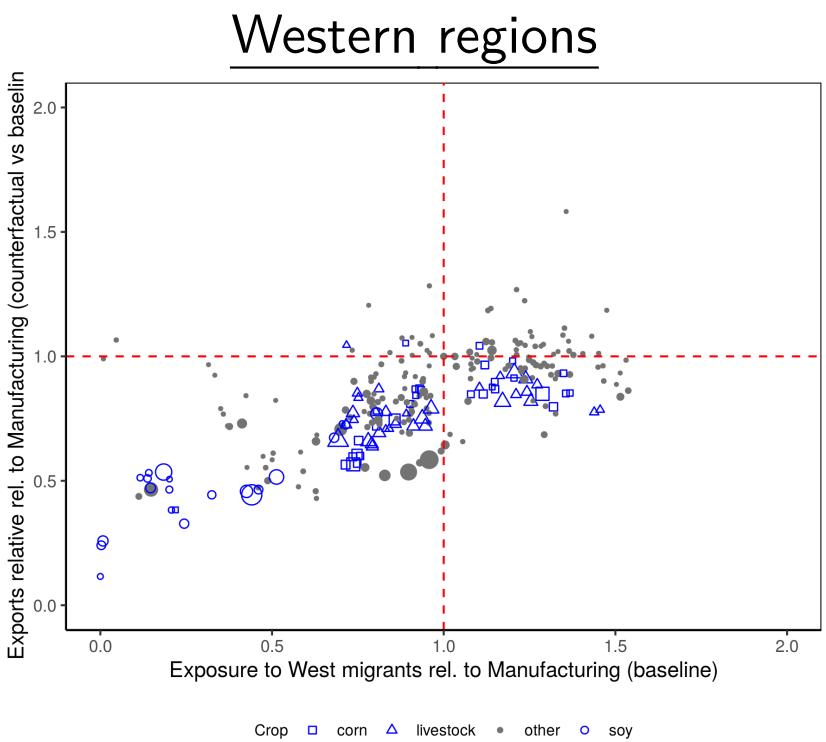
Mapping to Data - Migration Costs and Model Inversion

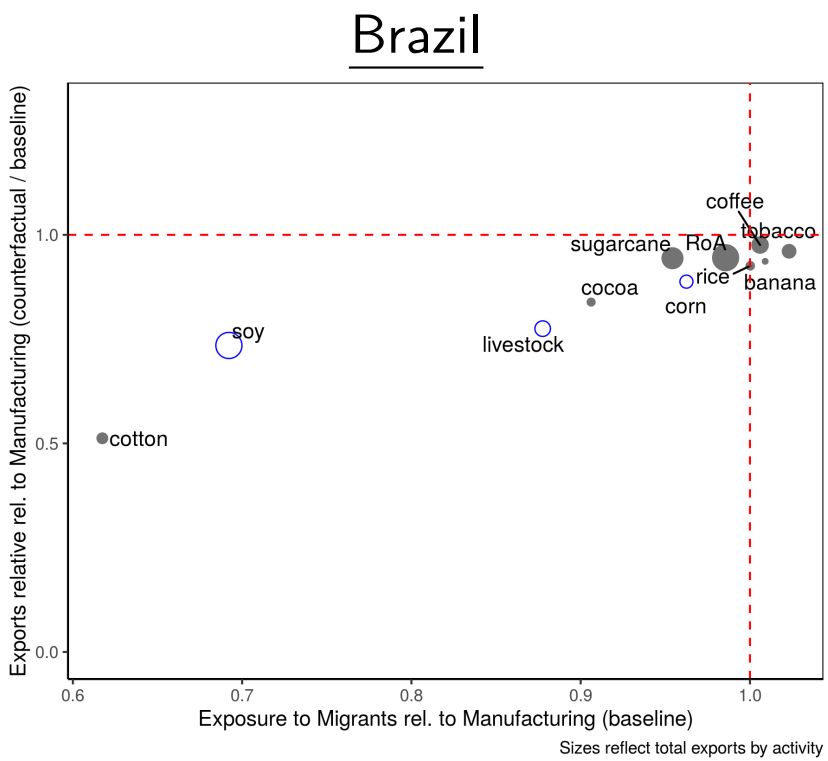
- Technology parameters $\rightarrow$ literature
- Set a generation to 30 years
- Separately, for each period $t = 1950, 1980$ and 2010
  - Interstate migration costs ($\mu_{ss,t}$) $\rightarrow$ migration gravity equations Details Results
  - Model inversion to recover
    - Natural advantage and preferences $\rightarrow$ revenues per activity
    - Land supply productivity $\rightarrow$ land use per meso-region Details
    - Trade costs $\rightarrow$ trade flows Details

Constructing the Counterfactual

- To construct a counterfactual evolution of the economy (1950-2010)
  - For $t = 1950$, no change in parameters
  - For $t = 1980$ and $t = 2010 \rightarrow$ keep interstate migration costs at $t = 1950$
  - Other factors evolve *as in the baseline economy*
    - Natural advantage and preferences
    - Trade costs
    - Land supply productivity

Effects on regional and aggregate specialization (2010)





- y-axis: change in specialization (*counterfactual vs baseline*)
- x-axis: share of non-migrants in employment (*baseline*)

H-O | No land | No scale | 1980

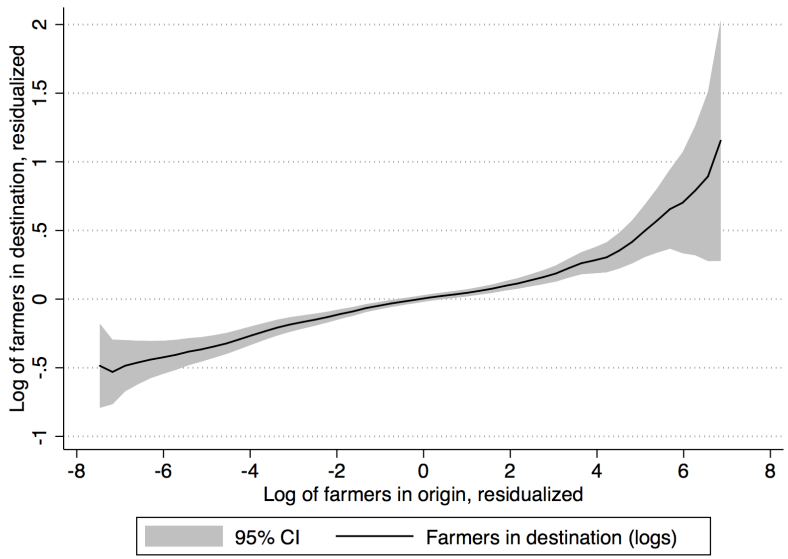
Conclusion

- Large internal migration and how it contributed to Brazil's export specialization
- We developed and estimated a dynamic GE model that incorporated worker heterogeneity
- Reductions in migration costs were key
  - Migrants knowledge played an important role in particular crops
- Episode highlights the importance of complementarities in policies

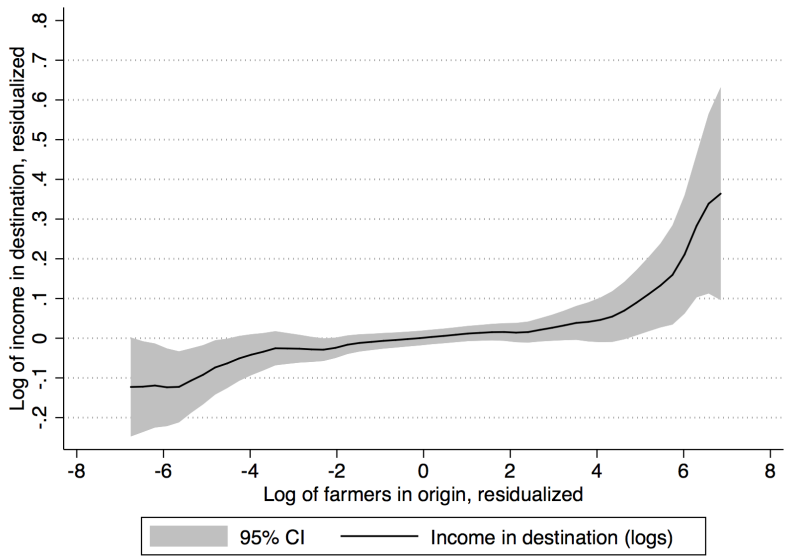
Appendix

Fact 3: Influence of the region of origin

LHS: Farmers in destination-crop



LHS: Income in destination-crop



Local polynomial regressions absorbing destination-crop-year fixed effects from each variable.

Go back

Fact 3 Robustness (OLS)

Geographic Unit	Meso	Meso	Meso	Meso	Meso	Micro	Meso	Meso
Lag (years)	30	20	10	20	10	30	30	30
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
a. Farmers in destination (logs)								
Farmers in origin	0.075***	0.086***	0.099***	0.097***	0.112***	0.072***	0.076***	0.081***
	(0.014)	(0.011)	(0.012)	(0.008)	(0.006)	(0.013)	(0.014)	(0.010)
R^2	0.751	0.738	0.738	0.771	0.779	0.775	0.752	0.759
Obs	7375	8443	8393	14449	24604	15437	7375	9597
b: Income (logs)								
Farmers in origin	0.023**	0.016	0.023**	0.003	0.013***	0.023*	0.026**	0.024***
	(0.010)	(0.010)	(0.010)	(0.007)	(0.004)	(0.012)	(0.010)	(0.008)
R^2	0.702	0.677	0.682	0.664	0.659	0.730	0.729	0.688
Obs	6794	7727	7685	13639	23529	14132	6794	8844
c. Farmers in destination (logs) - Above Q1								
Farmers in origin	0.101***	0.144***	0.166***	0.140***	0.167***	0.097***	0.098***	0.085***
	(0.022)	(0.018)	(0.019)	(0.014)	(0.010)	(0.021)	(0.023)	(0.017)
R^2	0.774	0.770	0.774	0.800	0.811	0.791	0.778	0.779
Obs	5609	6422	6395	10942	18614	11787	5478	7271
b: Income (logs) - Above Q1								
Farmers in origin	0.047***	0.051***	0.051***	0.039***	0.023***	0.037*	0.051***	0.039***
	(0.016)	(0.017)	(0.016)	(0.013)	(0.008)	(0.019)	(0.018)	(0.013)
R^2	0.729	0.704	0.712	0.687	0.682	0.746	0.760	0.715
Obs	5180	5903	5883	10365	17860	10872	5056	6712
Dest-Act-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Dest-Orig-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
SES							Y	
Years: 2000-2010	Y	Y	Y			Y	Y	Y
Years: 1990-2010				Y				
Years: 1980-2010					Y			
Age: 30-60	Y	Y	Y	Y	Y	Y	Y	Y
Age: 20-								

Notes: *, **, + denotes significance at the 10, 5, 1 percent level. Standard errors clustered at the destination-crop-year level in parenthesis.

Fact 3 Robustness (PPML)

Geographic Unit	Meso	Meso	Meso	Meso	Meso	Micro	Meso	Meso
Lag (years)	30	20	10	20	10	30	30	30
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
a. Farmers in destination (logs)								
Farmers in origin	0.120***	0.129***	0.148***	0.147***	0.168***	0.074***	0.121***	0.129***
	(0.013)	(0.011)	(0.012)	(0.009)	(0.007)	(0.012)	(0.013)	(0.011)
Obs	7375	8443	8393	14449	24604	15437	7375	9597
b: Income (logs)								
Farmers in origin	0.045***	0.043***	0.036***	0.019*	0.001	0.029*	0.044***	0.023*
	(0.012)	(0.013)	(0.012)	(0.010)	(0.009)	(0.016)	(0.012)	(0.013)
Obs	6794	7727	7685	13639	23529	14132	6794	8844
c. Farmers in destination (logs) - Above Q1								
Farmers in origin	0.131***	0.182***	0.186***	0.181***	0.215***	0.104***	0.114***	0.133***
	(0.023)	(0.017)	(0.019)	(0.013)	(0.010)	(0.019)	(0.022)	(0.017)
Obs	5609	6422	6395	10942	18614	11787	5478	7271
b: Income (logs) - Above Q1								
Farmers in origin	0.083***	0.081***	0.059***	0.055***	0.004	0.042**	0.082***	0.044***
	(0.020)	(0.019)	(0.017)	(0.016)	(0.020)	(0.018)	(0.022)	(0.017)
Obs	5180	5903	5883	10365	17860	10872	5056	6712
Dest-Act-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Dest-Orig-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
SES							Y	
Years: 2000-2010	Y	Y	Y			Y	Y	Y
Years: 1990-2010				Y				
Years: 1980-2010					Y			
Age: 30-60	Y	Y	Y	Y	Y	Y	Y	Y
Age: 20-								

Notes: * / ** / + denotes significance at the 10 / 5 / 1 percent level. Standard errors clustered at the destination-crop-year level in parenthesis.

Fact 3 – Individual level regressions

	OLS	OLS	OLS	PPML	PPML
	(1)	(2)	(3)	(4)	(5)
a. Income (logs)					
Farmers in origin	0.006	0.014**	0.043***	0.045***	0.082***
	(0.004)	(0.006)	(0.013)	(0.010)	(0.019)
R^2	0.257	0.386	0.389	-	-
Obs	18913	18913	13841	18913	13841
b. Income (logs) - SES controls					
Farmers in origin	0.006*	0.012**	0.033**	0.038***	0.070***
	(0.003)	(0.006)	(0.013)	(0.010)	(0.020)
R^2	0.366	0.460	0.459	-	-
Obs	18913	18913	13841	18913	13841
c. Income (logs) - Controls for previous migration					
Farmers in origin	0.006*	0.012**	0.033**	0.038***	0.070***
	(0.003)	(0.006)	(0.013)	(0.010)	(0.020)
R^2	0.366	0.460	0.459	-	-
Obs	18913	18913	13841	18913	13841
d. Income (logs) - Migrants from state of birth					
Farmers in origin	0.009	0.005	0.047***	0.033***	0.087***
	(0.005)	(0.008)	(0.017)	(0.012)	(0.022)
R^2	0.280	0.411	0.410	-	-
Obs	11964	11964	9340	11964	9340
Dest-Act-Year FE	Y	Y	Y	Y	Y
Dest-Orig-Year FE		Y	Y	Y	Y
Above Q1			Y		Y

Notes: * / ** / † denotes significance at the 10 / 5 / 1 percent level. Standard errors clustered at the destination-crop-year level in parenthesis.

Fact 3 – State level regressions 2000-10

	OLS	OLS	OLS	PPML	PPML	PPML
	(1)	(2)	(3)	(4)	(5)	(6)
a. Farmers in destination (logs)						
Farmers in origin	0.289***	0.157***	0.210***	0.210***	0.236***	0.213***
	(0.017)	(0.015)	(0.021)	(0.019)	(0.017)	(0.018)
R^2	0.462	0.849	0.883	-	-	-
Obs	2750	2750	2018	2750	2018	7948
b: Income (logs)						
Farmers in origin	0.061***	0.032***	0.033**	0.032**	0.039**	-
	(0.008)	(0.009)	(0.014)	(0.013)	(0.018)	-
R^2	0.361	0.612	0.639	-	-	-
Obs	2573	2573	1900	2573	1900	
Dest-Act-Year FE	Y	Y	Y	Y	Y	Y
Dest-Orig-Year FE		Y	Y	Y	Y	Y
Above Q1			Y		Y	
Include zeros						Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors clustered at the destination-crop-year level in parenthesis. This table replicates our main table in Panels a and b using state-level variation. Farmers in origin is defined by the state of birth. Here we include only 2000 and 2010, which are the years included in our main analysis.

Fact 3 – State level regressions 1980-2010

	OLS	OLS	OLS	PPML	PPML	PPML
	(1)	(2)	(3)	(4)	(5)	(6)
a. Farmers in destination (logs)						
Farmers in origin	0.247***	0.109***	0.117***	0.180***	0.161***	0.182***
	(0.012)	(0.009)	(0.014)	(0.018)	(0.021)	(0.018)
R^2	0.432	0.866	0.893	-	-	-
Obs	6439	6439	4724	6439	4724	17255
b: Income (logs)						
Farmers in origin	0.046***	0.021***	0.020***	0.017**	0.021**	-
	(0.004)	(0.005)	(0.007)	(0.006)	(0.008)	-
R^2	0.405	0.621	0.661	-	-	-
Obs	6211	6211	4575	6211	4575	
Dest-Act-Year FE	Y	Y	Y	Y	Y	Y
Dest-Orig-Year FE		Y	Y	Y	Y	Y
Above Q1			Y		Y	
Include zeros						Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors clustered at the destination-crop-year level in parenthesis. This table replicates our main table in Panels a and b using state-level variation. Farmers in origin is defined by the state of birth. Here we include 1980, 1990, 2000 and 2010, which are the years with available data.

Fact 3 – Return migration

back

	OLS	OLS	OLS	PPML	PPML
	(1)	(2)	(3)	(4)	(5)
a. Farmers in destination (logs)					
Farmers in origin	0.074***	0.075***	0.096***	0.120***	0.118***
	(0.007)	(0.014)	(0.024)	(0.013)	(0.023)
R^2	0.183	0.751	0.775	-	-
Obs	7375	7375	5478	7375	5478
b. Income (logs)					
Farmers in origin	0.016***	0.023**	0.076***	0.045***	0.076***
	(0.005)	(0.010)	(0.019)	(0.012)	(0.019)
R^2	0.342	0.702	-	-	-
Obs	6794	6794	5056	6794	5056
c. Farmers in destination (logs) - Controls for previous migration					
Farmers in origin	0.066***	0.074***	0.097***	0.120***	0.119***
	(0.007)	(0.013)	(0.024)	(0.013)	(0.022)
R^2	0.192	0.751	0.776	-	-
Obs	7375	7375	5478	7375	5478
d. Income (logs) - Controls for previous migration					
Farmers in origin	0.016***	0.023**	0.079***	0.045***	0.079***
	(0.005)	(0.010)	(0.019)	(0.012)	(0.019)
R^2	0.342	0.703	-	-	-
Obs	6794	6794	5056	6794	5056
e. Farmers in destination (logs) - Migrants from state of birth					
Farmers in origin	0.088***	0.117***	0.101***	0.161***	0.136***
	(0.009)	(0.019)	(0.032)	(0.019)	(0.027)
R^2	0.237	0.752	0.766	-	-
Obs	4794	4794	3560	4794	3560
f. Income (logs) - Migrants from state of birth					
Farmers in origin	0.020***	0.019	0.063***	0.036***	0.063***
	(0.006)	(0.013)	(0.024)	(0.011)	(0.024)
R^2	0.360	0.706	-	-	-
Obs	4462	4462	3326	4462	3326
Dest-Act-Year FE	Y	Y	Y	Y	Y
Dest-Orig-Year FE		Y	Y	Y	Y
Above Q1			Y		Y
Include zeros					

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors clustered at the destination-crop-year level in parenthesis. This table replicates our main table in Panels a and b. In panels c and d we include the share of return migrants and the share of

Fact 4: Abundance and Composition of Farmers

	Dependent Variable	
	Revenues	Output
Explanatory Variable	(1)	(2)
Abundance	0.925***	0.905***
	(0.040)	(0.066)
Composition	0.183***	0.229***
	(0.046)	(0.051)
R^2	0.858	0.834
Obs	1413	1460
Region-Year	Y	Y
Activity-Year	Y	Y

$$\log\left(y_{j,kt}\right) = \iota_{j,t} + \iota_{k,t} + \gamma_0 \underbrace{\log\left(L_{j,kt}\right)}_{Abundance} + \gamma_1 \underbrace{\log \sum_{i \neq j} \left(\frac{L_{ij,kt}}{L_{j,kt}}\right) \times L_{i,kt-1}}_{Composition} + \epsilon_{j,kt}$$

- Robustness: controls for land productivity, controls for share of migrants, instrument for composition based on gravity equation
- Go Back

Migration Parameters κ, β

	OLS	OLS	OLS	PPML	PPML	PPML
	(1)	(2)	(3)	(4)	(5)	(6)
a: Income (logs)						
Farmers in origin	0.016***	0.023**	0.047***	0.045***	0.083***	-
	(0.005)	(0.010)	(0.016)	(0.012)	(0.020)	-
R^2	0.342	0.702	0.729	-	-	-
Obs	6794	6794	5180	6794	5180	
b. Farmers in destination (logs)						
Farmers in origin	0.074***	0.075***	0.101***	0.120***	0.131***	0.165***
	(0.007)	(0.014)	(0.022)	(0.013)	(0.023)	(0.011)
R^2	0.183	0.751	0.774	-	-	-
Obs	7375	7375	5609	7375	5609	127950
c. Worker heterogeneity parameters						
κ	4.625	3.260	2.148	2.666	1.578	
β	0.016	0.023	0.047	0.045	0.083	
Dest-Act-Year FE	Y	Y	Y	Y	Y	Y
Dest-Orig-Year FE		Y	Y	Y	Y	Y
Above Q1			Y		Y	
Include zeros						Y

- Pick $\beta \in \{0.047, 0.083\}$ and $\kappa = 2$
  - κ: similar to Brian & Morten (2019), Tombe & Zhu (2018), Galle et al.(2018)
  - β : similar to De la Roca and Puga (2017) $\rightarrow$ elast. of earnings wrt city size of 0.05

Back

Migration costs

- Migration costs

$$\mu_{ij,kt} = \left[\mu_t \left(dist_{ij}\right)^{\delta^M}\right]^{\iota_{ij}^M} \left[\mu_{ss',t}\mu_{ss',kt} \left(dcap_i \times dcap_j\right)^{\delta^M}\right]^{1-\iota_{ij}^M}$$

  - ι_{ij}^M: equals one if i and j belong to the same state s
  - μ_t: match share of workers living in their region of birth
  - $\mu_{ss'k}$: match data on workers' flow from s to $s'k$
  - δ_M: elasticity from literature
  - $dist_{ij}$: travel distance between i and j
  - $dcap_i$: travel distance to state capital
  - $\mu_{ss',t}$ (symmetric): comes from state-to-state level regressions

$$L_{ss',kt} = \alpha_{s,t} + \beta_{s',kt} + \bar{\mu}_{ss',t} + \epsilon_{ss',kt}$$

Go back

Trade Costs

- Trade costs

$$\tau_{ij,kt} = \left[\delta_t \left(dist_{ij}\right)^{\delta_t^T}\right]^{\iota_{ij}^T} \left[\delta_t \delta_{ij,kt} \left(dport_i \times dport_j\right)^{\delta_t^T}\right]^{1-\iota_{ij}^T}$$

  - ι_{ij}^T: equals one if trade within the country
  - δ_t: interregional trade divided by sum of trade within brazil
  - $\delta_{ij,kt}$: match data on Brazil's trade and apparent consumption
  - δ^T: match domestic trade elasticity in OLS regressions
  - $dist_{ij}$: travel distance between i and j
  - $dport_i$: travel distance to nearest port

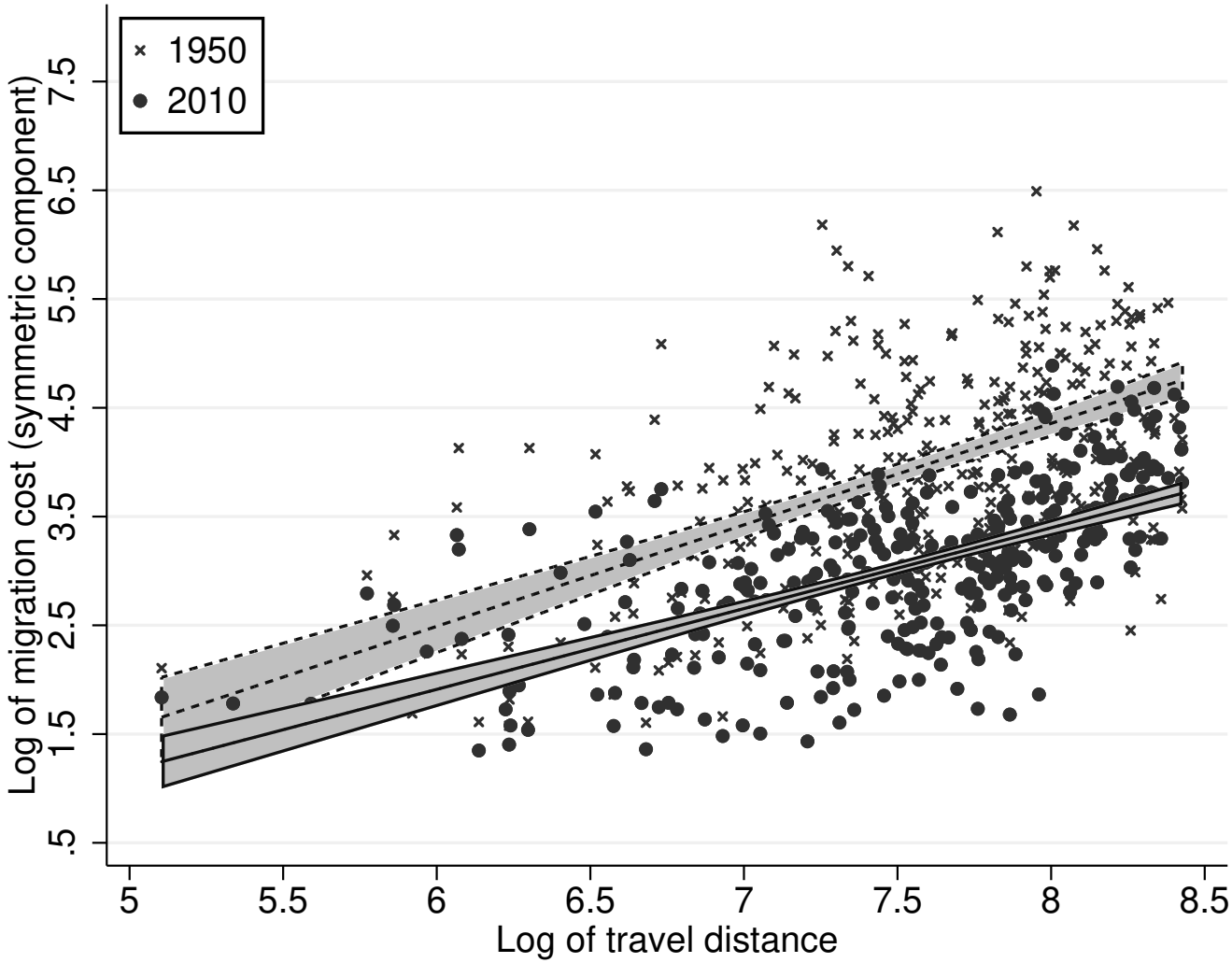
Go back

Calibration of Trade and Migration Costs

Parameter	Description	Source
c. Trade costs		
δ_t^1	Elasticity of trade cost wrt distance	Reduced form trade elasticity
δ_t^0	Intercept of trade cost	Domestic trade flows
δ_{kt}	International trade cost	International trade flows
d. Migration costs		
μ^1	Elasticity of migration cost wrt to distance	Morten and Bryan (2019)
μ_t^0	Intercept of migration cost	Workers living in region of birth
$\mu_{ss',t}$	State-to-state migration cost	Migration gravity equation
$\mu_{ss',kt}$	Residual migration shifters	Migration flows between states and sectors

Go back

Results from Calibration: Migration Costs



- Migration costs come from fixed effects in gravity equations of migration flows

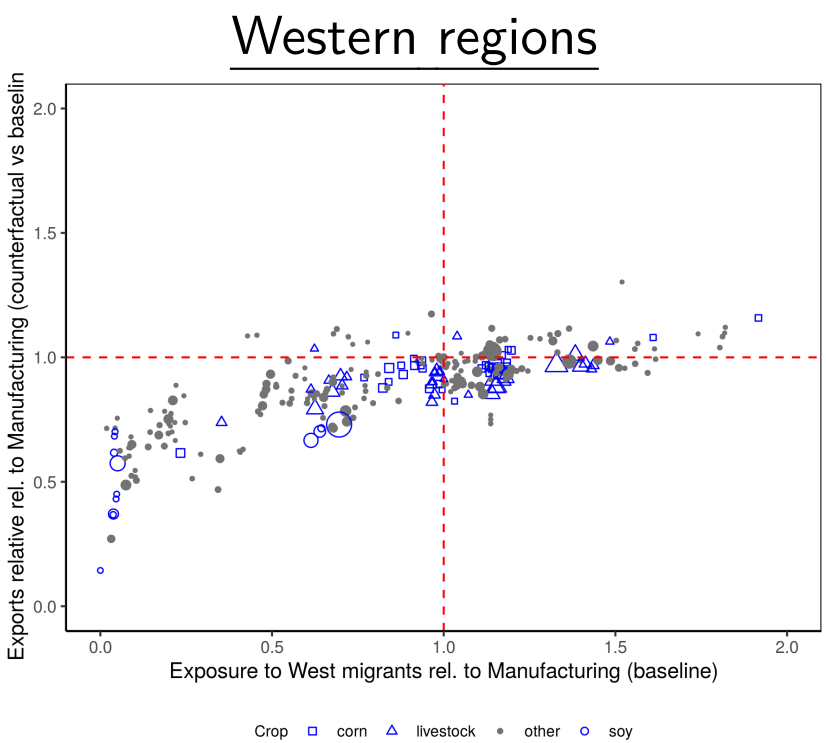
Go back

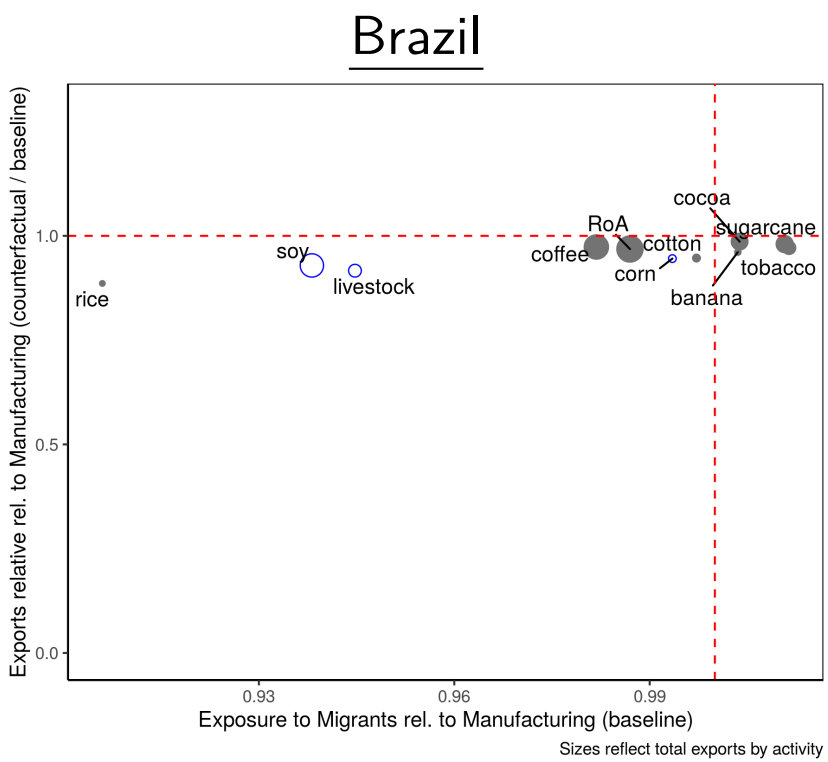
Selected Results from Quantification

	Year		
	1950 (1)	1980 (2)	2010 (3)
a. Migration costs			
Avg migration costs	34.78	21.45	19.24
Migration costs between states: East - West	109.99	45.63	40.47
Elast. of migration costs w.r.t. travel distance	1.01	0.81	0.73
b. Productivity			
Productivity in man in the West relative to the East	0.48	0.75	0.82
Productivity in agr in the West relative to the East	0.70	0.83	0.86
- Soybeans	0.20	0.94	1.00
- Livestock	2.32	1.36	1.18
- Corn	0.93	0.92	1.93
c. Trade costs			
Trade cost between Brazil and RoW - manufacturing	8.83	5.13	3.96
Trade cost between Brazil and RoW - agriculture	9.70	5.42	4.06

Go back

Effects on regional and aggregate specialization (1980)



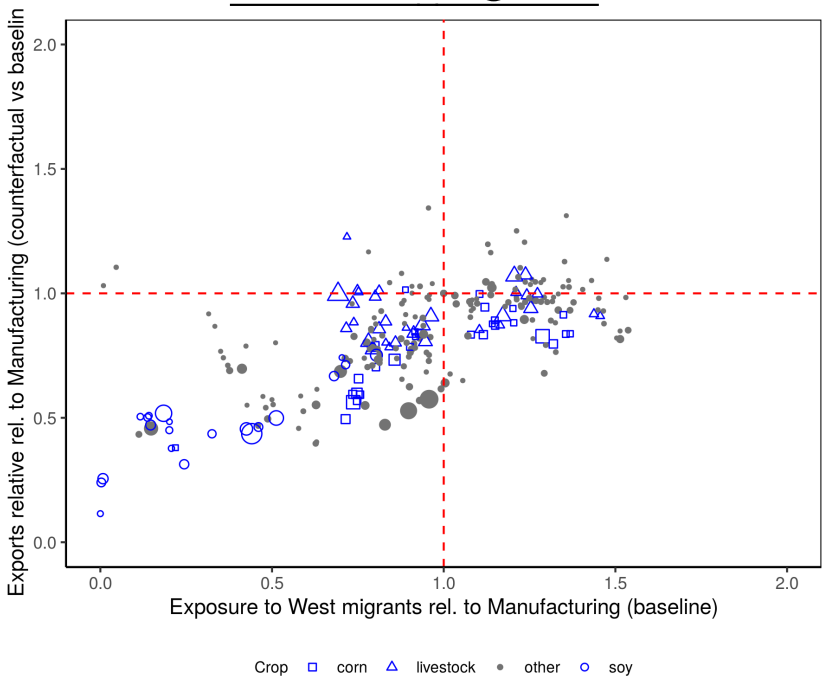


- y-axis: drop in specialization, absent μ reduction
- x-axis: share of non-migrants in employment

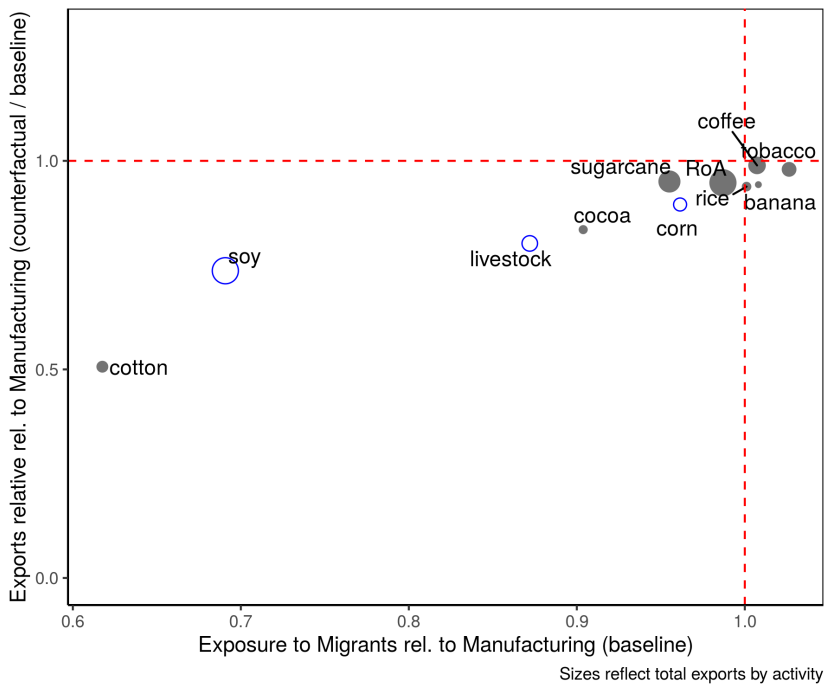
Back

Effects on regional and aggregate specialization (2010) - HO

Western regions



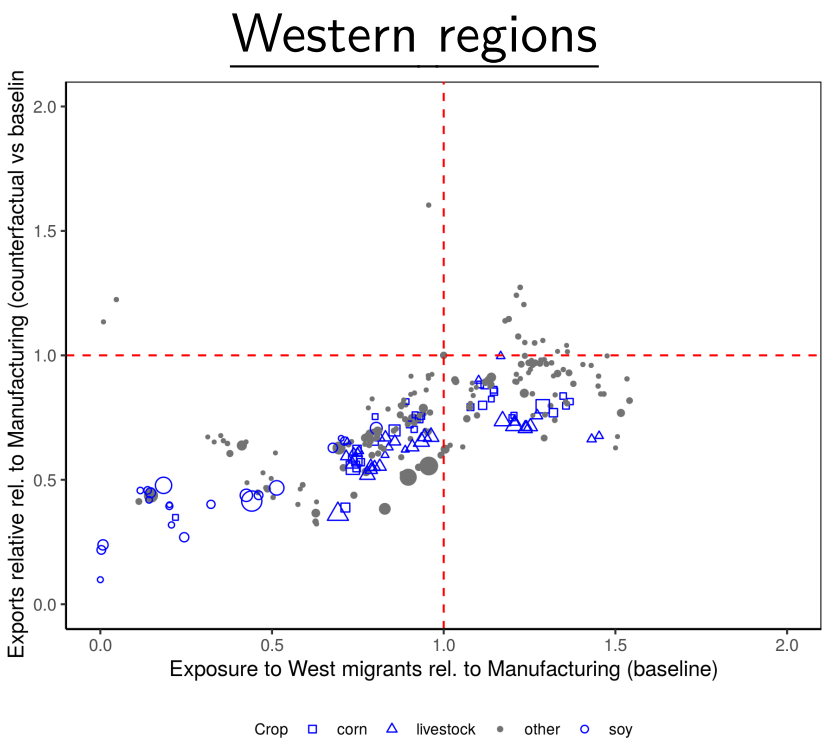
Brazil

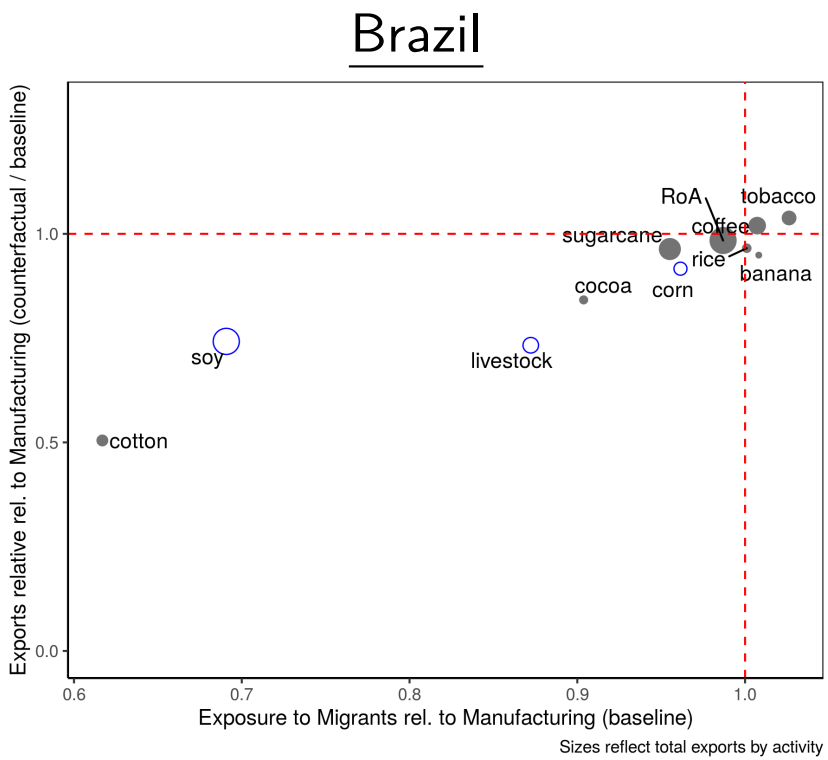


- y-axis: drop in specialization, absent μ reduction
- x-axis: share of non-migrants in employment

Go back

Effects on regional and aggregate specialization (2010) - No land

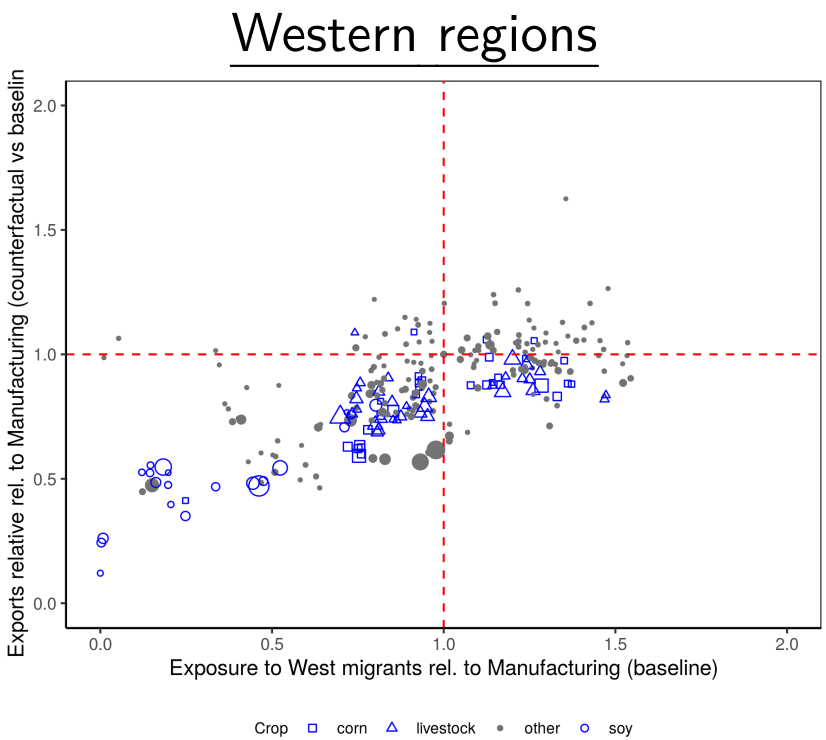


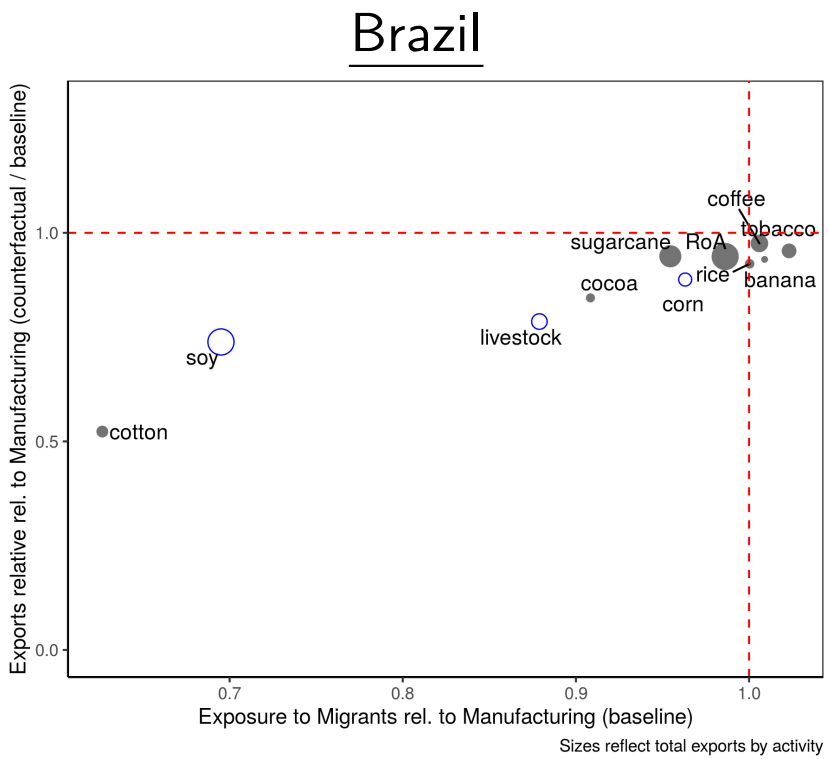


- y-axis: drop in specialization, absent μ reduction
- x-axis: share of non-migrants in employment

Go back

Effects on regional and aggregate specialization (2010)





- y-axis: drop in specialization, absent μ reduction
- x-axis: share of non-migrants in employment

Go back