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

Thesis Defense

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EMA Thesis
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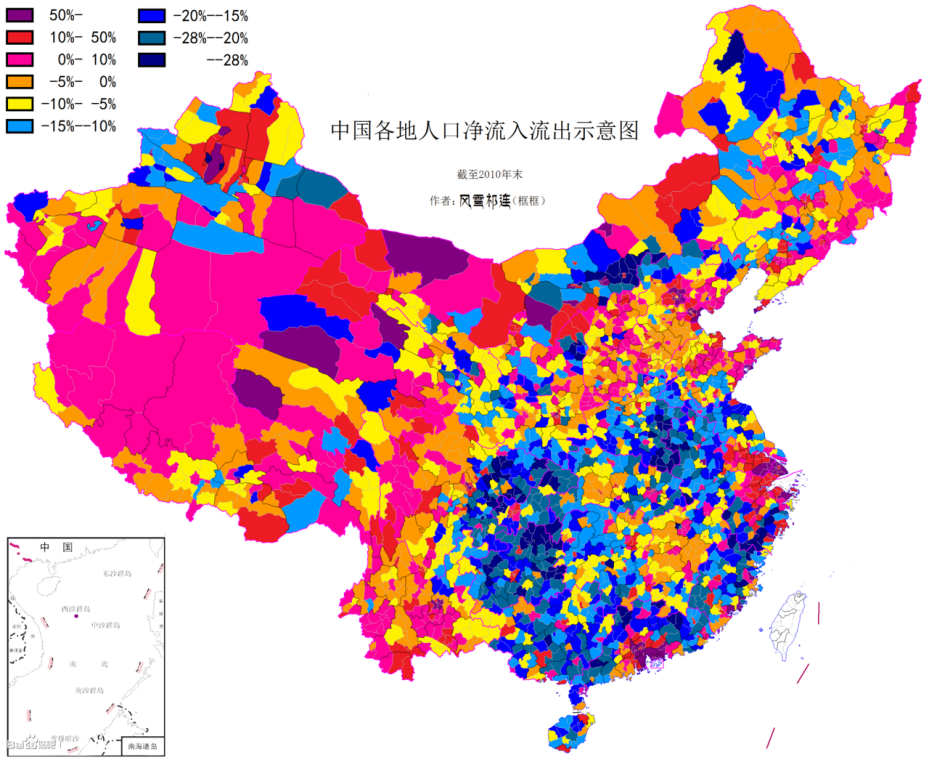
May 14, 2019

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

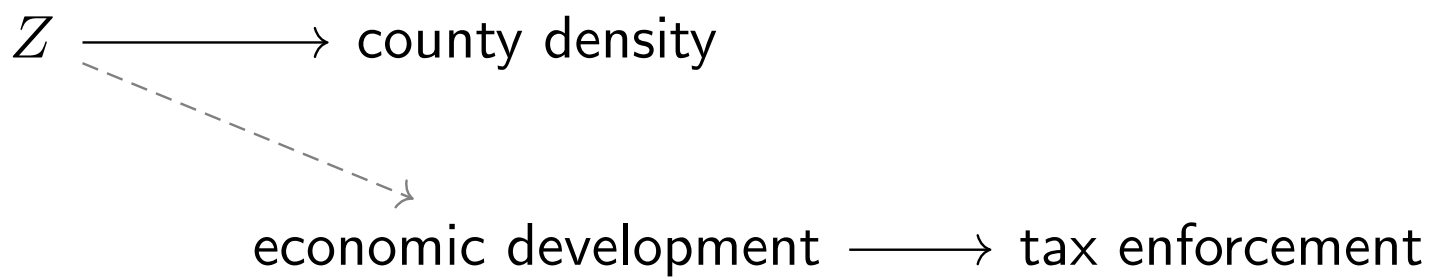
Firms are administered by new county (red), then register back to original

- 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

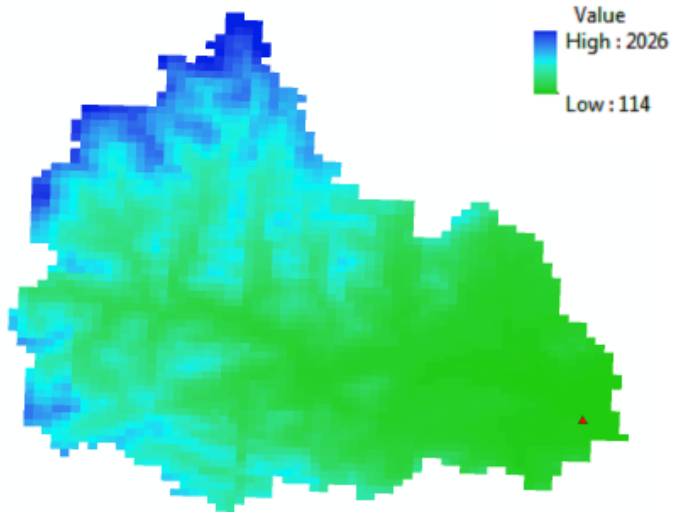
Official: "it was becoming difficult to continue some initiatives as all of the 'rich' villages had already been chosen" (Rogers, 2014).

- 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

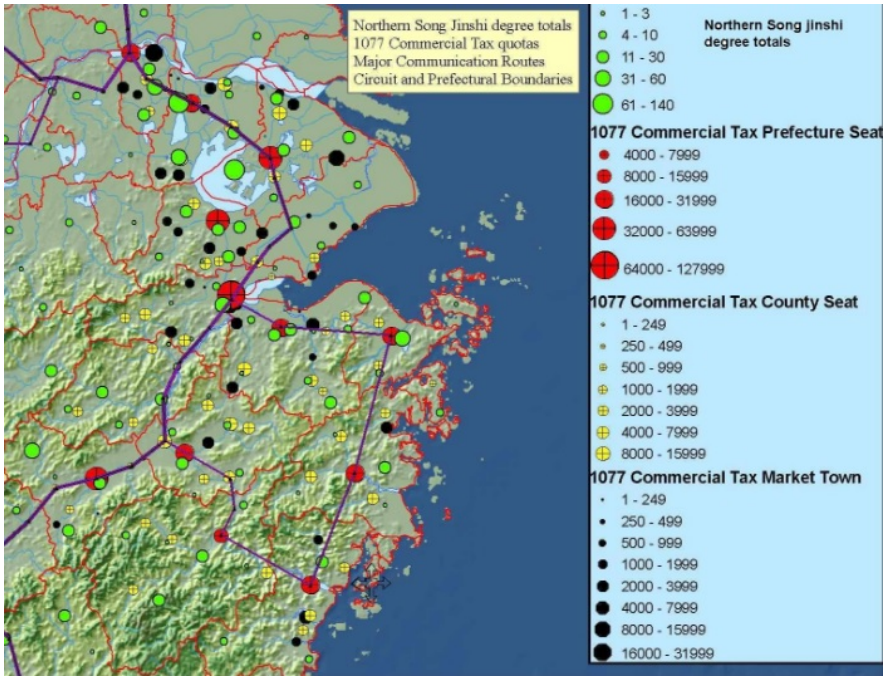
(a) Nightlights



(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

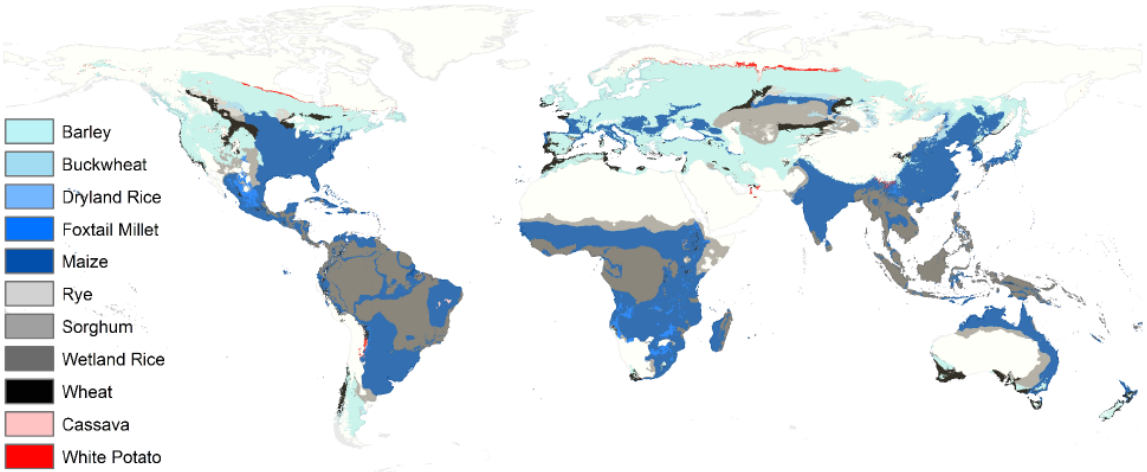


- CHGIS: datasets of administrative system between 221 BC & 1911 AD and major non-administrative towns for 1820 & 1911
- Use digital elevation model (DEM) – constant since 1911
- Calculate variance in elevation over areas of 100km^2

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 β on IV$'$ — spread among fewer counties
- High β, 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 β
- 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

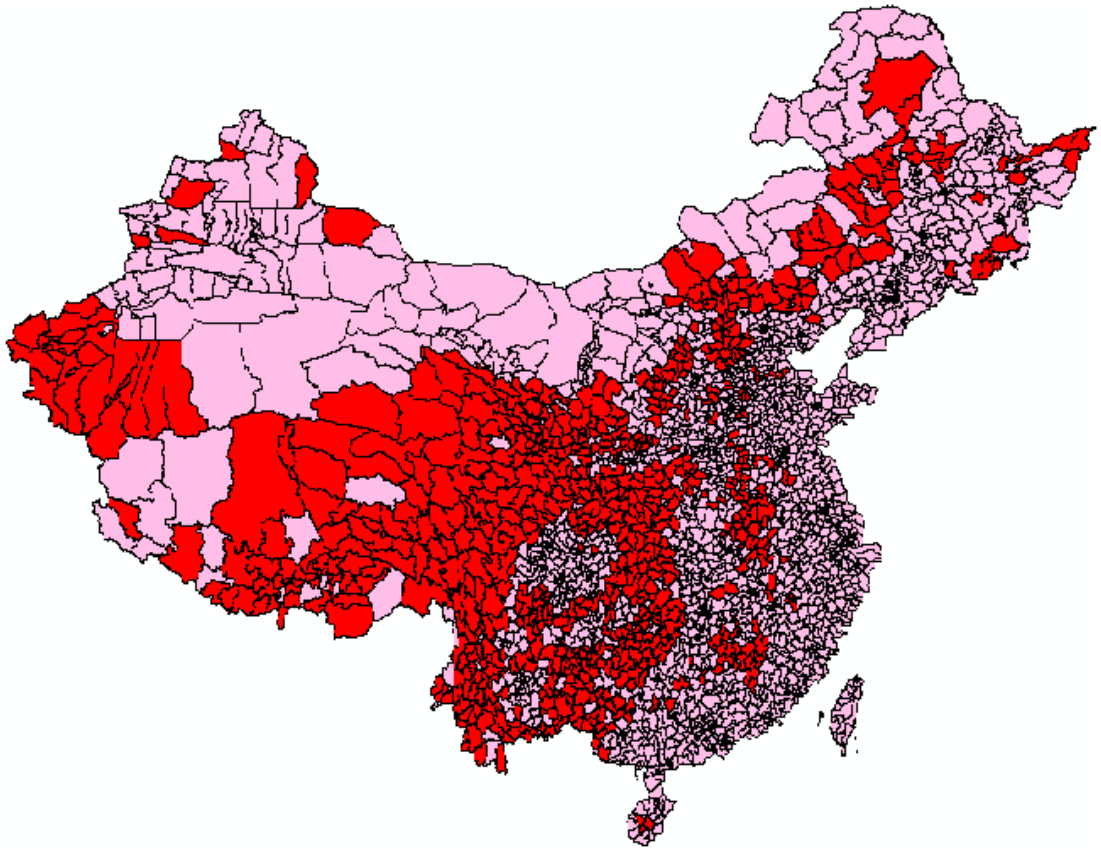
Full sample:

- 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

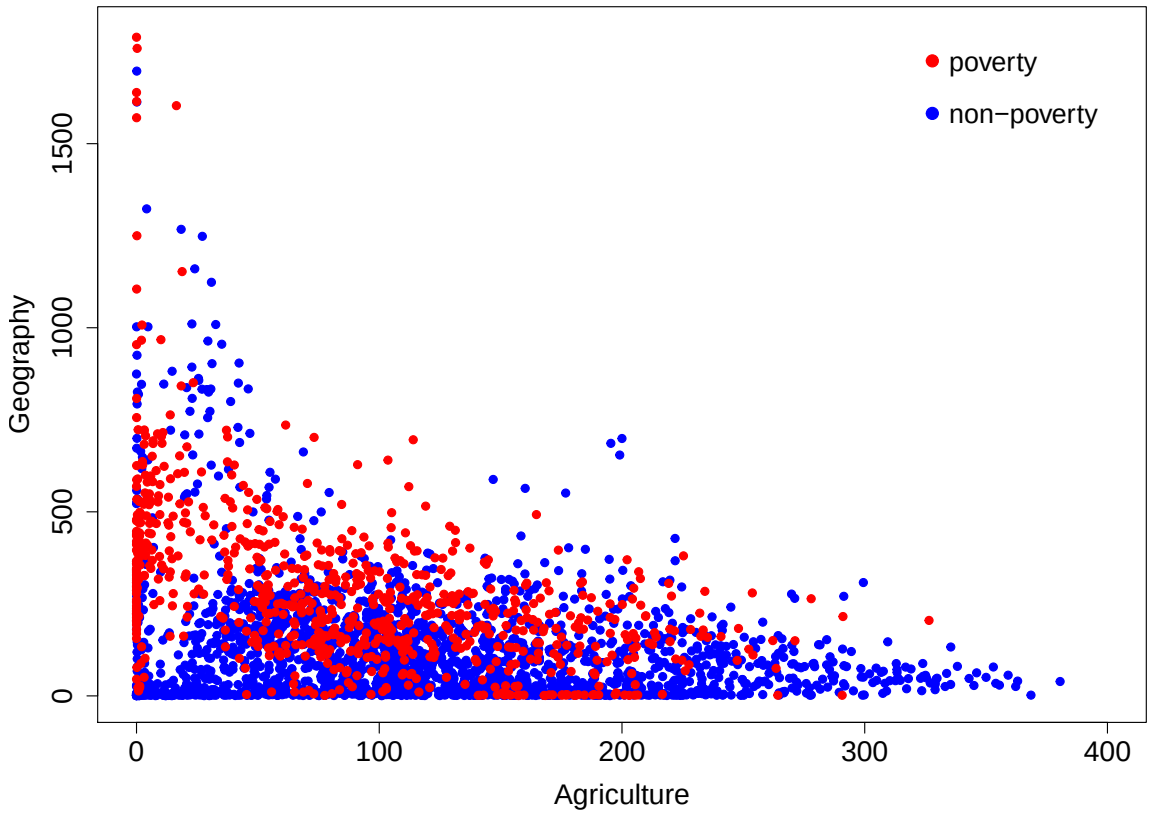
	(1)	(2)	(3)	(4)
geography	−0.012	−0.011	−0.012	−0.010
	(0.001)	(0.001)	(0.001)	(0.001)
agriculture	0.038	0.036	0.038	0.035
	(0.003)	(0.003)	(0.003)	(0.003)
lights	0.064	0.059	0.063	0.058
	(0.003)	(0.003)	(0.003)	(0.003)
poverty		−2.45		−3.74
		(0.38)		(0.73)
pov*light			−0.02	0.08
			(0.02)	(0.05)
density	−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 $(0.58 \div 0.077)$

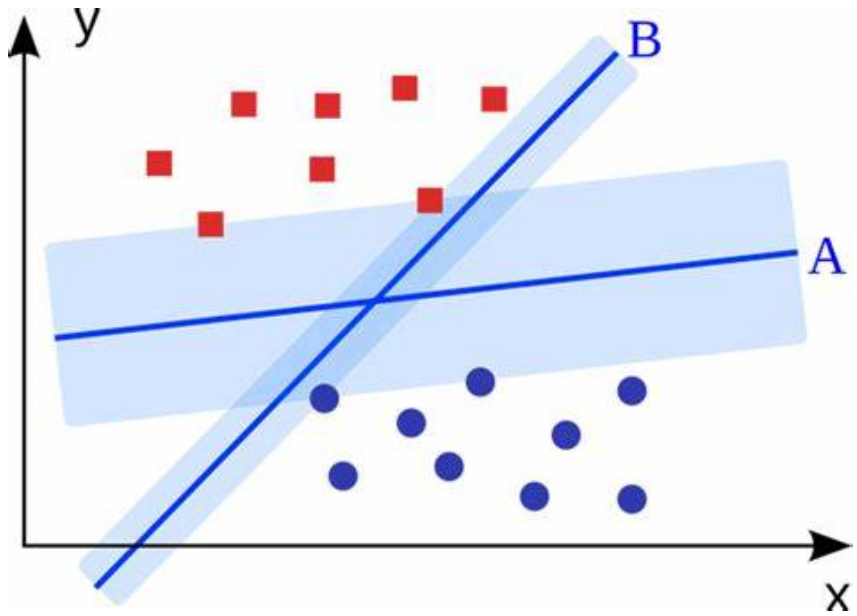
- Take rent-seeking approach
- Dissuades incoming firms
- Perpetuates poverty

Finding #3 – Poverty Counties



- Fertile land but rough terrain → 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!