Dynamic Urban Economics

Greaney, Parkhomenko, & Van Nieuwerburgh (2025)

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Overview

- **question:** What are the aggregate and *distributional* consequences of typically-studied spatial shocks and policies *when we consider that*...
  1. people and places are **heterogeneous**,
  2. people find it **costly to move** across places, and
  3. some people own large, immobile, undiversified assets—**homes!**

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Ambitious paper with many moving parts!

Solving dynamic spatial models is hard

Desmet and Rossi-Hansberg (2014) pointed out two key challenges...

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...to which I'll add two more:

3. usually requires thinking about **individual heterogeneity**, not just locational

4. number of parameters to estimate generally **scales with number of locations**, but model inversion unlikely to work w/ heterogeneity

The dimensionality at hand

- **stationary equilibrium:**
  - **individual states**: age a, liquid wealth b, house size h, labor productivity ζ, residential location i, workplace location j
  - **market clearing**: sufficient to solve for $\{L_{it},\, r_{Sit}\}$
- **transitional dynamics:** entire **paths** for $\{L_{it}, r_{Sit}, \mathbf{1}_{it}^{S}\}$
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Ultimately, encode model as **state-space transition matrix**...

...so prefer a **smaller, sparser, or more-structured** encoding!

So how do we make progress? A "mixed time" approach

1. **cast the model in continuous time**... (Achdou et al., 2022)
   - FOCs hold w/ equality, sufficient even if nonconvexities
   - FOCs involve only contemporaneous variables $\longrightarrow$ no root finding
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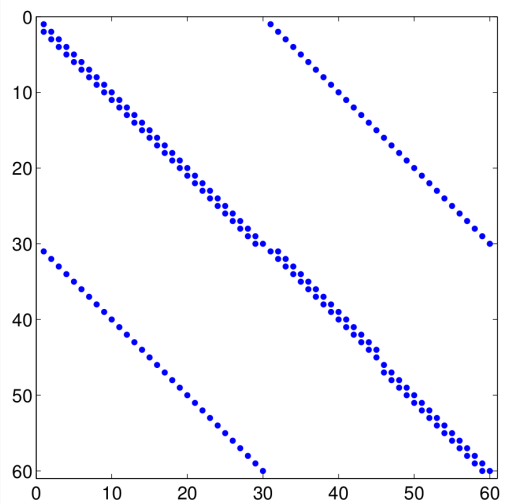
3. **...and keep small what we can**
   - 5 grid points for labor productivity (Rouwenhorst)
   - 6 grid points for house size (total floorsize, not unit size, is stock)
   - 50 grid points for liquid wealth
   - current wage is sufficient stat. for workplace choice (more on this later)

Mixed time, visualized

Zoom in on **residential location choice**...

- in cont. time: **Poisson arrival** of opp.

  $\longrightarrow$ must eval move in **every state**



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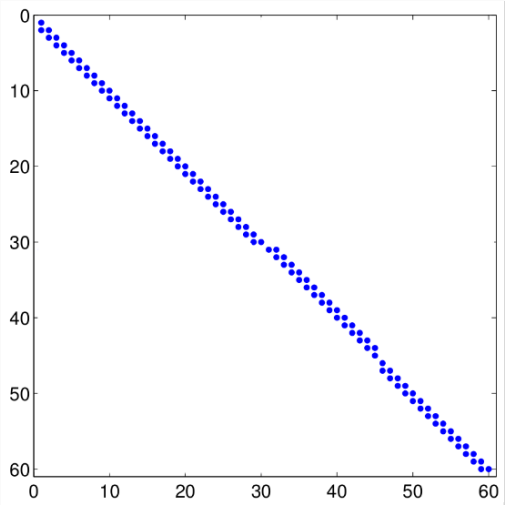

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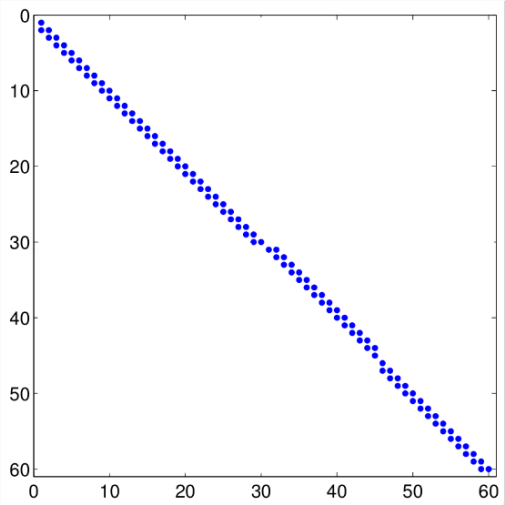
...all of $\{\zeta, h, i, j\}$ operate like this!



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- **possibly-distorted decisions:**
  - are there any **turnpike-like dynamics** near shock ages?
    - different behavior for "I know my shock age is in 5 years" vs. "A shock can happen whenever, but I expect it in 5 years"?
    - presumably depends on relative size of shock age vs. time step
    - computation seems to use 1-for-1, so it's always a shock age?
  - timing of **workplace location choice** buys a lot...
    - at shock age, j freely chosen + amenities enjoyed + commuting costs paid...
    - ...so j doesn't matter *between* shock ages except through w_j $\longrightarrow$ can reduce N^2 to $N \times |w|$

    ...but it seems brittle:
    - what if we think people choose j and i jointly? or just j first?
    - what if we add human capital so wage growth depends on j?
    - already, have to treat wages as **constant** between shock ages along transition path (fn.16)

And for what gain?

A LOT! We can see distributional, transitional, . . . , but **let's be greedy!**

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- **speed?** What's the fully-continuous time version? How slow would it be?
- **insight?** Counterfactuals without homeownership or consumption-saving. . .
  - make the **same positive predictions** → can recalibrate with fewer moments to get same response (high migration cost vs. mid migration cost + house transaction cost)
  - welfare effects are **less dispersed** somewhat by construction → we eliminated margins of heterogeneity!
- **predictive power?** Would prefer different counterfactuals. . .
  - see pre- and post-shock data (Dingel and Tintelnot, 2021)
  - show static or reduced dynamic model, calibrated to same moments, does **worse** than the full model

How easily can we generalize?

If I want to use this approach in my work, but I want to add...

- **additional states:** shock age or not?
- **additional locations:** showed scaling for PE stationary, but estimation? transitions?
- **local externalities:** what about **uniqueness of transition path**?
  - guess smoothly-decaying weighted avg. between old and new S.S. values...
  - ...but with externalities, could there be multiple paths to same S.S.?
- **open city:** not important for tractability, but closed-city could be driving welfare
  - decompose welfare gain into Δ(house value) and Δ(labor market)

Thank you!

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