Sex and the City:

Spatial Structural Changes and the Marriage Market

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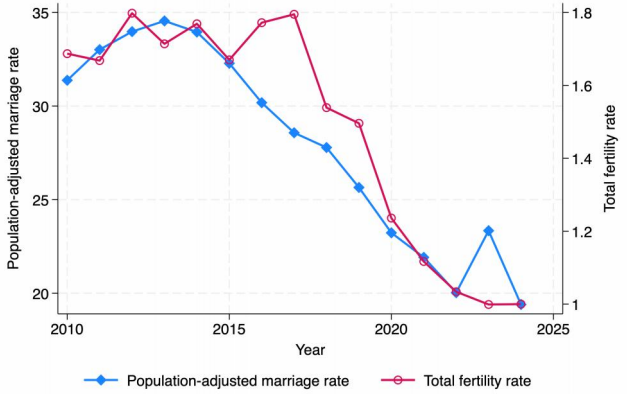
Marriage and Spatial Sorting: Motivation

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



Marriage and Spatial Sorting: Motivation

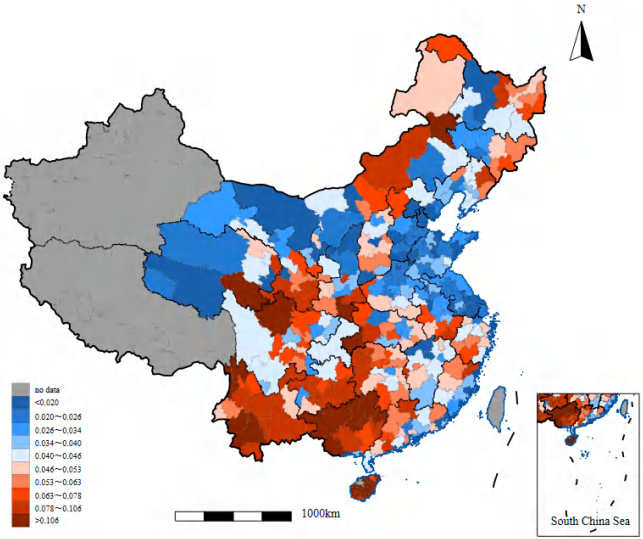


Figure Single Rate Gap (Male-Female) for People aged 30 to 45 (living location)

Marriage and Spatial Sorting

- **Spatial mismatch** in marriage market:
  There are more single
  - (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.

Goal: Understand & quantify the sources of observed patterns in the spatial marriage market.

This Paper (Empirical)

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

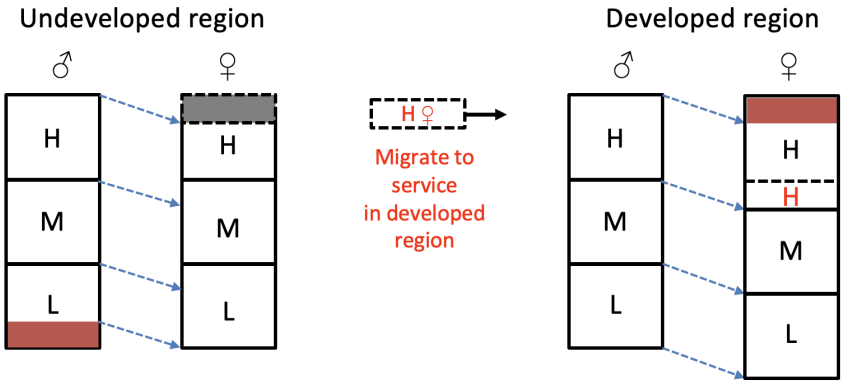
① **Spatial Structural Changes (SSC)**
- Educational shifter (more educated women than men)
- Sectoral shifter (women sort to the service sector)
- Spatial sectoral shifter (more so *in developed regions*)

② **Persistent social norms:** Females marry up, males marry down;

⇒ **Local marriage mismatch:**
- Low-skill single men in undeveloped regions;
- High-skill single women in developed regions.

This Paper (Empirical)

- "Squeeze effect" and mismatch in local marriage markets:



[With Spatial Structural Change]

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.

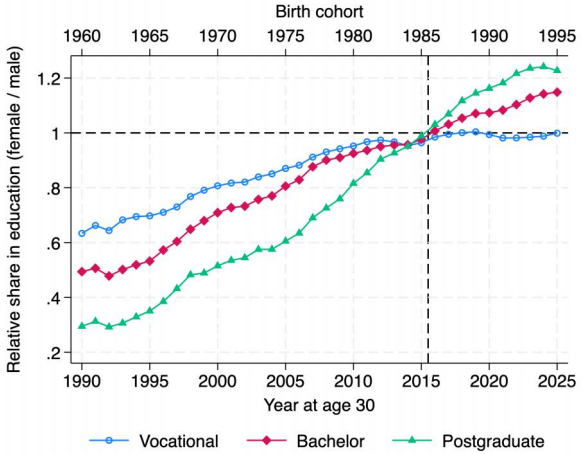
Preview of Results

- 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.
  - Overall sectoral change 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

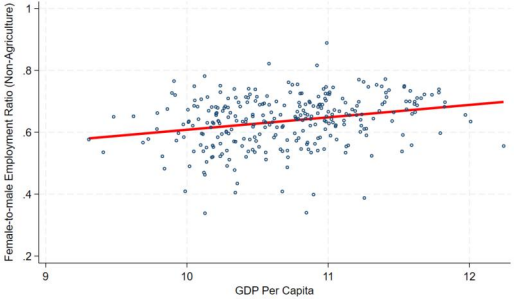
- **Gender employment gap** in the service sector decreases for females, particularly high-skill:

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%

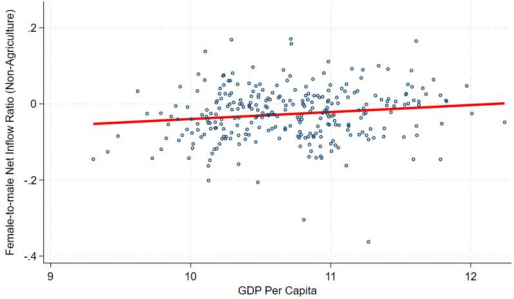
- **Gender wage gap** in the service sector also narrows more for college females.

Dramatic Gender-specific Structural Changes

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



(a) Overall Employment (female - male)



(b) Net Migration Inflow (female - male)

Persistent Social Norm in Marriage Matching

- 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 - 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

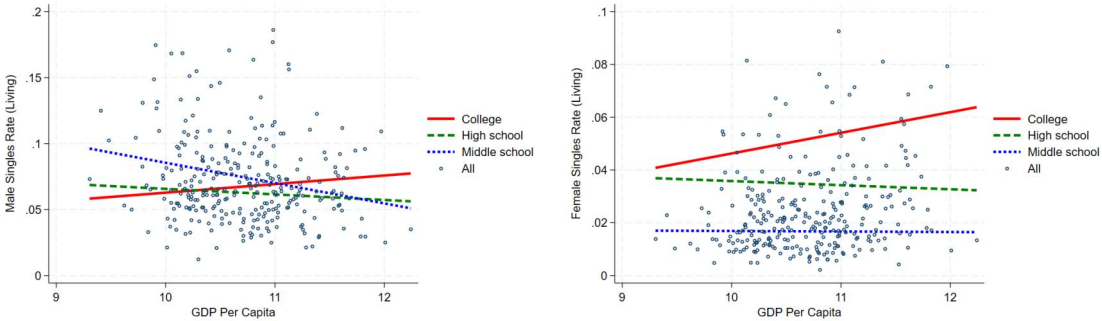
Preference

Persistent Social Norm in Marriage - homogamy/hypergamy

Table Relative Socioeconomic Status of Married Couples

Census Year	2000	2005	2010	2015
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)

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

- **A set of prefectures** indexed by $i = 1, \ldots, N$, 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:

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

- Compound allocation cost $\tau^{ge}_{i,jk}$: 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:

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

- Single workers enjoy own consumption, housing, and normalized value of single $m_j^o(\varnothing)$.

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:

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

  - $\mu^{ge}(e')$ is deterministic marital return (or love) relative to being single;
  - $\delta_j^{ge}(e')$ is equilibrium transfer within couple, and $\delta_j^{ge}(e') = -\delta_j^{g'e'}(e)$.

Production

- Sector-k (manufacturing/service) produce single final good Y by aggregating skills (e) in CES:

$$Y_{jk} = \left[\sum_{e} \left(A_{jk}^{e} H_{jk}^{e} \right)^{\frac{\sigma_k - 1}{\sigma_k}} \right]^{\frac{\sigma_k}{\sigma_k - 1}}$$

  - A_{jk}^{e} is city-level efficiencies of using e-skilled labor in sector k,
  - *Effective* labor supply H_{jk}^{e} accounts for gender wage/participation gaps.
  - In rural regions, production is simply $Y_{jr} = A_{jr} H_{jr}$, regardless of skill level.

Housing Market

- Essentially a congestion mechanism.

- Housing demand equals the supply of floor space allocated to residential use S_{ju}:

$$\underbrace{\phi_j L_{ju}}_{\text{Housing supply}} = S_{ju} = \underbrace{\mathbb{E}\left[h_{ju}\right] H_{ju}}_{\text{Housing demand}}$$

  * where highly-regulated construction sector uses geographic land L_{ju} and a regulated density of development ϕ_j to produce floor space S_{ju}.

Model Solution and Estimation

Data and Parameters

- Census 2015:
  - Population flow; marriage matching; individual characteristics
- City Statistical Yearbooks 2015: for each prefecture.
  - Wages; land supply; GDP by sector.
- China Real Estate Information (www.crei.cn):
  - Housing price.
  - (Run by the National Development and Reform Commission)

- Calibrated parameters from the literature/data Detail

Solve and Estimate the Spatial Equilibrium

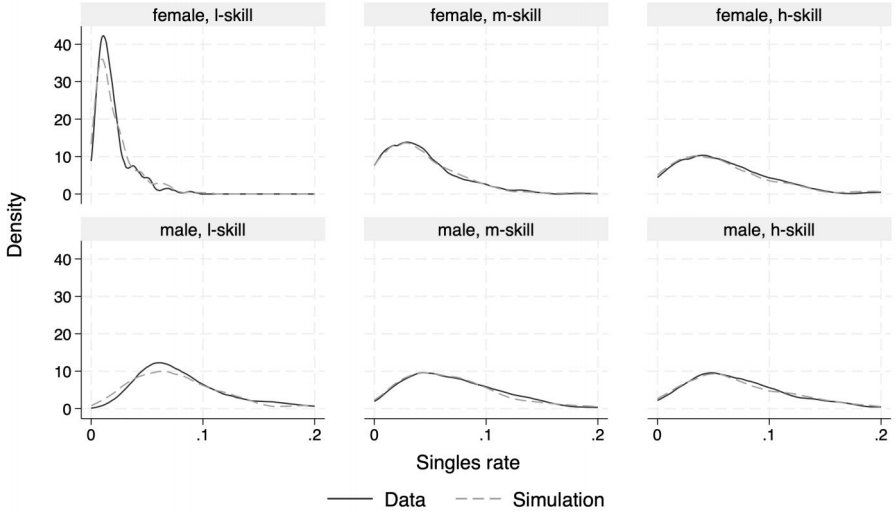
- **Inner loop:** Marriage market equilibrium.

  - We observe local marriage market equilibria across multiple locations. Detail

- **Outer loop:** Spatial general equilibrium.

  - Invert the spatial model to calibrate: Detail
    - Productivities A^e_{jk}
    - Floor space construction intensity ϕ_j
    - Migration costs $\tau^{ge}_{i,jk}$

Model Fit: Spatial-Distribution of Singles Rate



Estimated Model Parameters - Marriage Market

- For each search target (e'), the deterministic marital return $\mu^{ge}(e')$:

Male type	Wife type			Female type	Husband type		
	l-skill	m-skill	h-skill		l-skill	m-skill	h-skill
l-skill	3.312	-0.672	**-3.589**	l-skill	5.253	2.373	-0.277
m-skill	2.615	2.654	0.106	m-skill	2.707	3.850	2.280
h-skill	0.651	1.770	3.175	h-skill	**-0.101**	1.411	3.794

- For females, they do not like to marry down
- For males, they do not like to marry up

Estimated Model Parameters - Spatial/Sector Allocation Cost

- After recovering the allocation/migration cost τ, we further decompose it:

$$\ln(\tau_{i,jk}^{ge}) = G(d_{i,j}) + \overline{\tau}_{k}^{ge} + \varepsilon_{i,jk}^{ge}$$

  - $G(d_{i,j})$: a third-order polynomial for distance;
  - $\overline{\tau}_{k}^{ge}$: **average sectoral** allocation cost (no location variation)
  - $\varepsilon_{i,jk}^{ge}$: **sector-location specific** allocation cost

Estimated Model Parameters - Sector Allocation Cost $\bar{\tau}_k^{ge}$

- We normalize the allocation cost for high-skilled females in the service sector to zero
- Cost is low in the service sector for high-skilled workers regardless of gender
- Cost is low in the service sector for females regardless of skill

Table Relative Sectoral Allocation Costs by Gender and Skill

$\bar{\tau}_k^{ge}$	Male			Female		
	l-skill	m-skill	h-skill	l-skill	m-skill	h-skill
Agriculture	0.398	0.821	1.581	0.319	0.857	**1.785**
Manufacturing	0.126	0.159	0.215	0.178	0.249	**0.353**
Service	0.290	0.189	**0.080**	0.224	0.097	**0**

Estimated Model Parameters - Average Location Cost $\varepsilon^{ge}_{i,jk}$

- We average $\varepsilon^{ge}_{i,jk}$ over sectors and normalize the allocation cost for high-skilled females in the most developed cities to zero
- Cost is low in developed cities regardless of skill and gender
- Especially for high-skilled females

Table Relative Spatial Sectoral Allocation Costs by Gender and Skill

Average $\varepsilon^{ge}_{i,jk}$	Male			Female		
	l-skill	m-skill	h-skill	l-skill	m-skill	h-skill
Least Developed	0.463	0.488	0.592	0.473	0.564	**0.629**
Second Quartile	0.555	0.600	0.594	0.554	0.570	**0.610**
Third Quartile	0.448	0.445	0.417	0.439	0.425	**0.399**
Most Developed	0.171	0.104	**0.034**	0.171	0.079	**0**

Quantitative Analysis

Quantitative Analysis

- Evaluation and Decomposition of the SSC effect SSC Effect
- What is the future of China in 2030? China 2030
- Universal marriage subsidies Marriage Subsidies

Conclusion

Quantitative Analysis I: SSC Effect

- In the first quantitative analysis, we try to evaluate the impact of the spatial structural changes on 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

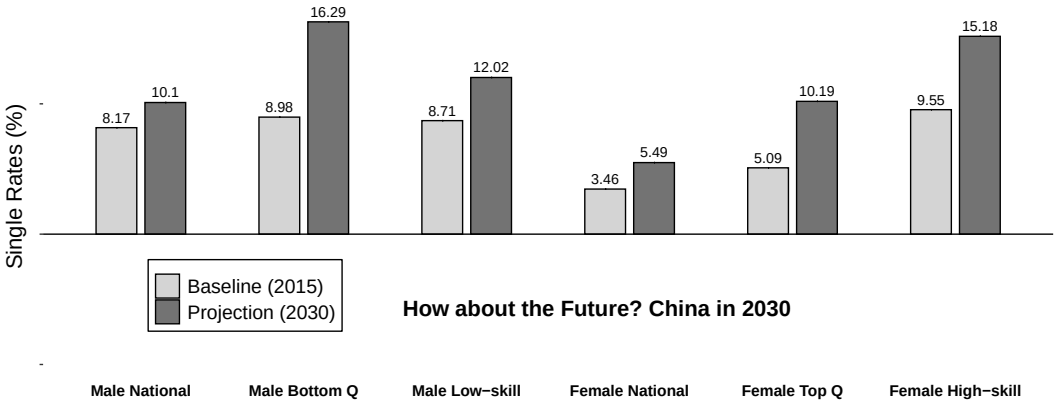
Table The Effects of Gender-specific Spatial Structural Changes on Singles Rate

National & Regional	Male			Female		
Singles Rate	National	Least Dev.	Low Skill	National	Most Dev.	High Skill
Panel A: Singles Rate and Percentage Changes						
Baseline	8.17%	8.98%	8.71%	3.46%	5.09%	9.55%
No GS-SSCs	7.21%	8.03%	7.63%	2.45%	3.11%	4.46%
% Changes	**-11.75%**	-10.58%	-12.40%	**-29.19%**	-38.90%	-53.30%
Panel B: Decomposition of the Percentage Changes						
National Educational	32.29%			31.68%		
National Sectoral	-1.04%			0.00%		
Spatial Sectoral	**68.75%**			**68.32%**		

Quantitative Analysis II: China in 2030

- In the second analysis, we predict what will happen if the SSC continues to 2030:
  - Gender college education rate is determined by gender college enrollment rate of cohort aged 20 in Census 2020;
  - Gender-specific sectoral shifts are projected linearly using trend from 2000 to 2015;
  - Gender gap in spatial sectoral allocation costs are doubled.

Quantitative Analysis II: China in 2030



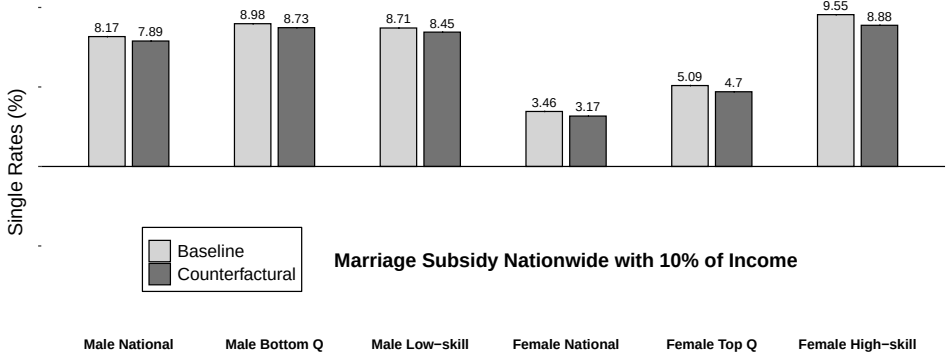
Quantitative Analysis III: Marriage Subsidies

- We inject a universal marriage subsidy of 10% lifetime family income (not from govt. budget).
- This would cost about 3.5% of the national GDP per year.

  $\Rightarrow$ Similar to that in Nordic countries combining all family policies.
- Much larger than most of the pure marriage policies: e.g.
  - Busan, Korea: $\$15,000$
  - Guangzhou, China: $\$8,000$

Quantitative Analysis III: Marriage Subsidies

- The policy effect is very small, despite large fiscal burden.
- A pure monetary reward cannot alter the fundamental spatial mismatch of SSCs.



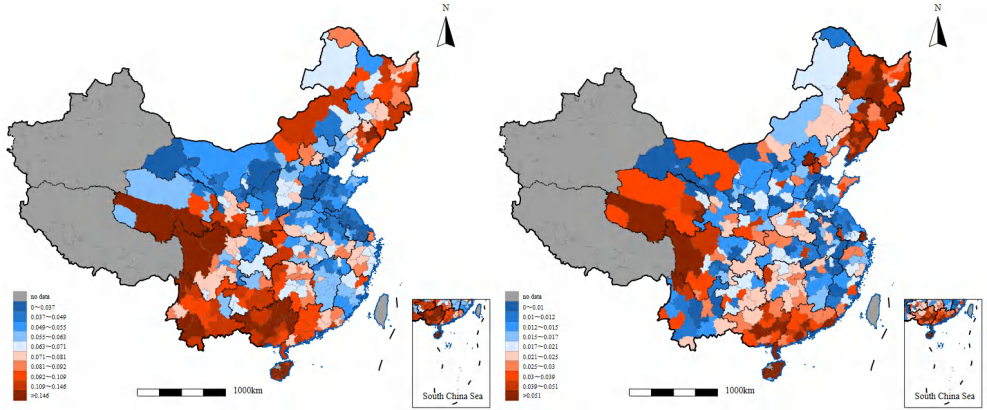
Conclusion

- 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
  - SSC accounts for 30 (12) percent of the singles rate for females (males) in China.
  - Reversed gender educational gap and gender-specific spatial sectoral allocation are the most important contributors.
  - Marriage rate in China is likely to continue to drop amid 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 35 in China

Persistent Social Norm in Marriage: Marriage Willingness

Back

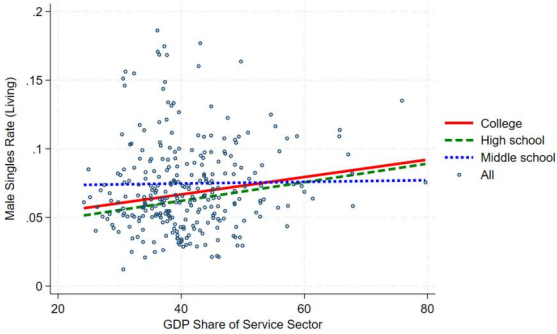
- Marriage is still important in China

- Young Chinese people still want to get married

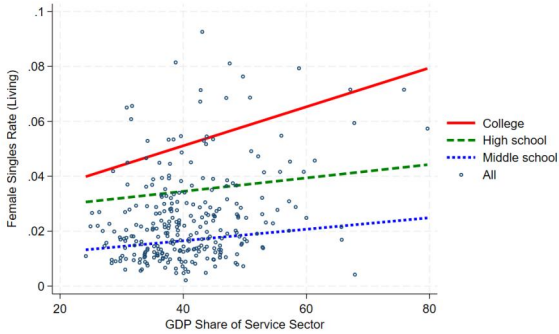
% don't want to get married: (Age 18-45)	Male	Female
CFPS 2018	2.54	3.41
CFPS 2020	2.41	2.88

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)

Location Preference and Migration

- After location pref. shock realized, individual chooses city-sector jk to live and work,
  - given $\overline{V}_{jk}^{ge}$ (wage, housing price, marriage market return) and migration cost $\tau_{i,jk}^{ge}$.

- Denote $\pi_{i,jk}^{ge}$ as the share of workers of gender g and skill e, from home i, migrating to jk.

- Gravity equation for the migration flow:

$$\pi_{i,jk}^{ge} = \frac{\left(\tau_{i,jk}^{ge}\right)^{-\sigma_z}\left(\overline{V}_{jk}^{ge}\right)^{\sigma_z}}{\sum_{j'k'}\left(\tau_{i,j'k'}^{ge}\right)^{-\sigma_z}\left(\overline{V}_{j'k'}^{ge}\right)^{\sigma_z}} = \frac{\Phi_{i,jk}^{ge}}{\Phi_{i}^{ge}}$$

Spatial General Equilibrium

- A Spatial General Equilibrium is defined by
  - a set of initial conditions and exogenous technology $\{\tau_{i,jk}^{ge}, A_j^e, \phi_j, L_j, H_i^{ge}\}$,
  - endogenous prices $\{w_{jk}^e, q_{ju}\}$ and marital transfer $\{\delta_j^{ge}(e')\}$,
  - endogenous quantities $\{Y_{jk}, H_{jk}^{ge}, c_{jk}^{ge}, h_{jk}^{ge}, P_{jk}^{ge}, S_{ju}\}$,
  - and distributions $\{\pi_{i,jk}^{ge}\}$,

  such that, under perfect foresight in labor and marriage market, followings are achieved:

  (1). [Worker optimization];

  (2). [Firm optimization];

  (3). [Goods and land market clearing];

  (4). [Marriage market stable matching].

Calibrated parameters from the literature/data

Back

Parameter	Description	Value	Source
From literature			
β	share of consumption in utility	0.77	Urban Household Survey
ξ	relative cost of rural housing	0.34	Census
σ_k	elasticity of skill substitution	4.0	Bils et al.(2024)
σ_z	migration elasticity	1.5	Tombe & Zhu (2019)
σ_ε	dispersion of marriage pref.	0.734	Marriage mkt. estimation
From microdata			
H_i^{ge}, H_{jk}^{ge}	Workers by type by location		Census
$\pi_{i,jk}^{ge}$	Migration flows between *in* and *jk*		Census
w_{jk}^{e}	Wage of skill skill *e* in city *j* sector *k*		Stat. Yearbook + Census
r_{jk}^{e}	Gender wage/participation gap of *e* in *jk*		Census + CFPS
q_{jk}	Unit rent in city *j* region *k*		Housing prices

Solve the Inner Loop - Marriage Market Equilibrium

Back

- We observe local marriage market equilibria across multiple locations.
- Use the property of the logit-type matching shares and log-linearization:

$$\ln\left[P_j^{ge}(e')\right] - \ln\left[P_j^{ge}(\varnothing)\right] = \frac{1}{\sigma_\varepsilon}\left[\tilde{\mu}_j^{ge} + \mu^{ge}(e') + \delta_j^{ge}(e') + \ln\left(\frac{W_j^{ge} + W_j^{g'e'}}{W_j^{ge}(1+\chi)}\right)\right]$$

  and symmetry constraint for marital transfers $\delta_j^{ge}(e') = -\delta_j^{g'e'}(e)$.

- Values on the LHS is observed
- It is over-identified $\Rightarrow$ estimate the parameters using GMM
  - $\tilde{\mu}_j^{ge}$ can be identified by the overall singles rate in each location j
  - $\mu^{ge}(e')$ can be identified by match rate of each pair (e, e') (no location variation)
  - $\delta_j^{ge}(e')$ can be identified by match rate of each pair across locations

Solve and Estimate the Spatial Equilibrium (Outer Loop) Back

- With data of population distributions, migration flows, prices, and expected marital payoff in each city, we can invert the model to calibrate:

  - Productivities A^e_{jk}
    - Under profit maximization and zero profits, inferred from employment and wages. Detail

  - Floor space construction intensity ϕ_j
    - Worker's FOC for housing gives required floor space, then back out construction intensity. Detail

  - Migration costs $\tau^{ge}_{i,jk}$
    - With all others known, calculated for each type and city-pair using the Gravity Equation. Detail

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:

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

Model Fit: City-Level Singles Rate by Gender and Skill