# The Impact of Inter-County Competition on Pro-Business Policy in China

## Thesis Defense

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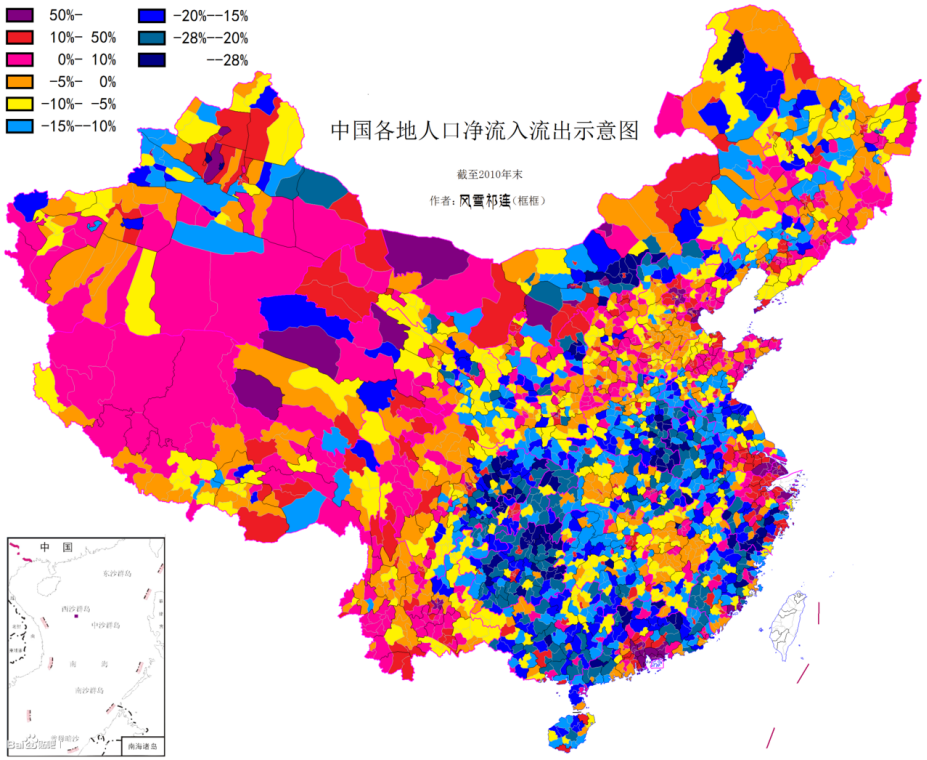
# Outline

# Introduction




- Claim: China's success hinges on competition among counties
- More competition $\rightarrow$ more pro-business policies (Cheung, 2014)
- Very little research, since competition is hard to measure

# Main Idea

## Ideal regression equation

$$\text{pro\_business\_policy} = \beta_0 + \beta_1 \cdot \text{county\_competition} + \alpha \mathbf{X} + \varepsilon$$

- Can use tax enforcement to measure pro-business policies
- Measure effective tax rate: $\frac{\text{tax paid}}{\text{sales}}$ (vs. government tax rate)
- Use county density as proxy for county_competition
- Counties compete with each other to attract firm investment
- More counties in a given area $\rightarrow$ stronger competition
- So: pro-business policies can be explained by county density

# Problem – Endogeneity

| Firm name | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|
| 宝鸡市爱姆食品有限责任公司 | | | | | | 渭滨区 | 金台区 | 渭滨区 | 渭滨区 | 渭滨区 |
| 新疆天风发电股份有限公司 | | 新市区 | 新市区 | 新市区 | 天山区 | 新市区 | 新市区 | 新市区 | 新市区 | 新市区 |
| 常州金马纺织品有限公司 | | | | 天宁区 | 天宁区 | 武进区 | 天宁区 | 天宁区 | 天宁区 | 天宁区 |
| 常州科新永安磁电设备有限公司 | | | 新北区 | 新北区 | 钟楼区 | 钟楼区 | 新北区 | | | |
| 广通机械工程有限公司 | | 黄埔区 | 黄埔区 | 黄埔区 | 黄埔区 | 黄埔区 | 萝岗区 | 萝岗区 | 萝岗区 | 黄埔区 |
| 宝鸡市热力有限责任公司 | | | | 渭滨区 | 渭滨区 | 金台区 | 金台区 | 金台区 | 渭滨区 | 渭滨区 |
| 内蒙古兴华服装厂 | 赛罕区 | 玉泉区 | 玉泉区 | 玉泉区 | 赛罕区 | 赛罕区 | 赛罕区 | 赛罕区 | 赛罕区 | 赛罕区 |
| 常州天元工程机械有限公司 | 新北区 | 新北区 | 天宁区 | 天宁区 | 天宁区 | 天宁区 | 天宁区 | 天宁区 | 天宁区 | 新北区 |

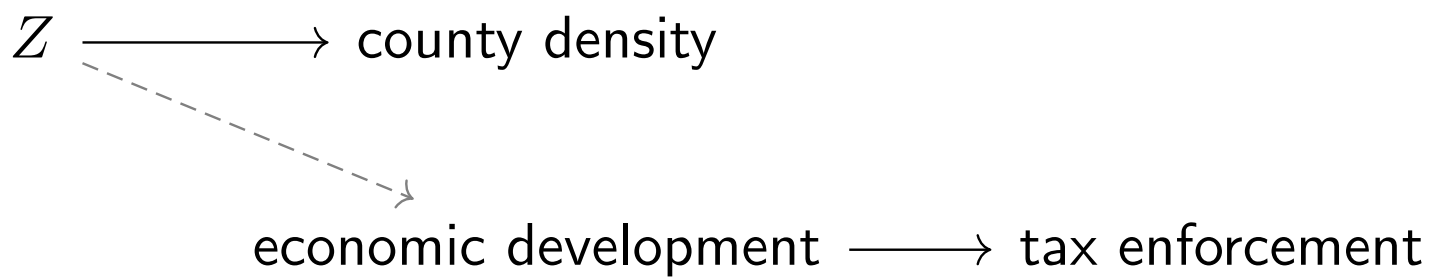
Firms are administered by new county (red), then register back to original

- Governors can adjust county boundaries for political reasons

  $\rightarrow$ e.g. including a certain town to inflate GDP
- Possible endogeneity: some historical factor may affect both county density and tax enforcement $\rightarrow$ spurious correlation
- Need exogenous variable to explain variation in county density

# Instrumental Variable

Want IV correlated with county density, but not development




- Most of China's counties have existed since Qin Shi Huang
- Ancestors' concerns: geography, agricultural productivity ($Z$)
- Geography affects county density, is clearly exogenous
- Can control for economic development using control variables
- TSLS: must have same set of controls in IV & main regression

# Research Findings

## Finding #1 – Geography

Debate: are counties with nice geography bigger or smaller?

- Counties with high agricultural productivity tend to be larger
- Counties with low geographic variation tend to be larger

## Finding #2 – TSLS vs. OLS

Geographic instrumental variables yield larger results than OLS

- Each additional neighbour $\rightarrow$ 0.092% less taxes (OLS: 0.037%)

## Finding #3 – Poverty Counties

Poverty counties can have good agriculture but poor terrain

- Higher opportunity costs for switching to industry
- High tax dissuades incoming firms $\rightarrow$ vicious cycle

# The Formation of Counties (Li, 2014)

## Regionally decentralized authoritarianism (Xu, 2011)

Political centralization, regional economic decentralization

- Shift from ritual-oriented Zhou dynasty to law-oriented Qin
- End of Zhou: king granted land in exchange for loyalty
- Long-term: fiefdoms became stronger, king became weaker
- Qin dynasty: monopolized land, tied population to homeland
- Fragmentation was political asset — cannot challenge center

# The 'China Puzzle' (中国谜题)

## China Puzzle

How did China grow so much despite poor institutions?

- Most countries: poor institutions → rent-seeking gov'ts
- China: heavy role of local gov'ts in promoting investment

**Answer**: promotion tied to growth → economy is run like a business

Why 'performance target system' succeeded (Li & Zhou, 2005):

1. Central gov't promotes based solely on economic indices
2. Each leader's performance distinguishable & comparable
3. Few links between public and private sector, officials have no prospects except through promotion

# Chinese Counties (xiàn 县)

Misleading English translation

- 2,860 counties in total
- Average city has 8.6县
- Average area: 3,000km$^2$
- Avg population: 450,000

Modularity allows experimentation without disrupting rest of economy

Freedom to experiment with reforms makes officials into entrepreneurs

Reforms can be:

- explicit (new policies), or
- implicit (enforcement)

Officials may take great personal risk, are rewarded if successful

- e.g. SEZs, privatized farms

Frequent rotations prevent collusion

# Intense Competition

Cheung (2014: 24): "A xian with a mere 300,000 in population would often employ 500 investment solicitors."

- Business-inviting conferences, beauty contests for delegates
- Researchers go to successful counties for investment advice
- Negative land prices, building infrastructure, legal legwork
- Inter-county competition $\rightarrow$ counties specialize in one industry

**Problem**: since managing a county is essentially managing a business, public officials now have job offers from private firms

# Undermining the Performance Target System

## Capital Misallocation (Bai, Hsieh & Song, 2016)

- Local gov'ts cannot run deficits, could use LFVs for stimulus
- Transfer assets to LFV, use as collateral for a bank loan
- LFV spending in 2014-15 over 3 times amount in 2009-10
- More funding to favored firms; crowding out other firms

## Land Financing as Resource Curse

- Since 1998, local gov'ts have exclusive rights to sell land
- 2008: up to 80% of finances from land revenues (1998: 10%)
- Used for corruption, ostentatious projects (Chen & Kung, 2016)
- Not reliant on taxes $\rightarrow$ less receptive to public (Zhan, 2013)

# 'Left-behind Counties'

- 1986: 206RMB poverty line, chose subset of 'poverty counties'
- 'Bet on the strong': strategically invest to maximize payback
- Underreport income of richer villages, to be eligible for funding

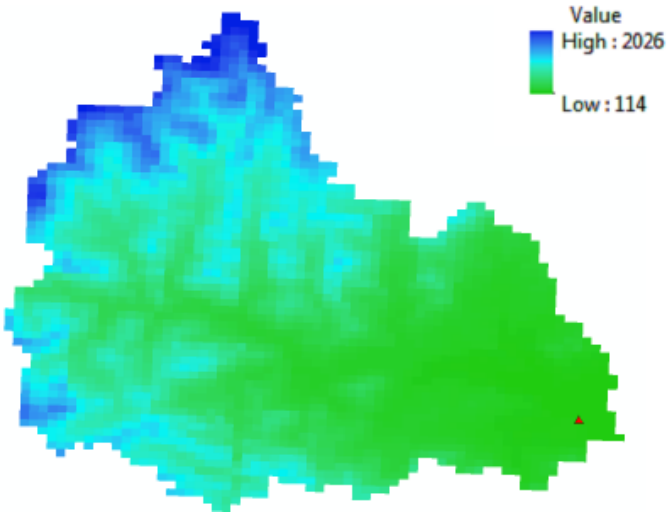
Official: "it was becoming difficult to continue some initiatives as all of the 'rich' villages had already been chosen" (Rogers, 2014).

- Poorest villages receive 'political achievement projects' (政绩工程) that look good for inspections, but do not help people
- Underproviding public goods with spillover effects (Yep, 2008)
- Myopic incentives $\rightarrow$ misappropriation of funds (Brehm, 2013)

**Main problem**: transition from growth-centrism to multiple criteria

# ArcGIS

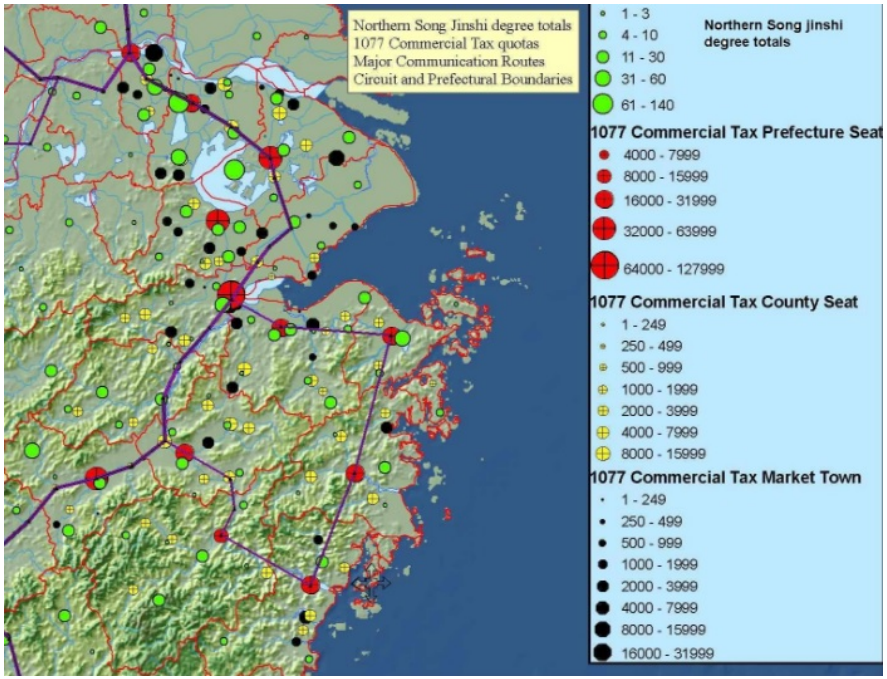

(a) Nightlights




(b) Elevation

- Common tool in economics – e.g. nightlights as proxy for GDP
- Various open-source datasets available (e.g. elevation, rivers)
- Collect summary statistics per unit of area (e.g. 100km$^2$)

# Data – China Historical GIS

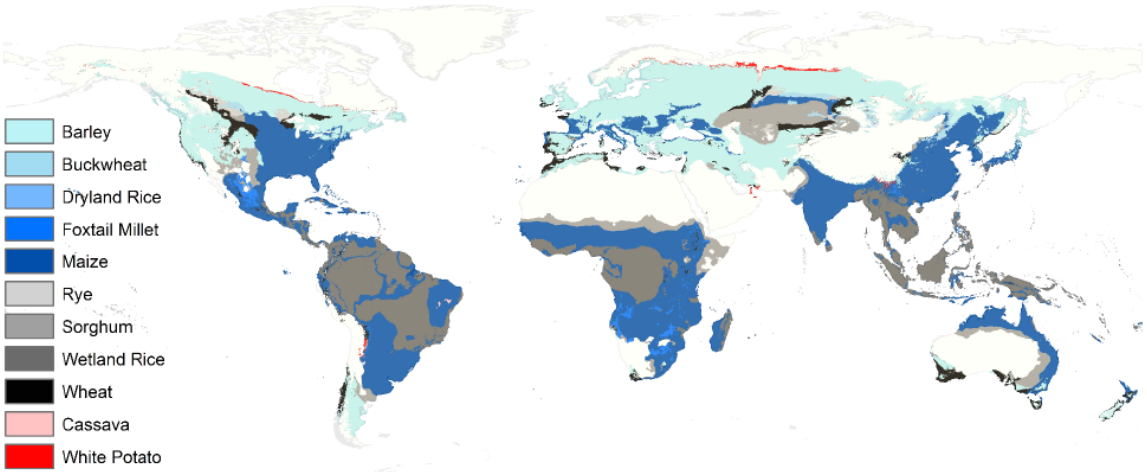



- CHGIS: datasets of administrative system between 221 BC & 1911 AD and major non-administrative towns for 1820 & 1911
- Use digital elevation model (DEM) – constant since 1911
- Calculate variance in elevation over areas of 100km$^2$

# Data – Global Agro-Ecological Zones

- GAEZ: global estimates of various potential crop yields
- Yields (in tons/ha/year) for 11 cereals and 4 roots & tubers
- Two categories of water supply: rain-fed and irrigation
- Three levels of inputs: high, medium, low

- Same crop (cereals) is optimal for all counties in China
- Use GAEZ as general index of agricultural productivity




Optimal crop in terms of caloric yields among cereals, roots & tubers

# TSLS Regression

Using ArcGIS data, run the following regression:

$$\text{county\_density} = \beta_0 + \beta_1 \cdot \text{geography} + \beta_2 \cdot \text{agriculture} + \gamma \mathbf{X} + \varepsilon$$

Where geography = geographic variation (variance of land height)
agriculture = agricultural productivity
$\mathbf{X}$ = control variables (for economic development)

Then, estimates for county density are used to run main regression:

$$\text{tax\_enforcement} = \beta_0 + \beta_1 \cdot \widehat{\text{county\_density}} + \alpha \mathbf{X} + \varepsilon$$

Expect to see $\beta_1 < 0$: higher county density leads to less taxes

# Results – Basic OLS

Table: OLS regression – Tax rate

| | (1) | (2) | (3) |
|---|---|---|---|
| density | $-0.04$ | | $-0.037$ |
| | $(0.0045)$ | | $(0.004)$ |
| lights | | $-0.005$ | $-0.002$ |
| | | $(0.0005)$ | $(0.0005)$ |
| $R^2$ | 0.010 | 0.006 | 0.011 |

Note: All variables significant at 1%; errors clustered by county. ($N = 268,809$)

- $\beta_{\text{density}} < 0$: higher county density implies less tax enforcement
- Highly significant, but low $R^2$, low magnitude ($0.037 \times 20 = 0.74$)

# Auxiliary Results (First-stage Regression)

## Geo-economics of county density

$$\text{county\_density} = \beta_0 + \beta_1 \cdot \text{geography} + \beta_2 \cdot \text{agriculture} + \gamma \mathbf{X} + \varepsilon$$

Two (contradictory) theories of how county density is determined:

- 山川形便 – advantages offered by terrain (mountains & rivers)
- 犬牙相错 – not letting local governments have enough geographic advantages that they could become independent

First theory predicts $\beta_1 > 0$: rough terrain makes an area harder to govern, thus leads to more counties

Second theory predicts $\beta_1 < 0$: areas with smooth terrain have higher county density, since emperor limits their size

# Finding #1 – Geography

## Agriculture

High agricultural productivity → fewer counties

- Supports 犬牙相错 – central government limits size

## Geography

High geographic variation → fewer counties
Low geographic variation → more counties

- Supports 犬牙相错 – central government limits size

**Possible Explanation**:

- Upper limit to how many people can be governed
- Grow more food / fit more people → more counties

# Two-Stage Least Squares (1)

Table: TSLS regression – Various specifications (2 variables)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| geography | −0.021 | −0.017 | −0.024 | | | |
| | (0.001) | (0.001) | (0.001) | | | |
| agriculture | 0.036 | | | 0.047 | 0.053 | |
| | (0.003) | | | (0.003) | (0.003) | |
| lights | | 0.063 | | 0.075 | | 0.075 |
| | | (0.003) | | (0.003) | | (0.003) |
| rivers | | | 2.89 | | 3.74 | 2.80 |
| | | | (0.26) | | (0.30) | (0.25) |
| density | −0.10 | −0.193 | −0.12 | −0.028 | −0.046 | −0.064 |
| | (0.01) | (0.019) | (0.009) | (0.013) | (0.008) | (0.019) |
| lights | | 0.010 | | −0.003 | | −0.002 |
| | | (0.002) | | (0.001) | | (0.0016) |
| F-statistic | 86.6 | 67.6 | 57.1 | 1.24 | 22.9 | 19.4 |

Note: Top is first-stage regression (dep. var: density), bottom is TSLS (dep. var: tax rate)
Standard errors are clustered at the county level. Number of observations: 268,809.

# Two-Stage Least Squares (2)

Table: TSLS regression – Various specifications (3+ variables)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| geography | −0.012 | −0.019 | −0.016 | | −0.010 |
| | (0.001) | (0.0013) | (0.001) | | (0.0009) |
| agriculture | 0.037 | 0.036 | | 0.046 | 0.038 |
| | (0.003) | (0.003) | | (0.003) | (0.003) |
| lights | 0.064 | | 0.06 | 0.07 | 0.06 |
| | (0.001) | | (0.003) | (0.003) | (0.003) |
| rivers | | 2.96 | 2.33 | 2.68 | 2.40 |
| | | (0.27) | (0.24) | (0.25) | (0.24) |
| density | −0.092 | −0.090 | −0.15 | −0.038 | −0.082 |
| | (0.013) | (0.008) | (0.015) | (0.011) | (0.011) |
| lights | 0.002 | | 0.007 | −0.002 | 0.001 |
| | (0.001) | | (0.001) | (0.001) | (0.001) |
| F-statistic | 23.1 | 58.8 | 28.9 | 14.5 | 22.8 |

Note: Top is first-stage (dep. var: density), bottom is TSLS (dep. var: tax rate)
Standard errors clustered by county. Number of observations: 268,809.

# Finding #2 – TSLS vs. OLS

Table: Comparing OLS vs. TSLS

| | OLS | TSLS |
|---|---|---|
| density | $-0.037$ | $-0.092$ |
| | $(0.004)$ | $(0.013)$ |
| lights | $-0.002$ | $0.002$ |
| | $(0.0005)$ | $(0.001)$ |

Note: All variables significant at 5%

**Possible Explanation**:

- Effects of initial (non-geographic) endowment last over time
- Wealthier in present, compete less for investment, higher tax
- TSLS controlling for wealth eliminates any such legacy effects

# Robustness Check #1 – Adjacent Neighbours

- Objection: only adjacent counties (sharing a border) matter
- Centroids of large adjacent counties may not be within 100km

Table: Tax rate – 100km$^2$ vs. adjacent ($'$) neighbours

| | OLS | OLS$'$ | IV | IV$'$ |
|---|---|---|---|---|
| density | $-0.037$ | $-0.036$ | $-0.092$ | $-0.27$ |
| | $(0.004)$ | $(0.025)$ | $(0.013)$ | $(0.146)$ |
| lights | $-0.002$ | $-0.006$ | $0.002$ | $-0.004$ |
| | $(0.0005)$ | $(0.0005)$ | $(0.001)$ | $(0.0005)$ |

Note: IV$'$ does not use weights, which give poor results.
Errors are clustered by county. ($N = 268,809$)

- Adjacent: smaller range (1-20) than for 100km (1-54)
- Expect higher $\beta$ on IV$'$ — spread among fewer counties
- High $\beta$, but variance too high $\rightarrow$ 100km$^2$ more reliable

# Robustness Check #2 – Tax Specifications

Table: Various specifications for tax enforcement

| | #1 | #2 | #3 | #4 |
|---|---|---|---|---|
| manage | | ✓ | | ✓ |
| subsidy | | | ✓ | ✓ |
| density | −0.092 | −0.68 | −0.072 | −0.67 |
| | (0.013) | (0.05) | (0.013) | (0.05) |
| lights | 0.002 | 0.04 | 0.001 | 0.04 |
| | (0.001) | (0.004) | (0.001) | (0.004) |
| firms | 268,809 | 267,673 | 266,093 | 266,646 |
| counties | 2780 | 2780 | 2777 | 2780 |

Note: Standard errors are clustered at the county level

- Manage – 'Management fee', e.g. bribes (9.8%, $s_x = 5.3$)
- Subsidy – Acts as a 'negative tax' (avg tax: 4%, $s_x = 3.8$)

# Tax Specifications

## Subsidy

- Gives lower magnitude for density's effect on tax enforcement
- Subsidies further reduce tax for incoming firms $\rightarrow$ large $\beta$
- Small $\beta \rightarrow$ subsidies given to firms that pay high taxes

## Management Fee (Bribes)

- High $\beta \rightarrow$ most bribes paid by firms in uncompetitive areas
- Many neighbours $\rightarrow$ can simply relocate if forced to pay bribes
- Few neighbours $\rightarrow$ can't relocate, must pay exorbitant fees

- Also tried using number of employees, nonsensical results

# Robustness Check #3 – GDP vs. Nightlights

Table: Density – lights vs. GDP ($'$)

| | density | density$'$ |
|---|---|---|
| geography | $-0.009$ | $-0.015$ |
| | $(0.001)$ | $(0.001)$ |
| agriculture | $0.05$ | $0.06$ |
| | $(0.003)$ | $(0.004)$ |
| lights | $0.15$ | |
| | $(0.008)$ | |
| log(gdp) | | $-0.308$ |
| | | $(0.11)$ |
| $R^2$ | $0.49$ | $0.32$ |
| density | $-0.072$ | $-0.077$ |
| | $(0.014)$ | $(0.011)$ |

Note: All variables are significant at 1%.
Clustered by county. ($N = 128,234$)

GDP available for 1959/2780 counties, 128,234/268,809 firms

TSLS for GDP vs. lights yields similar results, GDP has lower $R^2$

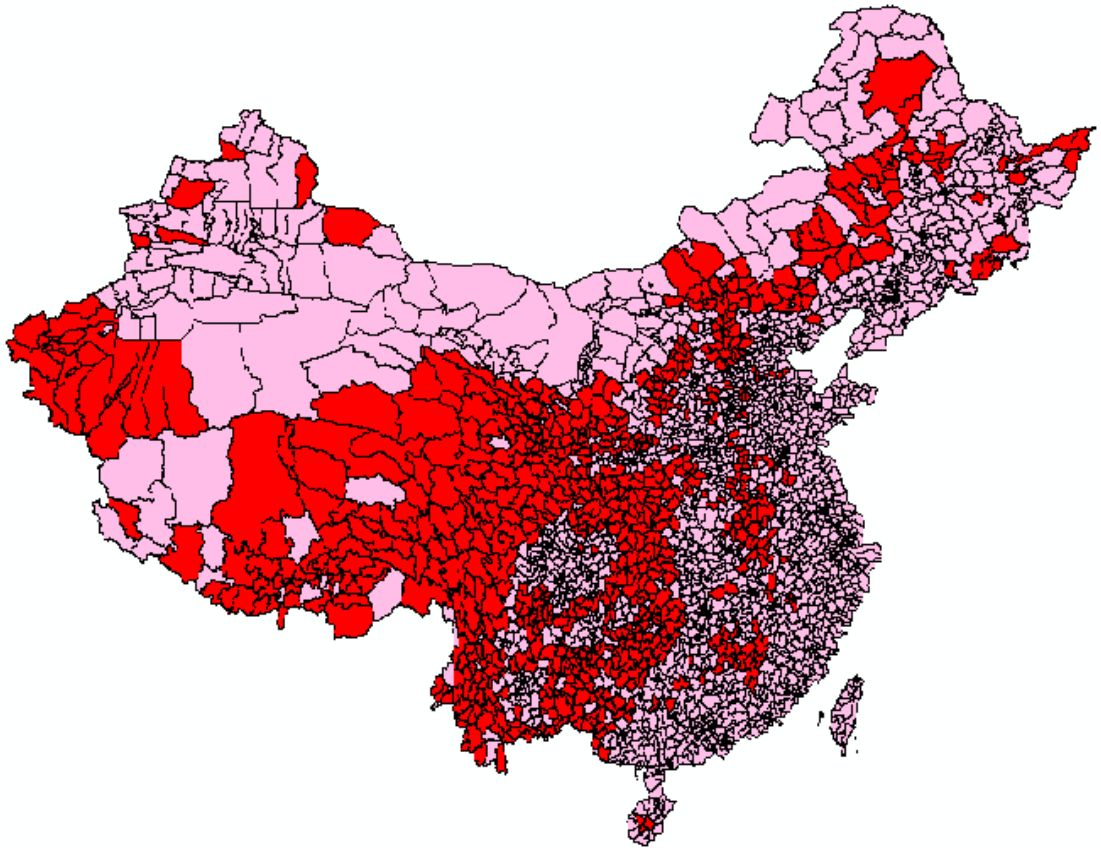
Full sample:

- Avg density: 20 ($s_x = 11.7$)
- Avg lights: 62.8 ($s_x = 74.15$)

Sample with GDP data:

- Avg density: 18.5 ($s_x = 11.6$)
- Avg lights: 30 ($s_x = 34.6$)
- Avg pcGDP: 101,790 (202,737)

# Policy Implications: Poverty Counties (贫困县)



- Claim: geography cannot change → unhelpful for economics
- Unclear criteria for poverty counties are easy to manipulate
- Geography is objective way to distinguish poverty counties

# Poverty Counties – Averages

All counties:

- Geography: 170 ($s_x = 199$)
- Agriculture: 112 ($s_x = 78$)
- Density: 20 ($s_x = 12$)
- Lights: 63 ($s_x = 74$)

Poverty counties

- Geography: 282 ($s_x = 221$)
- Agriculture: 90 ($s_x = 68$)
- Density: 13.6 ($s_x = 9$)
- Lights: 14.6 ($s_x = 14.5$)

Non-poverty counties

- Geography: 126 ($s_x = 170$)
- Agriculture: 121 ($s_x = 80$)
- Density: 23 ($s_x = 12$)
- Lights: 82 ($s_x = 79$)

Poverty counties: rougher terrain, less fertile land, fewer neighbours

# Poverty Counties – OLS with Dummy Variable

Table: OLS with poverty county dummy

| | (1) | (2) | (3) |
|---|---|---|---|
| density | −0.037 | −0.033 | −0.031 |
| | (0.005) | (0.004) | (0.004) |
| lights | −0.002 | | −0.0009 |
| | (0.0005) | | (0.0005) |
| poverty | | 0.825 | 0.786 |
| | | (0.12) | (0.13) |
| $R^2$ | 0.011 | 0.015 | 0.015 |

Note: Clustered by county. ($N = 268,809$)
Dependent variable: tax rate

- Poverty counties have higher taxes (all: $\mu = 4.4$, $\sigma = 4.3$)
- Average tax rate in poverty counties: 5.8% ($s_x = 5.5$)
- Average tax rate in non-poverty counties: 4.3% ($s_x = 4.2$)

# Poverty Counties – TSLS with Dummy

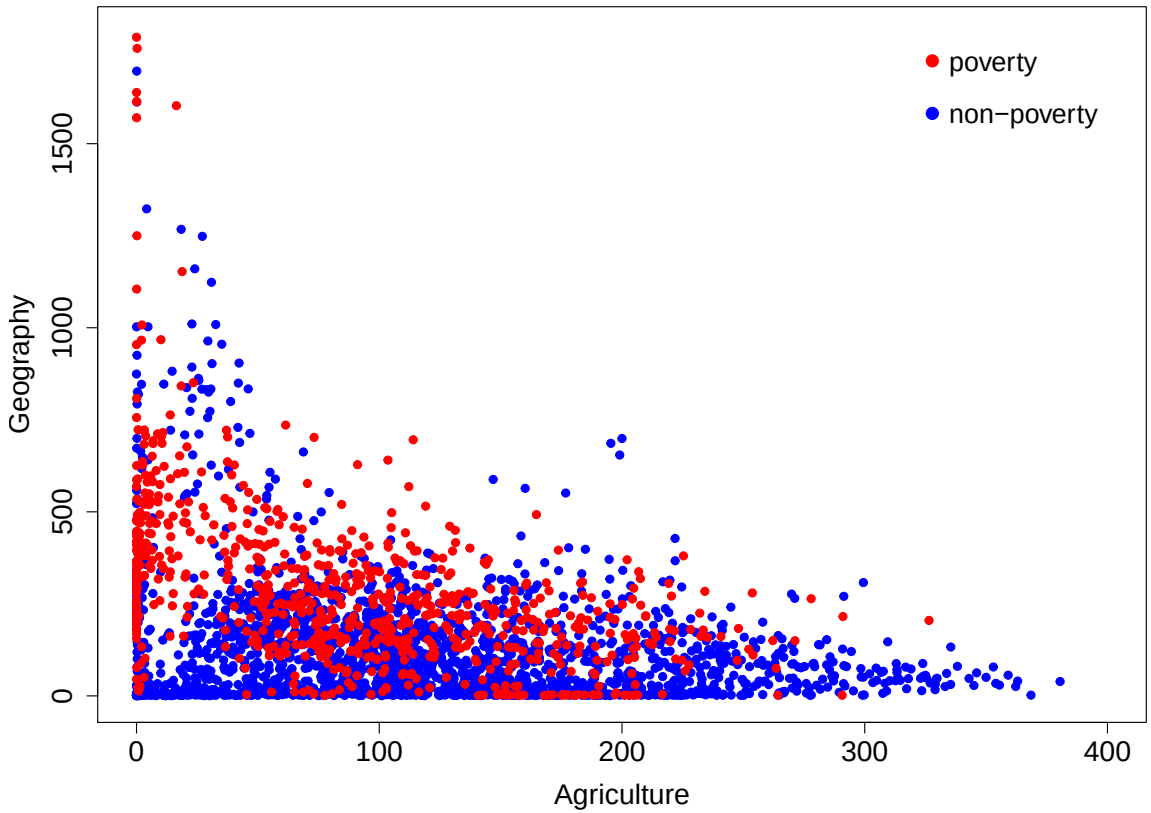
Table: TSLS with poverty dummy

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| geography | −0.012 | −0.011 | −0.012 | −0.010 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| agriculture | 0.038 | 0.036 | 0.038 | 0.035 |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| lights | 0.064 | 0.059 | 0.063 | 0.058 |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| poverty | | −2.45 | | −3.74 |
| | | (0.38) | | (0.73) |
| pov*light | | | −0.02 | 0.08 |
| | | | (0.02) | (0.05) |
| density | −0.092 | −0.077 | −0.092 | −0.079 |
| | (0.013) | (0.013) | (0.013) | (0.013) |
| lights | 0.002 | 0.002 | 0.003 | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| poverty | | 0.58 | | 0.53 |
| | | (0.13) | | (0.17) |
| pov*light | | | 0.016 | 0.003 |
| | | | (0.005) | (0.006) |
| F-statistic | 23.1 | 21.7 | 23.0 | 21.4 |

Note: Top is first-stage (density), bottom is TSLS (tax)
Standard errors clustered by county. ($N = 268,809$)

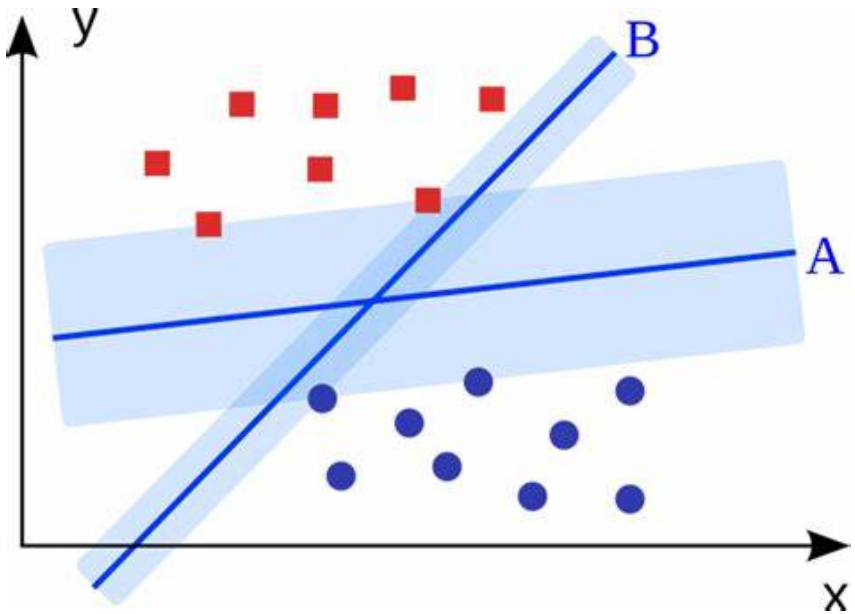
- Of 268,809 firms, 13,106 (5%) in poverty counties
- TSLS: Poverty counties have 0.58% higher tax rate
- Same effect as having 7.5 fewer neighbours $(0.58 \div 0.077)$
- Take rent-seeking approach
- Dissuades incoming firms
- Perpetuates poverty

# Finding #3 – Poverty Counties




- Fertile land but rough terrain $\rightarrow$ unable to compete
- But high opportunity costs for switching to industry

# Future Research




**Problem**: Which counties should be considered 'poverty counties'?

- False positives: underreport income to get extra funding
- Different lists at various times, some counties get delisted

This is a perfect problem for machine learning!

- Classifier algorithms (support vector machines, neural nets)

# Thesis Structure

1. Outline theories of Chinese inter-county competition
2. Get summary statistics from geographical datasets
3. Regress tax_enforcement on county_density + controls
4. Interpret regression results, do robustness checks
5. Outline policy implications for poverty counties

**Findings**:

- Counties with low geographic variation tend to be smaller
- TSLS with geography IVs show more impact of density on tax
- Poverty counties can have good agriculture but poor terrain

# Conclusion

Thank you!