Agglomeration Economies and Inequality: Theory and Evidence from Provincial China

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Outline

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3. Empirical Strategy & Data
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Motivation: The Paradox of Growth and Inequality

Remarkable Growth

- Since reforms, China has experienced unprecedented economic growth and spatial transformation.
- Coastal provinces grew at an average of **9.5%** annually, outpacing the 6-7% in inland regions.

Rising Inequality

- This growth created a stark **coastal-inland divide**, forming a core-periphery structure.
- Inequality, after a brief narrowing, worsened significantly after 1991.

Central Research Questions

1. How do agglomeration (dis)economies theoretically and empirically affect income inequality at the provincial level in China?
2. Do these effects differ across key sectors (manufacturing vs. tertiary)?
3. What is the role of spatial spillovers? Does agglomeration in one province impact its neighbors' inequality?

Key Contributions of This Study

- **Novel Theoretical Model:** We develop a formal model based on NEG principles to explain the mechanisms linking agglomeration to inequality via firm profits and labor mobility, explicitly including spatial interactions.
- **Comprehensive Dataset:** We use a long panel dataset from **1994 to 2019**. This extended timeframe captures crucial long-term dynamics of reform while avoiding the structural break caused by the COVID-19 pandemic.
- **Heterogeneous Agglomeration Proxies:** We move beyond a single measure of industrial agglomeration and use distinct proxies for Manufacturing, Tertiary (Service), and Urban concentration to reveal sector-specific effects.
- **Methodologically Robust Econometrics:** We employ the **Spatial Durbin Model (SDM)**, which is superior to OLS or SAR models in this context as it robustly estimates both direct (local) and indirect (spillover) effects, mitigating omitted variable bias from spatial dependencies.

Core Concepts: New Economic Geography (NEG)

- Our model builds on the foundational work of Krugman (1991) and Puga & Venables (1996).
- The spatial economy is shaped by a "tug-of-war" between two forces:

Centripetal Forces (Agglomeration)

- **Linkages:** Access to suppliers & customers.
- **Labor Pooling:** Thick market for specialized skills.
- **Knowledge Spillovers:** Easier diffusion of ideas.
- *Result: Economic activity concentrates.*

Centrifugal Forces (Dispersion)

- **Congestion:** Traffic, pollution.
- **Factor Costs:** High land/rent prices.
- **Competition:** Intense local competition.
- *Result: Economic activity disperses.*

- This dynamic interaction between economies of scale and transport costs can naturally lead to a **core-periphery** structure, providing a powerful explanation for regional inequality.

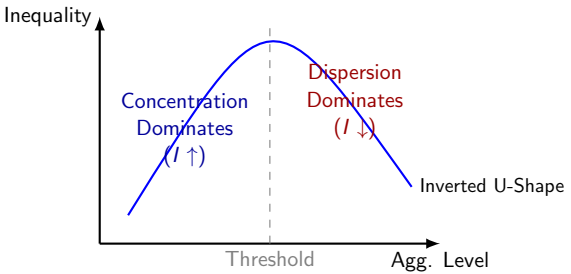
The Model: Key Equations and Dynamics

Model Setup (2 Regions: N, S)

- Utility: $U = C_M^{\mu} C_A^{1-\mu}$
- Production: $l_i = \alpha + \beta x_i$

Dynamic Process

1. **Concentration:** Firms cluster in N; $\omega_N > \omega_S \Rightarrow I \uparrow$
2. **Diseconomies:** Costs rise in N; profits $\pi_N \downarrow$
3. **Dispersion:** Firms move to S; $\omega_S \uparrow$
4. **Convergence:** Wage gap narrows; $I \downarrow$



Sectoral Heterogeneity: Why the Shape Differs

Proposition 1: Manufacturing Agglomeration → Inverted U-Shape

- **Early Stage (Concentration):** Driven by physical capital, infrastructure (ports, rail), and input suppliers. Concentration in coastal areas raises regional inequality.
- **Late Stage (Dispersion):** Highly sensitive to land costs, congestion, and pollution. Less skill-intensive firms are incentivized to relocate inland, boosting wages in the periphery and thus lowering inequality.

Proposition 2: Tertiary (Service) Agglomeration → U-Shape

- **Early Stage (Convergence):** Initial service sector growth creates a wide range of jobs (low to high skill) and increases overall provincial income, potentially reducing inequality.
- **Late Stage (Divergence):** The key driver becomes pooling of *highly-skilled talent* (e.g., finance, tech). This creates a powerful feedback loop, leading to significant skill-based wage premiums in core service hubs and widening the gap with other regions.

Empirical Model: Spatial Durbin Model (SDM)

- To test our hypotheses, we require a model that can handle spatial dependence.
- **Model Selection:**
  - Moran's I test on OLS residuals confirms significant spatial autocorrelation.
  - LM and Wald tests reject the reduction of the SDM to simpler SAR or SEM models.
  - This indicates that spillovers from both the dependent and independent variables are crucial.

The SDM Equation

$$\text{Inequality}_{it} = \underbrace{\rho \mathbf{W}\text{Inequality}_{it}}_{\text{Endogenous Interaction}} + \beta_1 \text{Ag}_{it} + \beta_2 \text{Ag}_{it}^2 + \theta_1 \text{PCGDP}_{it} + \theta_2 \text{PCGDP}_{it}^2 + \mathbf{X}_{it}\gamma + \underbrace{\mathbf{WZ}_{it}\delta}_{\text{Exogenous Spillover}} + \mu_i + \nu_t + \epsilon_{it}$$

W: Spatial weight matrix (contiguity).

ρ: Captures spatial autocorrelation in inequality.

δ: Captures spatial spillovers from neighboring regions' characteristics.

μ_i, ν_t: Province and time fixed effects to control for unobserved heterogeneity.

Data and Variables

- **Data Source:** Chinese provincial panel data from the National Bureau of Statistics (NBS) and other sources.
- **Time Period:** 1994 - 2019 (26 years).

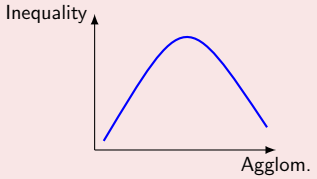
Variable Type	Variable Name	Description
Dependent Variable	Inequality	Income inequality measured by the Gini coefficient.
Agglomeration Proxies	Mfg_Agg	Manufacturing employment per square kilometer.
	Ter_Agg	Share of tertiary sector employment in total provincial employment.
	Urb_Agg	Urban population per square kilometer.
	FDI_Agg	Foreign Direct Investment as a share of provincial GDP (Robustness).
	lnPAT	Log of provincial patent applications accepted (Robustness).
Key Controls	ln(PCGDP)	Log of provincial per capita GDP (and its square for Kuznets curve).
	Fiscal Decentralization	Ratio of local to central government expenditure.
	Educ	Average years of schooling (Human Capital).
	Trade Openness	(Exports + Imports) / GDP.

Main Results: Non-Linear Relationships Confirmed

Manufacturing & Urban Agglomeration

A significant **Inverted U-shaped** relationship with inequality is found.

- `Mfg_agg`: Coeff. is positive $(+)$
- `Mfg_agg_sq`: Coeff. is negative $(-)$

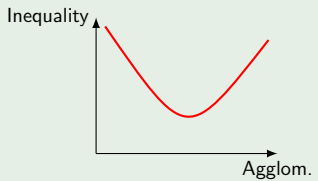


Initial concentration worsens inequality, but later dispersal reduces it.

Tertiary (Service) Agglomeration

A significant **U-shaped** relationship with inequality is found.

- `Ter_agg`: Coeff. is negative $(-)$
- `Ter_agg_sq`: Coeff. is positive $(+)$



Initial service growth reduces inequality, but advanced, high-skill concentration later increases it.

Results: Direct vs. Indirect (Spillover) Effects from SDM

Effect Decomposition

- **Direct Effect:** Within-province impact (e.g., Jiangsu → Jiangsu)
- **Indirect Effect:** Cross-province spillovers (e.g., Jiangsu → Zhejiang)

Key Finding

Tertiary agglomeration has a significant **negative indirect effect** (-0.207^{*}), indicating **positive spatial spillovers**.

Manufacturing and urban agglomeration effects are primarily localized.

Variable	Direct	Indirect	Total
Manufacturing			
Mfg_Agg	0.001^{***}	0.000	0.001^{*}
Mfg_Agg_Sqr	-0.000^{***}	0.000	-0.000
Tertiary			
Ter_Agg	-0.206^{***}	$\mathbf{-0.207}^{*}$	-0.413^{***}
Ter_Agg_Sqr	0.239^{***}	0.165	0.404^{***}
Urban			
Urb_Con	-0.062^{*}	-0.139	-0.201^{*}
Urb_Con_Sqr	0.068^{*}	0.131	0.199^{*}

Robustness Checks Confirm Main Findings

- The main findings are robust and hold up under various sensitivity analyses.

- **Alternative Agglomeration Proxies:**
  - Using **FDI as a share of GDP** and the **density of patent applications** as alternative proxies.
  - Both tests confirm a significant inverted U-shaped relationship, suggesting that innovation and investment-driven agglomeration follow a similar path.

- **Alternative Estimation Specifications:**
  - Results (signs and significance of key variables) are consistent when using non-clustered standard errors.
  - The SDM model consistently outperforms simpler OLS and SAR models based on statistical tests (Wald, LR tests), confirming the importance of accounting for spatial effects.

Summary of Findings & Policy Implications

Key Takeaways

1. **The effect of agglomeration on inequality is non-linear and sector-specific**: Inverted U-shape for Manufacturing/Urban, U-shape for Tertiary.
2. **Space Matters**: Provincial economies are interconnected. Tertiary agglomeration generates significant inequality-reducing spillovers to neighbors.
3. **Kuznets Curve Holds**: Development first increases, then decreases inequality.

Policy Implications

- **Avoid Over-Concentration:** Policy should aim for a "sweet spot" of agglomeration to balance growth benefits against diseconomies and inequality.
- **Promote Balanced Development:** Encourage dispersal of manufacturing to inland regions to stimulate growth and reduce disparities.
- **Leverage Infrastructure:** Investments like the BRI can facilitate this dispersal by reducing transport costs.

Future Research Directions

- The findings of this study open up several avenues for future research:

- **More Granular Sectoral Analysis:**
  - Decomposing the manufacturing and tertiary sectors into more detailed sub-sectors (e.g., high-tech vs. low-tech manufacturing) to uncover even more nuanced relationships.

- **City-Level Analysis:**
  - Replicating the analysis at the city level could provide deeper insights into intra-provincial inequality and the specific dynamics within urban systems.

- **Dynamic Panel Threshold Models:**
  - Exploring the "threshold" point more formally using models that can endogenously determine when the relationship between agglomeration and inequality changes.

Thank You!

Questions & Discussion

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