Internal Migration and the Microfoundations of Gravity

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- Third fact about internal migration:
  3. Return migration is extremely common
  3'. t-year migration rate is proportional to $\sqrt{t}$
  - Suggestive of persistent preferences?

Outline

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    - Preferences correlated across space and time
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4. Compare to a moving cost model
   - Different implications for macro misallocation, long-run population elasticities, speed of adjustment

Contributions to the Literature

- Spatial dynamics
  - Rise and decline of regional economies
    Blanchard and Katz (1992); Caliendo, Dvorkin and Parro (2019); Allen and Donaldson (2020); Morris-Levenson and Prato (2022); Glaeser and Gyourko (2005); Liu, Klieman and Redding (2021); Amior and Manning (2018); Davis, Fisher and Veracierto (2021)
  - Macro adaptation to external shocks
    Tombe and Zhu (2019); Hao, Sun, Tombe and Zhu (2020); Eckert and Peters (2018); Giannone (2017); Heise and Porzio (2021); Bryan and Morten (2019); Cruz and Rossi-Hansberg (2021); Oliveira and Pereda (2020)
- How to model migration
  - Modifications of the dynamic logit
    Kennan and Walker (2011); Kaplan and Schulhofer-Wohl (2017); Giannone, Li, Paixao and Pang (2020); Porcher (2020); Mangum and Coate (2019); Monras (2018); Coen-Pirani (2010); Davis et al. (2021)
  - Persistent preferences
    Bayer and Juessen (2012)
  - Empirical evidence
    Saks and Wozniak (2011); Farrokhi and Jinkins (2021); Koşar, Ransom and Van der Klaauw (2021); Fujiwara, Morales and Porcher (2022)
- Multinomial probits
  - Butler and Moffitt (1982); Keane (1992); Geweke, Keane and Runkle (1994)

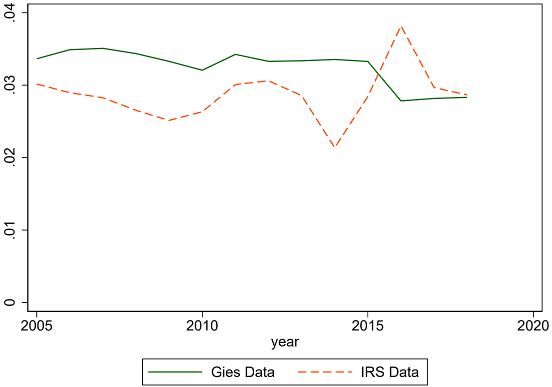
3 Facts about Internal Migration

Data

- Gies Consumer and Small Business Credit Panel (GCCP)
  - Credit data from one of the leading providers of credit reports
  - 1 percent of Americans with credit reports
  - Includes state of residence
  - Panel data, 2004-2018
- IRS Migration Data
  - Based on tax filings
  - Aggregated flows of state-to-state migration

Fact #1

Migration is rare



Comparison of interstate migration rates in IRS and GCCP

Fact #2

Migration follows a gravity pattern

Poisson regression:

$$\log m_{i \to j} = \beta \log \text{distance}_{ij} + \alpha \log p_i + \gamma \log p_j + \epsilon_{ij}$$

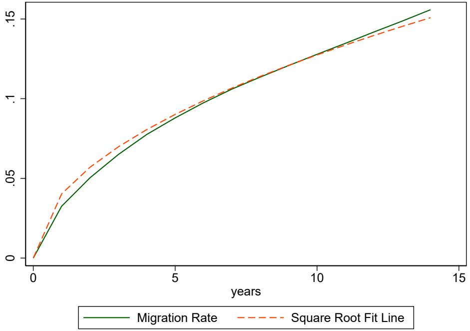
	(1) Migration (IRS)	(2) Migration (Credit)
Log Distance	-0.736***	-0.744***
	(0.0572)	(0.0515)
Log Origin Population	0.900***	0.923***
	(0.0832)	(0.0797)
Log Destination Population	0.822***	0.893***
	(0.0976)	(0.0799)
Observations	2550	2550

Standard Errors are two-way clustered by origin and destination states

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Fact #3 (New)

t-year interstate migration rate is proportional to $\sqrt{t}$



- Implies a high rate of return or onward migration
- Suggestive of persistent preferences

The SPACE Model

Model

I locations indexed by i, continuum of individuals indexed by n, and discrete time indexed by t:

- Agents choose location that maximizes utility

$$u_{nt} = \max_i u_{int} = \max_i v_{it} + \epsilon_{int}$$

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- Spatially and Persistently Auto-Correlated Epsilons (SPACE)

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- Square root fact

Proposition 2

As $\rho \to 1$, the t-year migration rate is proportional to $\sqrt{t}$

Parameterization

- Two parameters: persistence ρ, and spatial correlation A
- Target: migration rate, gravity equation
- Simulate 10 million people for two periods, fifty U.S. states and D.C.
  - v_i matches population

Matching the Facts Quantitatively

- Persistence: $\rho = .9996$,
- Spatial correlation: $A = .000299$ km^{-1}
- Hits 3.34 percent migration rate

	(1) Migration (IRS)	(2) Migration (Credit)	(3) Simulated Migration
Log Distance	-0.736***	-0.744***	-0.744***
	(0.0572)	(0.0515)	(0.0396)
Log Origin Population	0.900***	0.923***	0.892***
	(0.0832)	(0.0797)	(0.0486)
Log Destination Population	0.822***	0.893***	0.889***
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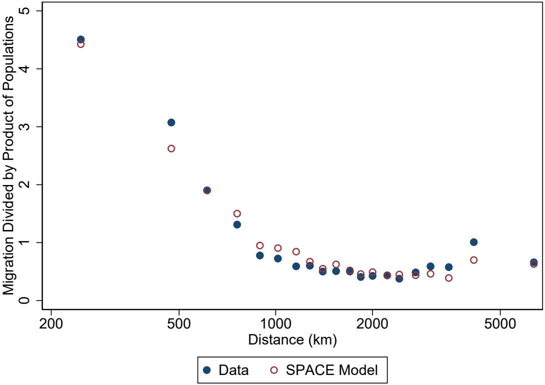
Gravity



- Curvature is untargeted

Square Root Fact

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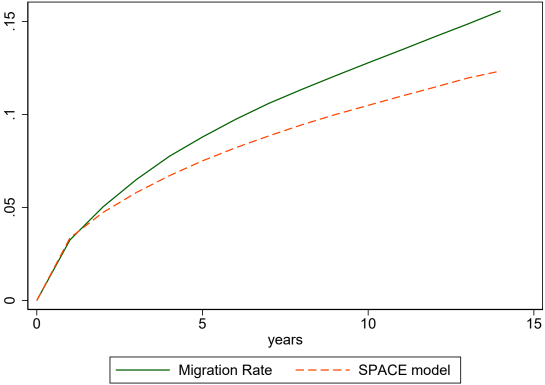
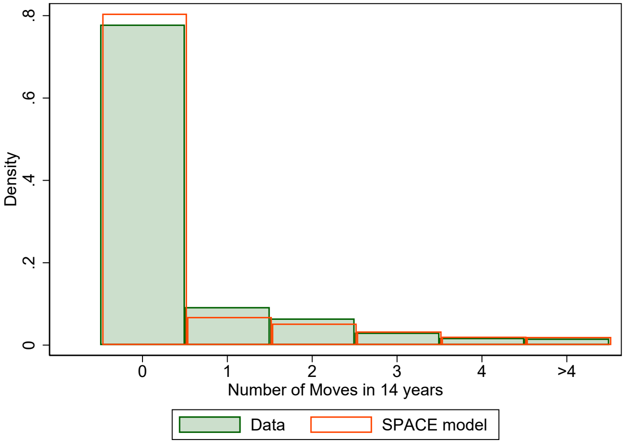


5-year Calibration

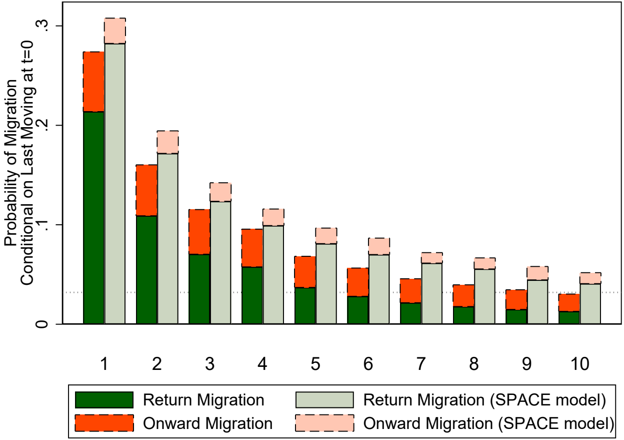
Frequency of Migration



5-year Calibration

Return Migration

- Conditional probability of moving after previous move



5-year Calibration

Implications of the Model

Is the model useful?

- Population elasticities critical for a variety of questions in the literature
- One reason for skepticism: multinomial probits do not have a closed-form solution for these elasticities as a function of parameters

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Proposition 3

As $\rho \to 1$, the semi-elasticity of the population in i with respect to u_j is

$$\frac{\partial \log p_i}{\partial v_j} = -\lim_{\rho \to 1} \frac{m_{i \to j}}{p_i} \frac{1}{\sqrt{1 - \Sigma_{ij}}} \sqrt{\frac{\pi}{1 - \rho^2}}$$

- If you know migration, distance, and the parameters, sufficient to calculate these elasticities

Why do we care about Population Elasticities?

1. Counterfactuals:
   - How much adjustment is there to the China shock? (Caliendo et al., 2019)
   - Where will people move in response to global warming? (Cruz and Rossi-Hansberg, 2021)

- Answers from these elasticities:

$$\frac{\partial \log p_i}{\partial v_j} = -\lim_{\rho \to 1} \frac{m_{i \to j}}{p_i} \frac{1}{\sqrt{1 - \Sigma_{ij}}} \sqrt{\frac{\pi}{1-\rho^2}}$$

$$\frac{\partial \log p_i}{\partial v_i} = \lim_{\rho \to 1} \sum_{j \neq i} \left[\frac{m_{i \to j}}{p_i} \frac{1}{\sqrt{1 - \Sigma_{ij}}} \sqrt{\frac{\pi}{1-\rho^2}} \right]$$

- More gross migration = more elastic population
- Higher migration rate i to j = higher cross-elasticity

Why do we care about Population Elasticities?

2. Speed of adjustment
    - How fast does the economy react? (Liu et al., 2021)

- Population reacts immediately; short-run and long-run elasticities are the same

Why do we care about Population Elasticities?

3. Welfare:

- To second order:

$$d\mathbb{E}u \approx \underbrace{p \cdot dv}_{\text{Direct effect}} + \underbrace{\frac{1}{2} dv^T \frac{\partial p}{\partial v} dv}_{\text{Migratory insurance}}$$

- High gross migration of shocked places = more insurance
- Higher migration between shocked places = less insurance

- Quantitative analysis in paper: spatial correlation of utility changes 1980-2018 meant there was only 50 percent of the insurance as if the utility changes had been randomly spatially located

Comparison to the Standard Model

2 types of comparison

- Comparison based on simplicity
  - Fewer state variables
  - Naturally hits dynamics
  - Naturally matches short-run migration elasticities

  - Argument for model being more feasible to compute
  - Argument for the truth of the model only from Occam's Razor

- Comparison of implications
  - Misallocation
  - Dynamics
  - Long-run population elasticities

  - Could be used to falsify one model or the other
  - If these were easy to measure, would not need spatial dynamic models

Conclusion

- Persistent preferences help to match dynamic moments of migration *and* gravity
- SPACE model has important implications for counterfactuals and welfare
- SPACE model has several advantages over dynamic logit and different implications

Square Root Rule, 5-year calibration

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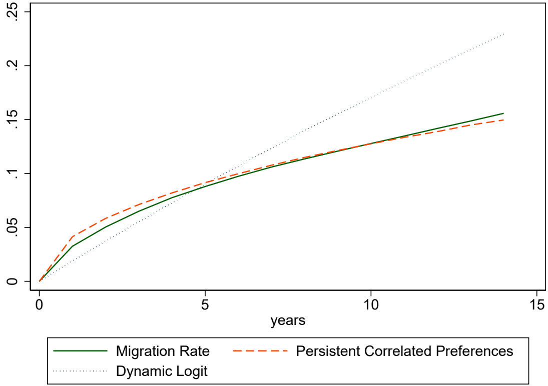

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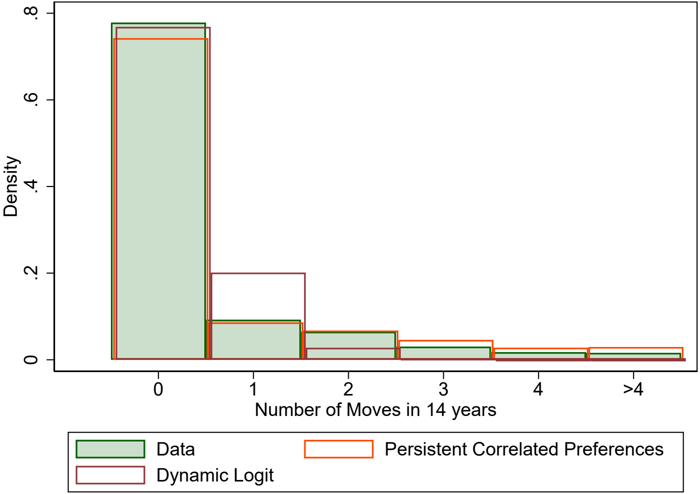
Frequency of Migration, 5-year calibration



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Return Migration, 5-year calibration

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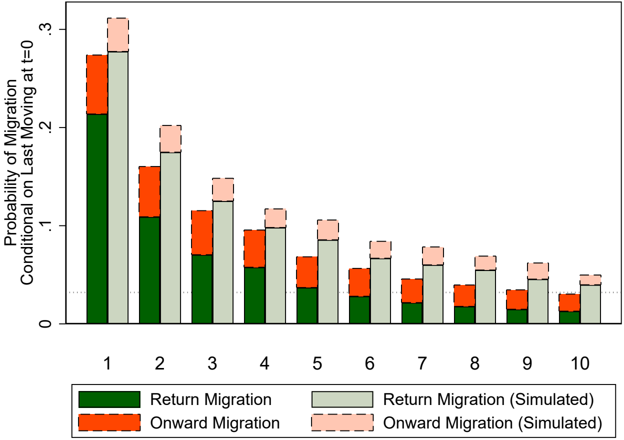

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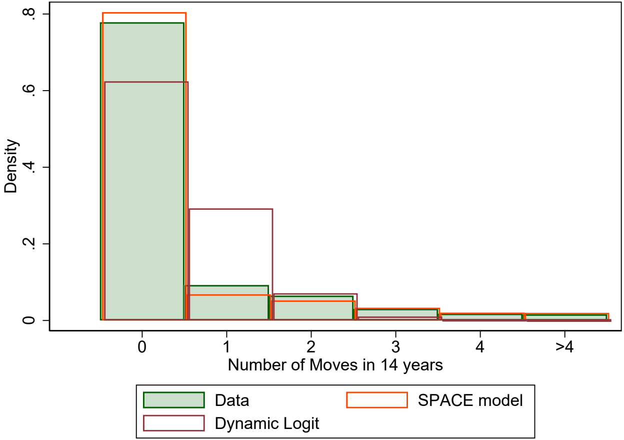
Frequency of Moves, Dynamic Logit Model



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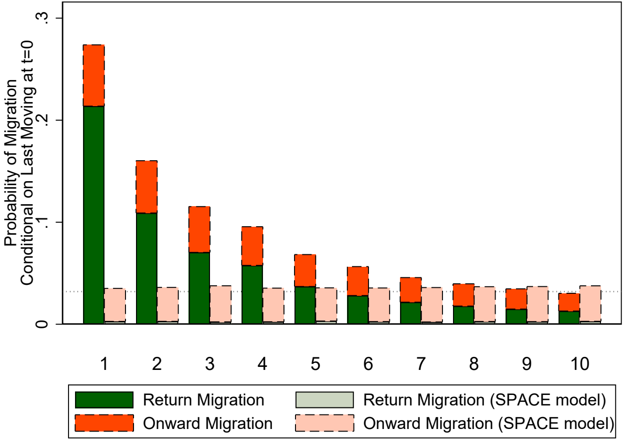

Return

Bibliography

Allen, Treb and Dave Donaldson, "Persistence and path dependence in the spatial economy," 2020. National Bureau of Economic Research Working Paper.

Amior, Michael and Alan Manning, "The persistence of local joblessness," *American Economic Review*, 2018, *108* (7), 1942–70.

Bayer, Christian and Falko Juessen, "On the dynamics of interstate migration: Migration costs and self-selection," *Review of Economic Dynamics*, 2012, *15* (3), 377–401.

Blanchard, Olivier Jean and Lawrence F Katz, "Regional evolutions," *Brookings Papers on Economic Activity*, 1992, *1992* (1), 1–75.

Bryan, Gharad and Melanie Morten, "The aggregate productivity effects of internal migration: Evidence from Indonesia," *Journal of Political Economy*, 2019, *127* (5), 2229–2268.

Butler, John S and Robert Moffitt, "A computationally efficient quadrature procedure for the one-factor multinomial probit model," *Econometrica: Journal of the Econometric Society*, 1982, pp. 761–764.

Caliendo, Lorenzo, Maximiliano Dvorkin, and Fernando Parro, "Trade and labor market dynamics: General equilibrium analysis of the china trade shock," *Econometrica*, 2019, *87* (3), 741–835.

Coen-Pirani, Daniele, "Understanding gross worker flows across US states," *Journal of Monetary Economics*, 2010, *57* (7), 769–784.