Bottom-up Institutional Change and Growth in China

Heng Chen
HKU

Bingjing Li
HKU

Xiaodong Zhu
HKU

The ABFER 12th Annual Conference

21 May 2025

Introduction

- The main driver of China's spectacular economic growth during the reform period from 1978-2007 is the total factor productivity (TFP) growth. (Zhu, 2012; Zilibotti, 2017)
- Numerous studies have attempted to identify the sources of its TFP growth:
  - Improvement in factor allocation: capital (Song et al., 2011); labor (Tombe and Zhu, 2019; Hao et al., 2020)
  - Internal and external trade liberalization (Brandt et al., 2017; Tombe and Zhu, 2019)
- Yet, a large residual remains.
- This paper examines the contribution from **bottom-up institutional change**, a prominent aspect within the broader framework of institutional reforms in China.

Introduction

"After the Third Plenary Session of the Fifth National People's Congress, the central government put forward four principles to the local governments. They are as follows:

- *If the central government hasn't considered it, the local government can come up with ideas;*
- *if the central government hasn't given instructions, but the local government sees it fit, they can take action;*
- *if what the central government says doesn't suit the local situation, the local government can make flexible arrangements;*
- *if the central government makes a wrong decision, the local government can debate it."*

—Hu Yaobang, November 1980

Literature

- Institution and economic development:(North, 1990; Acemoglu, Johnson, and Robinson, 2001)
- Policy experimentation in China: institutional setup and political logic (Qian, et al., 2006; Heilmann, 2007; Heilmann, 2008; Xu, 2011), and potential biases in policy learnings (Wang and Yang, 2022)
- Policy diffusion across time and space: cross-country (Buera et al., 2011) and cross-region within the U.S. (Bernecker et al., 2021; DellaVigna and Kim, 2022)
- Quantitative models and empirical studies on the creation and diffusion of ideas: Kortum (1997); Buera and Oberfield (2020); Bloom et al. (2023)
- Centralized v.s. Decentralized systems: Lange (1936); Von Hayek (1945); Aghion et al. (2021)

Roadmap

1. Unique Data:
    * Snapshots of the best-known policy reforms in China
    * Bottom-Up Reform Index
2. Empirical Analysis:
    * Who were the policy innovators?
    * Diffusion of institutional reforms within China's region-based multilevel hierarchical system
    * Correlation between local institutional innovation and economic performance
3. Model on policy innovation and diffusion
    * Based on Kortum (1997) and Buera and Oberfield (2020)
    * Political costs of local policy experimentation

Data

Data: Local Events

- Local events from county-level and prefecture-level gazetteers:

  - After the upheaval of the Cultural Revolution, the Chinese government continued the age-old tradition of compiling local gazetteers. The information and data are sourced from official archives and from the local communities. (Xue, 2010)

  - Text from the chapter on "Chronicle of Events" ("大事记")

    * First round: >646,000 events in 2,515 counties/prefectures of 30 provinces, mostly covering the period 1976-1985.
    * Second round: >1,190,000 events in 2,288 counties/prefectures of 30 provinces, mostly covering the period 1986-2005.
    * A team of RAs spent two years visiting 10+ libraries/archives nationwide to scan and digitize the text data.

- The text data provides a panoramic yet detailed view of the nation's reform period (1978-2005).

▸ Coverage ▸ Selection

Data: Reform Events at the Central Government Level

- Reform Data (reformdata.org), a database maintained by the China Institute of Reform and Development (CIRD)
  - 7,692 reform events documented over the period 1978-2018
  - 25 critical policy reforms over 1978-2005
    * Sectors: urban v.s. rural; state v.s. private
    * Industries: agriculture, industry, real estate, finance, etc.
    * Domains: tax, labor market, pension, land use, migration, trade/FDI, technology, etc.
- Methods to identify county-level events related to these policies:
    * Keywords
    * A supervised machine learning method

▸ Details

Reforms	Year when Central Govt. Gave Partial Consent (1)	Year when Central Govt. Endorsed Nationwide Reform (2)	Bottom-Up Reform Index (3)
Household Responsibility System (家庭联产承包制)	1980	1982	3.033
Privatization of SOEs (国企私有化)	1995	1997	1.888
Urban Credit Coorporative Development (城市信用社发展)	1986	1986	1.792
Developing Township and Village Enterprises (发展乡镇企业)	1979	1984	1.102
Setting Up A Modern Enterprise System (建立现代企业制度)	1993	1999	1.036
Rural Financial Reform (农村金融改革)	1980	1984	0.885
Importing Tech and Complete Sets of Equip (引进新技术和成套设备)	1978	1984	0.707
Hukou Reform (户籍制度改革)	1984	2001	0.671
Labor Contract System (劳动合同制)	1983	1994	0.605
Horizontal Economic Cooperation (横向经济联合)	1980	1986	0.285
Development of Private Economy (发展私营经济)	1988	1997	0.283
Urban Pension System Reform (城镇养老制度改革)	1983	1991	0.278
Transformation of SOEs into Shareholding Companies (企业股份制)	1984	1992	0.127
Land Use System Reform (土地使用制度改革)	1988	1992	-0.028
SOE Managerial Responsibility Contract (经营责任承包制)	1979	1987	-0.137
Development of Individual Economy (发展个体经济)	1979	1982	-0.444
Advancing Western Development (西部大开发)	1999	1999	-0.684
FDI and Special Economic Zones (外资，经济特区)	1980	1992	-0.783
Price Reform (价格改革)	1984	1992	-0.844
Housing Reform (住房制度改革)	1979	1998	-1.001
Bankruptcy Reform (破产制度改革)	1984	2006	-1.078
Wage System Reform (工资体制改革)	1978	1985	-1.119
Rural Tax and Fee Reform (农村税费改革)	1993	2004	-1.565
Substitution of Profit with Taxes (利改税)	1980	1983	-2.138
Tax Sharing Reform (分税制改革)	1992	1994	-2.874

Snapshots of High-Profile Reform Policies and Bottom-Up Reform Index

Snapshots: Bottom-Up Reforms

Household Responsibility System (HRS)

- China's economic reform started in the agricultural sector.
- Over 1978-84, the previous "collective farming system" was gradually shifted to the "household-responsibility system."
  * Households are responsible to remit a fixed amount (quota) of grain to the government, and can keep any additional output
  * The institutional change was an important driver of agricultural productivity growth (McMillan et al., 1989; Lin, 1992)
- In the early stage, the institutional reform was officially banned by the central government
  * The HRS was banned in the landmark meeting known as the Third Plenum of the 11th Central Committee of the CCP in Dec 1978.
  * The *People's Daily* issued commentaries that opposed land reform attempts in March 1979.

Snapshots: Bottom-Up Reforms

Household Responsibility System (HRS)

- So how did the HRS start? Experiment was initiated and carried out by subnational governments without a design at the national level.
- Regions that carried out best-known HRS experiments include Anhui and Sichuan:

▸ Xiaogang Village

  * Anhui and Sichuan were hit hardest by the 1959-1961 famine; Anhui experienced a severe drought in 1978.
  * "To eat grain, look for Ziyang (then the governor of Sichuan); to eat rice, look for Wan Li (then the governor of Anhui)"
- Since 1980, the HRS had received more explicit blessings from the central government.
- In Jan 1982, the Central Committee of the CCP announced its "No. 1 document" for the year, which officially established the HRS for China's agricultural production.

Snapshots: Bottom-Up Reforms

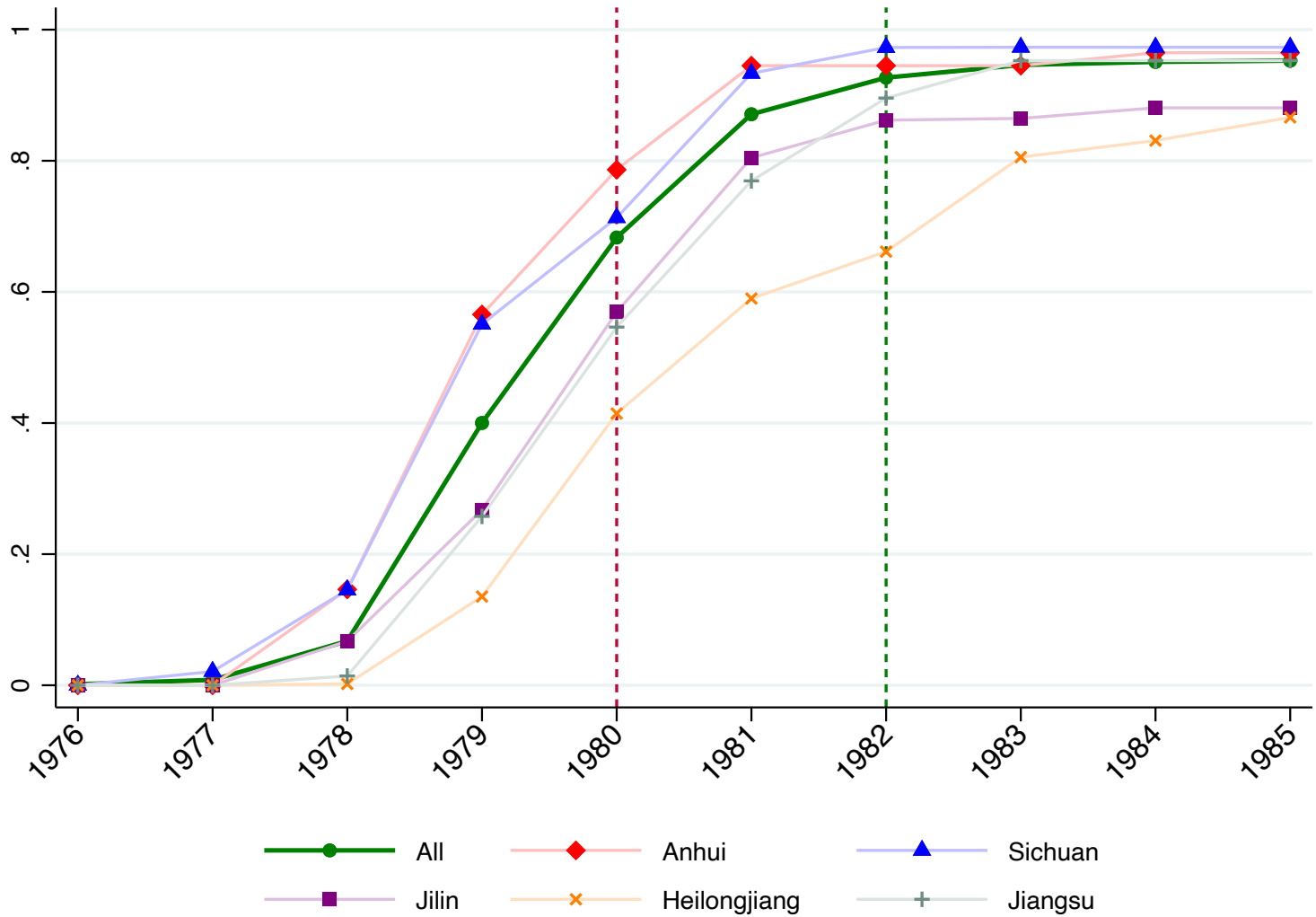
Household Responsibility System (HRS)

- Identify local events related the HRS reform based on keywords:
  - 生产责任制 联产承包 包产到户 包干到户 分田到户 包群到户 大包干 联产到劳 定额计酬 承包土地 土地承包 山林承包 果树承包 水面承包 小段包工 , etc.
  - Production responsibility system, Collective production contracting, Household responsibility system, Household contract responsibility system, Land distribution to households, Collective contract responsibility system to households, Overall contract responsibility system, Collective production to labor system, Quota-based remuneration, Land contracting, Land contract system, Forest land contracting, Fruit tree contracting, Water surface contracting, Piecework subcontracting, etc.
- Policy in Place $= 1$ for a county in year t if any of the keywords are observed in the local events of year t or earlier

Snapshots: Bottom-Up Reforms

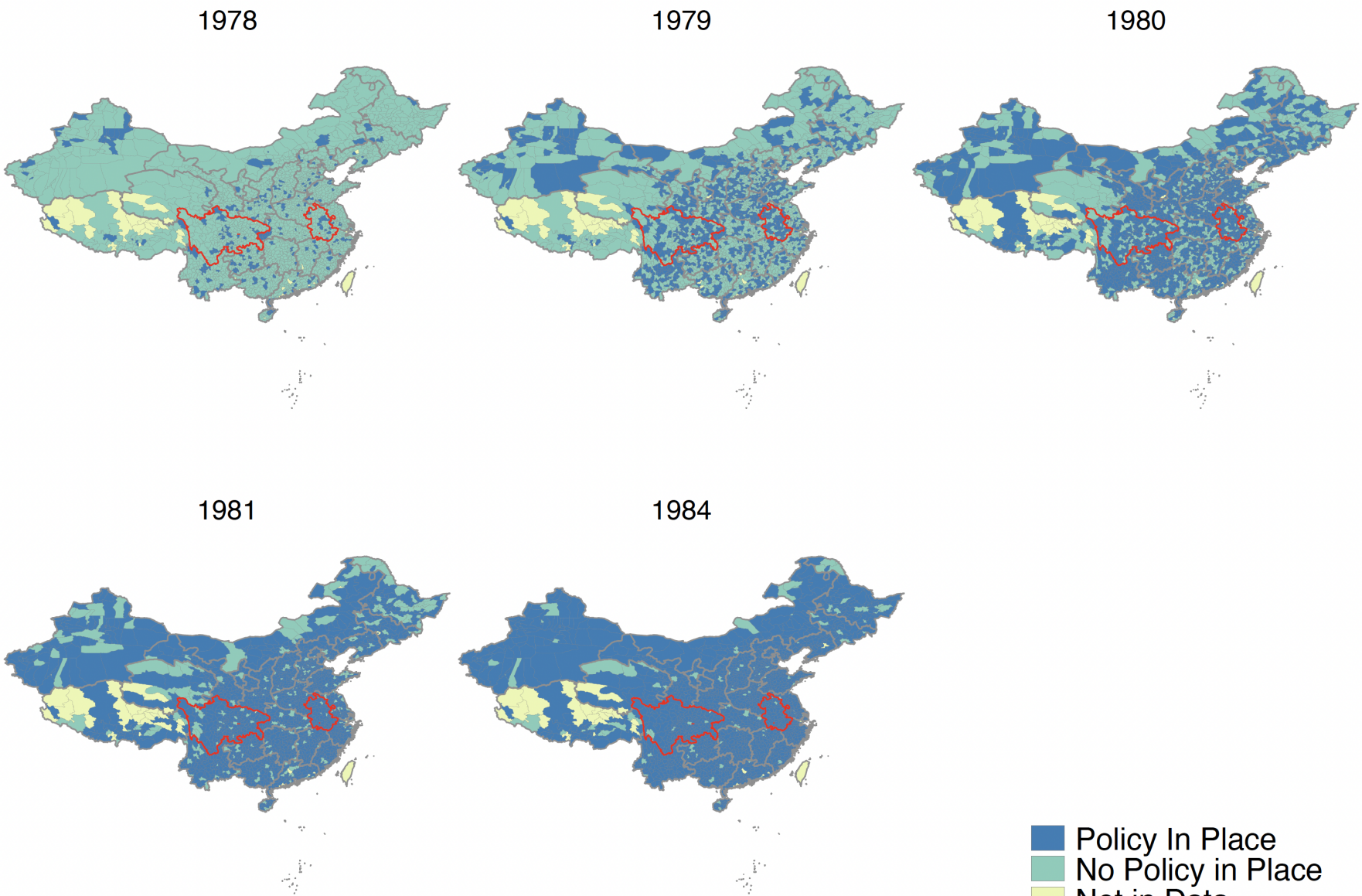
Household Responsibility System (HRS)

Share of Population Living in Counties That Have the HRS in Place



Snapshots: Bottom-Up Reforms

Household Responsibility System (HRS)

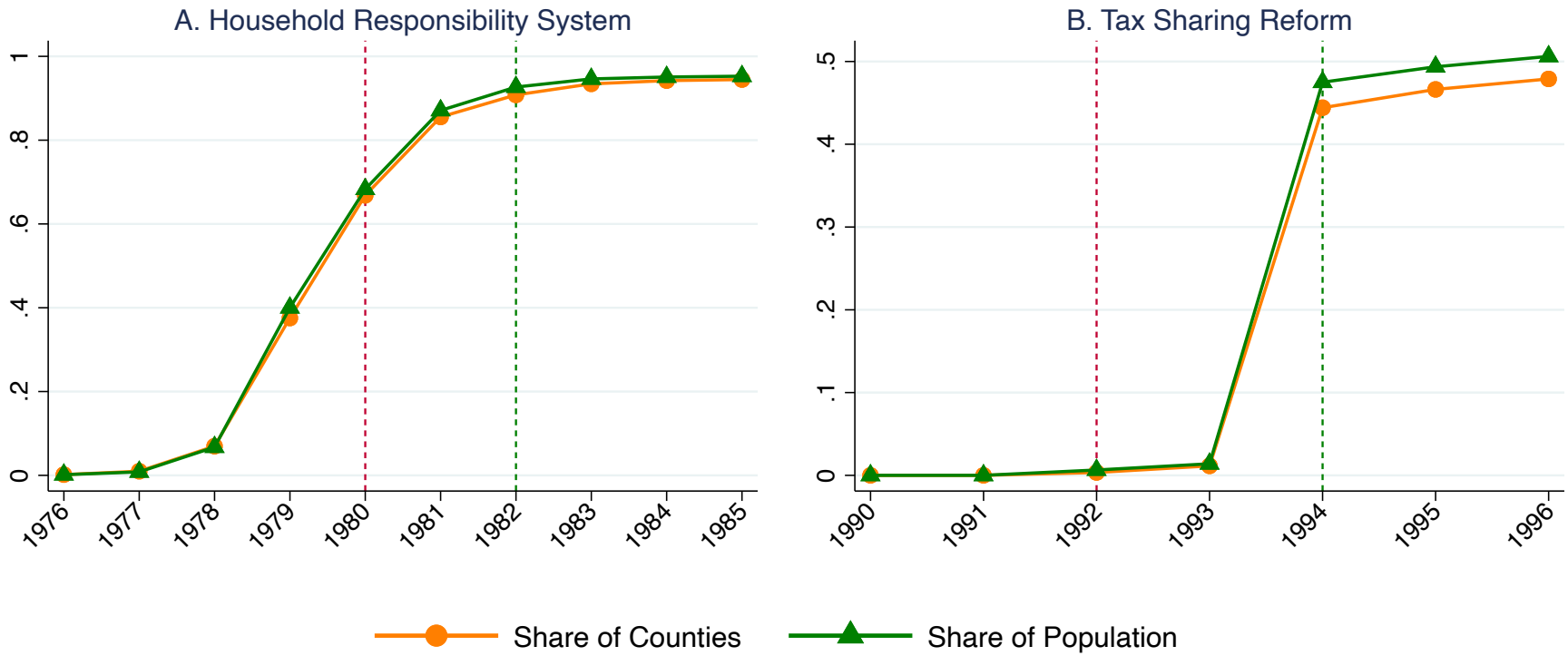


Snapshots: Top-Down Reforms

1994 Tax-Sharing Reform

- Prior to the reform, China implemented a "fiscal responsibility system" whereby local govts only paid a fixed amount of fiscal tax to the central govt every year.
  - The central govt obtained only 22% of the fiscal revenues while the local govts kept the rest.
- The central government initiated a fiscal and taxation system reform in 1992, assigning several regions as experiment sites across the country.
- The reform reclassified the central tax, the local tax, and the shared tax, which enabled more tax sources for central govt.
- The tax-sharing reform was finally implemented in Jan 1994.

Snapshots: Bottom-Up v.s. Top-Down Reforms



- The formation and dissemination processes of reforms vary by:
  - the degree to which local governments initiate the reform experiments;
  - the extent to which the top-down directive influences the reform diffusion.

Bottom-Up Reform Index: Two Sub-indices

(1) *Actions before Central Government's Partial Consent:* The ratio of early adopters to total adopters

* For the HRS, nearly 40% of the counties adopted the reform before the partial consent.
* Apply a zero-skewness log transform of this ratio so that it is approximately normally distributed.

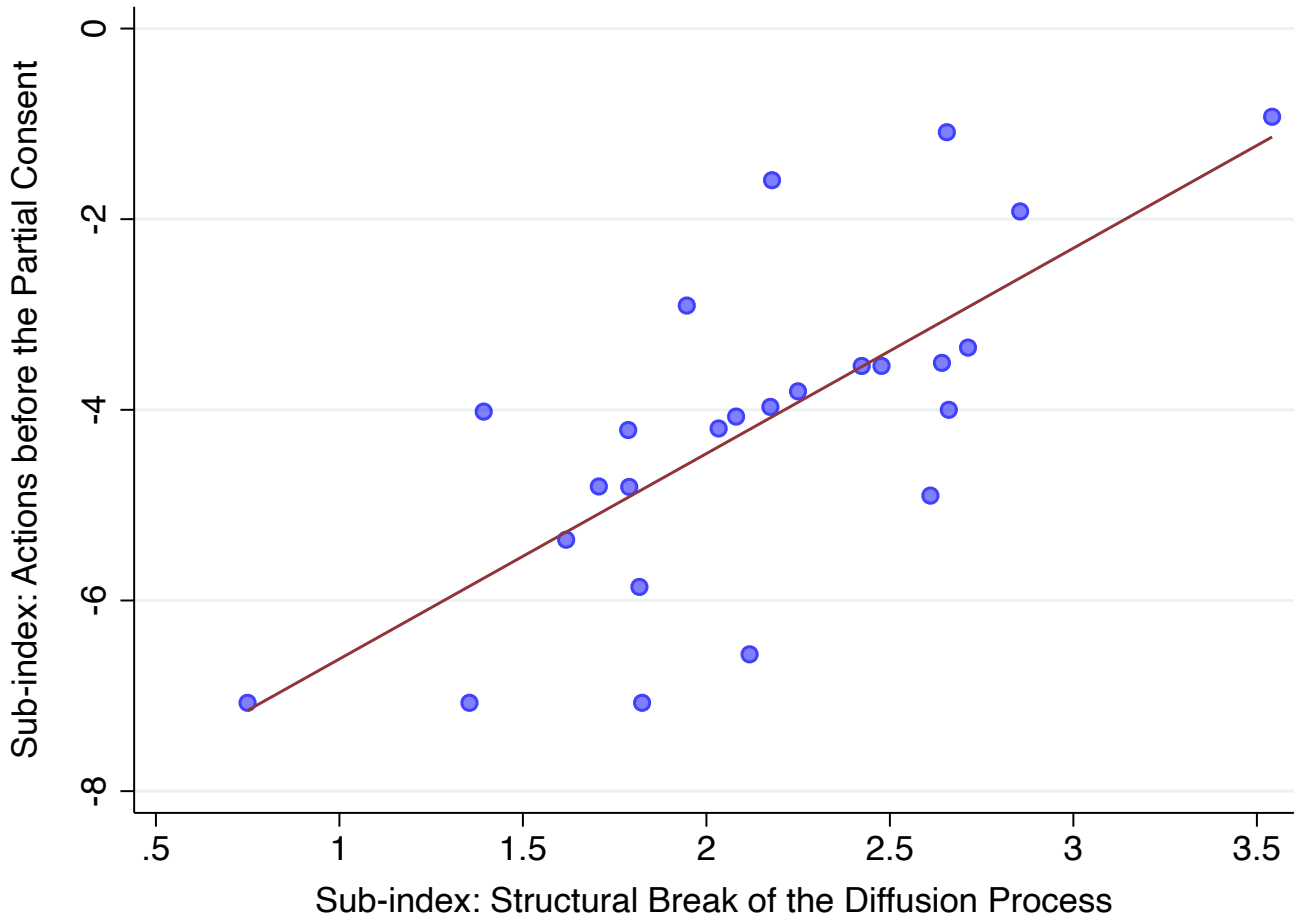
(2) *Structural Break of the Diffusion Process:* The magnitude of the structural break is

$$\Delta Num\ of\ Adopters_{q,t_q} - \Delta Num\ of\ Adopters_{q,t_q-1}$$

where t_q is the year with the largest increase in the adoption rate.

* For the Tax Sharing Reform, the largest diffusion jump ($>$40%) occurring in 1994
* Apply a zero-skewness log transformation to the *negative* value of this structural break measure.

Bottom-Up Reform Index



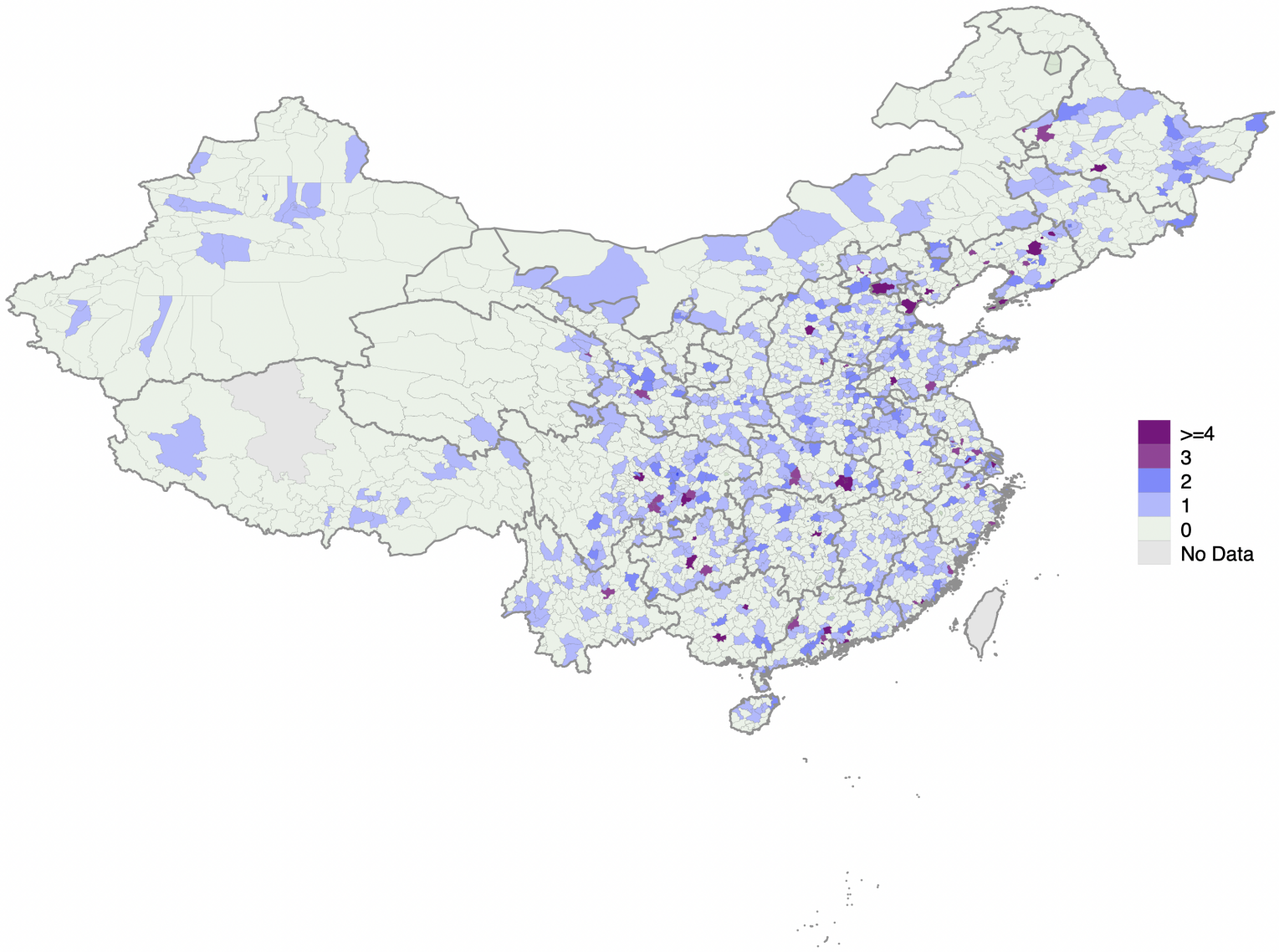
- *Bottom-Up Index*$_q$: the principal component of these two sub-indices

Who Are the Policy Innovators?

Spatial Distribution

▸ Map Hetero.

- PolicyInnovator$_{i,q}$=1 if county i belongs to the first 3 percent of the counties that adopt the policy q



Characteristics of Reform Policy Innovators

- Policy innovation and county characteristics:

$$\text{PolicyInnovator}_{i,q} = \mathbf{X}'_{i0}\gamma + D_q + u_{i,q}$$

- Supply factors:
  - Resources, capacity, or "legislative professionalism" (Besley and Persson, 2009; Mulligan and Shleifer, 2005)
  - Political risks (proxied by the distance to the railway network)
- Demand factors:
  - The suitability of the old institutions for the local economy's needs (e.g., Industry structure)

Characteristics of Reform Policy Innovators

Dependent Variable: $Innovator_{i,q}$	(1)	(2)	(3)
$Share\ College\ or\ above_i$	0.0158**	0.0109	0.0109
	(0.0061)	(0.0066)	(0.0066)
$Bottom\text{-}Up\ Index_q \times Share\ College\ or\ above_i$			0.0025
			(0.0020)
$Share\ Middle\ \&\ High\ School_i$	-0.0021	-0.0004	-0.0004
	(0.0038)	(0.0044)	(0.0044)
$Bottom\text{-}Up\ Index_q \times Share\ Middle\ \&\ High\ School_i$			0.0024
			(0.0016)
$Share\ Agri_i$	-0.0295	-0.0396	-0.0396
	(0.0249)	(0.0280)	(0.0280)
$Bottom\text{-}Up\ Index_q \times Share\ Agri_i$			0.0053
			(0.0064)
$Share\ Ind_i$	-0.0257	-0.0328	-0.0328
	(0.0225)	(0.0244)	(0.0244)
$Bottom\text{-}Up\ Index_q \times Share\ Ind_i$			0.0040
			(0.0046)
$Log\ Pop_i$	0.0263***	0.0262***	0.0262***
	(0.0078)	(0.0068)	(0.0068)
$Bottom\text{-}Up\ Index_q \times Log\ Pop_i$			0.0024
			(0.0019)
$Log\ Dist.\ to\ Railway_i$	0.0029**	0.0029***	0.0029***
	(0.0012)	(0.0010)	(0.0010)
$Bottom\text{-}Up\ Index_q \times Log\ Dist.\ to\ Railway_i$			**0.0014*** **
			(0.0005)
$Log\ Fiscal\ Revenue_i$	-0.0031	-0.0014	-0.0014
	(0.0070)	(0.0045)	(0.0045)
$Bottom\text{-}Up\ Index_q \times Log\ Fiscal\ Revenue_i$			**-0.0025****
			(0.0012)
$Log\ Agri\ \&\ Ind\ Output\ per\ capita_i$	0.0113*	0.0106**	0.0106**
	(0.0057)	(0.0049)	(0.0049)
$Bottom\text{-}Up\ Index_q \times Log\ Agri\ \&\ Ind\ Output\ per\ capita_i$			0.0019
			(0.0018)
coast	0.0007		
	(0.0077)		
Province FEs	N	Y	Y
Reform FEs	N	Y	Y
Observations	56,750	56,750	56,750
R-squared	0.0648	0.0833	0.0842

▸ Robustness: ML ▸ Visits

Spatial Diffusion of Policy Reforms

Empirical Model

- Hazard Model of Diffusion:

$$\ln\left(\frac{P(Y_{iqt}=1)}{1-P(Y_{iqt}=1)}\right) = \alpha\Lambda_{iqt} + \delta Sim_{i,\Omega_{q,t-1}} + X'_{i0}\eta + D_{rqt} + \varepsilon_{iqt}$$

  - For each county i that have not yet adopted policy q in year t, we model the discrete-choice decision to adopt ($Y_{igt}=1$) with a logit specification.
  - For each q, the estimation sample starts in the first year when $\geq$5 counties have adopted the policy, and ends in 5 years after the central govt has endorsed the nationwide adoption of the policy.
  - Standard errors are clustered at the province level.

Empirical Model

- Hazard Model of Diffusion:

$$\ln\left(\frac{P(Y_{iqt}=1)}{1-P(Y_{iqt}=1)}\right) = \alpha\Lambda_{iqt} + \delta Sim_{i,\Omega_{q,t-1}} + X'_{i0}\eta + D_{rqt} + \varepsilon_{iqt}$$

  - Policy learning:

    * Λ_{iqt}: exposure to policy reform q for i in year t

$$\Lambda_{iqt} = \sum_j \frac{(Dist_{ij})^{-1} Pop_{j0}}{\sum_{j'} (Dist_{ij'})^{-1} Pop_{j'0}} \mathbf{1}(j \in \Omega_{q,t-1})$$

    where $\Omega_{q,t-1}$ is the set of counties that had adopted policy q in $t-1$.

Empirical Model

- Hazard Model of Diffusion:

$$\ln\left(\frac{P(Y_{iqt}=1)}{1-P(Y_{iqt}=1)}\right) = \alpha\Lambda_{iqt} + \delta Sim_{i,\Omega_{q,t-1}} + X'_{i0}\eta + D_{rqt} + \varepsilon_{iqt}$$

  - Suitability:
    - $Sim^{Avg}_{i,\Omega_{q,t-1}}$: Similarity between county i to an average county in $\Omega_{q,t-1}$:

$$Sim^{Avg}_{i,\Omega_{q,t-1}} = -\frac{1}{K}\sum_{k}\left[\frac{1}{N_{q,t-1}}\sum_{j\in\Omega_{q,t-1}}\left|x^k_{i0}-x^k_{j0}\right|\right]$$

      where x^k_{i0} represent the baseline characteristics (standardized), including: agricultural employment share, industrial employment share, share of pop with high-school educ, share of pop with college educ or above, and log pop.

Empirical Results

Dependent Variable: $Y_{iqt} = 1$	(1)	(2)	(3)	(4)
Λ_{iqt}	**2.5846*** **	2.6206***	3.5886***	3.6125***
	(0.6981)	(0.6923)	(0.6009)	(0.5972)
Bottom-Up Index$_q \times \Lambda_{iqt}$		0.5799		0.4930
		(0.3901)		(0.4367)
$Sim^{Avg}_{i,\Omega_{q,t-1}}$	**0.6198*** **	0.6049***	0.9883***	0.4467***
	(0.0833)	(0.0833)	(0.0923)	(0.0911)
Bottom-Up Index$_q \times Sim^{Avg}_{i,\Omega_{q,t-1}}$		0.0697***		0.0663***
		(0.0148)		(0.0147)
County Baseline Characteristics	Y	Y	Y	Y
Region×Reform FEs	Y	Y	N	N
Reform×Year FEs	Y	Y	N	N
Region×Year FEs	Y	Y	N	N
Region×Reform×Year FEs	N	N	Y	Y
Observations	587,004	587,004	557,255	557,255

▸ Hetero. ▸ Robustness

Empirical Results

Dependent Variable: $Y_{iqt} = 1$	(1)	(2)	(3)	(4)
Λ_{iqt}	2.5846***	2.6206***	3.5886***	3.6125***
	(0.6981)	(0.6923)	(0.6009)	(0.5972)
Bottom-Up Index$_q \times \Lambda_{iqt}$		**0.5799**		0.4930
		(0.3901)		(0.4367)
$Sim^{Avg}_{i,\Omega_{q,t-1}}$	0.6198***	0.6049***	0.9883***	0.4467***
	(0.0833)	(0.0833)	(0.0923)	(0.0911)
Bottom-Up Index$_q \times Sim^{Avg}_{i,\Omega_{q,t-1}}$		**0.0697*** **		0.0663***
		(0.0148)		(0.0147)
County Baseline Characteristics	Y	Y	Y	Y
Region×Reform FEs	Y	Y	N	N
Reform×Year FEs	Y	Y	N	N
Region×Year FEs	Y	Y	N	N
Region×Reform×Year FEs	N	N	Y	Y
Observations	587,004	587,004	557,255	557,255

▸ Hetero. ▸ Robustness

Local Institutional Innovation and Economic Growth

Empirical Model

$$\Delta \ln y_{p\tau} = \alpha \textit{Policy Innovator}_{p\tau} + \beta \textit{Policy Follower}_{p\tau} + X'_{p0}\gamma_\tau + D_p + D_\tau + u_{p\tau}$$

- $\Delta \ln y_{pt}$: Growth in log GDP per worker (log capital per worker, or log TFP) in province t over a three-year period $t-2$ to t.
- $\textit{Innovation}_{i,q,\tau} = \sum_{\iota=t-3}^{t-1} \textit{Innovator}_{i,q,\iota}$ if county i innovates reform policy q during the period from $t-3$ to $t-1$. Aggregation to the province level:

$$\textit{Policy Innovator}_{p\tau} = \sum_{i \in p} \sum_{q} \frac{\textit{Pop}_{i0}}{\textit{Pop}_{p0}} \textit{Innovation}_{i,q,\tau}$$

- $\textit{Adoption}_{i,q,\tau} = \sum_{\iota=t-3}^{t-1} \textit{Follower}_{i,q,\iota}$ if county i adopts reform policy q during the period from $t-3$ to $t-1$. Aggregation to the province level:

$$\textit{Policy Follower}_{p\tau} = \sum_{i \in p} \sum_{q} \frac{\textit{Pop}_{i0}}{\textit{Pop}_{p0}} \textit{Adoption}_{i,q,\tau}$$

- Eight stacked differences: 1980-1983, 1983-1986, ..., 2001-2004

Empirical Model

To investigate the differential growth enhancing effects of bottom-up reform policy innovations:

$$\begin{aligned}\Delta \ln y_{p\tau} =& \alpha_1 \textit{Policy Innovator}_{p\tau} + \alpha_2 \textit{Bottom-Up Policy Innovator}_{p\tau} \\ &+ \beta_1 \textit{Policy Follower}_{p\tau} + \beta_2 \textit{Bottom-Up Policy Follower}_{p\tau} \\ &+ X'_{p0}\gamma_\tau + D_p + D_\tau + u_{p\tau}\end{aligned}$$

where

$$\textit{Bottom-Up Policy Innovator}_{p\tau} = \sum_{i \in p} \sum_{q} \textit{Bottom-Up Index}_q \times \frac{\textit{Pop}_{i0}}{\textit{Pop}_{p0}} \times \textit{Innovator}_{i,q,\tau},$$

$$\textit{Bottom-Up Policy Follower}_{p\tau} = \sum_{i \in p} \sum_{q} \textit{Bottom-Up Index}_q \times \frac{\textit{Pop}_{i0}}{\textit{Pop}_{p0}} \times \textit{Follower}_{i,q,\tau}$$

Empirical Results

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	**0.0878*** **	0.0608**	0.0595**	0.0458*
	(0.0317)	(0.0287)	(0.0280)	(0.0229)
Policy Follower$_{p\tau}$	0.0077	0.0170**	0.0175**	-0.0384***
	(0.0105)	(0.0083)	(0.0080)	(0.0098)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.4764***		
		(0.0592)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7230	0.8007	0.7324	0.6354

Empirical Results

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	0.0878***	**0.0608****	**0.0595****	0.0458*
	(0.0317)	(0.0287)	(0.0280)	(0.0229)
Policy Follower$_{p\tau}$	0.0077	**0.0170****	**0.0175****	-0.0384***
	(0.0105)	(0.0083)	(0.0080)	(0.0098)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.4764***		
		(0.0592)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7230	0.8007	0.7324	0.6354

Empirical Results

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	0.0878***	0.0608**	0.0595**	**0.0458***
	(0.0317)	(0.0287)	(0.0280)	(0.0229)
Policy Follower$_{p\tau}$	0.0077	0.0170**	0.0175**	**-0.0384*****
	(0.0105)	(0.0083)	(0.0080)	(0.0098)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.4764***		
		(0.0592)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7230	0.8007	0.7324	0.6354

Empirical Results

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	0.0434	0.0267	0.0251	0.0749**
	(0.0348)	(0.0349)	(0.0349)	(0.0288)
Bottom-Up Policy Innovator$_{p\tau}$	**0.0838*****	0.0654**	0.0636**	-0.0497**
	(0.0297)	(0.0262)	(0.0260)	(0.0238)
Policy Follower$_{p\tau}$	0.0095	0.0175*	0.0182**	-0.0372***
	(0.0105)	(0.0085)	(0.0084)	(0.0083)
Bottom-Up Policy Follower$_{p\tau}$	**0.0303****	0.0201**	0.0191*	-0.0021
	(0.0132)	(0.0095)	(0.0094)	(0.0102)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.4561***		
		(0.0518)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7691	0.8305	0.7691	0.6350

▸ Pre-trend ▸ IPS ▸ Robustness

Empirical Results

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	0.0434	0.0267	0.0251	0.0749**
	(0.0348)	(0.0349)	(0.0349)	(0.0288)
Bottom-Up Policy Innovator$_{p\tau}$	0.0838***	0.0654**	**0.0636****	-0.0497**
	(0.0297)	(0.0262)	(0.0260)	(0.0238)
Policy Follower$_{p\tau}$	0.0095	0.0175*	0.0182**	-0.0372***
	(0.0105)	(0.0085)	(0.0084)	(0.0083)
Bottom-Up Policy Follower$_{p\tau}$	0.0303**	0.0201**	**0.0191***	-0.0021
	(0.0132)	(0.0095)	(0.0094)	(0.0102)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.4561***		
		(0.0518)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7691	0.8305	0.7691	0.6350

▸ Pre-trend ▸ IPS ▸ Robustness

Empirical Results

Dependent Variable:	$\Delta \ln GDP$ per $worker_{p\tau}$ (1)	$\Delta \ln GDP$ per $worker_{p\tau}$ (2)	$\Delta \ln TFP_{p\tau}$ ($\alpha = 0.5$) (3)	$\Delta Investment\ Rate_{p\tau}$ (4)
$Policy\ Innovator_{p\tau}$	0.0434	0.0267	0.0251	0.0749**
	(0.0348)	(0.0349)	(0.0349)	(0.0288)
$Bottom\text{-}Up\ Policy\ Innovator_{p\tau}$	0.0838***	0.0654**	0.0636**	**-0.0497****
	(0.0297)	(0.0262)	(0.0260)	(0.0238)
$Policy\ Follower_{p\tau}$	0.0095	0.0175*	0.0182**	-0.0372***
	(0.0105)	(0.0085)	(0.0084)	(0.0083)
$Bottom\text{-}Up\ Policy\ Follower_{p\tau}$	0.0303**	0.0201**	0.0191*	-0.0021
	(0.0132)	(0.0095)	(0.0094)	(0.0102)
$\Delta \ln Capital\ per\ worker_{p\tau}$		0.4561***		
		(0.0518)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7691	0.8305	0.7691	0.6350

▸ Pre-trend ▸ IPS ▸ Robustness

Prefecture-Level Evidence: Firm Entry

Dependent Variable:	*Entries of Private Firms per Capita*$_{j\tau}$			*Entries of SOEs&COEs per Capita*$_{j\tau}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Innovator$_{j\tau}$	0.3155***	0.3569***	0.0395*	0.0429	0.0389	-0.0418
	(0.1120)	(0.1002)	(0.0217)	(0.0413)	(0.0431)	(0.0517)
Bottom-Up Policy Innovator$_{j\tau}$		0.1452**	**0.0337****		-0.0559**	**-0.0484***
		(0.0680)	(0.0170)		(0.0223)	(0.0263)
Policy Follower$_{j\tau}$	0.0340**	0.0374**	0.0038	0.0095*	0.0115**	0.0025
	(0.0139)	(0.0147)	(0.0031)	(0.0051)	(0.0052)	(0.0025)
Bottom-Up Policy Follower$_{j\tau}$		0.0157*	**0.0053***		0.0117**	**0.0079****
		(0.0080)	(0.0029)		(0.0048)	(0.0038)
Prefecture Baseline Characteristics×Period	Y	Y	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y	Y	Y
Prefecture	N	N	Y	N	N	Y
Observations	2,608	2,608	2,608	2,608	2,608	2,608

- Data: The Business Registry Database

▸ Pre-trend ▸ IPS ▸ Robustness

County-Level Evidence: Structural Transformation

Dependent Variable:	Δ ln *Share Agri*$_{i\tau}$			
Sample:	82-90,90-00,00-05		82-90,90-00	
	(1)	(2)	(3)	(4)
Policy Innovator$_{i\tau}$	-0.0551**	-0.0544**	-0.0550**	-0.0544**
	(0.0230)	(0.0219)	(0.0229)	(0.0217)
Bottom-Up Policy Innovator$_{i\tau}$		**-0.0185***		**-0.0193***
		(0.0095)		(0.0098)
Policy Follower$_{i\tau}$	0.0022**	0.0018*	0.0020	0.0016
	(0.0010)	(0.0011)	(0.0020)	(0.0021)
Bottom-Up Policy Follower$_{i\tau}$		**-0.0031**		**-0.0051***
		(0.0021)		(0.0029)
County Baseline Characteristics×Period	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y
Observations	6,806	6,806	4,539	4,539
R-squared	0.2872	0.2879	0.1798	0.1814

- Data: Population Censuses 1982, 1990, 2000 and 2010

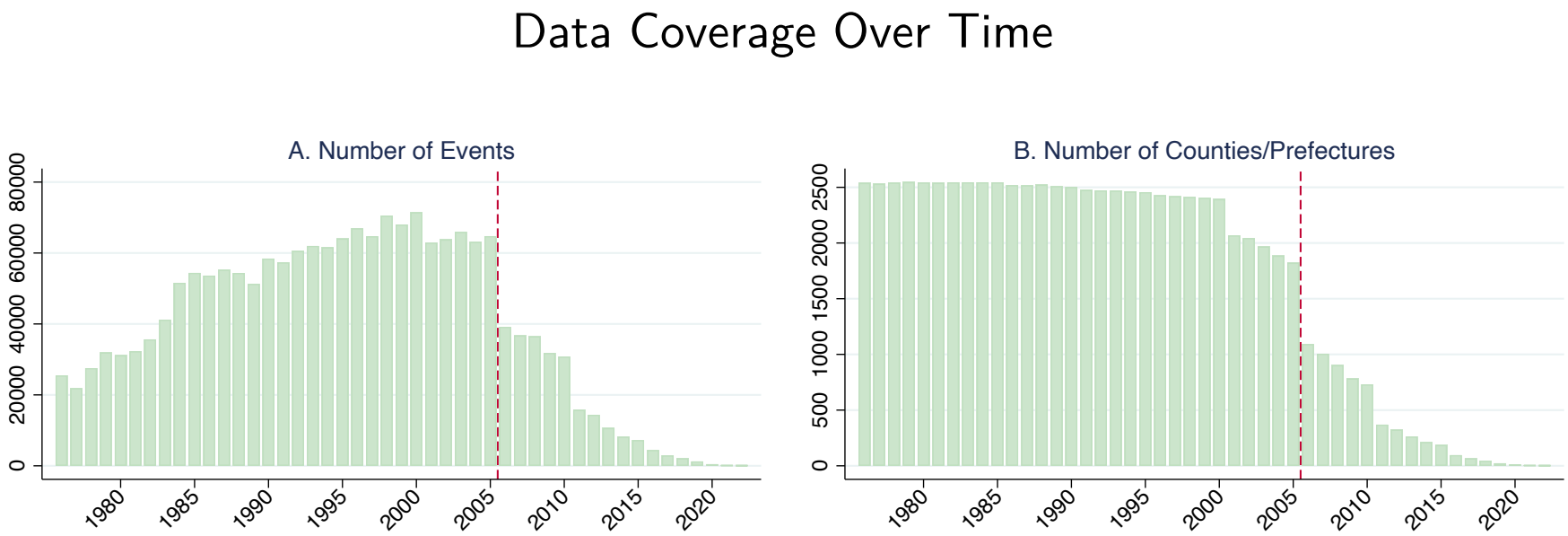
▸ Pre-trend ▸ IPS ▸ Robustness

Concluding Remarks

- We compiled a large textual database about local government actions, and use it to measure policy changes. Some empirical results:
  - Characteristics of the policy innovators
  - Spatial diffusion patterns of institutional innovations
  - Effects of bottom-up and centrally sponsored/top-down policy changes on GDP and TFP growth
- Lessons from China's growth experience:
  - Many think that a strong central government and its willingness to reform through experimentation is the key to China's economic success.
  - In contrast, we argue that it's the bottom-up innovations of farmers, entrepreneurs, and low-level government officials that are the key to China's growth miracle.

Appendix

Data: Local Events

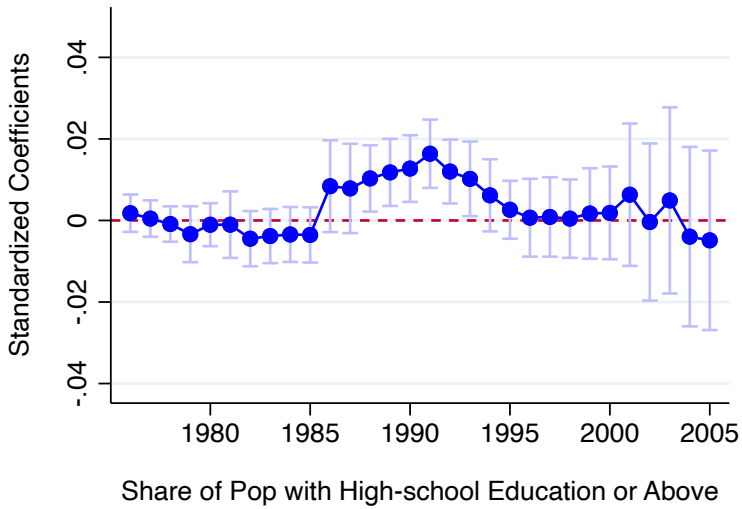


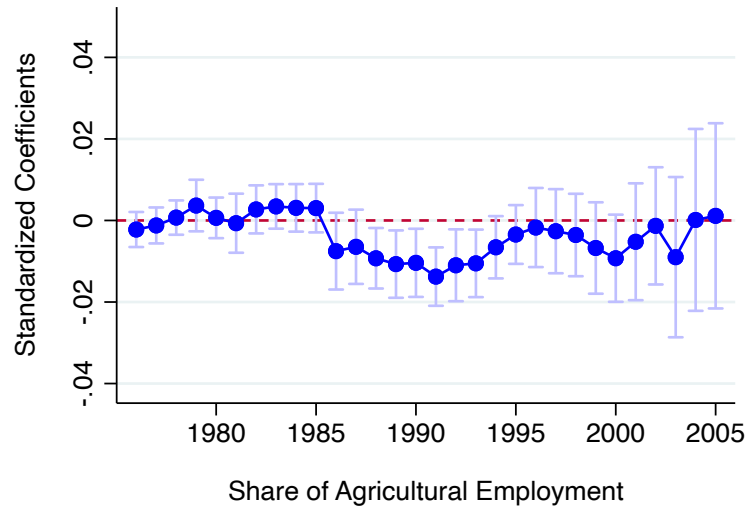
▸ Back

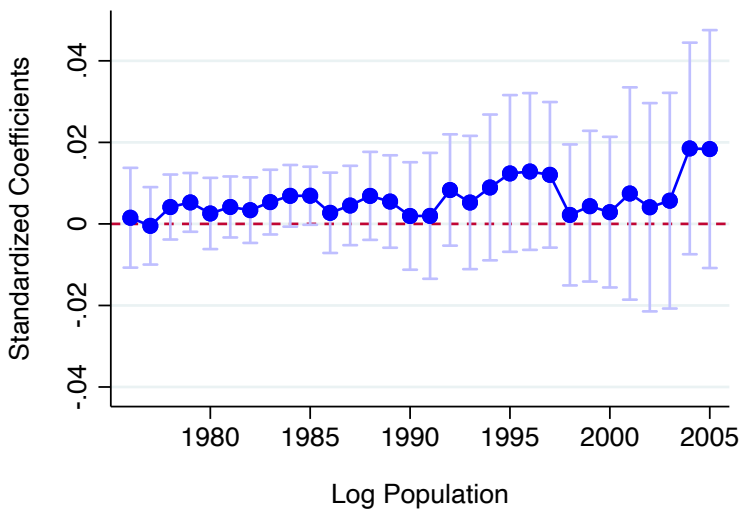
Data: Local Events

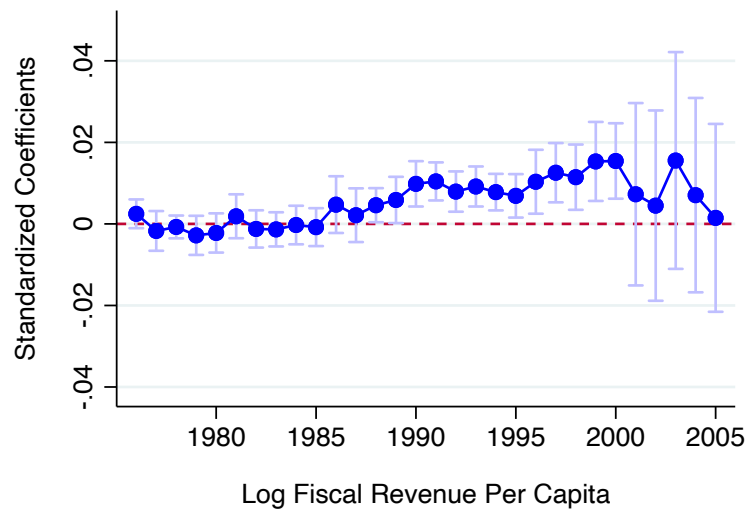
Back

Selective Attrition? Missing Status and County Characteristics

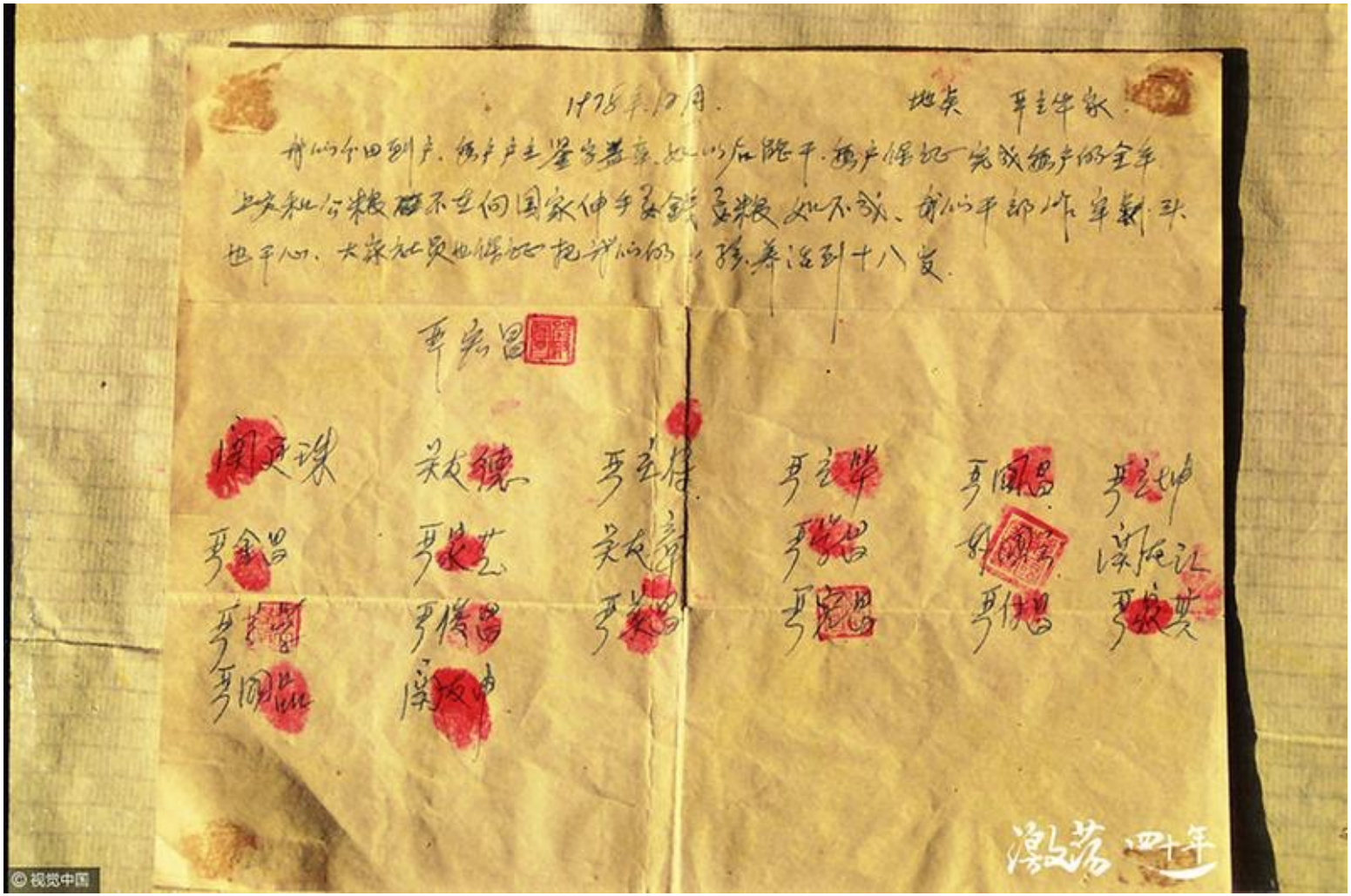








Xiaogang Village in Fengyang County of Anhui



A contract agreement signed by local government and peasants

Back

Supervised Learning: Construct a Training Set

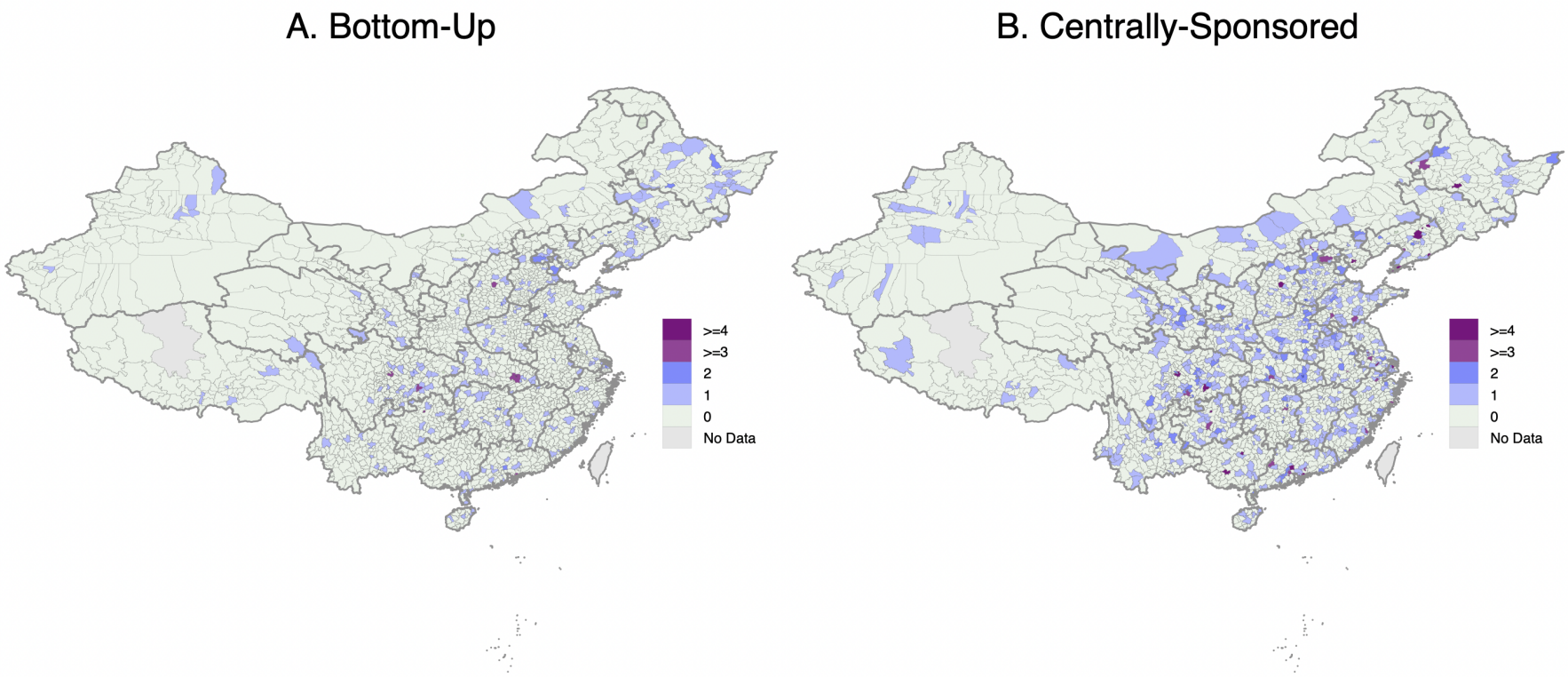
- Randomly select 400 urban counties and 400 rural counties from our sample.
- Pool and shuffle the gazetteer entries from those counties.
- Search entries for those that can be labelled as one of the 23 policies.
- Stop searching when there are sufficient entries found for each policy (i.e., 100 entries for each policy).
- Select randomly 10,125 entries unrelated to any of the policies.
- Totalling around 12,500 entries

Supervised Learning: Train a Classification Model

- BERT, a large language model (LLM), has popularized the approach of "pre-trained model + fine-tuning" for NLP tasks.
  - Replace the original output layer of a pre-trained model (RoBERTa in our case) with a task-specific layer (classification in our case).
  - Train the model to learn task-specific features, leveraging the pre-trained knowledge for faster and better performance on the new task.
  - Use *Bert For Sequence Classification* package with the Focal Loss function (to address sample imbalance).
  - The model was used to label any entries not in the training set.

Back

Spatial Distribution: Bottom-Up v.s. Centrally Sponsored



Back

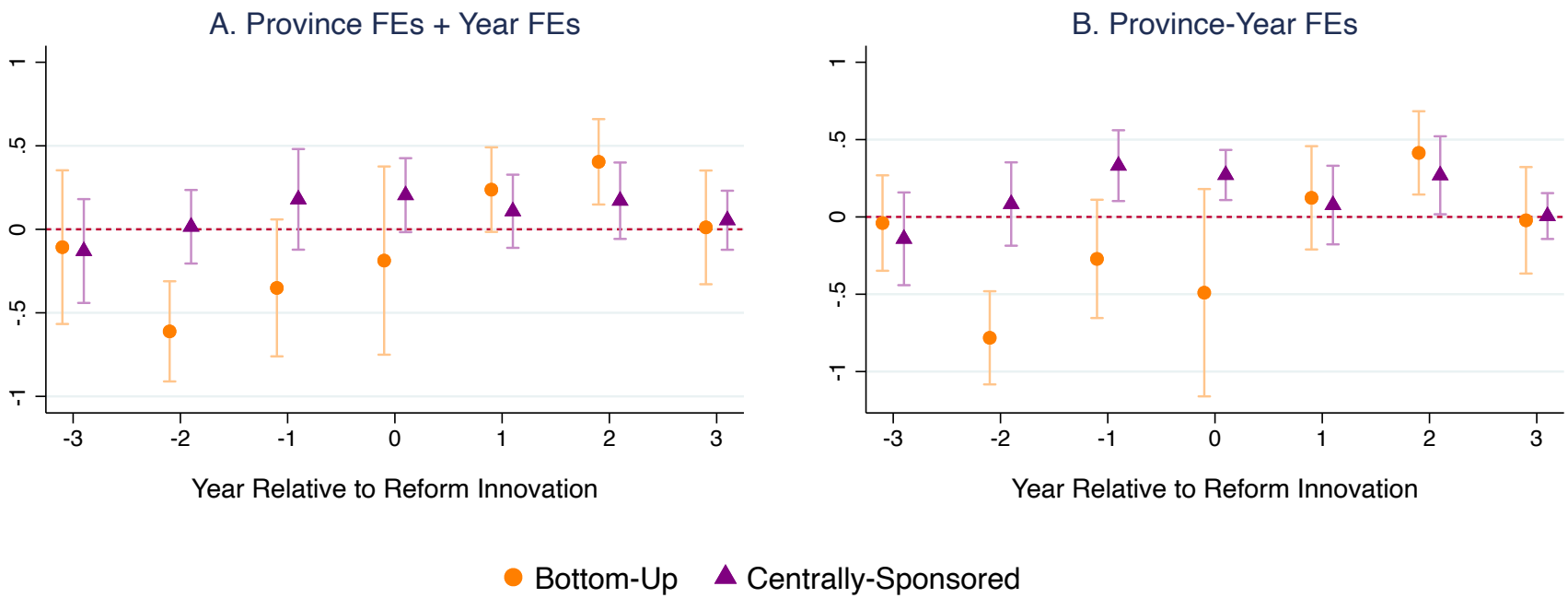
Robustness: Characteristics of Reform Policy Innovators

Dependent Variable: $Innovator_{i,q}$	(1) OLS	(2) OLS	(3) OLS	(4) IV
$Share\ College\ or\ above_i$	0.0169**	0.0133*	0.0133*	0.0109
	(0.0065)	(0.0075)	(0.0075)	(0.0066)
$Bottom\text{-}Up\ Index_q \times Share\ College\ or\ above_i$			0.0044*	0.0037
			(0.0025)	(0.0023)
$Share\ Middle\ \&\ HighSchool_i$	0.0000	0.0013	0.0013	-0.0004
	(0.0055)	(0.0065)	(0.0065)	(0.0044)
$Bottom\text{-}Up\ Index_q \times Share\ Middle\ \&\ HighSchool_i$			0.0007	0.0026*
			(0.0010)	(0.0014)
$Share\ Agri_i$	-0.0314	-0.0334	-0.0334	-0.0396
	(0.0272)	(0.0302)	(0.0302)	(0.0280)
$Bottom\text{-}Up\ Index_q \times Share\ Agri_i$			0.0066	0.0070
			(0.0067)	(0.0068)
$Share\ Ind_i$	-0.0272	-0.0297	-0.0297	-0.0328
	(0.0242)	(0.0257)	(0.0257)	(0.0244)
$Bottom\text{-}Up\ Index_q \times Share\ Ind_i$			0.0056	0.0053
			(0.0051)	(0.0050)
$Log\ Pop_i$	0.0275***	0.0280***	0.0280***	0.0262***
	(0.0079)	(0.0075)	(0.0075)	(0.0068)
$Bottom\text{-}Up\ Index_q \times Log\ Pop_i$			0.0036	0.0027
			(0.0034)	(0.0026)
$Log\ Dist.\ to\ Railway_i$	0.0021**	0.0025***	0.0025***	0.0029***
	(0.0010)	(0.0009)	(0.0009)	(0.0010)
$Bottom\text{-}Up\ Index_q \times Log\ Dist.\ to\ Railway_i$			0.0008*	0.0014***
			(0.0005)	(0.0005)
$Log\ Fiscal\ Revenue_i$	-0.0040	-0.0020	-0.0020	-0.0014
	(0.0070)	(0.0049)	(0.0049)	(0.0045)
$Bottom\text{-}Up\ Index_q \times Log\ Fiscal\ Revenue_i$			-0.0022	-0.0021
			(0.0024)	(0.0016)
$Log\ Agri\ \&\ Ind\ Output\ per\ capita_i$	0.0093	0.0108**	0.0108**	0.0106**
	(0.0055)	(0.0048)	(0.0048)	(0.0049)
$Bottom\text{-}Up\ Index_q \times Log\ Agri\ \&\ Ind\ Output\ per\ capita_i$			0.0020	0.0021
			(0.0016)	(0.0019)
coast	0.0005			
	(0.0068)			
Province FEs	N	Y	Y	Y
Reform FEs	N	Y	Y	Y
Observations	56,750	56,750	56,750	56,750
R-squared	0.0648	0.0833	0.0842	–

▸ Back

Visits by the Politburo Standing Committee Members

$$NumVisit_{it} = \exp\Big(\sum_{\tau=-3}^{3} \beta^{\tau} NumInnov^{BU}_{i,t-\tau} + \sum_{\tau=-3}^{3} \gamma^{\tau} NumInnov^{CS}_{i,t-\tau} + X'_{i0}\delta + D_p + D_t \Big)\varepsilon_{it}$$



▸ Back

Spatial Diffusion of Policy Reforms: Heterogeneity

Dependent Variable: $Y_{iqt} = 1$	(1)	(2)	(3)	(4)
Λ_{iqt} (within prov)	0.7700***			
	(0.1462)			
Λ_{iqt} (outside prov)	0.4967			
	(1.0475)			
$Sim^{Avg}_{i,\Omega_{q,t-1}}$ (within prov)	0.2460***			
	(0.0586)			
$Sim^{Avg}_{i,\Omega_{q,t-1}}$ (outside prov)	0.4007***			
	(0.0930)			
Λ_{iqt}		2.3188**	3.7386***	0.9780
		(0.9265)	(0.8356)	(1.1820)
$Sim^{Avg}_{i,\Omega_{q,t-1}}$		0.6935***	0.5179***	0.4286***
		(0.1184)	(0.0773)	(0.1517)
Sample:	All	1976-1985	1986-1995	1996-2005
County Baseline Characteristics	Y	Y	Y	Y
Region×Reform FEs	Y	Y	Y	Y
Reform×Year FEs	Y	Y	Y	Y
Region×Year FEs	Y	Y	Y	Y
Observations	480,819	219,442	264,935	100,745

▸ Back

Robustness: Spatial Diffusion of Policy Reforms

Dependent Variable: $Y_{iqt} = 1$	(1)	(2)	(3)	(4)
Panel A: Alternative Measure of Suitability				
Λ_{iqt}	2.8276***	2.8604***	3.8513***	3.8744***
	(0.7024)	(0.6970)	(0.6015)	(0.5969)
Bottom-Up Index$_q \times \Lambda_{iqt}$		0.5631		0.4689
		(0.3856)		(0.4318)
$Sim^{p10}_{i,\Omega_{q,t-1}}$	1.1541***	1.1249***	1.1557***	1.1294***
	(0.0906)	(0.0909)	(0.0893)	(0.0898)
Bottom-Up Index$_q \times Sim^{p10}_{i,\Omega_{q,t-1}}$		0.0617***		0.0566**
		(0.0228)		(0.0228)
Observations	587,004	587,004	557,255	557,255
Panel B: Linear Probability Model				
Λ_{iqt}	0.1789***	0.1815***	0.2388***	0.2397***
	(0.0364)	(0.0356)	(0.0324)	(0.0317)
Bottom-Up Index$_q \times \Lambda_{iqt}$		0.0419		0.0226
		(0.0252)		(0.0274)
$Sim^{Avg}_{i,\Omega_{q,t-1}}$	0.0063**	0.0058**	0.0063**	0.0058**
	(0.0027)	(0.0027)	(0.0026)	(0.0026)
Bottom-Up Index$_q \times Sim^{Avg}_{i,\Omega_{q,t-1}}$		0.0058***		0.0055***
		(0.0012)		(0.0012)
Observations	587,004	587,004	587,004	587,004
Panel C: Alternative Measures Based on ML+Manual Annotation				
Λ_{iqt}	2.5772***	2.5888***	3.6012***	3.6015***
	(0.8016)	(0.8033)	(0.7152)	(0.7175)
Bottom-Up Index$_q \times \Lambda_{iqt}$		0.2584		0.1278
		(0.4150)		(0.4326)
$Sim^{Avg}_{i,\Omega_{q,t-1}}$	0.6368***	0.6215***	0.6295***	0.6155***
	(0.0798)	(0.0790)	(0.0804)	(0.0796)
Bottom-Up Index$_q \times Sim^{Avg}_{i,\Omega_{q,t-1}}$		0.0799***		0.0759***
		(0.0163)		(0.0159)
Observations	605,217	605,217	571,489	571,489
County Baseline Characteristics	Y	Y	Y	Y
Region×Reform FEs	Y	Y	N	N
Reform×Year FEs	Y	Y	N	N
Region×Year FEs	Y	Y	N	N
Region×Reform×Year FEs	N	N	Y	Y

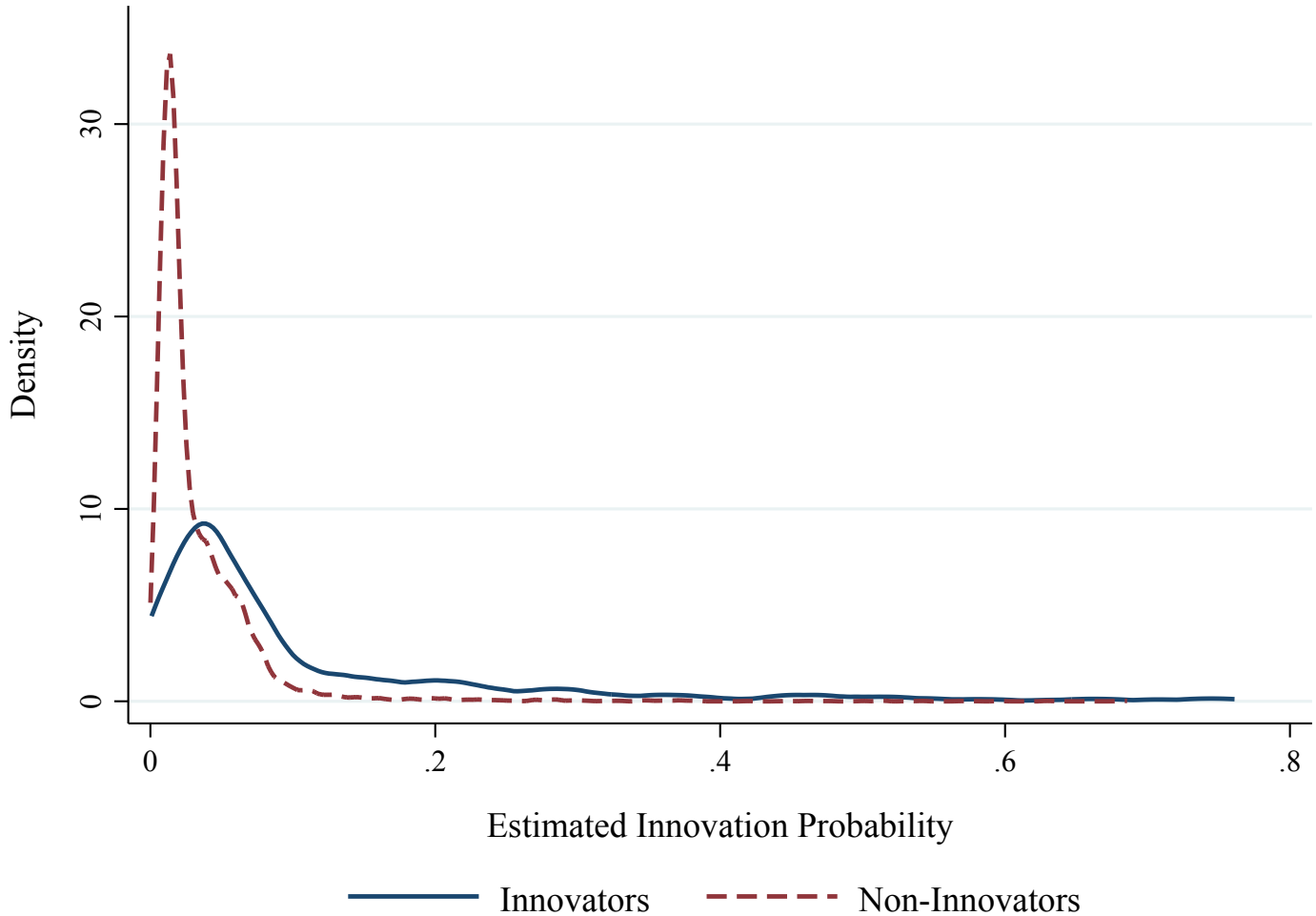
▸ Back

Pre-trend: Institutional Innovation and Economic Growth

Dependent Variable:	3-*Year Lagged Period* $\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	3-*Year Lagged Period* $\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	3-*Year Lagged Period* $\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	3-*Year Lagged Period* Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	-0.0361	-0.0355	-0.0347	0.0437
	(0.0381)	(0.0407)	(0.0428)	(0.0397)
Bottom-Up Policy Innovator$_{p\tau}$	0.0378	0.0216	0.0123	0.0260
	(0.0322)	(0.0303)	(0.0303)	(0.0276)
Policy Follower$_{p\tau}$	0.0016	-0.0067	-0.0105	0.0185
	(0.0099)	(0.0119)	(0.0121)	(0.0109)
Bottom-Up Policy Follower$_{p\tau}$	-0.0035	-0.0083	-0.0104	-0.0075
	(0.0122)	(0.0120)	(0.0115)	(0.0132)
3-*Year Lagged Period* $\Delta \ln$ *Capital per worker*$_{p\tau}$		0.3273***		
		(0.0666)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7495	0.7766	0.7874	0.6309

▸ Back

Inverse-Propensity Score Weighted: Institutional Innovation and Economic Growth



- Weight: $\omega_{i,\tau} = \frac{\mathbf{1}(Innovation_{i,\tau}=1)}{\hat{p}_{i,\tau}} + \frac{1-\mathbf{1}(Innovation_{i,\tau}=1)}{1-\hat{p}_{i,\tau}}$

Inverse-Propensity Score Weighted: Institutional Innovation and Economic Growth

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	0.0452	0.0342	0.0302	0.0695*
	(0.0363)	(0.0390)	(0.0404)	(0.0350)
Bottom-Up Policy Innovator$_{p\tau}$	0.0645*	0.0583*	0.0560*	-0.0602*
	(0.0349)	(0.0315)	(0.0322)	(0.0319)
Policy Follower$_{p\tau}$	0.0123	0.0163*	0.0179*	-0.0345***
	(0.0092)	(0.0085)	(0.0088)	(0.0096)
Bottom-Up Policy Follower$_{p\tau}$	0.0256*	0.0193*	0.0170	-0.0123
	(0.0128)	(0.0112)	(0.0109)	(0.0090)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.3648***		
		(0.0523)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7672	0.8039	0.7484	0.7379

▸ Back

Inverse-Propensity Score Weighted: Institutional Innovation and Economic Growth

Dependent Variable:	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (1)	$\Delta \ln$ *GDP per worker*$_{p\tau}$ (2)	$\Delta \ln$ *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Policy Innovator$_{p\tau}$	0.0452	0.0342	0.0302	0.0695*
	(0.0363)	(0.0390)	(0.0404)	(0.0350)
Bottom-Up Policy Innovator$_{p\tau}$	0.0645*	0.0583*	0.0560*	-0.0602*
	(0.0349)	(0.0315)	(0.0322)	(0.0319)
Policy Follower$_{p\tau}$	0.0123	0.0163*	0.0179*	-0.0345***
	(0.0092)	(0.0085)	(0.0088)	(0.0096)
Bottom-Up Policy Follower$_{p\tau}$	0.0256*	0.0193*	0.0170	-0.0123
	(0.0128)	(0.0112)	(0.0109)	(0.0090)
$\Delta \ln$ *Capital per worker*$_{p\tau}$		0.3648***		
		(0.0523)		
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	232	232	232	232
R-squared	0.7672	0.8039	0.7484	0.7379

▸ Back

Robustness: Institutional Innovation and Economic Growth

Dependent Variable:	Δ ln *GDP per worker*$_{p\tau}$ (1)	Δ ln *GDP per worker*$_{p\tau}$ (2)	Δ ln *TFP*$_{p\tau}$ ($\alpha = 0.5$) (3)	Δ*Investment Rate*$_{p\tau}$ (4)
Panel A: Alternative Measures Based on ML+Manual Annotation				
Policy Innovator$_{p\tau}$	-0.0181	-0.0304	-0.0310	0.0532***
	(0.0222)	(0.0212)	(0.0217)	(0.0160)
Bottom-Up Policy Innovator$_{p\tau}$	0.0770***	0.0720***	0.0717***	-0.0361**
	(0.0234)	(0.0239)	(0.0238)	(0.0156)
Policy Follower$_{p\tau}$	0.0125	0.0209**	0.0214**	-0.0527***
	(0.0124)	(0.0099)	(0.0099)	(0.0100)
Bottom-Up Policy Follower$_{p\tau}$	0.0344***	0.0222**	0.0216**	-0.0187**
	(0.0111)	(0.0099)	(0.0101)	(0.0084)
Δ ln *Capital per worker*$_{p\tau}$		0.4754***		
		(0.0540)		
Observations	232	232	232	232
R-squared	0.7372	0.8117	0.7441	0.6586
Panel B: IV Estimation				
Policy Innovator$_{p\tau}$	-0.0405	-0.0396	-0.0395	0.1200**
	(0.0486)	(0.0447)	(0.0449)	(0.0451)
Bottom-Up Policy Innovator$_{p\tau}$	0.1296***	0.1010***	0.0990***	-0.0712*
	(0.0357)	(0.0298)	(0.0294)	(0.0368)
Policy Follower$_{p\tau}$	0.0291*	0.0340***	0.0343***	-0.0483***
	(0.0150)	(0.0109)	(0.0106)	(0.0102)
Bottom-Up Policy Follower$_{p\tau}$	0.0580**	0.0425**	0.0414**	-0.0228
	(0.0246)	(0.0182)	(0.0182)	(0.0149)
Δ ln *Capital per worker*$_{p\tau}$		0.4667***		
		(0.0512)		
Observations	232	232	232	232
F-stat	6.265	6.162	6.265	6.265
Province Baseline Characteristics×Period	Y	Y	Y	Y
Province	Y	Y	Y	Y
Year	Y	Y	Y	Y

▸ Back

Robustness: Institutional Innovation and Firm Entry

Dependent Variable:	*Entries of Private Firms per Capita*$_{j\tau}$			*Entries of SOEs&COEs per Capita*$_{j\tau}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Innovator$_{j\tau}$	0.2370***	0.3137***	0.0464*	0.0296	0.0240	-0.0346
	(0.0876)	(0.0730)	(0.0246)	(0.0387)	(0.0385)	(0.0487)
Bottom-Up Policy Innovator$_{j\tau}$		0.1521***	0.0173		-0.0531*	-0.0512
		(0.0494)	(0.0238)		(0.0292)	(0.0324)
Policy Follower$_{j\tau}$	0.0240**	0.0254**	0.0020	0.0085	0.0097*	0.0004
	(0.0115)	(0.0110)	(0.0024)	(0.0053)	(0.0052)	(0.0025)
Bottom-Up Policy Follower$_{j\tau}$		0.0042	0.0041		0.0093	0.0063
		(0.0098)	(0.0037)		(0.0057)	(0.0051)
Prefecture Baseline Characteristics×Period	Y	Y	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y	Y	Y
Prefecture	N	N	Y	N	N	Y
Observations	2,608	2,608	2,608	2,608	2,608	2,608

▸ Back

Pre-trend: Institutional Innovation and Firm Entry

Dependent Variable:	*Entriess of SOEs per Capita*$_{j\tau}$ (1)	*Entries of COEs per Capita*$_{j\tau}$ (2)	3-*Year Lagged Period Entries of Private Firms per Capita*$_{j,\tau}$ (3)	3-*Year Lagged Period Entries of SOEs&COEs per Capita*$_{j,\tau}$ (4)
Policy Innovator$_{j\tau}$	-0.1074*	0.0021	0.0564	0.0308
	(0.0573)	(0.0346)	(0.0381)	(0.0255)
Bottom-Up Policy Innovator$_{j\tau}$	-0.1049***	-0.0281	-0.0351	-0.0117
	(0.0330)	(0.0220)	(0.0284)	(0.0167)
Policy Follower$_{j\tau}$	0.0058	0.0018	-0.0034	0.0010
	(0.0038)	(0.0029)	(0.0038)	(0.0028)
Bottom-Up Policy Follower$_{j\tau}$	0.0057	0.0079*	-0.0063**	0.0051
	(0.0057)	(0.0041)	(0.0029)	(0.0051)
Prefecture Baseline Characteristics×Period	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y
Prefecture	Y	Y	Y	Y
Observations	2,608	2,608	2,608	2,608

▸ Back

Inverse Propensity Score Matching: Institutional Innovation and Firm Entry

Dependent Variable:	*Entries of Private Firms per Capita*$_{j\tau}$			*Entries of SOEs&COEs per Capita*$_{j\tau}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Innovator$_{j\tau}$	0.2455**	0.3219***	0.0175	0.0271	0.0156	-0.0283
	(0.1165)	(0.1094)	(0.0243)	(0.0399)	(0.0433)	(0.0479)
Bottom-Up Policy Innovator$_{j\tau}$		0.1267*	0.0135		-0.0562**	-0.0422
		(0.0759)	(0.0196)		(0.0252)	(0.0260)
Policy Follower$_{j\tau}$	0.0304**	0.0317**	0.0003	0.0058	0.0067	0.0022
	(0.0140)	(0.0139)	(0.0028)	(0.0055)	(0.0055)	(0.0028)
Bottom-Up Policy Follower$_{j\tau}$		0.0060	0.0084***		0.0027	0.0063*
		(0.0078)	(0.0031)		(0.0057)	(0.0032)
Prefecture Baseline Characteristics×Period	Y	Y	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y	Y	Y
Prefecture	N	N	Y	N	N	Y
Observations	2,608	2,608	2,608	2,608	2,608	2,608

Back

Pre-trend: Institutional Innovation and Structural Transformation

Dependent Variable: *Lagged Period* Δ ln *Share Agri*$_{i\tau}$	(1)	(2)
Policy Innovator$_{i\tau}$	0.0043	0.0061
	(0.0259)	(0.0293)
Bottom-Up Policy Innovator$_{i\tau}$		0.0031
		(0.0158)
Policy Follower$_{i\tau}$	0.0012	0.0009
	(0.0017)	(0.0018)
Bottom-Up Policy Follower$_{i\tau}$		-0.0033*
		(0.0017)
County Baseline Characteristics$\times$Period	Y	Y
Province$\times$Period	Y	Y
Observations	4,532	4,532
R-squared	0.1750	0.1757

Back

Inverse-Propensity Score Weighted: Institutional Innovation and Structural Transformation

Dependent Variable:	$\Delta \ln Share\ Agri_{i\tau}$			
Sample:	82-90,90-00,00-05		82-90,90-00	
	(1)	(2)	(3)	(4)
Policy Innovator$_{i\tau}$	-0.0226	-0.0241*	-0.0223	-0.0240*
	(0.0145)	(0.0139)	(0.0144)	(0.0138)
Bottom-Up Policy Innovator$_{i\tau}$		-0.0125**		-0.0132**
		(0.0057)		(0.0060)
Policy Follower$_{i\tau}$	0.0005	0.0001	-0.0002	-0.0005
	(0.0018)	(0.0018)	(0.0024)	(0.0024)
Bottom-Up Policy Follower$_{i\tau}$		-0.0063**		-0.0081**
		(0.0029)		(0.0038)
County Baseline Characteristics×Period	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y
Observations	6,806	6,806	4,539	4,539
R-squared	0.3003	0.3032	0.2362	0.2413

Back

Inverse-Propensity Score Weighted: Institutional Innovation and Structural Transformation

Dependent Variable: $\Delta \ln$ *Share Agri*$_{i\tau}$	(1)	(2)	(3)	(4)
Panel A: Alternative Measures Based on ML+Manual Annotation				
Policy Innovator$_{i\tau}$	-0.0648**	-0.0626**	-0.0643**	-0.0623**
	(0.0261)	(0.0238)	(0.0261)	(0.0238)
Bottom-Up Policy Innovator$_{i\tau}$		-0.0400***		-0.0404***
		(0.0088)		(0.0087)
Policy Follower$_{i\tau}$	0.0025**	0.0020	0.0014	0.0008
	(0.0012)	(0.0012)	(0.0020)	(0.0020)
Bottom-Up Policy Follower$_{i\tau}$		-0.0048**		-0.0065**
		(0.0020)		(0.0028)
Observations	6,806	6,806	4,539	4,539
R-squared	0.2886	0.2909	0.1821	0.1867
Panel B: IV Estimation				
Policy Innovator$_{i\tau}$	-0.0992**	-0.1008***	-0.0983**	-0.0998***
	(0.0363)	(0.0325)	(0.0364)	(0.0326)
Bottom-Up Policy Innovator$_{i\tau}$		-0.0664***		-0.0674***
		(0.0148)		(0.0147)
Policy Follower$_{i\tau}$	0.0033**	0.0023	0.0022	0.0011
	(0.0014)	(0.0015)	(0.0023)	(0.0023)
Bottom-Up Policy Follower$_{i\tau}$		-0.0062**		-0.0084**
		(0.0025)		(0.0034)
Observations	6,806	6,806	4,539	4,539
Kleibergen-Paap F-stat	157.4	43.45	154.8	42.32
Sample:	82-90,90-00,00-05		82-90,90-00	
County Baseline Characteristics×Period	Y	Y	Y	Y
Province×Period	Y	Y	Y	Y

▸ Back

Model

Modeling Bottom-Up Institutional Change

- A theoretical framework linking institutional change to growth, which
  - is based on Kortum (1997) and Buera and Oberfield (2020)
  - and introduces political costs of local policy experimentation that depends on
    * central government policy
    * policy experimentation in other regions
- The setup
  - N regions, indexed by n
  - A continuum of locales with productivity φ, $y = \varphi$
  - Producivity distribution in each region n in period t, $F_{n,t}(\varphi)$
  - Time is discrete

Local experiementation to reduce distortions

- Productivity φ_t of a locale at t is a result of local conditions and existing policies
- In 1978, there were many distorting policies (wedges) that lowers productivity
- Policy experimentation is effort to reduce distortions (eliminating wedges) and improve productivity
- Local leaders have better information about local distortions then the central government

Top-Down Policy Reform by the Central Government

- Central government decides on a certain policy reform (Δ_{t+1}) that is supposed to improve local productivity
- The effectiveness of the reform depends on local conditions (ε_{t+1}):

$$\varphi_{t+1} = \varphi_t + \Delta_{t+1}\varepsilon_{n,t+1}$$

- $E\left[\Delta_{t+1}\varepsilon_{n,t+1}\right]$ is often negative due to a lack of local information (or bad incentives)

Experimentation and Random Productivity Growth

- An agent with productivity φ_t at t may get $\widetilde{m}$ number of independent ideas between t and $t+1$
- The arrival of ideas is a Poisson process with mean arrival rate $\alpha_{n,t+1} = Ba_{n,t+1}A_{n,t}^{1-\delta}, \delta \in (0,1]$.

$$\Pr\left[\widetilde{m} = m\right] = \frac{\alpha_{n,t+1}^{m} e^{-\alpha_{n,t+1}}}{m!}, m = 0, 1, ...;$$

$$\sum_{m=0}^{\infty} \frac{\alpha_{n,t+1}^{m} e^{-\alpha_{n,t+1}}}{m!} = 1.$$

- An idea is a combination of z and x, which are independently drawn from two distributions $H(z)$ and $G_{n,t}(x)$, respectively. If the agent adopts the idea, its productivity would be zx^{β}, $\beta \in (0,1]$.
- Therefore, the agent's productivity at $t+1$ is

$$\varphi_{t+1} = \max\left\{\varphi_t, \max\left\{z_1 x_1^{\beta}, ..., z_{\tilde{m}} x_{\tilde{m}}^{\beta}\right\}\right\}$$

Evolution of Productivity Distribution (1)

Let $F_{n,t}(\varphi) = \Pr[\varphi_t \leq \varphi]$. Then,

$$\begin{aligned} F_{n,t+1}(\varphi) &= \Pr\left[\max\left\{\varphi_t, \max\left\{z_1 x_1^{\beta}, ..., \underset{m}{\sim} x_{\underset{m}{\sim}}^{\beta}\right\}\right\} \leq \varphi\right] \\ &= F_{n,t}(\varphi) \Pr\left[\max\left\{z_1 x_1^{\beta}, ..., \underset{m}{\sim} x_{\underset{m}{\sim}}^{\beta}\right\} \leq \varphi\right] \end{aligned}$$

Note that

$$\Pr\left[\max\left\{z_1 x_1^{\beta}, ..., \underset{m}{\sim} x_{\underset{m}{\sim}}^{\beta}\right\} \leq \varphi\right] = \sum_{m=0}^{\infty} \frac{\alpha_{n,t+1}^{m} e^{-\alpha_{n,t+1}}}{m!} \Pr\left[\max\left\{z_1 x_1^{\beta}, ..., z_m x_m^{\beta}\right\} \leq \varphi\right]$$

and

$$\begin{aligned} \Pr\left[\max\left\{z_1 x_1^{\beta}, ..., z_m x_m^{\beta}\right\} \leq \varphi\right] &= \Pr\left[z_1 \leq \tfrac{\varphi}{x_1^{\beta}}, ..., z_m \leq \tfrac{\varphi}{x_m^{\beta}}\right] \\ &= \left(\Pr\left[z \leq \varphi x^{-\beta}\right]\right)^m \\ &= \left(\int H\left(\varphi x^{-\beta}\right) dG_{n,t}(x)\right)^m \end{aligned}$$

Evolution of Productivity Distribution (2)

Let $h_{n,t}(\varphi) = \int H\left(\varphi x^{-\beta}\right) dG_{n,t}(x)$

$$\begin{aligned}
\Pr\left[\max\left\{z_1 x_1^{\beta}, ..., z_{\tilde{m}} x_{\tilde{m}}^{\beta}\right\} \leq \varphi\right] &= \sum_{m=0}^{\infty} \frac{\alpha_{n,t+1}^{m} e^{-\alpha_{n,t+1}}}{m!} h_{n,t}^{m}(\varphi) \\
&= \sum_{m=0}^{\infty} \frac{\left(\alpha_{n,t+1} h_{n,t}(\varphi)\right)^{m} e^{-\alpha_{n,t+1} h_{n,t}(\varphi)}}{m!} e^{-\alpha_{n,t+1}\left(1-h_{n,t}(\varphi)\right)} \\
&= e^{-\alpha_{n,t+1}\left(1-h_{n,t}(\varphi)\right)}
\end{aligned}$$

Therefore,

$$F_{n,t+1}(\varphi) = F_{n,t}(\varphi) e^{-\alpha_{n,t+1}\left(1-h_{n,t}(\varphi)\right)}$$

If H is Pareto: $H(z) = 1 - z^{-\theta}$, then

$$1 - h_{n,t}(\varphi) = \varphi^{-\theta} \int x^{\beta\theta} dG_{n,t}(x)$$

and

$$F_{n,t+1}(\varphi) = F_{n,t}(\varphi) e^{-\alpha_{n,t+1}\varphi^{-\theta} \int x^{\beta\theta} dG_{n,t}(x)}$$

Evolution of Productivity Distribution (3)

- If $F_{n,t}(\varphi) = e^{-A_{n,t}\varphi^{-\theta}}$, then

$$F_{n,t+1}(\varphi) = F_{n,t}(\varphi)\, e^{-\alpha_{n,t+1}\varphi^{-\theta}\int x^{\beta\theta} dG_{n,t}(x)} = e^{-\left(A_{n,t}+\alpha_{n,t+1}\int x^{\beta\theta} dG_{n,t}(x)\right)\varphi^{-\theta}}$$

  is also a Frechet distribution with productivity $A_{n,t+1}$ given by,

$$A_{n,t+1} = A_{n,t} + \alpha_{n,t+1} s_{n,t},$$

  where $s_{n,t} = \int x^{\beta\theta} dG_{n,t}(x)$ measures the average usefulness of ideas, which depends on the distribution $G_{n,t}$.

- Thus, the productivity growth in region n is

$$\frac{A_{n,t+1}}{A_{n,t}} = 1 + B a_{n,t+1} A_{n,t}^{-\delta} s_{n,t}$$

Agents' Dynamic Decision (OLG)

- Given φ_t, an agent (county leader) in region n faces the following problem:

$$V_{n,t}(\varphi_t) = \max_{a_{n,t+1}} \{\ln(\varphi_t) + \rho E_t [\ln(\varphi_{t+1}) - \chi_{n,t+1}\widetilde{m}_{n,t+1}]\}$$

  Here $\chi_{n,t+1}\widetilde{m}_{n,t+1}$ is the political cost of experimenting.

- Since $E_t[\widetilde{m}_{n,t+1}] = \alpha_{n,t+1}$,

$$V_{n,t}(\varphi_t) = \max_{a_{n,t+1} \geq 0} \{\ln(\varphi_t) + \rho E_t [\ln(\varphi_{t+1}) - \chi_{n,t+1}\alpha_{n,t+1}]\}$$

Political Cost of Experimentation

- We assume that

$$\chi_{n,t+1} = \frac{r_n c_t}{\psi(\alpha_t)}, \alpha_t = \sum_{i=1}^{N} \alpha_{i,t},$$

  where

  - ψ is a strictly increasing and concave function and $\psi(0) = 1$: The more experiments happened in the nation, the lower the political cost of experimentation.
  - r_n is a region specific cost parameter: Regions differ in chances to be promoted and therefore political cost varies across regions
  - and c_t is a time-varying parameter that represents how intolerant the central government is with respect to experimentation.

- Thus, the political cost varies across regions and is a decreasing function of total number of experiments in the country.

Agents' Innovation Effort

Given φ_t, an agent in region n faces the following problem:

$$V_{n,t}(\varphi_t) = \max_{a_{n,t+1} \geq 0} \left\{ \ln(\varphi_t) + \rho E_t \left[\ln(\varphi_{t+1}) - r_n c_t \frac{\alpha_{n,t+1}}{\psi(\alpha_t)} \right] \right\}$$

Because φ_{t+1} follows a Frechet distribution, we have, for some constant μ,

$$E_t[\ln(\varphi_{t+1})] = \mu \ln(A_{t+1}) + constant$$

The optimal innovation effort:

$$a_{n,t+1} = A_{n,t}^{\delta} \frac{\max\left\{ \frac{\mu B s_{n,t} \psi(\alpha_t)}{r_n c_t A_{n,t}^{\delta}} - 1, 0 \right\}}{B s_{n,t}}$$

Regional growth:

$$\frac{A_{n,t+1}}{A_{n,t}} - 1 = \max\left\{ \frac{\mu s_{n,t} \psi(\alpha_t)}{r_n c_t A_{n,t}^{\delta}} - 1, 0 \right\} = \frac{\alpha_{n,t+1} s_{n,t}}{A_{n,t}}$$

Summary Remarks

- Regions with higher political costs (r_n) experiment less
- Regions with higher income ($A_{n,t}$) experiment less
- Regions with better chance of getting good ideas (e.g., coastal regions with exposure to foreign trade/FDI) experiment more
- When there are higher number of experiments in the last period (α_t), all regions experiment more this period.
- A region's growth is directly related to the average number of experiments in the region normalized by the region's productivity.
- Two channels for policy diffusion to other regions:
  - First, technology or knowledge diffusion through $s_{n,t}$ as in Burea and Oberfield (2020)
  - Second, political diffusion through $\psi(\alpha_t)$