Moving Cost Magnitudes in Moving Cost Models

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- "...while unobserved and potentially very large costs might help explain migration rates that are low relative to the potential earnings gains from migration, different models imply substantively different estimates of the size of these costs" (Jia, Molloy, Smith, and Wozniak, 2023, *JEL*)

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- Informally, I've observed two attitudes towards these estimates:
  1. Approach is reasonable, but we need to have a rich enough model to truly estimate moving costs
  2. Moving costs are too sensitive to assumptions over timing and geography to be useful

This Paper

- Moving costs measure *information*
- Formally, in the steady-state of a standard model,

$$\text{Average Moving Costs} = \frac{H(\text{Future Location}) - I(\text{Not Moving})}{\text{Migration Elasticity} \times \text{Migration Rate}}$$

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Preferred Interpretation

Moving costs tell us about the informativeness of the model regarding next period's locations

- Lower moving costs tell us that the model is better at predicting future locations
- Suggests not taking moving costs too literally
- Can help make sense of the literature

Outline

1. Review of Shannon information theory
2. Standard moving cost model
3. Main result
4. Usefulness

Shannon (1950)

- Developed a mathematical description of communication, which is used widely across academic fields
  - In economics, commonly-used functional form for rational inattention
- Key concept is the "information content" of an event
- A unit of information is related to a bit; i.e. the answer to a yes-or-no question

Shannon information theory

- Shannon information measures how surprising an event is:

$$I(j) = -\log \mathbb{P}(j)$$

  - j is the realization of a random variable
- Rare events are more surprising; therefore have more information
  - If I move to Wyoming next year, that event would have a lot of Shannon information
  - If I stay in Illinois, little Shannon information

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- Shannon entropy is a measure of expected information:

$$H(J) = \mathbb{E}I(j) = -\sum_j \mathbb{P}(j) \log \mathbb{P}(j)$$

  - Shannon entropy of future location is low for a tenured professor, high for a graduating PhD Student

Relevant Facts

- Shannon entropy is sensitive to how we define random variables
  - The Shannon entropy of future locations is mechanically higher if we define smaller geographies
- Shannon entropy is sensitive to the length of a time period
  - Harder to predict locations farther in the future, more Shannon entropy
- Shannon entropy is sensitive to what we already know about a person
  - My future location has less Shannon entropy given my information set than your information set

Standard Model

Model setup:

- Continuum of agents n choose a location i at each time t
- Each location has a baseline utility u_{it}—includes things like average wages, amenities, rents
- Each agent also has idiosyncratic utility ϵ_{int} over each location
- An agent who at time t is in j faces utility moving costs δ_{ij} if they move to i.

Value function:

$$V_{nt}(j) = \max_i u_{it} - \delta_{ij} + \frac{1}{\mu}\epsilon_{int} + \beta \mathbb{E} V_{nt+1}(i)$$

Standard Model

- Define $v_{it} = u_{it} + \beta \mathbb{E} V_{nt+1}(i)$
- Then the migration rate from j to i is given by

$$m_{j \to i,t} = \frac{\exp(\mu(v_{it} - \delta_{ji}))}{\sum_k \exp(\mu(v_{kt} - \delta_{jk}))}$$

- δ_{ii} is assumed be zero:

$$\delta_{ji} = v_{it} - v_{jt} - \frac{1}{\mu} \log m_{j \to i,t} + \frac{1}{\mu} \log m_{j \to j,t}$$

Standard Model

- Consider the average moving cost paid by movers in steady-state:

$$\bar{\delta} \equiv \mathbb{E}^m[\delta_{ij}]$$

  where $\mathbb{E}^m$ is a migration-weighted average

- A bit of algebra:

$$\bar{\delta} = \frac{1}{\mu}\frac{1}{\mathbb{E}_i m_i}\mathbb{E}_i\Big[H(J|i) - I(i|i)\Big] + \mathbb{E}^m(v_i - v_j)$$

  - μ is the migration elasticity
  - $\mathbb{E}_i m_i$ is the average migration rate
  - $H(J|i)$ is the Shannon entropy of next period's location given current location i
  - $I(i|i)$ is the Shannon information of when a person does not move
  - $\mathbb{E}^m(v_i - v_j)$ is the average "baseline" utility gain of migration

Main Theorem

Proposition 1

In steady state of a standard moving cost model,

$$\bar{\delta} = \frac{1}{\mathbb{E}_i m_i} \frac{1}{\mu} \mathbb{E}_i \Big[H(J|i) - I(i|i) \Big]$$

- In steady-state, the last term cancels out because equal numbers of people are moving in and out of each location
- Moving costs measure expected information of next period's location minus the information of not moving

Alternative Formulation

Proposition 2

$$\bar{\delta} = \frac{1}{\mu}\mathbb{E}^m\left[H(J|i, i \to \not i) + I(\not i|i) - I(i|i)\right]$$

where

- $H(J|i, i \to \not i)$ is the Shannon entropy of tomorrow's location, given today's location, and that tomorrow's location is not the same as today's location
- $I(\not i|i)$ is the information content of moving somewhere
- $I(i|i)$ is the information content of staying
- $\mathbb{E}^m$ signifies that the average for this equation is weighted based on the number of migrants

3 Corollaries

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Formalize some "folk wisdom" about migration costs:

1. Average moving costs depend on the modeler's choice of time period
2. Average moving costs depend on the modeler's choice of geographic unit
3. Average moving costs depend on the modeler's information about the agents
    - Suppose we knew some immutable characteristic about a person; e.g. race
    - Including this characteristic in our model, but keeping migration elasticity and bilateral migration constant, lowers moving costs mechanically

Estimated Moving Costs for Different Models

- Each row estimates moving costs for moving within the United States based on data from 2000 (Census/ACS)
- Assume $\mu = 1$

Estimated Moving Costs for Different Models

	Shannon Entropy	Migration Rate	Estimated Moving Cost	Cost in \$1000's
1 year, states	0.182	0.024	6.692	315
	(0.0017)	(0.0002)	(0.0138)	(0.65)
5 year, states	0.561	0.085	5.585	262
	(0.0005)	(0.0001)	(0.0014)	(0.07)
5 year, states (modeler knows birthplace)	0.512	0.085	4.981	234
	(0.0004)	(0.0001)	(0.0018)	(0.08)
5 year, MIGPUMAs	1.231	0.173	5.983	281
	(0.0007)	(0.0001)	(0.0014)	(0.07)

Notes: All datasets are from 2000. 1 year migration uses migration measured over 1 year from the ACS. 5 year migration uses migration measured over 5 years from the Census. The unit of geography is a state or a MIGPUMA, a subset of a state with at least 100,000 people in it. Birthplace is an indicator variable either for the state of birth or for being from anywhere outside the 51 U.S. states. The median household income in 2000 (for people also living in the U.S. in 1995) was \$47,000, so for 1-year migration, the last column is that times the estimated moving cost. For 5-year migration, the last column is \$47,000 times five times the estimated moving cost.

Implications for Literature

- A literal interpretation of moving costs requires us to take a stand on the correct time period, geography, and information content of the model

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- A literal interpretation of moving costs requires us to take a stand on the correct time period, geography, and information content of the model
- But the information interpretation can help make sense of the literature

Literature

- Models with more information about the agents should have lower moving costs
- In general, this comparison is going to be a bit hand-wavy because papers do not only vary with information, they also do different settings, different time periods, and measure costs in different units
- A couple of results within papers is a straightforward comparison:
    - Porcher (2020) adds rational inattention to a migration model
        - Modeler knows the signal the agents get, which is helpful to predict their migration decision
        - With the rational inattention, migration costs are estimated to be 40 percent lower than without rational inattention (using the same data)
    - Zerecero (2021) compares a migration model with and without birthplace as a state variable
        - Without home bias, migration costs are 10% larger

Estimated Costs in the Literature

Paper	(1) Estimated Migration Costs	(2) Length of time	(3) Geography	(4) Modeler's Information	(5) Notes
Tombe and Zhu (2019)	282% of lifetime income	lifetime	Chinese provinces × urban/rural	birthplace	Paper reports the parameter which I called $\bar{\delta}$ as 2.82 which I interpreted as a share of lifetime income because in their model, moving costs are paid every year a migrant is away from their birthplace
Zerecero (2021)	56% of lifetime consumption	1 year	French départments	current location and birthplace	Without home bias, migration costs estimated to be 10% larger
Bryan and Morten (2019)	39% of lifetime income	lifetime	Indonesian regencies	birthplace	
Bryan and Morten (2019)	15% of lifetime income	lifetime	U.S. States	birthplace	
Ransom (2022)	\$394,000 to \$459,000 (2004-2013 dollars)	1 year	35 U.S. core-based statistical areas	current location, work experience, age, employment and labor force status, and unobserved type	
Kennan and Walker (2011)	\$312,146 (2010 dollars)	1 year	U.S. States	current location, birthplace, current wage, age, type (stayer or mover), last year's location, and wage at that location	
Giannone et al. (2023)	196,202 CAD (2016 dollars)	2 years	Canadian provinces	current location, wealth, income shock, age, housing tenure status, and housing consumption	
Porcher (2020)	75% of annual earnings	1 year	Brazilian mesoregions	current location, information acquired by the agent about productivity in different locations	Without information frictions, migration costs estimated to be 40% larger
Heise and Porzio (2022)	3.1%-5.3% of lifetime income	continuous	4 German regions	current location, home location, current employment status, current wage, location of job offer, wage of job offer	While the model is continuous time, workers only consider moving at discrete times when they get a job offer

- Lower moving costs are typically high-information
- Time periods and geography also play a role

Takeaways

- Average moving costs, in the steady-state of a standard moving cost model are proportional to a measure of information about future locations

References

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

Giannone, Elisa, Qi Li, Nuno Paixao, and Xinle Pang, "Unpacking moving: A Spatial Equilibrium Model with Wealth," 2023.

Heise, Sebastian and Tommaso Porzio, "Labor Misallocation Across Firms and Borders," 2022.

Kennan, John and James R Walker, "The effect of expected income on individual migration decisions," *Econometrica*, 2011, *79* (1), 211–251.

Porcher, Charly, "Migration with costly information," 2020. Job Market Paper.

Ransom, Tyler, "Labor market frictions and moving costs of the employed and unemployed," *Journal of Human Resources*, 2022, *57* (S), S137–S166.

Tombe, Trevor and Xiaodong Zhu, "Trade, migration, and productivity: A quantitative analysis of china," *American Economic Review*, 2019, *109* (5), 1843–1872.

Zerecero, Miguel, "The Birthplace Premium," 2021. Job Market Paper.