Sex and the City:

Spatial Structural Changes and the Marriage Market

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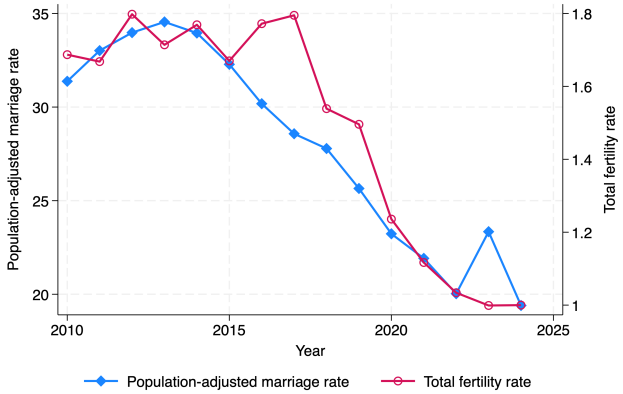
Marriage and Spatial Sorting: Motivation

- Marriage and fertility rates are declining globally;
- It is not only for developed economies, but also for developing countries.



Marriage and Spatial Sorting: Motivation

- Marriage rate in China has almost halved in the past decade (similarly for fertility).
- It also shows a clear spatial pattern:

  - Singles rate for males is high in underdeveloped regions, low in developed regions;

  - Singles rate for females is low in underdeveloped regions, high in developed regions.

Marriage and Spatial Sorting: Motivation

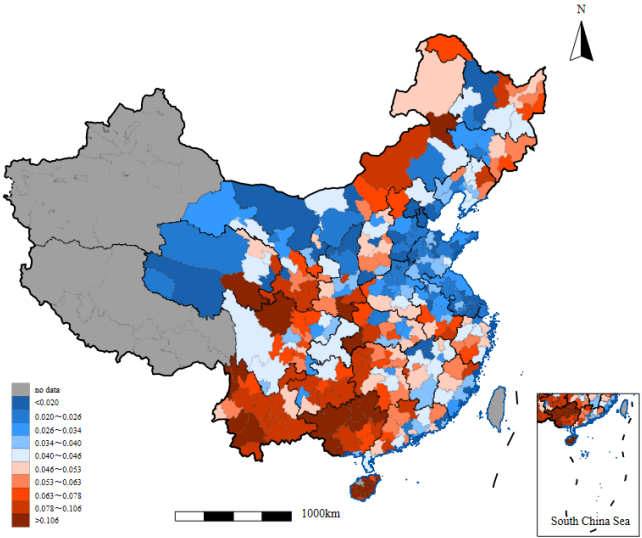


Figure Single Rate Gap (Male-Female) for People over 35 (living location)

Marriage and Spatial Sorting

- **Spatial mismatch** in marriage market:
  - (High-skill) women in developed/urban areas;
  - (Low-skill) men in less developed/rural areas.

- Previous studies investigate these two issues separately (Ong et al., 2020; Edlund et al., 2013)

- What if they are two sides of the same coin from a spatial equilibrium perspective?
  - Both jobs and marriage are local;
  - People (by gender & skill) make migration decisions incorporating considerations of both.

Marriage and Spatial Sorting

Goal of this paper:

- Quantitatively describe this location & marriage decision.
- Identify & quantify the sources of observed patterns in the spatial marriage market:

  Gender-specific Spatial Structural Changes (SSC)

  * Educational shifter (more educated women than men);
  * Sectoral shifter (women sort to the service sector);
  * Spatial sectoral shifter (women sort to the service sector *in developed regions*).

  ⇒ Spatial distribution of gender and skill ⇒ Local marriage matching.

This Paper (Empirical)

- Three stylized facts on China's labor and marriage markets that summarize our story:

① **Spatial structural changes** { Females get more and more education than males. / Females sort into service sector located in more developed cities. }

② **Persistent norms of marriage:** Females marry up, males marry down.

} ⇒

③ **Spatial pattern of singles rate:** { Low SES males in undeveloped regions. / high SES females in developed regions. }

- It is a race between **persistent social norms** and **gender-biased spatial structural changes.**

This Paper (Quantitative)

- Build a prefecture-level spatial equilibrium model:
  - multi-sector and multi-skill production;
  - migration across prefectures;
  - local marriage market.
- Embed a marriage matching model à la Choo & Siow (2006).
- Parameterize the model to match the Chinese economy in 2015.
- Decompose & quantify the sources of observed spatial marriage patterns.
- Counterfactual policies.

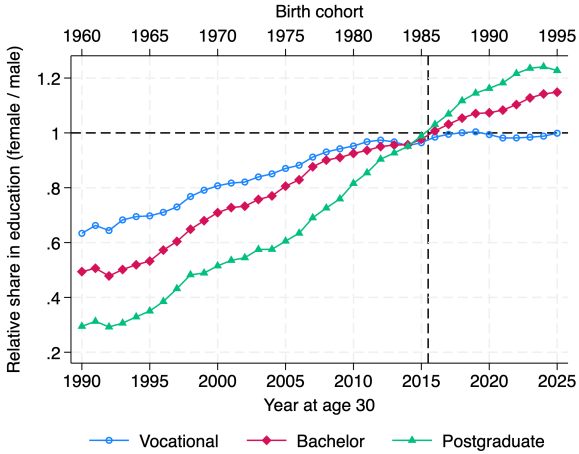
Preview of Results

- Gender-specific spatial structural changes matter: If we remove gender specificity:
  - National singles rate ↓ 30% for females; ↓ 12% for males.
  - Driven by high-skilled (low-skilled) females (males) in more developed (less developed) regions.
- We then decompose the SSCs into three parts:
  - Educational shifter explains one-third of this decline.
  - Spatial sectoral shifter explains the remaining two-thirds.
  - Sectoral shifter alone plays a minimal role.
- We project that if the SSC continues to 2030:
  - Spatial mismatch ↑ in China.
  - Singles rate ↑ 60% for females and 20% for males.
- Marriage subsidies have a very limited policy effect, sadly.

Empirical Patterns

Dramatic Gender-specific Structural Changes

- **Gender educational gap** for females narrows and reverses over time:



*For birth cohorts after 2005, undergraduate admission female/male has been over 2:1.

Dramatic Gender-specific Structural Changes

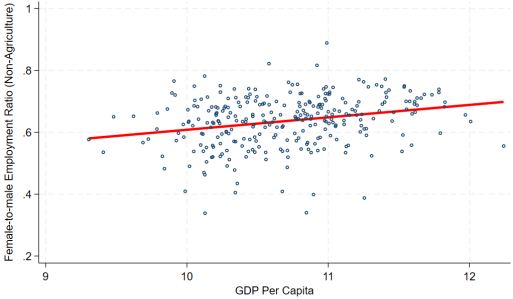
- **Gender employment gap** in the service sector decreases for females, particularly high-skill:

Education	Sector	2000	2005	2010	2015
College and Above	Agriculture	-45.0%	-32.3%	-16.2%	-13.2%
	Manufacturing	-34.6%	-26.9%	-23.3%	-22.7%
	Service	**-16.6%**	**-1.4%**	**+12.0%**	**+21.2%**
High School	Agriculture	-39.5%	-38.6%	-24.3%	-17.5%
	Manufacturing	-22.1%	-28.9%	-29.8%	-33.1%
	Service	**-0.4%**	**-3.4%**	**+1.1%**	**+4.1%**
Middle School and Below	Agriculture	+14.9%	+17.8%	+19.0%	+18.6%
	Manufacturing	-18.6%	-18.0%	-17.7%	-24.1%
	Service	**-14.6%**	**-11.2%**	**+4.7%**	**+9.3%**

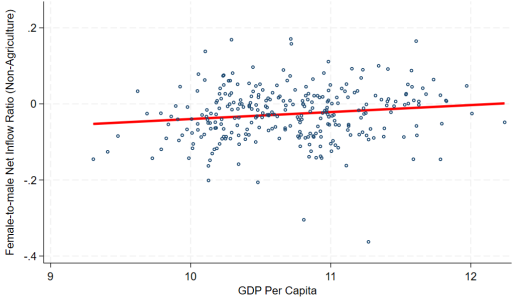
- **Gender wage gap** in the service sector also narrows more for college females.

Dramatic Gender-specific Structural Changes

- **Gender spatial employment gap**:
  Females are more likely to work in non-agricultural sectors in developed regions.



(a) Overall Employment



(b) Net Migration Inflow

Persistent Social Norm in Marriage

- Married males have **higher education level** than their unmarried counterparts
- Married females have **lower education level** than their unmarried counterparts

Table Relative Socioeconomic Status Gap of Married versus Never-married

Census Year	2000		2005		2010		2015	
	Male	Female	Male	Female	Male	Female	Male	Female
College Degree	+0.05	-0.09	+0.04	-0.12	+0.04	-0.08	+0.06	-0.14
Education Year	+2.41	-0.56	+2.13	-0.62	+1.33	-0.69	+1.49	-0.66

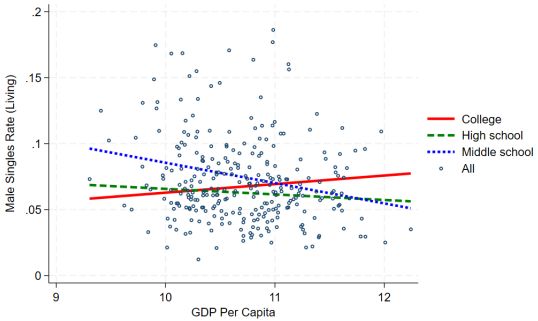
Preference

Persistent Social Norm in Marriage - homogamy/hypergamy

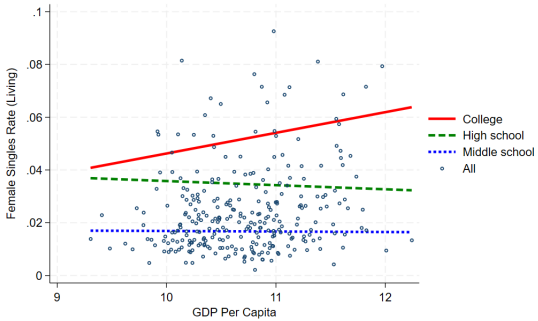
Table Relative Socioeconomic Status of Married Couples

Census Year	2000	2005	2010	2015
Panel A. College Degree				
Females marry up	3.44%	4.10%	3.87%	3.97%
Females marry down	0.86%	1.31%	1.48%	1.80%
Equal	95.70%	94.60%	94.65%	94.23%
Panel B. Education Year				
Females marry up	38.61%	37.90%	30.01%	28.33%
Females marry down	9.29%	9.67%	8.96%	9.77%
Equal	52.10%	53.23%	61.04%	61.90%

Spatial Distribution of Singlehood - GDP p.c.



(a) Male



(b) Female

Figure GDP and Singles Rate of Age 30-45 (City-level, living pop)

Service Share

A Spatial Equilibrium Model with Marriage Matching

Overview of the Model

A quantitative spatial equilibrium migration model (Eaton & Kortum, 2002; Tombe & Zhu, 2019; Fang et al., 2022)

$\mapsto$ Embedded with a marriage matching model (Choo & Siow, 2006)

- **A set of prefectures** indexed by $i = 1, ..., N$, each with three sectors:
  - [manufacturing , service] $\Leftarrow$ combine different skilled labor
  - [agriculture] $\Leftarrow$ indifferent labor

- **A measure of workers** H_i: endowed with gender, skill, hometown. start as single; migrate, work, then participate in local marriage market.

Location Preference and Migration

- For an individual o of gender $g = \{male, female\}$ and edu/skill $e = \{high, med, low\}$, migrate from city i to city j and work in sector k:

$$U^o_{i,jk} = \underbrace{\overline{V}^{ge}_{jk}}_{\text{expected payoff i } jk} \cdot \underbrace{\frac{1}{\tau^{ge}_{i,jk}}}_{\text{migration cost}} \cdot \underbrace{z^o_{i,jk}}_{\text{location pref. shock}}$$

- Exogenous (iceberg) migration/allocation cost: flexible type- & flow-specific
- Gravity equation for the migration flow $\pi^{ge}_{i,jk}$.

Workers: Utility of Married Individuals

- A worker o in destination jk, married to e'-type spouse to form a household ω, has a log-linear utility:

$$V_{jk}^{\omega,o} = \ln\left[\underbrace{\left(\frac{c_{jk}^{\omega}}{\beta}\right)^{\beta}}_{\text{HH final goods consumption}} \cdot \underbrace{\left(\frac{h_{jk}^{\omega}}{1-\beta}\right)^{1-\beta}}_{\text{HH housing consumption}} \Big/ \underbrace{(1+\chi)}_{\text{economy of scale}} \right] + \underbrace{m_{j}^{\omega,o}(e')}_{\text{marital payoff}}$$

Marriage Market

- In destination city j, there is a local marriage market (across sectors).
- Following Choo & Siow (2006), assume transferable utility (TU), individual o's marital payoff from marrying a type-e' spouse:

$$m_j^{\omega,o}(e') = \underbrace{\tilde{\mu}_j^{ge}}_{\text{value of not single in } j} + \underbrace{\mu^{ge}(e')}_{\text{deterministic partner pref.}} + \underbrace{\delta_j^{ge}(e')}_{\text{eq'm marital transfer in } j} + \underbrace{\varepsilon_j^o(e')}_{\text{idiosyncratic partner pref.}}$$

  - where $\tilde{\mu}_j^{ge}$ is value of not being single in j ($= 0$ in reference city)
  - $\mu^{ge}(e')$ is deterministic marital return (or love) relative to being single;
  - $\delta_j^{ge}(e')$ is equilibrium transfer within couple, and $\delta_j^{ge}(e') = -\delta_j^{g'e'}(e)$;
  - $\varepsilon_j^o(e')$ is idiosyncratic preference for partner type, $\sim$TIEV w/ dispersion σ_ε.
- Identification comes from variations of marriage matching eq'm across locations.

Workers: Utility of Being Single

- If a worker o in destination jk is single,

$$V^o_{jk}(\varnothing) = \ln\Bigg[\underbrace{\left(\frac{c^o_{jk}}{\beta}\right)^{\beta}}_{\text{final goods consumption}} \cdot \underbrace{\left(\frac{h^o_{jk}}{1-\beta}\right)^{1-\beta}}_{\text{housing consumption}}\Bigg] + m^{\omega,o}_j(\varnothing)$$

  funded by own income W^{ge}_{jk}.

- Marriage value of being single is determined by:

$$m^{\omega,o}_j(\varnothing) = \varepsilon^o_j(\varnothing)$$

- ***Production, Housing market, Eqm, Data, and Estimation* are skipped for today!**

Quantitative Analysis

Quantitative Analysis I: SSC Effect

- What is the impact of the gender-specific spatial structural changes on the singles rate?
- We consider three adjustments for males and females:
  - (1) Equalizing gender education levels
  - (2) Equalizing gender sectoral allocation costs $\bar{\tau}_k^{ge}$
  - (3) Equalizing gender spatial-sectoral allocation costs $\varepsilon_{i,jk}^{ge}$
- We first equalize (1), (2), (3) at the same time to erase all gender-specific SSCs
- Then, we equalize them one by one to implement a decomposition

Quantitative Analysis I: SSC Effect

Table The Effects of Gender-specific Spatial Structural Changes on Singles Rate

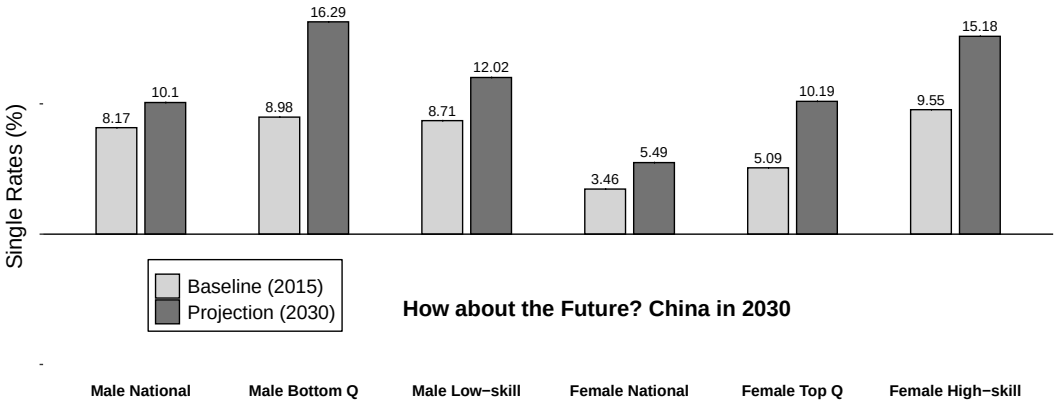
National & Regional	Male			Female		
Singles Rate	National	Least Dev.	Most Dev.	National	Least Dev.	Most Dev.
Panel A: Singles Rate and Percentage Changes						
Baseline	8.17%	8.98%	8.11%	3.46%	2.36%	5.09%
No GS-SSCs	7.21%	8.03%	5.97%	2.45%	1.99%	3.11%
% Changes	-11.75%	-10.58%	-26.39%	-29.19%	-15.68%	-38.90%
Panel B: Decomposition of the Percentage Changes						
National Educational	32.29%	93.68%	-15.89%	31.68%	-18.92%	44.44%
National Sectoral	-1.04%	-41.05%	15.89%	0.00%	16.22%	-6.06%
Spatial Sectoral	68.75%	47.37%	100.00%	68.32%	102.70%	61.62%

Quantitative Analysis II: China in 2030

What will happen if the gender-specific SSCs continue to 2030?

- Gender college education rate is determined by the gender college enrollment rate of the cohort aged 20 in the Census 2020;
- Gender specific sectoral changes are projected linearly using the trend from 2000 to 2015;
- The Gender gap in spatial sectoral allocation costs is doubled.

Quantitative Analysis II: China in 2030

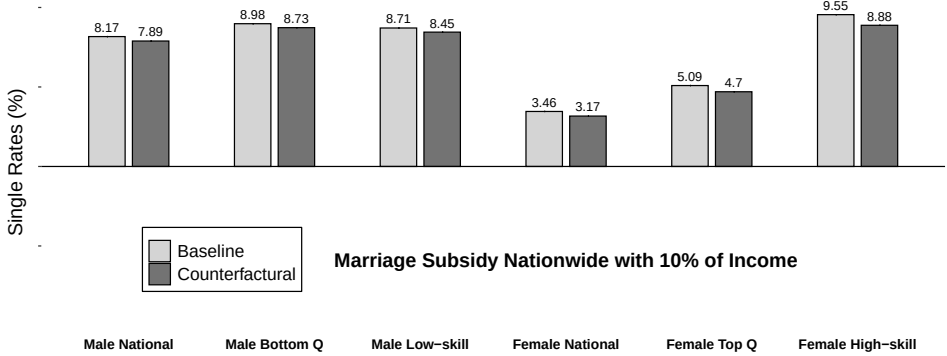


Quantitative Analysis III: Marriage Subsidies

- Finally, we consider a universal marriage subsidy of 10% of lifetime family income.
- This would cost about 3.5% of the national GDP per year.
- This is much larger than most of the current marriage subsidies:
  - Busan, Korea: $15,000 (one-time)
  - Guangzhou, China: Up to $5,500 (one-time)

Quantitative Analysis III: Marriage Subsidies

- The policy effect is very small, despite a large fiscal burden.
- A pure monetary reward cannot alter the fundamental trends of Gender-specific SSCs.



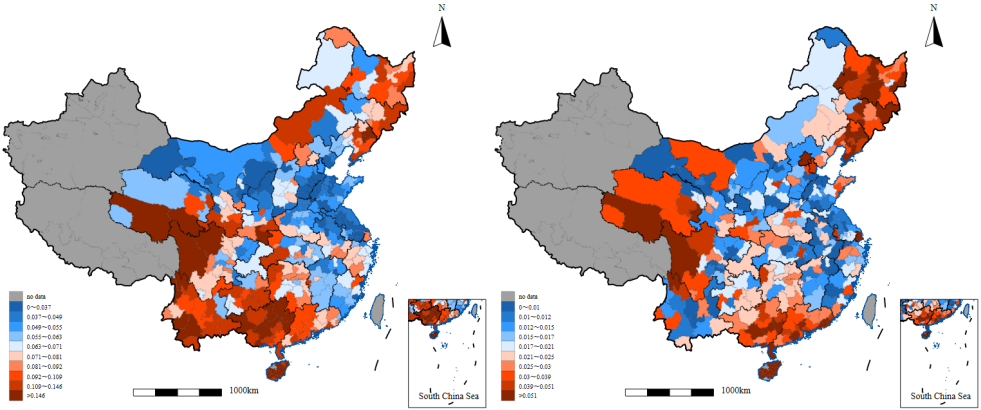
Conclusion

- This paper develops a spatial GE migration model incorporated with local marriage matching.
- We closely match the spatial disparity of marriage outcomes by gender and skill.
  - A race between the persistent social norm and the dramatic spatial structural changes.
- Using the spatial GE model, we find that
  - Gender-specific SSC accounts for 30 (12) percent of the singles rate for females (males) in China.
  - Marriage rate in China is likely to continue to drop amid the current trend.
  - Marriage subsidy is costly and relatively ineffective.

Appendix

Marriage and Spatial Sorting: Motivation

Back



(a) Male **(b)** Female

Figure Prefecture-level Singles Rate of People over 30 in China

Persistent Social Norm in Marriage: Marriage Willingness

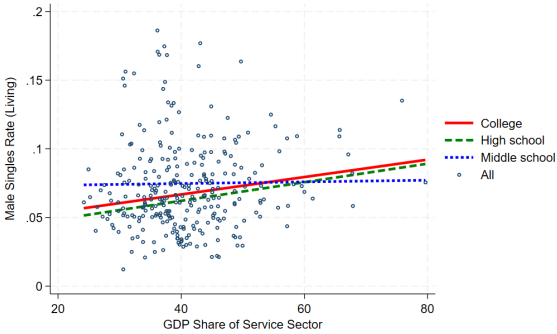
Back

- Marriage is still important in China
- Young Chinese people still want to get married

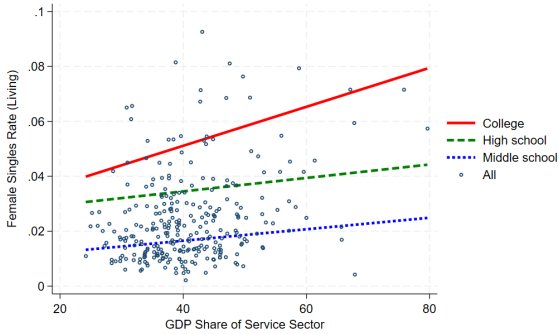
% don't want to get married: (Age 18-45)	Male	Female
CFPS 2018	2.54	3.41
CFPS 2020	2.41	2.88

Spatial Distribution of Singlehood - Service Sector Share

Back



(a) Male



(b) Female

Figure Employment Share in Service and Singles Rate of Age 30-45 (City-level, living pop)

Solve the spatial equilibrium: Productivities

Back

- From profit maximization and zero profits, we can infer urban sectoral productivity from the data on employment and wages for $k = \{m, s\}$.
- First, we solve for productivity A^h_{jk} as a function of A^l_{jk} using the first order conditions $A^h_{jk} = A^l_{jk}(H^h_{jk}/H^l_{jk})^{1/(\sigma_k-1)}(w^h_{jk}/w^l_{jk})^{\sigma_k/(\sigma_k-1)}$.
- Plugging A^h_{jk} into the definition of Y_{jk}, we have:

$$Y_{jk} = A^l_{jk}H^l_{jk}\Big[\frac{w^h_{jk}H^h_{jk} + w^l_{jk}H^l_{jk}}{w^l_{jk}H^l_{jk}}\Big]^{\frac{\sigma_k}{\sigma_k-1}} \equiv A^l_{jk}H^l_{jk}(\Xi^l_{jk})^{-\frac{\sigma_k}{\sigma_k-1}}$$

where $\Xi^l_{jk} = \frac{w^l_{jk}H^l_{jk}}{w^h_{jk}H^h_{jk}+w^l_{jk}H^l_{jk}}$ is the share of labor income distributed to low skill workers.

- We also assume that agricultural productivity equals agricultural wages $A^e_{jr} = w_{jr}$, for both $e = \{h, m, l\}$. Intuitively, higher wages or skill shares require higher skill s productivity at equilibrium for urban sectors.
- We can then calculate the productivities for both skill types as follows:

$$A^l_{jk} = w^l_{jk}(\Xi^l_{jk})^{\frac{1}{\sigma_k-1}}, \quad A^h_{jk} = w^h_{jk}(1-\Xi^l_{jk})^{\frac{1}{\sigma_k-1}}.$$

Solve the spatial equilibrium: Land market clearing Back

- From workers' first-order conditions for residential floor space and the summation of all workers residing in each prefecture and region jk,

  we can calculate both urban and rural floor space:

$$S_{ju} = \frac{1-\beta}{q_{ju}} \sum_{k} \left[w_{jk}^{l} H_{jk}^{l} + w_{jk}^{m} H_{jk}^{m} + w_{jk}^{h} H_{jk}^{h} \right], \qquad S_{jr} = \frac{1-\beta}{q_{jr}} \left[w_{jr} H_{jr} \right]$$

- We can then back out the implied construction intensity $\phi_j = S_{ju} / L_j$.

Solve the spatial equilibrium: Migration costs

Back

- We first to compute the prefecture-level equally-divided rent income for residents $\frac{q_i S_i}{H_i}$ from the residential floor space S_i calculated above, to which we can add observed wages to determine incomes of workers of skill e moving from in to jk: $inc^e_{i,jk} = w^e_{jk} + \frac{q_{jn} S^R_{jn}}{H^R_i}$.
- Second, we need to calculate the workers' marriage utility $m^{ge}_{i,jk}$.
- Then, we can calculate all migration costs between all prefecture pairs from the gravity equations.
- We assume the iceberg migration cost for staying in one's original prefecture is $\tau^{ge}_{i,in} = 1$.
- With q_i, $inc^e_{i,jk}$, $m^e_{i,jk} = E(m^{ge}_{i,jk})$, and $\pi^e_{i,jk} = \sum_{ge} \pi^{ge}_{i,jk}$ in hand, along with the gravity equation:

$$\Phi^e_i = \sum_{jk}^{JK} (\tau^{ge}_{i,jk} q_{jk}^{1-\beta})^{-\sigma_z} (inc^e_{i,jk} m^e_{i,jk})^{\sigma_z} = \frac{(q_{jk}^{1-\beta})^{-\sigma_z} (inc^e_{i,in} m^e_{i,jk})^{\sigma_z}}{\pi^e_{i,in}}$$

- By inserting Φ^e_i into the original gravity equation, we have:

$$\tau^e_{i,jk} = \frac{ic^e_{i,jk} m^e_{i,jk}}{q_{jk}^{1-\beta} (\pi^e_{i,jk} \Phi^e_i)^{1/\sigma_z}}, \text{ for } in \neq jk$$