What We Do in the Shadows: How Urban Density Facilitates Information Diffusion

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Motivation

- Density is one of the defining characteristics of cities
    - Important source of agglomeration economies: Rosenthal and Strange (2004)
    - Increased knowledge diffusion leads to higher productivity: Jacobs (1969)

- However, testing how density affects information diffusion is difficult:
    - Density is an endogenous decision, based of local conditions
    - "Information" is generally unobservable to the researcher

This Paper

- Exploits national policy in China that requires minimum amount of sunlight for all residential buildings
    - China's expansive size → northern cities face shallower solar angles
    - Developers must place taller buildings farther apart → Southern cities are more dense

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- Study difference in speed of information diffusion across latitudes in China
    - Measure government and user activity on Local Leader Message Boards
    - Document S-shaped response to increase in government response rates
    - Cumulative increase to posts is 2.7 times higher in southern cities
    - Survey data: similar individuals more likely to gossip in the South
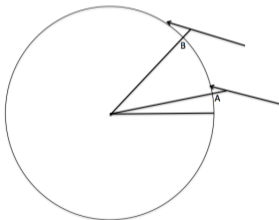
Sunlight Policy in China

- Access to sunlight influenced by *feng shui* and Soviet building practices

- Codified into law in 1993:
    - *Urban Residential Planning and Design Ordinance (GB50180-93)*
    - Lowest level of any residential building required to have at least 2 hours of sunshine on *Dahan* (trans: Major Cold) – around January 20th
    - Implication: buildings must be farther apart in the North

Latitude and Solar Angle
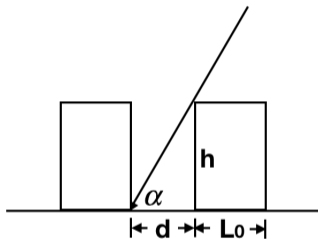
- Solar angle (α) as a function of latitude (ϕ) in radians:

$$\alpha(\phi) = \arcsin\left[\sin(\delta)\,\sin\phi + \cos(\delta)\,\cos(h)\,\cos\phi\right]$$

- Where the declination δ on *Dahan* is approximately -20 degrees ($\delta \approx -\frac{\pi}{9}$)
- Sunlight must reach building by 11am $\rightarrow h \approx -\frac{\pi}{12}$ (approximately -15 degrees)
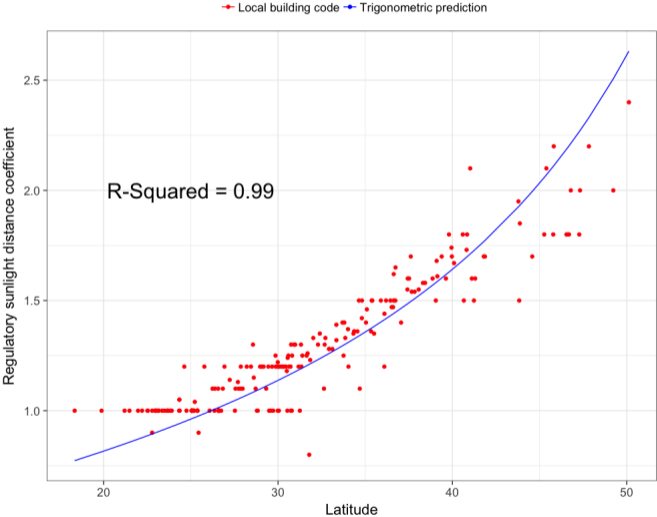
Sunlight Policy in China

- Local building codes reflect sunlight policy
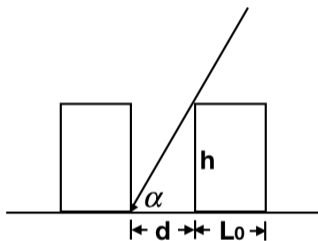   - Sunlight distance coefficient = ratio of building distance to height

Local Building Codes Reflect Policy

Sunlight Policy in China

- Local building codes reflect sunlight policy
   - Sunlight distance coefficient = ratio of building distance to height

- Substantial variation in building codes:
    - Changchun (43.79° N) requires buildings 1.95x as far apart as in Kunming (25.19° N)

- Developers required to use officially-sanctioned sunlight analysis software

Data

- Land Transactions from Ministry of Land and Resources
    - Location, zone use, FAR, contract date, etc.
    - Scraped in 2017 $\rightarrow$ 1.3 million transactions
    - 40% of parcels for residential use

- 2005 1% population census (National Bureau of Statistics)
    - HH and individual data, including whether HH lives in high-rise

- Postings on the Local Leader Message Board, run by the People's Daily
    - Sub-boards for all administrative units
    - Government responses to posts viewable to everyone
    - Jiang, Meng and Zhang (2018) scraped data through 2016 $\rightarrow$ 900,000 postings
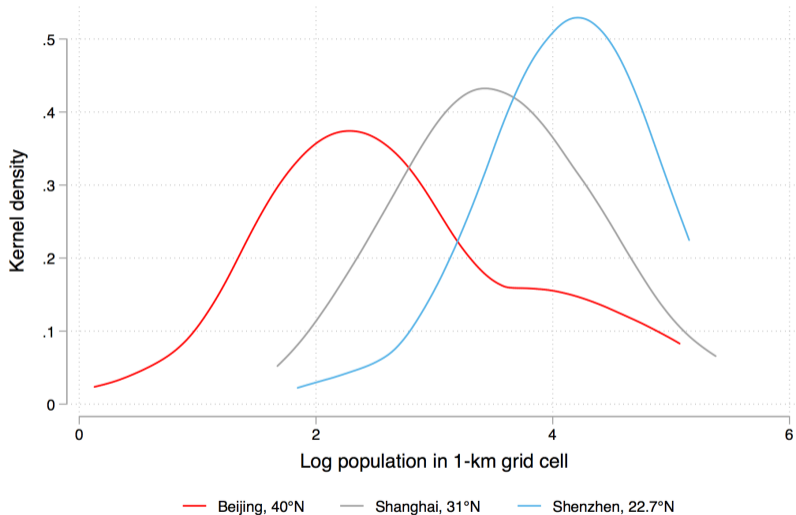
Latitude Explains Building Density Well
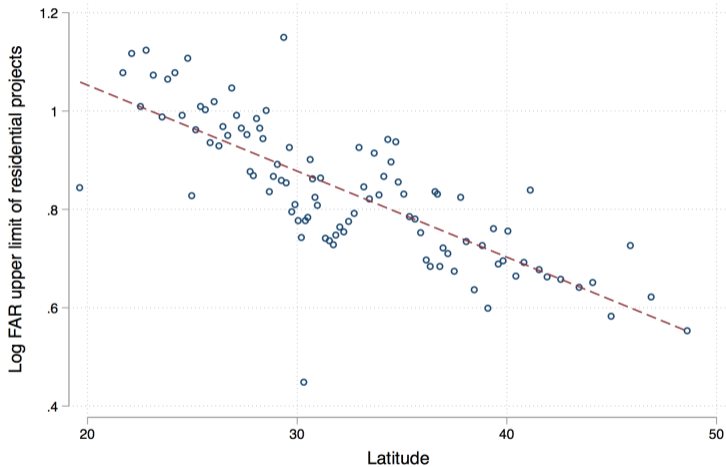
Difference in High Rise Construction after 1993
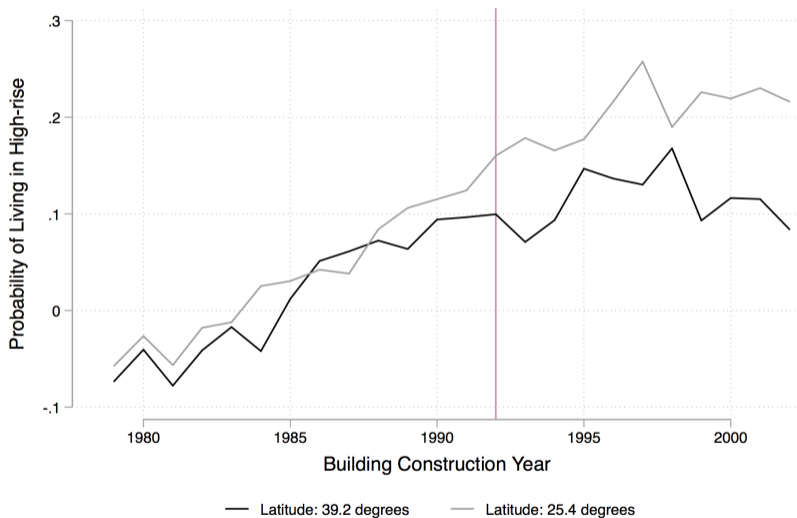
Population Density Across China's Biggest Cities

Information Diffusion

- How does this affect information diffusion?

- Use Local Leader Message Boards (LLMBs) from (Jiang, Meng and Zhang, 2018)
    - Often grievances or petitions not easily resolved through the legal system
    - Analyze topics of postings using LDA model (Blei, Ng and Jordan, 2003)
    - Wide range of topics: housing expropriation, pollution, teacher compensation, pyramid schemes...
    - Local governments leave public replies to approximately 60% of postings

Dynamic Responses to Government Postings

- Measure dynamic response to increase in government postings as:

$$\text{Posts}_{ict} = \gamma_c + \delta_{it} + \sum_{j=0}^{J} \beta_j \text{Reply}_{ict-j} + \epsilon_{ict}$$

Dynamic Responses to Government Postings

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$$\text{Posts}_{ict} = \gamma_c + \delta_{it} + \sum_{j=0}^{J} \beta_j \text{Reply}_{ict-j} + \epsilon_{ict}$$

- Study whether density causes differing dynamics with the specification:

$$\text{Posts}_{ict} = \gamma_c + \delta_{it} + \sum_{j=0}^{J} \beta_j \text{Reply}_{ict-j} + \sum_{j=0}^{J} \eta_j \text{Reply}_{ict-j} \times \widehat{\log \text{FAR}}_c$$

$$+ \sum_{j=0}^{J} \text{Reply}_{ict-j} \times \sigma_j' X_c + \epsilon_{ict}$$

- If density leads to faster information diffusion, should expect that Southern cities to respond faster to government replies
- $\widehat{\log \text{FAR}}_c$ is "predicted FAR" and is a function of latitude
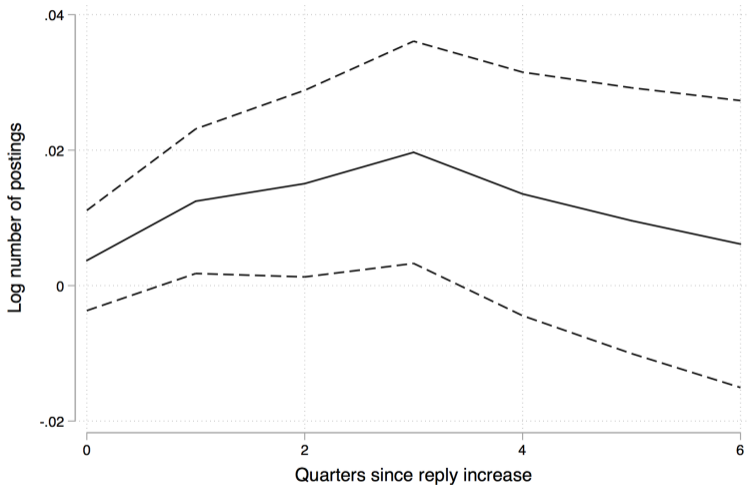- Add in rich set of city-level controls (X_c)

Dynamic Response to Government Postings

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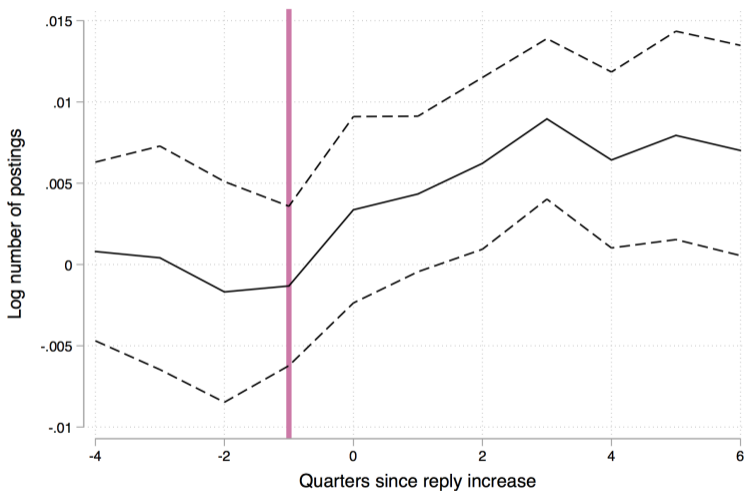
[1]Coefficient and 95% CI of dynamic model with 6 lags and 4 leads of reply rate

Cumulative Differential Response Across Latitude

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[2]Difference in response to 10% increase in postings for cities in the 75th and 25th percentile of latitude

Extensions and Robustness

- Suggestive evidence on word-of-mouth from China Social Governance Survey
  - Extensive survey run by Zheng, Su and Zhang (2018)
  - Residents in Southern cities are more likely to gossip or have heard gossip
  - 5 degree increase in latitude $\rightarrow$ approximately 3% decrease in gossip

- Address threats to validity
  - Attitudes toward government similar across latitude
  - Trust in public institutions similar across latitude
  - Internet use not systematically different across latitude

Next Step - Exploit COVID Lockdown

- Extend analysis using COVID lockdown in China
    - Internet channel still active (on LLMBs)
    - Lockdown "shuts down" the physical proximity from denser buildings
    - Study whether physical interactions play a large part in information diffusion

- Currently scraped LLMBs through 2023
    - Use the lockdown in 2019 as a natural experiment
    - If density's role is through physical proximity $\rightarrow$ expect the difference between northern and southern cities to disappear during lockdown

Summary

- Use plausibly exogenous variation in urban density caused by sunlight policy in China

- Find that
    - ... Southern cities are more dense than Northern cities
    - ... Southern cities have faster responses to government postings than Northern ones
    - ... residents of Southern cities more likely to gossip
    - ... cannot be explained by difference in internet usage or attitudes toward government

- Paper points to the role that urban density plays in the diffusion of information