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Market-Based Innovation Policy: Evidence from High-Tech Incubators in China

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Growth of High-Tech Industries in China

- **As early as 2010, Chinese policymakers publicly declared their intent to upgrade from traditional manufacturing industries to an advanced technology-driven economy.**
  - The two primary sources of economic growth - labor force expansion and heavy capital investment – are fading away (Woetzel et al., 2015; Wei et al., 2017).

- **China has rapidly increased its research and development (R&D) intensity and is now on par with major developed economies.**
  - The number of patents filed by Chinese firms has increased four fold over the past decade.

Figure 1A: R&D Intensity

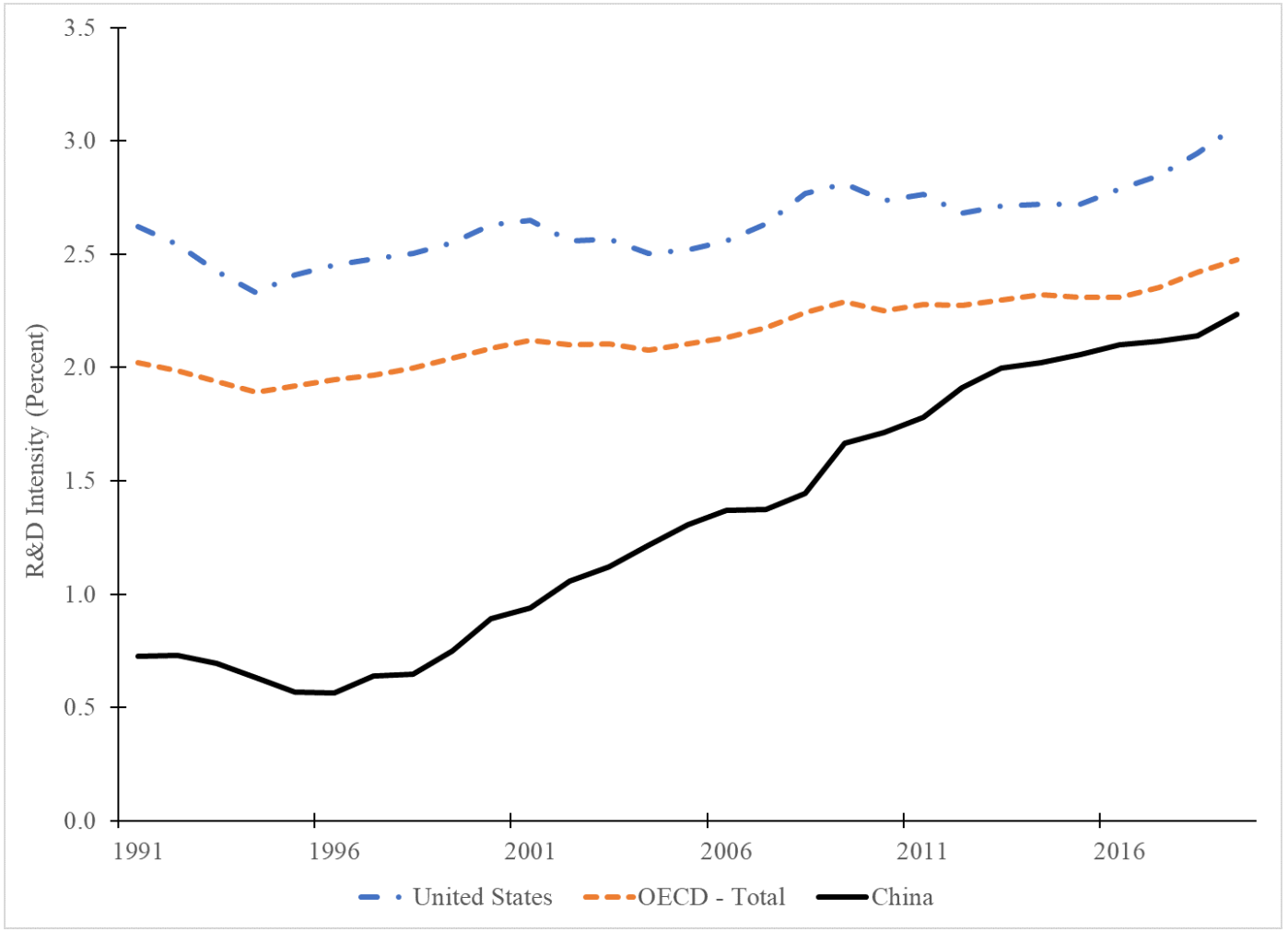
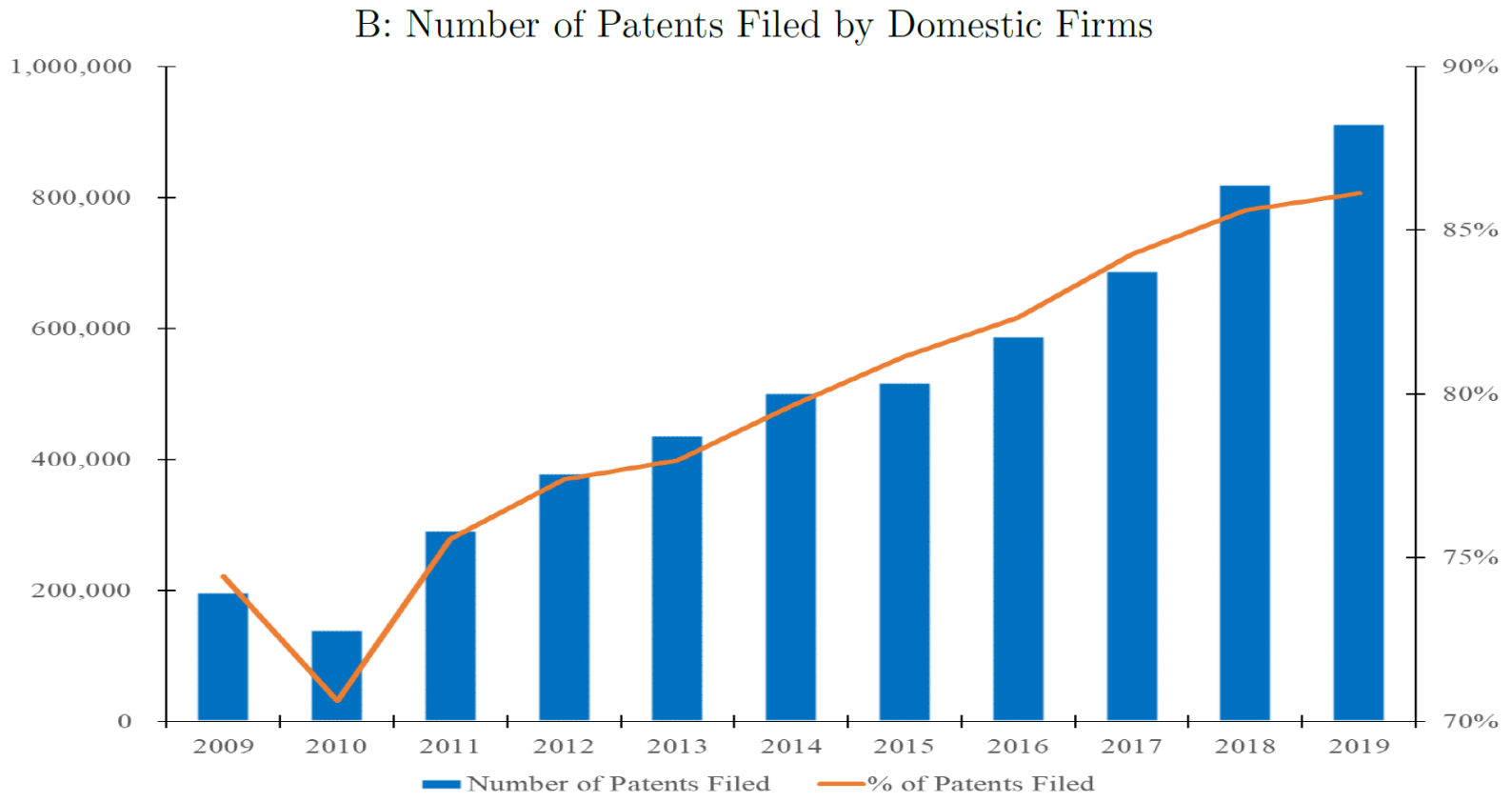


Figure 1B: Number of Patents



Our Paper

- **There has been limited research on the efficacy of China's government policies on fostering innovation.**
  - Several papers have analyzed government policies on innovation in China, including government subsidies (Wei et al., 2017), high-tech zones (Tian and Xu, 2021), Innofund (Guo et al., 2016), and InnoCom (Chen et al., 2021b).
  - Much thinner research compared to a large literature on China's rapid growth in traditional industries (e.g., Brandt and Zhu, 2000; Li and Zhou, 2005; Song et al., 2011; Hsieh and Song, 2015; Xiong, 2018).

- **We examine a unique mechanism where the Chinese government employs high-tech incubators as market intermediaries to achieve its policy goals in high-tech industries.**
  - Unlike the conventional approach of direct subsidization, the government can utilize high-tech incubators as intermediaries to stimulate the growth of high-tech startups by directing its support through them.

High Tech Incubators

- **High-tech incubators identify and foster the growth of nascent startup companies in their early stages.**
  - Offer a range of services to startups, including office space, mentoring, professional services, technical support, and access to capital financing, to facilitate their growth until they are ready to "graduate".
  - Generate revenue from service charges and, more importantly, equity investments in startups, and their success is contingent on their ability to select and foster high-potential incubatees.
  - Gonzalez-Uribe and Leatherbee (2018), Madaleno et al. (2018), Yu (2020), Hallen et al. (2020), Gonzalez-Uribe and Reyes (2021).

High Tech Incubators in China

- **China's high-tech incubators has witnessed rapid expansion in the past two decades.**
  - Over 5,000 incubators and more than 200,000 incubated startups in 2019.
  - Approximately 70% of high-tech incubators are privately owned, while the remaining 30% are state-owned.
  - The vast majority of incubated startups are privately owned.
  - High-tech incubators in China are registered and accredited by the government, and they receive subsidies from the government to support their operations.
  - For example, a district government in Shenzhen provides each high-tech incubator with a one-time subsidy of up to $300,000 (RMB 2,000,000) and an annual performance-based bonus.

Research Design

- **We analyze the effectiveness of the incubator mechanism in China using a unique dataset of all high-tech incubators from 2015 to 2019.**
  - The dataset contains information on incubator and startup characteristics.
- **We leverage the variation in industrial policies that target different "strategic emerging industries" (SEIs) across different provinces.**
  - Industrial policies implemented under the 13th Five-Year Plan (FYP, 2016-2020), designed to support targeted SEIs.
  - The SEIs targeted by the policy vary significantly across provinces.
- **We use a DiD analysis to estimate the impact of the industrial policy on the government support received by incubators and the innovation of their startups.**
  - Compare the differential outcomes between the targeted and control industries and between the periods before and after the policy implementation.

Summary of Findings

- **High-tech incubators in the targeted industries, relative to those in the control industries, receive significantly more government support after the implementation of the industrial policy.**
  - Increase in all three forms of government support: cash subsidies, equity investment, and tax reduction.
  - In contrast, we find little change in non-government funding, such as funding from corporations, nonprofit organizations, or individuals.

- **Government support to incubators has a significant and positive effect on the innovation activity of incubated startups.**
  - To address endogeneity concerns, we conduct 2SLS regressions with two instrumental variables (IVs) for government support based on the predicted tenure of local politicians and local exposure to China's anti-corruption campaign.

Summary of Findings

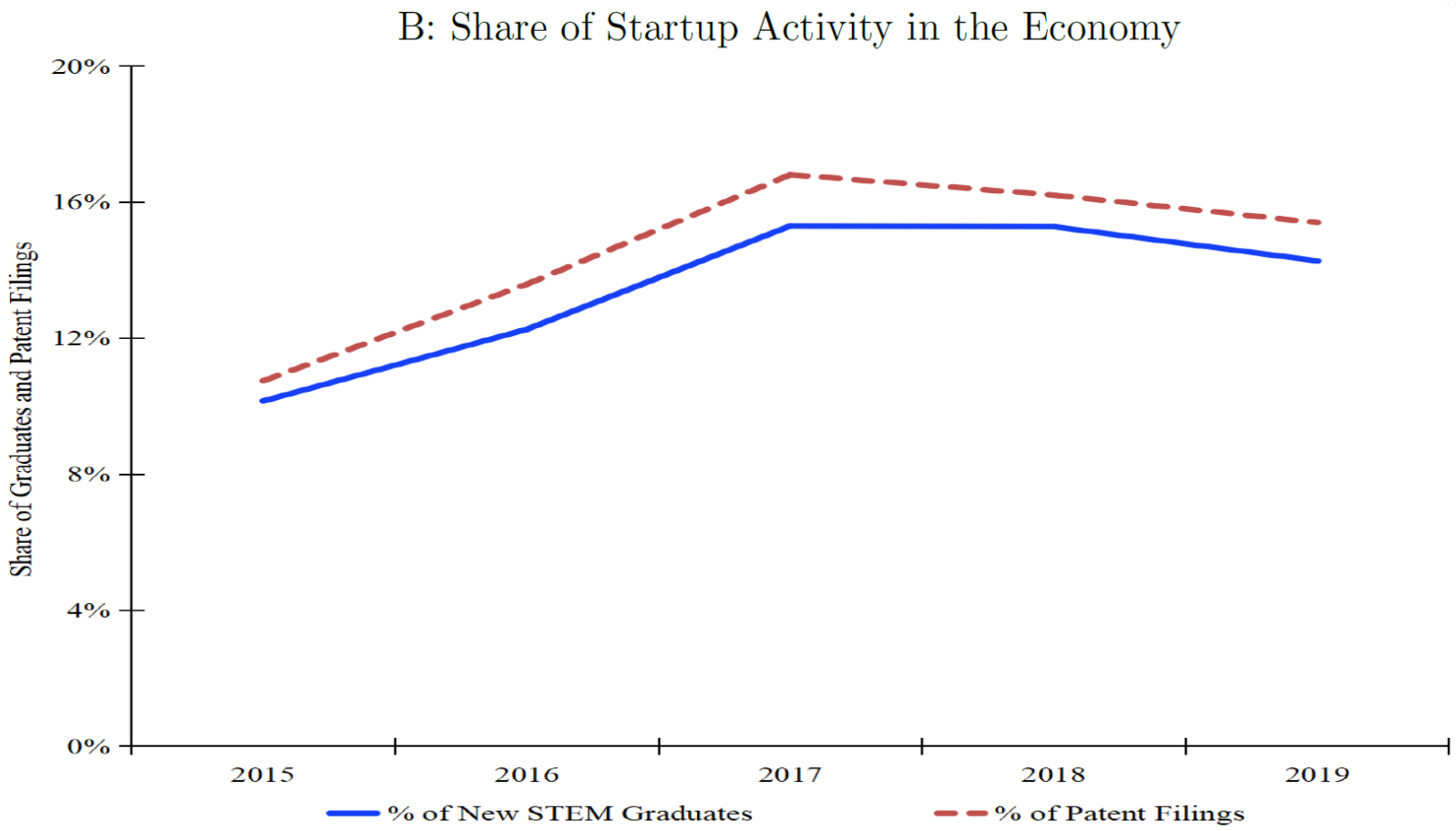
- **Combining the first two findings, we conclude that the incubator-based mechanism significantly increases the innovation measures of startups following the policy implementation.**
  - We estimate that the incubator approach accounts for over one-seventh of the policy effects on the innovation activity of high-tech startups in targeted SEIs.

- **Treated state-owned incubators receive disproportionately more support from local governments than their treated private counterparts after the policy implementation.**
  - However, startups in treated state-owned incubators experience significantly lower growth in innovation activity following the policy than those in the treated private incubators.
  - Our finding that less efficient state-owned incubators receive more government subsidy post-policy than private incubators may indicate potential resource misallocation despite the market-based approach.

Data and Sample

- **We obtain data on all Chinese high-tech incubators from 2015 to 2019 from China's Ministry of Science and Technology (MOST).**
  - Constructed under China's "Torch Program", a national initiative aimed at promoting the development of high-tech industries.
  - The sample size grows rapidly over time, from 2,071 incubators and 120,000 startups in 2015 to 5,206 incubators and 270,000 startups in 2019.
  - Incubators: year of establishment, national incubator, location, industry, ownership (SOE), types of funding, revenue, operating costs, profit, employment, services, high-tech zone, etc.
  - Incubated startups: year of establishment, year of entering the incubator, founder information (repeated, background, gender, etc.), HTF, location, industry, VC funding, area, revenue, profit, export, R&D, tax, employment, patents, licenses, graduate, etc.

Figure 2B: Startup Activity in the Economy



- **In 2019, these high-tech startups hire 260,000 new STEM graduates and file 270,000 patent applications.**

Classifications of Policy-Targeted Industries

- **We identify the targeted industries in the province-level "13th Five-Year Plan" that were announced by provinces during 2016 and early 2017.**
  - These FYPs include "key development industries", and the number varies from two to over a dozen across provinces.
  - We identify the first three "key development industries" as the policy-targeted industries in a province.

- **Sample for the difference-indifferences (DiD) analysis.**
  - Since our DiD analysis requires lagged data, this part of the sample starts from 2016.
  - We set 2016 as the pre-event period, and 2017-2019 as the post-event period.
  - Include only incubators and startups that exist in 2016.
  - Our final sample of incubators contains 8,322 incubator-year observations from 2016 to 2019, and the sample of startups contains 169,377 startup-year observations from 2016 to 2019.

Figure 3. Province-Specific Industrial Policy

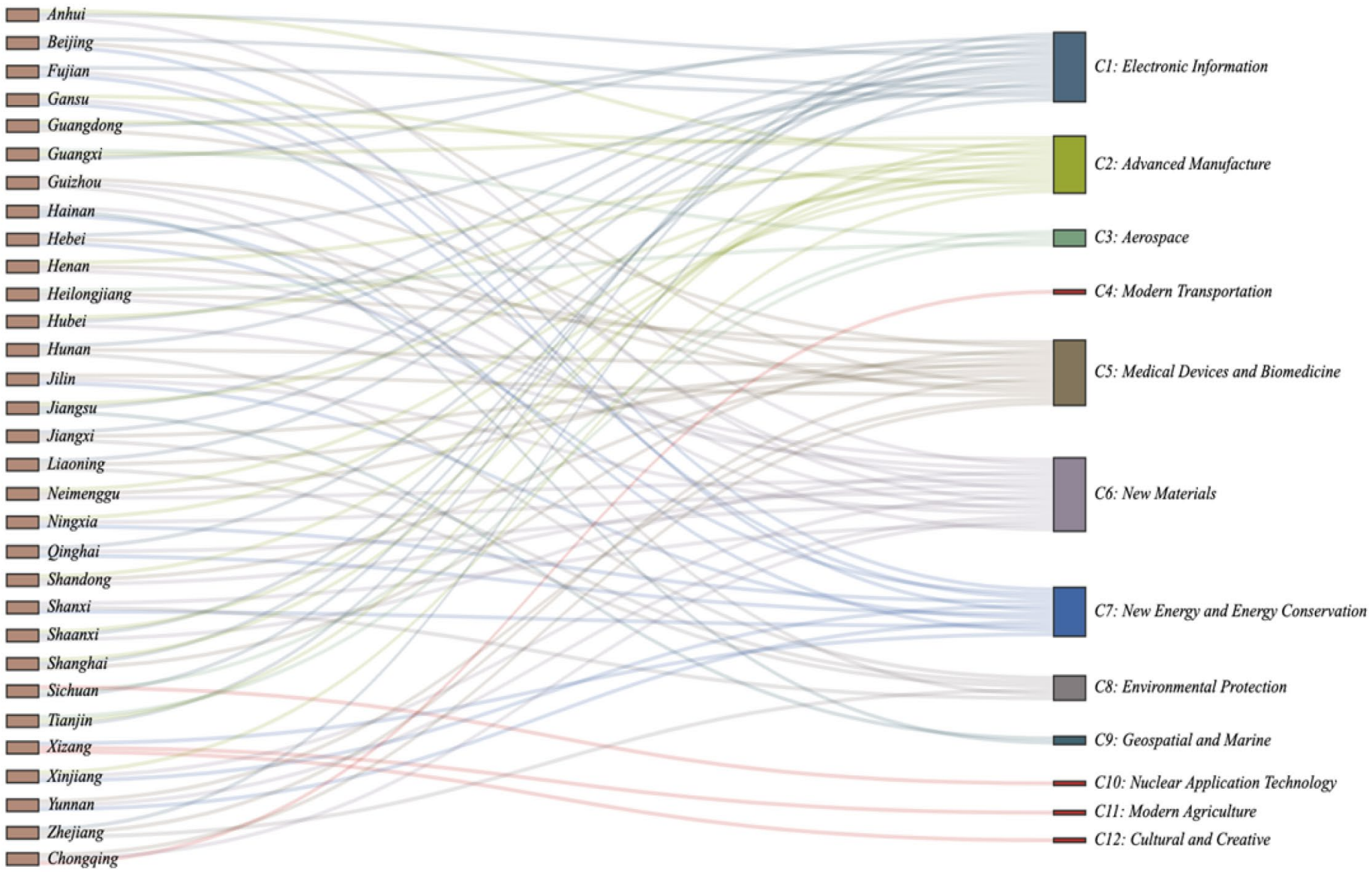


Table 1A: Summary Statistics

Sample	Treated = 0				Treated = 1			
	Post = 0		Post = 1		Post = 0		Post = 1	
Variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Govt Subsidy (RMB mil)	1.631	4.581	1.277	3.537	1.749	4.061	3.681	8.098
Govt Invest (RMB mil)	6.209	31.761	3.636	23.878	2.065	18.505	3.170	22.397
Govt Tax (RMB mil)	0.191	0.868	0.176	0.787	0.092	0.531	0.153	0.875
Govt All (RMB mil)	6.088	17.651	3.935	13.805	3.312	10.409	6.043	14.243

- **Summary statistics suggest a large re-allocation of government support between targeted and control industries.**

Table 2A: Industrial Policy and Government Support

Dep Var	Log(Govt Subsidy)	Log(Govt Invest)	Log(Govt Tax)	Log(Govt All)
	(1)	(2)	(3)	(4)
$\text{Treated}_i \times \text{Post}_t$	2.673***	2.826***	1.622***	3.310***
	(6.57)	(6.82)	(4.75)	(8.35)
$\text{Log(Capital)}_{i,t-1}$	0.072	-0.463***	-0.039	-0.140*
	(0.80)	(-4.14)	(-0.75)	(-1.73)
$\text{I(Old Incubator)}_{i,t-1}$	-0.141	-0.291	-0.021	-0.409
	(-0.55)	(-0.98)	(-0.09)	(-1.49)
$\text{I(SOE Incubator)}_{i,t-1}$	-0.485	-2.513***	0.424	-1.130***
	(-1.10)	(-5.20)	(1.07)	(-3.19)
$\text{I(HTE Zone)}_{i,t-1}$	0.186	0.436	1.313***	0.222
	(0.43)	(0.91)	(4.73)	(0.49)
$\text{Log(No_Firms)}_{i,t-1}$	0.416*	-0.110	0.278***	0.480**
	(1.79)	(-0.70)	(2.84)	(2.25)
Province × Industry	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Province × Year	Yes	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes	Yes
N	8322	8322	8322	8322
Adj. R^2	0.362	0.314	0.424	0.369

Table 2B: Industrial Policy and non-Government Funding

Dep Var	Investments by Corporations	Investments by Non-Corp Org.	Investments by Others
	(1)	(2)	(3)
$\text{Treated}_i \times \text{Post}_t$	0.259	-0.154	0.004
	(0.61)	(-1.16)	(0.02)
$\text{Log(Capital)}_{i,t-1}$	-1.653***	0.001	-0.073
	(-11.93)	(0.03)	(-1.11)
$\text{I(Old Incubator)}_{i,t-1}$	-0.698**	-0.047	-0.356***
	(-2.14)	(-0.58)	(-2.63)
$\text{I(SOE Incubator)}_{i,t-1}$	3.191***	-0.173	0.767***
	(5.55)	(-1.10)	(3.28)
$\text{I(HTE Zone)}_{i,t-1}$	-0.375	0.021	-0.354
	(-0.67)	(0.16)	(-1.32)
$\text{Log(No_Firms)}_{i,t-1}$	-0.248	0.136	0.095
	(-1.14)	(1.42)	(1.23)
Province × Industry	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes
Province × Year	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes
N	8322	8322	8322
Adj. R^2	0.222	0.184	0.162

Table 3A: Government Support and Start-Up Innovation Activity

Dep Var	Log(R&D)	Log(Employ)	Log(Patents)	Log(Sales)	Log(VC)	Log(Graduate)
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Log(Govt All)}_{i,t-1}$	0.020***	0.028***	0.025***	0.009***	0.293***	0.007***
	(3.41)	(8.21)	(4.27)	(3.89)	(5.93)	(5.78)
$\text{Log(Capital)}_{i,t-1}$	0.095**	0.050**	-0.050**	0.044***	0.198*	0.017*
	(2.24)	(2.42)	(-2.09)	(2.65)	(1.93)	(1.86)
$\text{I(Old Incubator)}_{i,t-1}$	-0.026	0.027	0.069	-0.007	-0.540	-0.074**
	(-0.19)	(0.42)	(1.18)	(-0.19)	(-1.40)	(-2.25)
$\text{I(SOE Incubator)}_{i,t-1}$	-0.260	-0.075	0.125	0.092	1.143***	0.013
	(-1.41)	(-0.69)	(0.98)	(1.02)	(3.36)	(0.26)
$\text{I(HTE Zone)}_{i,t-1}$	0.434**	0.005	-0.135	-0.020	-0.285	-0.292***
	(1.99)	(0.07)	(-1.38)	(-0.33)	(-0.51)	(-4.59)
$\text{Log(No_Firms)}_{i,t-1}$	0.322***	0.098**	0.096*	0.455***	1.044***	0.253***
	(2.94)	(2.49)	(1.67)	(10.76)	(3.84)	(8.10)
Province × Industry	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year	Yes	Yes	Yes	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes	Yes	Yes	Yes
N	8322	8322	8322	8322	8322	8322
Adj. R^2	0.631	0.172	0.298	0.755	0.384	0.653

Table 3B: Government Support and Incubator Services

Dep Var	Staff Edu	Log(Agents)	Log(Tutorships)	Log(Invest Funds)
	(1)	(2)	(3)	(4)
Log(Govt All)$_{i,t-1}$	0.003***	0.005***	0.008***	0.055***
	(3.82)	(4.19)	(4.00)	(4.70)
Log(Capital)$_{i,t-1}$	-0.003**	0.025***	0.022*	0.056
	(-2.02)	(2.75)	(1.72)	(0.70)
I(Old Firm)$_{i,t-1}$	0.003	-0.034	-0.066*	0.046
	(0.59)	(-1.59)	(-1.82)	(0.21)
I(SOE)$_{i,t-1}$	0.008	0.012	0.077	-0.235
	(0.88)	(0.37)	(1.17)	(-0.77)
I(HTE Zone)$_{i,t-1}$	-0.008*	0.022	0.039	0.210
	(-1.68)	(0.50)	(0.78)	(0.60)
Log(No_Firms)$_{i,t-1}$	0.000	0.143***	0.135***	1.033***
	(0.07)	(4.57)	(2.80)	(5.82)
Province × Industry	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Province × Year	Yes	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes	Yes
N	8322	8322	8322	8322
Adj. R^2	0.576	0.816	0.655	0.615

2SLS Analysis

- **Omitted variables may drive both the government support received by incubators and incubated startups' performance.**
  - A well-managed incubator may also be good at obtaining government support.

- **The first IV is a dummy variable for the *predicted* first and second year of a city party-secretary's tenure, and zero otherwise**.
  - Ru (2018): New officials tend to increase public investment in their early years of tenure., which may lead to less government support to incubators due to policy interruption or a more passive policy.
  - This is likely to increase government support to high-tech incubators but unlikely to be directly related to startup's innovation activity.

2SLS Analysis

- **The second IV is a dummy variable for the first and second year when a city's party secretary or mayor is investigated for corruption during the anti-corruption campaign.**
  - Fang et al. (2022): The anti-corruption campaign can deter government officials from dealing with private firms.
  - It is also well documented that some government officials become more passive after the campaign to "play it safe".
  - Local exposure to the anti-corruption campaign may decrease government support to high-tech incubators.

Table 4A: 2SLS Analysis: Predicted Tenure of Local Politicians

	First Stage	Second Stage					
Dep Var	Log(Govt All)	Log(R&D)	Log(Employ)	Log(Patents)	Log(Sales)	Log(VC)	Log(Graduate)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Political Tenure	3.432***						
	(6.73)						
$\widehat{Log(GovtAll)}$		0.054*	0.045***	0.190***	0.020*	0.506***	0.025**
		(1.97)	(4.03)	(6.09)	(1.84)	(3.95)	(2.15)
$\text{Log(Capital)}_{i,t-1}$	-0.120	0.100**	0.053**	-0.025	0.046***	0.232**	0.020**
	(-1.47)	(2.27)	(2.54)	(-0.98)	(2.79)	(2.09)	(2.05)
$\text{I(Old Incubator)}_{i,t-1}$	-0.524*	-0.010	0.035	0.143*	-0.003	-0.443	-0.066**
	(-1.84)	(-0.08)	(0.53)	(1.76)	(-0.07)	(-1.11)	(-2.05)
$\text{I(SOE Incubator)}_{i,t-1}$	-1.032***	-0.219	-0.054	0.323**	0.105	1.398***	0.035
	(-2.92)	(-1.18)	(-0.49)	(2.44)	(1.13)	(3.47)	(0.74)
$\text{I(HTE Zone)}_{i,t-1}$	0.315	0.424*	-0.000	-0.187	-0.023	-0.352	-0.298***
	(0.71)	(1.96)	(-0.00)	(-1.59)	(-0.39)	(-0.66)	(-4.88)
$\text{Log(No_Firms)}_{i,t-1}$	0.529***	0.306***	0.090**	0.020	0.450***	0.945***	0.244***
	(2.83)	(2.82)	(2.19)	(0.27)	(10.27)	(3.49)	(7.84)
Province × Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8322	8322	8322	8322	8322	8322	8322
Adj. R^2	0.388	-0.019	-0.004	-0.404	0.015	0.016	-0.019
KP F-stat	45.313						

Table 4B: 2SLS Analysis: Local Exposure to Anti-Corruption Campaign

	First Stage	Second Stage					
Dep Var	Log(Govt All)	Log(R&D)	Log(Employ)	Log(Patents)	Log(Sales)	Log(VC)	Log(Graduate)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Anti-Corruption Exp.	-4.132***						
	(-6.14)						
$\widehat{Log(GovtAll)}$		0.086*	0.051**	0.121***	0.042**	0.344***	0.035**
		(1.72)	(2.34)	(2.84)	(2.51)	(2.87)	(2.05)
$\text{Log(Capital)}_{i,t-1}$	-0.153*	0.105**	0.054**	-0.035	0.049***	0.206*	0.022**
	(-1.87)	(2.40)	(2.50)	(-1.43)	(2.93)	(1.97)	(2.27)
$\text{I(Old Incubator)}_{i,t-1}$	-0.416	0.004	0.038	0.112*	0.008	-0.517	-0.061
	(-1.53)	(0.03)	(0.56)	(1.73)	(0.20)	(-1.35)	(-1.59)
$\text{I(SOE Incubator)}_{i,t-1}$	-1.308***	-0.181	-0.048	0.240*	0.132	1.204***	0.047
	(-3.59)	(-0.96)	(-0.40)	(1.74)	(1.64)	(3.16)	(0.79)
$\text{I(HTE Zone)}_{i,t-1}$	0.290	0.414**	-0.002	-0.165*	-0.030	-0.301	-0.301***
	(0.64)	(1.98)	(-0.02)	(-1.71)	(-0.49)	(-0.54)	(-4.81)
$\text{Log(No_Firms)}_{i,t-1}$	0.437**	0.291***	0.087**	0.051	0.439***	1.020***	0.240***
	(2.04)	(2.65)	(2.18)	(0.77)	(9.40)	(3.86)	(7.36)
Province × Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8322	8322	8322	8322	8322	8322	8322
Adj. R^2	0.368	-0.036	-0.010	-0.143	-0.025	0.048	-0.058
KP F-stat	37.684						

Evaluation of Incubator Channel

- **We estimate that the incubator channel increase startups' innovation activity in targeted SEIs after policy implementation by:**
  - 6.6% for startup R&D; 9.3% for startup employment
  - 8.3% for startup patent applications.
  - 3.0% for startup total revenue.
  - 97.0% for outside VC funding.
  - 2.3% for probability of "graduation".

- **Overall, the incubator channel accounts for 13.6%, or over one-sixth of the policy benefits for the sample high-tech startups.**
  - We estimate the overall policy benefits for high-tech startups by running DiD regressions of startup innovation activities on *Treated*×*Post*.
  - Caveat: Our data does not cover the high-tech startups that are not incubated.

Startup-Level Analyses

- **The results of the start-up level analyses are consistent with those of the incubator-level analyses.**
  - Startups that are not government-classified "high-tech" firms.
  - Non-SOE startups.
  - Young startups.

- **Cross-sectional analyses show larger policy benefits for the subsample of less resourceful start-ups**
  - Startups that are not government-classified "high-tech" firms.
  - Young startups.

Table 10A: Government Support to SOE and Private Incubators

Dep Var	Log(Govt Subsidy)	Log(Govt Invest)	Log(Govt Tax)	Log(Govt All)
	(1)	(2)	(3)	(4)
$\text{Treated}_i \times \text{Post}_t$	3.746***	3.817***	3.767***	4.359***
	(7.29)	(8.09)	(7.94)	(9.64)
$\times$ I(Private Incubator)$_{i,t-1}$	-1.625***	-1.501***	-3.248***	-1.589***
	(-3.51)	(-4.03)	(-5.97)	(-4.06)
I(Private Incubator)$_{i,t-1}$	1.254**	3.223***	1.113***	1.882***
	(2.40)	(5.33)	(2.85)	(4.29)
Log(Capital)$_{i,t-1}$	0.071	-0.464***	-0.042	-0.141*
	(0.79)	(-4.14)	(-0.81)	(-1.73)
I(Old Incubator)$_{i,t-1}$	-0.099	-0.252	0.062	-0.368
	(-0.38)	(-0.85)	(0.26)	(-1.34)
I(HTE Zone)$_{i,t-1}$	0.176	0.427	1.293***	0.212
	(0.41)	(0.89)	(4.79)	(0.47)
Log(No_Firms)$_{i,t-1}$	0.470**	-0.059	0.387***	0.534**
	(2.02)	(-0.36)	(3.97)	(2.51)
Province $\times$ Industry	Yes	Yes	Yes	Yes
Industry $\times$ Year	Yes	Yes	Yes	Yes
Province $\times$ Year	Yes	Yes	Yes	Yes
Incubator FE	Yes	Yes	Yes	Yes
N	8322	8322	8322	8322
Adj. R^2	0.364	0.316	0.440	0.371

Table 10B: Efficiency of SOE and Private Incubators

Dep Var	Log(R&D)	Log(Employ)	Log(Patents)	Log(Sales)	Log(VC)	I(Graduate)
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Treated}_i \times \text{Post}_t$	2.859***	0.267***	0.153***	1.100***	1.401***	0.282***
	(10.59)	(14.28)	(4.00)	(3.90)	(10.92)	(6.30)
$\times$ $\text{I(Private Incubator)}_{i,t-1}$	0.622*	0.058**	0.118***	0.513**	0.286**	0.039*
	(1.75)	(2.29)	(3.00)	(1.99)	(1.98)	(1.92)
$\text{I(Private Incubator)}_{i,t-1}$	-0.484***	-0.031**	-0.037**	-1.487***	-0.013	0.023***
	(-3.40)	(-2.38)	(-2.59)	(-9.84)	(-0.21)	(2.69)
$\text{Log(Capital)}_{i,t-1}$	0.027	0.030***	0.006	0.014	-0.011	0.003
	(0.68)	(6.48)	(0.99)	(0.45)	(-0.30)	(0.76)
$\text{I(Old Firm)}_{i,t-1}$	-0.260***	-0.025**	-0.061***	-0.750***	-0.112	0.096***
	(-2.80)	(-2.35)	(-4.54)	(-9.32)	(-1.56)	(8.32)
$\text{I(SOE Firm)}_{i,t-1}$	-0.347	0.025	-0.041	-0.441	-0.580	-0.117**
	(-0.44)	(0.25)	(-0.49)	(-0.67)	(-1.28)	(-2.05)
Province $\times$ Industry	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year	Yes	Yes	Yes	Yes	Yes	Yes
Province $\times$ Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	169377	169377	169377	169377	169377	169377
Adj. R^2	0.581	0.758	0.415	0.529	0.303	0.620

Conclusions

- **High-tech incubators serve as important market-based intermediaries in carrying out government policies that foster innovation.**
  - Using the 13th FYP as a policy setting, we find that high-tech incubators in the targeted industries receive significantly more government support after the implementation of the policy.
  - Government support to incubators has a significant and positive effect on the innovation activity of incubated startups.
  - The incubator approach accounts for approximately one-seventh of the policy effects on the high-tech startups' innovation activity.

- **State-owned incubators, relative to privately owned incubators, receive more government support but are less efficient in promoting growth of startups.**
  - Potential resource misallocation despite the market-based approach.