Macro-Spatial Economics

Lecture 4: Workhorse Framework, Estimation & Applications

Allen & Arkolakis (2025), Part C — Sections 6–10

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Where We Are

Part B:

- built and solved the simple model
- catalogued its isomorphic extensions

Today: scale up, estimate, and take stock of what we have learned

- **Workhorse framework**: arbitrary elasticities, equilibrium properties, counterfactuals
- **Taking to data**: trade frictions & four elasticities
- **Empirical lessons**: three robust findings from applications
- **Extensions & frontiers**: brief tour

Payoff

By the end of today you will have a complete, estimable, counterfactual-ready quantitative spatial toolkit.

The Workhorse Framework: Two Components

Goal: a framework that nests *any* spatial model, not just the simple-model special case.

The framework has two components:

Component 1 — Spatial linkages (trade)
Locations are connected by goods flows that satisfy a gravity equation

Component 2 — Labor markets (supply & demand)
Each location has log-linear inverse supply and demand curves

Key abstraction

Replace structural micro-parameters with *four reduced-form elasticities*. The specific model determines how they map to primitives; the framework works for any values.

The Workhorse Gravity Equation

Component 1: bilateral trade flows satisfy

$$X_{ij} = T_{ij} \times \frac{Y_i}{\mathrm{MA}_i^{\mathrm{out}}} \times \frac{E_j}{\mathrm{MA}_j^{\mathrm{in}}} \tag{61}$$

- $T_{ij} \leq 1$: bilateral trade friction
- Y_i: total income (output) of i
- E_j: total expenditure of j
- $\mathrm{MA}_i^{\mathrm{out}}$: outward market access of i (how well i reaches buyers)
- $\mathrm{MA}_j^{\mathrm{in}}$: inward market access of j (how well j is reached by suppliers)

Note on trade frictions

Only the composite $T_{ij} \equiv \tau_{ij}^{1-\sigma}$ matters for the *distribution* of economic activity. τ_{ij} and σ need not be separately identified for counterfactual analysis.

Why this form?

It is the model-consistent gravity. All the microfoundation models deliver this gravity equation as a special case.

Workhorse Labor Supply & Demand

Component 2: log-linear inverse supply and demand

Labor supply (eq. 62)

$$\ln w_i = \varepsilon^S_{\mathrm{loc}} \ln L_i - \varepsilon^S_{\mathrm{glob}} \ln \mathrm{MA}^{\mathrm{in}}_i - \ln C^S_i - \ln \phi^S \tag{62}$$

Labor demand (eq. 63)

$$\ln w_i = -\varepsilon^D_{\mathrm{loc}} \ln L_i + \varepsilon^D_{\mathrm{glob}} \ln \mathrm{MA}^{\mathrm{out}}_i + \ln C^D_i + \ln \phi^D \tag{63}$$

- C^S_i, C^D_i: exogenous supply/demand shifters (productivity, amenities, ...)
- ϕ^S, ϕ^D: endogenous aggregate scalars (numeraire + labor market clearing)
- **Sign convention**: all four ε are typically *positive*

Table 1 — Models as Special Cases

All major spatial models map to the four elasticities:

Model	$\varepsilon^S_{\text{loc}}$	$\varepsilon^S_{\text{glob}}$	$\varepsilon^D_{\text{loc}}$	$\varepsilon^D_{\text{glob}}$
Roback (1982)	$-\beta$	0	α	0
Krugman (1991)	0	$\frac{1}{\sigma-1}$	0	$\frac{1}{\sigma}$
Allen-Arkolakis (2014)	$-\beta$	$\frac{1}{\sigma-1}$	$\frac{1-\alpha(\sigma-1)}{\sigma}$	$\frac{1}{\sigma}$

- Roback: no global elasticities $\Rightarrow$ no trade, just location choice
- Krugman: no local supply/demand $\Rightarrow$ indeterminate scale without externalities
- AA (2014): all four non-zero $\Rightarrow$ full spatial equilibrium

Equilibrium — Definition

Given: Geography $\{T_{ij}\}_{i,j\in\mathcal{N}}$, $\{C_i^S, C_i^D\}_{i\in\mathcal{N}}$, elasticities $\{\varepsilon^S_{\text{local}}, \varepsilon^S_{\text{global}}, \varepsilon^D_{\text{local}}, \varepsilon^D_{\text{global}}\}$.

An equilibrium is a distribution $\{L_i, w_i, \mathrm{MA}_i^{\text{in}}, \mathrm{MA}_i^{\text{out}}\}_{i\in\mathcal{N}}$ and scalars ϕ^S, ϕ^D such that:

1. **Goods markets clear:** $Y_i = \sum_{j\in\mathcal{N}} X_{ij}$ and $E_i = \sum_{j\in\mathcal{N}} X_{ji}, \quad \forall i$.
2. **Labor markets clear:** labor supply (62) = labor demand (63), $\quad \forall i$.
3. **Income identity (Walras):** $w_i L_i = Y_i = E_i, \quad \forall i$.
4. **Aggregation and numeraire:** $\sum_{i\in\mathcal{N}} L_i = \bar{L}$, and ϕ^S, ϕ^D pinned down by normalization.

Market access system (Goods clearing + Gravity (61)):

$$\mathrm{MA}_i^{\text{out}} = \sum_{j\in\mathcal{N}} T_{ij} \frac{E_j}{\mathrm{MA}_j^{\text{in}}} \tag{64}$$

$$\mathrm{MA}_i^{\text{in}} = \sum_{j\in\mathcal{N}} T_{ji} \frac{Y_j}{\mathrm{MA}_j^{\text{out}}} \tag{65}$$

Equilibrium — In Shares

Define income share $y_i \equiv w_i L_i / Y^W$, population share $l_i \equiv L_i / \bar{L}$, and combined geography $K_{ij} \equiv T_{ij} (C_i^D)^{1/\varepsilon^D_{\text{glob}}} (C_j^S)^{1/\varepsilon^S_{\text{glob}}}$.

The full equilibrium collapses to a two-equation system in (y_i, l_i):

$$\lambda\, y_i^{1/\varepsilon^D_{\text{glob}}}\, l_i^{(\varepsilon^D_{\text{loc}}-1)/\varepsilon^D_{\text{glob}}} = \sum_j K_{ij}\, y_j^{(\varepsilon^S_{\text{glob}}+1)/\varepsilon^S_{\text{glob}}}\, l_j^{-(1+\varepsilon^S_{\text{loc}})/\varepsilon^S_{\text{glob}}} \tag{68}$$

$$\lambda\, y_i^{-1/\varepsilon^S_{\text{glob}}}\, l_i^{(\varepsilon^S_{\text{loc}}+1)/\varepsilon^S_{\text{glob}}} = \sum_j K_{ji}\, y_j^{(\varepsilon^D_{\text{glob}}-1)/\varepsilon^D_{\text{glob}}}\, l_j^{(1-\varepsilon^D_{\text{loc}})/\varepsilon^D_{\text{glob}}} \tag{69}$$

- (68) governs outward linkages: K_{ij} — how well i reaches buyers in j
- (69) governs inward linkages: K_{ji} — how well i is reached by suppliers in j
- λ absorbs aggregate scale; same structure as eqs. (31)–(32)

Key insight

$\bar{L}$ and Y^W only shift λ — they do *not* affect the *distribution* of economic activity across locations.

Equilibrium Properties [Technical]

Three results. The proofs use Brouwer's fixed-point theorem and the Collatz-Wielandt formula.

Existence (Sec. 6.4)

- Under mild regularity, a solution to (68)–(69) *always* exists
- Proof: map on (y_i, l_i) shares is continuous on a compact set $\Rightarrow$ Brouwer

Uniqueness (Sec. 6.5)

- Sufficient condition: $\rho(|\mathbf{A}|) \leq 1$ (spectral radius of interaction matrix)
- Economic content: agglomeration forces must not be "too strong"
- This condition is also *globally necessary*: if violated, some geography has multiple equilibria

Practical implication

If uniqueness holds at baseline, it holds for *all* counterfactuals $\Rightarrow$ no multiplicity concerns when doing policy analysis.

Counterfactual Analysis — Exact Hat Algebra

Question: how does a policy shock $K_{ij}^A \to K_{ij}^B$ change the equilibrium?

Method: Dekle-Eaton-Kortum (2008) "exact hat" algebra. Define $\hat{x}_i \equiv x_i^B / x_i^A$.

Equilibrium system *in changes* — one equation per market access direction:

$$\hat{\lambda}\, \hat{y}_i^{1/\varepsilon^D_{\text{glob}}}\, \hat{l}_i^{(\varepsilon^D_{\text{loc}}-1)/\varepsilon^D_{\text{glob}}} = \sum_j \underbrace{\frac{X_{ij}^A}{Y_i^A}}_{\text{export share}} \hat{K}_{ij}\, \hat{y}_j^{(\varepsilon^S_{\text{glob}}+1)/\varepsilon^S_{\text{glob}}}\, \hat{l}_j^{-(1+\varepsilon^S_{\text{loc}})/\varepsilon^S_{\text{glob}}} \tag{80}$$

$$\hat{\lambda}\, \hat{y}_i^{-1/\varepsilon^S_{\text{glob}}}\, \hat{l}_i^{(\varepsilon^S_{\text{loc}}+1)/\varepsilon^S_{\text{glob}}} = \sum_j \underbrace{\frac{X_{ji}^A}{E_i^A}}_{\text{import share}} \hat{K}_{ji}\, \hat{y}_j^{(\varepsilon^D_{\text{glob}}-1)/\varepsilon^D_{\text{glob}}}\, \hat{l}_j^{(1-\varepsilon^D_{\text{loc}})/\varepsilon^D_{\text{glob}}} \tag{81}$$

Three inputs required

1. Observed baseline data $\{X_{ij}, Y_i, E_i, L_i\}$
2. The policy shock $\hat{K}_{ij}$
3. The four elasticities $(\varepsilon^S_{\text{loc}}, \varepsilon^S_{\text{glob}}, \varepsilon^D_{\text{loc}}, \varepsilon^D_{\text{glob}})$

Import and Export Shares

Step 1 — Evaluate eq. (68) at A and B, then divide.

At A: $\lambda^A (y_i^A)^{1/\varepsilon^D_{\text{glob}}} (l_i^A)^{(\varepsilon^D_{\text{loc}}-1)/\varepsilon^D_{\text{glob}}} = \sum_j K_{ij}^A (y_j^A)^{(\varepsilon^S_{\text{glob}}+1)/\varepsilon^S_{\text{glob}}} (l_j^A)^{-(1+\varepsilon^S_{\text{loc}})/\varepsilon^S_{\text{glob}}}$

At B: same form with B superscripts and geography K_{ij}^B.

Dividing B by A (with $\hat{x} \equiv x^B/x^A$), the baseline terms collect into normalised weights:

$$C_{ij} \equiv \frac{K_{ij}^A (y_j^A)^{\frac{\varepsilon^S_{\text{glob}}+1}{\varepsilon^S_{\text{glob}}}} (l_j^A)^{-\frac{1+\varepsilon^S_{\text{loc}}}{\varepsilon^S_{\text{glob}}}}}{\sum_k K_{ik}^A (y_k^A)^{\frac{\varepsilon^S_{\text{glob}}+1}{\varepsilon^S_{\text{glob}}}} (l_k^A)^{-\frac{1+\varepsilon^S_{\text{loc}}}{\varepsilon^S_{\text{glob}}}}}, \qquad \sum_j C_{ij} = 1$$

Step 2 — Connect to observable trade shares.

Divide (61) by Y_i^A, use $\mathrm{MA}_i^{A,\text{out}} = \sum_k T_{ik}^A E_k^A / \mathrm{MA}_k^{A,\text{in}}$ [eq. (64)]:

$$\frac{X_{ij}^A}{Y_i^A} = \frac{T_{ij}^A \, E_j^A / \mathrm{MA}_j^{A,\text{in}}}{\mathrm{MA}_i^{A,\text{out}}} = \frac{T_{ij}^A \, E_j^A / \mathrm{MA}_j^{A,\text{in}}}{\sum_k T_{ik}^A \, E_k^A / \mathrm{MA}_k^{A,\text{in}}}$$

Same ratio structure as C_{ij}: in equilibrium

$T_{ij} E_j / \mathrm{MA}_j^{\text{in}} \propto K_{ij} (y_j)^{(\varepsilon^S_{\text{glob}}+1)/\varepsilon^S_{\text{glob}}} (l_j)^{-(1+\varepsilon^S_{\text{loc}})/\varepsilon^S_{\text{glob}}}$, **common proportionality factor cancels**

$\Rightarrow \; C_{ij} = X_{ij}^A / Y_i^A \checkmark$

Why Exact Hat Algebra is Powerful

Traditional approach: estimate all structural parameters $\{T_{ij}, C_i^S, C_i^D\}$, solve for two full equilibria, compare.

Exact hat approach:

- Only need *observable trade shares* X_{ij}^A / Y_i^A plus elasticities
- Unobserved heterogeneity (productivity, amenity levels) cancels out
- No specification error from imputing unobserved T_{ij} for each pair

Trade cost change

$\hat{K}_{ij} = \hat{T}_{ij}$
(e.g. new highway: $T_{ij}^B < T_{ij}^A$)

Productivity shock

$\hat{K}_{ij} = (\hat{C}_i^D)^{1/\varepsilon^D_{\text{glob}}}$
(e.g. place-based subsidy in i)

Bottom line: a researcher armed with a trade matrix, population data, and four elasticities can evaluate any geography change.

Taking the Framework to Data

Central question: given a policy change $K^A \to K^B$, how does it reshape the spatial distribution of economic activity and welfare?

Equations (80)–(81) require three ingredients:

1. **Observed spatial data**: bilateral trade flows $\{X_{ij}\}$ and location totals $\{Y_i, E_i, L_i\}$ — these pin down the baseline weights $C_{ij} = X_{ij}^A / Y_i^A$ and $D_{ji} = X_{ji}^A / E_i^A$
2. **Policy-induced geography change**: $\hat{K}_{ij}$, where $K_{ij} \equiv T_{ij}(C_i^D)^{1/\varepsilon_{\text{glob}}^D}(C_j^S)^{1/\varepsilon_{\text{glob}}^S}$ — requires estimating trade frictions T_{ij}
3. **Four model elasticities**: $(\varepsilon_{\text{loc}}^S, \varepsilon_{\text{glob}}^S, \varepsilon_{\text{loc}}^D, \varepsilon_{\text{glob}}^D)$ — govern how locations respond to market access changes

Two empirical steps

- **Step 1**: estimate trade frictions T_{ij} and recover market access
- **Step 2**: estimate the four elasticities

Step 1 — Estimating Trade Frictions via PPML

Strategy: parameterise $T_{ij} = f_{ij}(z;\beta)$ (distance, borders, language, . . .) and estimate via PPML *(Silva & Tenreyro 2006)*:

$$X_{ij} = \exp\Big[\ln f_{ij}(z;\beta) + \underbrace{\gamma_i}_{\ln Y_i/\mathrm{MA}_i^{\mathrm{out}}} + \underbrace{\delta_j}_{\ln E_j/\mathrm{MA}_j^{\mathrm{in}}}\Big]\,\varepsilon_{ij} \tag{96}$$

Fally (2015): fixed effects are market access

The PPML origin/destination fixed effects (γ_i, δ_j) automatically satisfy the market access system (64)–(65). No separate inversion step is needed: the estimated FEs *are* $\ln Y_i/\mathrm{MA}_i^{\mathrm{out}}$ and $\ln E_j/\mathrm{MA}_j^{\mathrm{in}}$.

Identification caveat

C_j^S and C_i^D *cannot* be separately identified from T_{ij} using trade data alone. Researchers impose $T_{ii} = 1$ (no own trade frictions) as a normalisation. This does *not* affect counterfactual validity.

Step 2 — Direct IV: Issue 1

Write supply and demand equations (62)–(63) in terms of observables (eqs. 103–104):

$$\ln Y_i = (1 + \varepsilon^S_{\mathrm{loc}}) \ln L_i - \varepsilon^S_{\mathrm{glob}} \ln \mathrm{MA}^{\mathrm{in}}_i - \ln C^S_i - \ln \phi^S \quad (103)$$

$$\ln Y_i = (1 - \varepsilon^D_{\mathrm{loc}}) \ln L_i + \varepsilon^D_{\mathrm{glob}} \ln \mathrm{MA}^{\mathrm{out}}_i + \ln C^D_i + \ln \phi^D \quad (104)$$

Issue 1 — Market access is not observed

$\mathrm{MA}^{\mathrm{in}}_i$ and $\mathrm{MA}^{\mathrm{out}}_i$ do not appear directly in the data.

Solution: substitute the estimates $\widehat{\mathrm{MA}}^{\mathrm{in}}_i$ and $\widehat{\mathrm{MA}}^{\mathrm{out}}_i$ recovered from Step 1 (PPML fixed effects or system inversion of eqs. 64–65).

Step 2 — Direct IV: Issue 2

Write supply and demand equations (62)–(63) in terms of observables (eqs. 103–104):

$$\ln Y_i = (1 + \varepsilon^S_{\mathrm{loc}}) \ln L_i - \varepsilon^S_{\mathrm{glob}} \ln \mathrm{MA}^{\mathrm{in}}_i - \ln C^S_i - \ln \phi^S \tag{103}$$

$$\ln Y_i = (1 - \varepsilon^D_{\mathrm{loc}}) \ln L_i + \varepsilon^D_{\mathrm{glob}} \ln \mathrm{MA}^{\mathrm{out}}_i + \ln C^D_i + \ln \phi^D \tag{104}$$

Issue 2 — Simultaneity

L_i and $\mathrm{MA}^{\mathrm{in/out}}_i$ are endogenous: a location with better amenities C^D_i attracts more workers, which in turn raises its market access. OLS is inconsistent.

Solution: IV. Estimate (103) with instruments that shift labor *demand* but are uncorrelated with C^S_i (e.g. crop suitability). Estimate (104) with instruments that shift labor *supply* but not C^D_i (e.g. climate/AC adoption). Two instruments per equation are needed — one for $\ln L_i$, one for $\ln \mathrm{MA}_i$ — the latter built as $\ln \mathrm{MA}^{z,\mathrm{in}}_i \equiv \ln \sum_j \tilde{T}_{ji} z_j$ (Allen-Donaldson 2018).

Step 2 — Direct IV: Issue 3

Write supply and demand equations (62)–(63) in terms of observables (eqs. 103–104):

$$\ln Y_i = (1 + \varepsilon^S_{\text{loc}}) \ln L_i - \varepsilon^S_{\text{glob}} \ln \text{MA}^{\text{in}}_i - \ln C^S_i - \ln \phi^S \quad (103)$$

$$\ln Y_i = (1 - \varepsilon^D_{\text{loc}}) \ln L_i + \varepsilon^D_{\text{glob}} \ln \text{MA}^{\text{out}}_i + \ln C^D_i + \ln \phi^D \quad (104)$$

Issue 3 — Recovering C^S_i and C^D_i

Once the four elasticities $(\varepsilon^S_{\text{loc}}, \varepsilon^S_{\text{glob}}, \varepsilon^D_{\text{loc}}, \varepsilon^D_{\text{glob}})$ are estimated, the supply and demand shifters are recovered as the *residuals* of (103) and (104):

$$\ln C^S_i = (1 + \varepsilon^S_{\text{loc}}) \ln L_i - \varepsilon^S_{\text{glob}} \ln \widehat{\text{MA}}^{\text{in}}_i - \ln Y_i - \ln \phi^S$$

They absorb whatever is needed for the model to exactly match the observed spatial distribution (Y_i, L_i) — calibration without loss of generality.

Step 2 — Market Access Approach

Alternative: use a *discrete policy change* (new infrastructure, border opening) as a natural experiment. First-differencing supply and demand eliminates location fixed effects (eqs. 105–106):

$$\Delta \ln L_i = \frac{\varepsilon^S_{\mathrm{glob}}}{\varepsilon^S_{\mathrm{loc}} + \varepsilon^D_{\mathrm{loc}}} \Delta \ln \mathrm{MA}^{\mathrm{in}}_i + \frac{\varepsilon^D_{\mathrm{glob}}}{\varepsilon^S_{\mathrm{loc}} + \varepsilon^D_{\mathrm{loc}}} \Delta \ln \mathrm{MA}^{\mathrm{out}}_i + \text{res.} \tag{105}$$

Intuition: a road built elsewhere shifts $\mathrm{MA}^{\mathrm{in}}_i$ for location i without directly affecting i's productivity or amenities — provides quasi-experimental variation.

Classic applications

- German division/reunification (Berlin Wall): Ahlfeldt et al. (2015) — $\Delta \ln \mathrm{MA}$ from Wall construction used to recover $\varepsilon^S_{\mathrm{glob}}$ and $\varepsilon^D_{\mathrm{glob}}$
- US railroad expansion: Donaldson-Hornbeck (2016)

All four elasticities are recoverable from regression coefficients on $\Delta \ln \mathrm{MA}^{\mathrm{in}}$ and $\Delta \ln \mathrm{MA}^{\mathrm{out}}$.

Three Big Lessons

Twenty years of quantitative spatial economics have produced three robust lessons:

1. **Market access is the key mechanism**: infrastructure effects work through market access improvements, and trade cost reductions have larger effects where partners are larger/closer
2. **Agglomeration forces matter quantitatively and qualitatively**: getting α wrong changes not just the magnitude but potentially the sign of comparative statics
3. **Geography shapes the distribution of winners and losers**: spatial models generate heterogeneous predictions that the data confirm

Methodological point

All three lessons require a *structural* spatial model — reduced-form regressions alone cannot identify them.

Lesson 1 — Market Access and Infrastructure

Mechanism: a trade cost reduction from i to j raises $\mathrm{MA}_i^{\mathrm{out}}$ and $\mathrm{MA}_j^{\mathrm{in}}$ $\Rightarrow$ higher wages and welfare, with larger effects where partners are bigger/closer.

Evidence:

- **US Railroads** (Donaldson & Hornbeck 2016): land values rose proportionally to MA improvement; substantial estimated welfare gains from railroad network
- **US Interstates** (Allen & Arkolakis 2014): welfare gain $\approx$ 1.1–1.5%; agglomeration forces amplify the direct effect
- **Indian Railroads** (Donaldson 2018): structural model correctly predicts the *cross-district* variation in welfare gains as a function of pre-colonial geography

Punchline

The quantitative spatial model is not just a theoretical device — it predicts heterogeneous welfare impacts that match what we observe in the data.

Lesson 2 — Agglomeration Forces Matter

Varying α (agglomeration in production) changes welfare estimates by $\approx$30% in typical applications.

The Berlin Wall (Ahlfeldt, Redding, Sturm & Wolf 2015)

- Construction (1961) and destruction (1989) $\Rightarrow$ quasi-experimental variation in intra-urban market access
- Identification: distance to the Wall $\perp$ changes in amenities/productivity
- Estimates: agglomeration *and* congestion forces quantitatively significant

London Underground (Heblich, Redding & Sturm 2020)

- Subway expansion changes commuting market access
- Agglomeration forces *amplify* the direct transport cost reduction

Warning

Getting agglomeration wrong affects signs of comparative statics, not just magnitudes, and can create spurious multiplicity in counterfactuals.

Lesson 3 — Geography Shapes the Distribution

Spatial models predict *heterogeneous* impacts. The data confirm them.

- **Iron Curtain** (Redding & Sturm 2008)
  - West German cities near the border grew slower after partition
  - Decline larger for *smaller* cities — consistent with trading less with themselves
  - Exactly the model's prediction: smaller cities rely more on external market access
- **Million-Dollar Plants** (Monte, Redding & Rossi-Hansberg 2018)
  - Employment gain from winning a new plant larger where *commuting* MA is higher
  - The spatial structure of the local economy shapes the multiplier
- **Path dependence** (Allen & Donaldson 2018)
  - Strong agglomeration $\Rightarrow$ equilibrium path-dependent
  - Which city dominates depends on history, not just fundamentals

Takeaway

Geography determines *who* gains and *who* loses — not just the aggregate welfare number.

Open Frontiers

Inequality and agent heterogeneity

All agents are identical in the baseline. Reality: workers differ by skills, race, gender, age — affecting where they live and work. Richer heterogeneity is needed to study segregation and the distributional impacts of spatial policy.

Discrete firms

Current models assume a continuum of symmetric firms. Missing: discrete location choices and spatial hierarchies (Central Place Theory).

Optimal policy

Existing work evaluates policies ex post. Frontier: optimal infrastructure placement, place-based subsidies, Pigouvian externality pricing.

Dynamics

Current frameworks are static. Needed: capital accumulation, inter-generational transfers, persistent shocks. *Ref*: Desmet–Parro (2025)

Next: Welfare and Incidence of Local Shocks

Lecture 5: from building the toolkit to using it — who gains and who loses when a city becomes more productive?

Papers:
- Desmet & Rossi-Hansberg (2013): decompose welfare losses by source — efficiency, amenities, frictions
- Hornbeck & Moretti (2024): general-equilibrium incidence — workers, landowners, and other cities

Key questions:
- How large are aggregate welfare losses from spatial misallocation when equilibrium works?
- When TFP rises in a city, what share accrues to workers vs. landowners vs. residents elsewhere?
- Does housing tenure determine who captures the gains?

Reading: Desmet & Rossi-Hansberg (2013) *AER*; Hornbeck & Moretti (2024) *REStat*