Picking Winners or Building Them? Central and Local Government Venture Capital in Chinese Semiconductors

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Abstract

When does state equity investment in private firms spur productivity growth and innovation? I examine this question in China's semiconductor sector by comparing firms backed by central and local government venture capital funds. Using administrative records and balance sheet data, I show that central funds invest in firms that are more productive in the nation, while local funds back local champions that are on average less productive. I also find that managers' prior educational and employment ties to government fund managers, formed mostly through prestigious academic institutions, predict investment. Despite lower initial productivity, locally backed firms experience larger post-investment gains in revenue productivity, intellectual property output, manufacturing capacity, and government procurement. Local government fund managers are more likely to enter the board of their portfolio firms, adding directors and executives with government experience, graduate degrees, and technical expertise. These effects are strongest among firms without prior ties to government fund managers, and local government funds are more likely to invest and participate in the management of unconnected firms. The findings suggest that decentralized government venture capital can promote growth in high-tech sectors by providing capital and managerial resources to initially less connected and well-resourced firms.

1 Introduction

Industrial policy has regained attention in economics, in large part driven by increasing policy interest in cultivating domestic strategic sectors such as semiconductors, electric vehicles, and shipping (Juhász and Lane, 2024; Barwick et al., 2024; Goldberg et al., 2024). Much of the current debate has focused on the appropriate sectors to support, which tools to implement, and how large should interventions be. A separate question is at least as important: within a sector deemed necessary for the state to support, could governments selectively target the right firms and help them succeed? The literature has found that governments regularly support inefficient firms as officials are prone to capture and are biased towards connected firms (Baldwin and Robert-Nicoud, 2002; Fang et al., 2018; Branstetter et al., 2023). Furthermore, discretionary government support targeting individual firms often comes with quid pro quo that distort firm decisions, casting doubt over its

efficacy (Colonnelli et al., 2024). Could the level of government responsible for "picking winners" matter for both the selection and outcome of targeted firms? This question is especially salient in China, where strategic industrial policy is implemented through a highly decentralized system in which provincial and municipal governments retain substantial discretion over the actual allocation of resources (Xu, 2011; Luo et al., 2025; Fang et al., 2025).

The Chinese semiconductor industry presents a natural setting to study this institutional design problem. As a capital-intensive technology sector with salient strategic importance, developing a homegrown semiconductor supply chain across diverse sectors has long been a national priority. Since the introduction of "Made in China 2025" initiative in 2014, central and local governments have invested heavily in this industry through government-guidance funds and other state-backed investment vehicles (Branstetter and Li, 2023). Rich variation in the timing of semiconductor investments across levels of government in different localities and subsectors as well as the strategic importance of the sector makes semiconductors an unusually informative setting for studying how different types of government funds invest and whether they perform differently.

This paper studies government equity investment in private firms from two angles. First, which firms do local and central government funds invest in? Second, how do firms' size, productivity, and innovation change after receiving government investment, and do central and local government-invested firms perform differently? To answer these questions, I construct a panel of Chinese semiconductor firms from 1998 to 2024 by combining registered shareholder data, firm balance sheets, intellectual property records, board/management composition and biographies, procurement contracts, and commercial plant-level semiconductor data. The curated dataset allows me to identify whether a firm first received equity investment from a central or local government fund, and to track productivity, innovation, manufacturing capacity, procurement outcomes, and board composition before and after investment.

The first set of results documents the differential incentives of central and local governments in selecting investment targets. Consistent with the central government implementing industrial policy to maximize national output, central government funds are more likely to invest in private firms with the highest revenue productivity (TFPR) in the nation. Local governments, by contrast, are more likely to support more productive local firms that are on average not the most productive firms in the nation. From the viewpoint of static allocative efficiency, this appears to be the cost of decentralization under a model where marginal return to investment in a firm is increasing with its baseline revenue productivity. This pattern is consistent with a decentralized industrial policy system where different levels of government face different incentives: local governments are evaluated on local industrial output, while the national government focuses on promoting established national champions. Furthermore, controlling for firm productivity rank and other rich firm characteristics such as intellectual property, firm size, and firm board characteristics, government funds are more likely to invest in firms which board/management share past education or work experience with a board member of the government fund's general partner (GP) firm. This suggests that personnel

matters for the implementation of industrial policy: government fund managers allocate state capital based on not simply observable firm characteristics, but also on shared inter-personnel ties in tight alumni and industry networks.

That government fund managers invest in connected firms may reflect corruption and preferential treatment, or prudent use of soft information critical for successful venture capital targeting. This motivates the second set of results on post-investment firm performance. I study productivity and innovation outcomes of firms invested by local and central government funds in a series of event study/differences-in-differences analyses, while also exploring treatment effect heterogeneity by whether the invested firm has personal ties with the government fund prior to investment. To account for the fact that a firm may be invested by a central and a local fund simultaneously or at different times in the data, I modify the standard Callaway and Sant'Anna (2021) staggered event study design to estimate cohort (first year of local/central government investment)-specific dynamic effects of one government fund type conditioning on the subsample of firms invested by the other government type in the same year, before aggregating across cohorts and other government-investment histories to arrive at an interpretable average treatment effect on the treated.

The results suggest that despite being initially less productive on average, local-invested firms experienced faster growth in revenue productivity, invention patents, chip-design layouts, manufacturing capacity, and procurement contracts, with little evidence of pre-investment differential trends. Local funds are more likely to bring their managers onto the board of invested firms, and expand the number of directors with graduate, engineering, and R&D backgrounds. This is driven by the fact that government fund managers enter their invested firm's board/management more often if the firm is geographically closer to the fund and if the fund had invested in fewer firms. Central government funds invest in more firms and are geographically more distant from their portfolio firms, hence they participate less in the portfolio firms' management. The overall picture suggests that local government funds do not merely inject capital, but appear to mobilize organizational and managerial support that help invested firms grow. Furthermore, for local government funds in particular, initially unconnected firms grow faster in both productivity as well as the number of board members with technical and government backgrounds. A potential explanation is that connected firms were already larger and better-resourced prior to investment, thus the marginal impact of government investment is lower. As local government funds are more likely to invest in unconnected firms, this also contributes to the observed larger post-investment performance improvement for local-invested firms.

Related Literature and Contributions. To study the industry-level impact of Chinese policies, a growing literature adopts a model-based econometric approach to estimate production and entry subsidies from model-implied cost differentials between Chinese and international firms after major Chinese policy implementation at the *industry level* (Barwick et al., 2025, 2021; Kalouptsidi, 2017; Banares-Sanchez et al., 2026). Critically, such an approach attributes model-implied reduction in costs post-policy to subsidies rather than endogenous productivity improvement in

order to quantify the magnitude of subsidies. Other literature using firm-level balance sheet and subsidies data has found government subsidies to have had little effect on firm-level productivity or innovation (Branstetter et al., 2023; Garcia-Macia et al., 2025; Ang et al., 2024), while encouraging the entry of less productive firms (Kalouptsidi, 2017; Barwick et al., 2025). However, there are potential differences between pure transfer grants and government equity investments that have stronger incentives to profit from investing in future winners. Furthermore, the literature does not distinguish between subsidies administered by the central government versus those allocated by local governments. In a setting where investment decisions could be attributed to a particular government type, I show that the level of government implementing policy matters for firm growth.

The paper primarily engages with a growing literature on government venture capital as a separate and alternative industrial policy instrument to conventional subsidies (Beraja et al., 2024; Colonnelli et al., 2024; Chen et al., 2026; Aragoneses and Saxena, 2025). I contribute by showing that the distinguishing difference between equity investment and conventional subsidies is that government fund investors can influence firm board and management as a shareholder. The type of personnel government venture capital funds place in their portfolio firms' management could be a driving factor of firm performance, which is a novel form of non-monetary intervention in firms that is less understood.

The paper also demonstrates that the government entity that makes the investment matters for targeted policy outcomes. Colonnelli et al. (2024) document that while professional managers of government-funded venture capital (general partners, GP) dislike government investors in general, the effect is driven by central government investors. Government venture capital GPs show a mild preference for local government investors, suggesting that local governments may bring additional benefits to their portfolio firms. Beraja et al. (2024) find that AI firms invested by local government venture capital funds create more products, and that local government funds support AI firms in remote provinces that are less likely to get noticed by private venture capital in wealthier coastal regions.

Seminal theoretical work in organizational and public economics characterizes decentralization as a problem of delegation to informed but biased agents (Oates, 1999; Besley and Coate, 2003; Alonso et al., 2008; Bardhan and Mookherjee, 2000). Xu (2011) characterized China's political economic institutions as "regionally decentralized authoritarianism". The central government sets general policy direction and guidelines, but local governments are given free rein to interpret central guidelines and implement their own policies. Local governments experiment with different policy bundles and compete intensely for political promotion, which depends on relative local economic performance (Li and Zhou, 2005). The literature on the Chinese economy has documented numerous inefficiencies of the Chinese "tournament model", including the erection of local trade & investment barriers (Barwick et al., 2021; Fang et al., 2022), graft/misrepresentation (Wang and Yang, 2023), excessive leverage (Xiong, 2018), and overemphasis on performance targets rather than meaningful technology upgrading (Fuller, 2016; Ang et al., 2024). Instead, other work emphasizes

local initiative and experimentation as a fundamental driver of past Chinese growth and dynamism (Li et al., 2025; Luo et al., 2025). Despite misaligned preferences on the sectors and firms to target, local governments may have better information on the right local firms and subsectors to support *in the long term* and have more nimble policy tools to address targets' needs.

This paper also speaks to the vast literature on misallocation and productivity in China (Adamopoulos et al., 2022; Hsieh and Klenow, 2009; Brandt et al., 2022, 2017, 2012) and the relationship between state ownership and firm productivity (Chen et al., 2021; Brandt et al., 2022; Lian and Zhang, 2026). The literature shares a broad consensus that private firms in the 2000s are more productive than state-owned enterprises (SOE), and that privatized SOEs became more productive (Chen et al., 2021). There is less evidence on how private firms fare after becoming partially state-owned, which became increasingly common as the state strengthened its grip on the economy in the Xi Jinping era. Lian and Zhang (2026) found that firm productivity decreased after selling minority stakes to state-owned companies in data from 1998-2013, while studies of state equity investments in the post-2013 Xi Jinping era found positive effects on measures of firm size and intellectual property from government acquisitions (Bai et al., 2020; Beraja et al., 2024; Chen et al., 2026). The paper contributes by focusing on the differential incentives of central and local government investors, and investigates the heterogeneous impact of different state investors on capital allocation and productivity growth.

The paper also enriches the field's understanding of Chinese industrial policy by studying a setting in which Chinese domestic firms are still largely competing with technologically advanced foreign imports (Bown and Wang, 2024). As of 2025, integrated circuits remained China's largest category of imports by value, exceeding crude petroleum.[1] By not selecting on well-documented success stories like electric vehicles, shipping, and clean energy, my empirical results point to a more nuanced assessment of ongoing Chinese industrial policy efforts by documenting the varied outcomes of different government investors.

The rest of the paper proceeds as follows. Sections 2 and 3 discuss the institutional setting and data. Section 4, together with Section A of the Appendix, introduces a model of firm dynamics with central and local government investment that motivates the estimation of revenue productivity and the following empirical tests. Section 5 shows how central and local government funds invest based on productivity rankings and personnel ties. Section 6 presents the main regression results on productivity, innovation, and board/management under the modified Callaway-Sant'Anna design for two staggered treatments. Section 7 further investigates the determinants of government fund managers' participation in invested firms' management and the heterogeneity in post-investment trajectories between initially connected and unconnected firms. Section 8 links government investment intensity to aggregate productivity and market structure. Section 9 concludes.

[1] "China's Major Imports by Quantity and Value, Dec 2025 (in USD)". China Customs. http://english.customs.gov.cn/Statics/83fb6750-e095-47c6-9890-14979f5a22e8.html.

2 Setting: Chinese Government Venture Capital in Semiconductors

In the late 1990s, local governments in major cities pioneered government venture capital specializing in high tech investments. Prominent examples include Shanghai Science & Technology Venture Capital established in 1992 and the Shenzhen Capital Group founded in 1999. Government venture capital was institutionalized at the national level via a series of policy decrees in the 2000s. In 2005 the National Development and Reform Commission (NDRC) formally defined "Government Guidance Fund" as a government "mother fund" that invests as a "limited partner" (LP) in venture capital funds managed by professional private or state-owned "general partner" (GP) investors (Wei et al., 2023). The State Council in 2008 further specified the purpose of government guidance funds as "to correct market failures resulting from private allocation of startup capital". It authorized local government above prefectural levels to fund venture capital that invests in early startups in priority high-tech sectors. Government LPs expect and monitor their GPs to operate according to policy guidance, but not interfere in the GPs' daily operations. Such institutional arrangements are intended to allow government capital to take advantage of the GP's market expertise in allocating to the best firms while adhering to industrial policy objectives (Luong et al., 2021).

Government venture capital at both national and subnational level proliferated after 2014 as a consequence of two major policy changes. First, "Made in China 2025" cemented government support of the capital- and technology-intensive manufacturing sectors as a central priority. Second, the State Council's "Document No.62" in 2014 barred local governments from giving out fiscal subsidies and tax incentives to firms without explicit legal authority. This spurred a movement to "replace subsidies with investment" (*bo gai tou*). Unlike traditional subsidies and tax incentives that would be spent once allocated, equity injections provide local governments the option to recover and even profit from their initial investment. In addition, government funds develop close relationships with the management of portfolio firms as long-term investors, facilitating continued monitoring of firm performance.

The rapid rise of Chinese electronics sector following trade liberalization in the 2000s helped cultivate the initial homegrown semiconductor supply chain, but the market share of domestic firms remains limited (Chu, 2013; Fuller, 2016). The watershed moment of Chinese semiconductor industrial policy arrived in June 2014 when the central government promulgated the "National Integrated Circuit Industry Development Promotion Outline", which sets a target for homegrown producers to supply 70% of domestic demand by 2025. It established a "National Integrated Circuit Industry Investment Fund", nicknamed the "Big Fund", that raised around 138.7 billion RMB in its initial funding round ("Phase I") in August 2014 from the Ministry of Finance, central SOEs like China Development Bank and China Tobacco, and local government funds and SOEs such as Beijing E-Town and Shanghai Guosheng Group. The fund is managed by state-owned Sino IC Capital and was the largest government VC/PE fund. "Phase I" of the fund invested primarily in notable national leaders in semiconductor manufacturing and design.

Following the Big Fund, local governments at the provincial and municipal levels also instituted

government guidance funds dedicated to investing in local semiconductor firms. Figure 1 documents the dramatic rise of government equity investment relative to traditional fiscal subsidies since 2014 in semiconductors. Figure B.1 in the Appendix shows that the total government funds' paid-in capital stock (the nominal amount shareholders paid to the firm in exchange for shares) increased to about 7% of total paid-in capital stock across the semiconductor supply chain in China by 2024. Figure 2 plots the count of new investment events, defined as the first year a firm receives investment by a particular fund type, by fund type over time. After 2014, an increasing number of initially private firms have received equity injections from government funds. Figure B.2 in the Appendix shows that about 14% of firms in the sample are government invested by 2024 from around 6-8% before 2014. Overall, the aggregates suggest that equity funding from local governments is the dominant form of support that Chinese semiconductor firms receive. Section C in the appendix discusses in greater detail the set of policy tools central and local governments employ to support the industry.

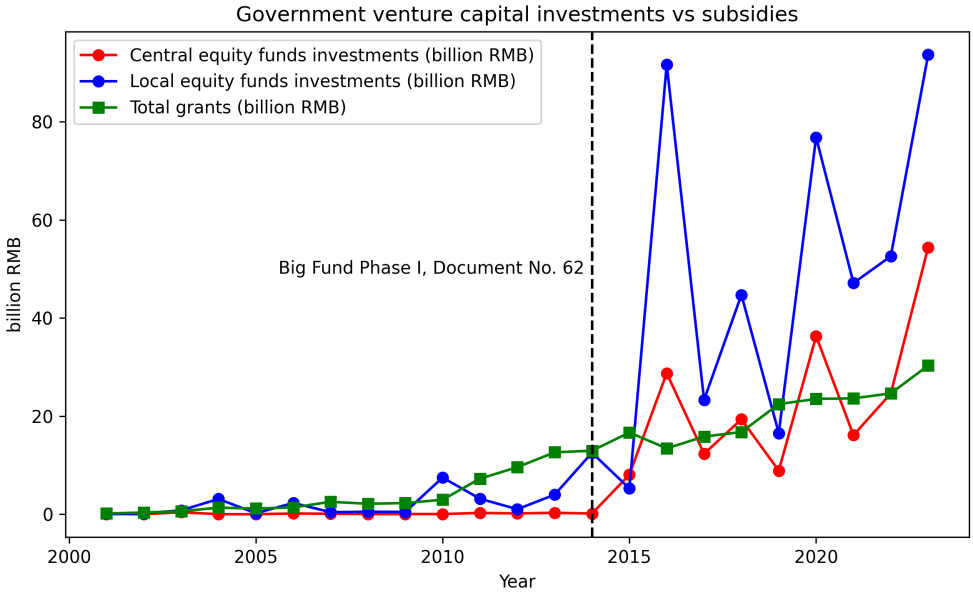


Figure 1: New Invested Capital and Subsidies

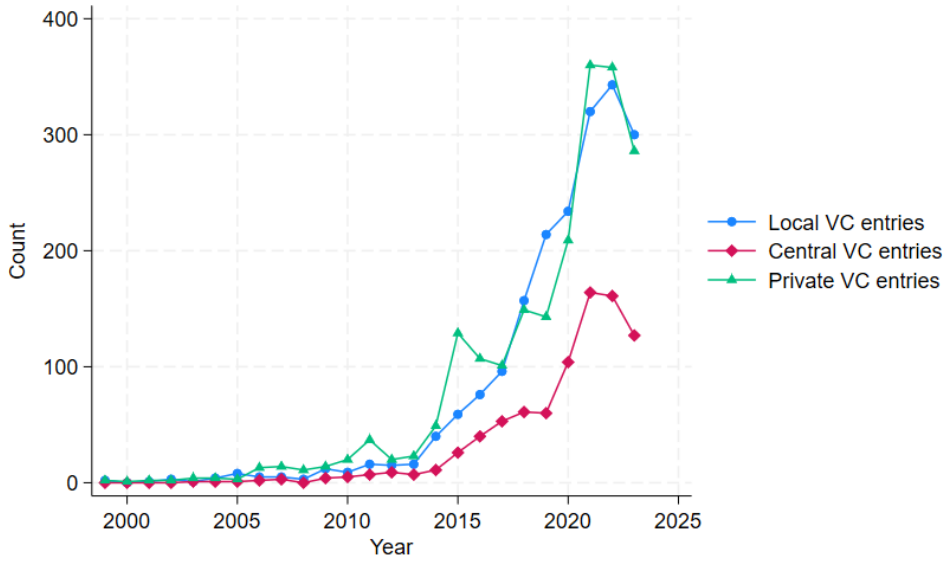


Figure 2: Count of New Investment Events

3 Data

Firm-level balance sheet data. I focus on the set of firms belonging to the following 4-digit sectors in China's National Economic Industry Classification: Integrated Circuits Design (I6520), Integrated Circuits Manufacturing (C3973), Discrete Semiconductor Manufacturing (C3972), Semiconductor Optoelectronics (C3975), Semiconductor Equipment (C3562), and Materials for Electronic Manufacturing (C3985). I combine and harmonize multiple data sources to build an unbalanced panel of semiconductor firms in China from 1998 to 2024. For outcomes prior to 2013, I rely primarily on the National Bureau of Statistics Survey of Above-Scale Industrial Firms (ASIF), which contains survey outcomes for all Chinese manufacturing firms with sales exceeding 5 million RMB before 2010 and 20 million RMB thereafter (Brandt et al., 2014). For balance sheet outcomes post 2013, I obtain data on firm revenue, total/noncurrent assets, employees, and cost of goods sold from Orbis and Wind.

Business registration data. To document Chinese government equity investments, I leverage Chinese business registration data published by the National Enterprise Credit Information Publicity System and available on business intelligence platforms Qichacha and Tianyancha. The platforms provide the history of shareholders, shareholder capital, main personnel (board and management), and intellectual property of the universe of firms in China. This enables me to track the immediate shareholders of firms, their equity share, and paid-in capital contribution across time, as well as that of their shareholders, and so on. For each corporate shareholder, the data platform identifies the "ultimate controller" of the corporate shareholder via shareholding and/or voting rights. I am thus able to identify whether a given venture capital/private equity (VC/PE) fund is owned by a central (typically the State Council, the Ministry of Finance, or the State Council State-owned Assets Supervision and Administration Commission (SASAC)) or a local government entity

(provincial/municipal people's government, finance bureaus, or provincial/municipal SASAC). To account for the fact that many majority private-controlled firms and investment funds have minority government shareholders that exert significant influence (Bai et al., 2020), I collect the ultimate controllers of the shareholders of each direct corporate shareholder of a firm. Following Chen et al. (2026), a corporate shareholder is a "central", "provincial", or "municipal" equity fund if it is a VC/PE fund and has over 20% of its share controlled by shareholders identified by Qichacha to be ultimately controlled by a central, provincial, or municipal entity respectively. Figure 3 illustrates this logic by showing the major shareholders of Shanghai Enflame Technology, a graphics processing unit (GPU) designer for artificial intelligence (AI) applications. Enflame's major shareholders include Big Fund Phase II, which invested in the firm in 2022, and Shanghai Wuyuefeng Phase II Integrated Circuits Equity Investment Limited Partnership, which invested in 2020. Via chains of controlling shareholders as documented in the figures, Shanghai Wuyuefeng's major shareholders, Shanghai Venture Capital Co. and Shanghai Shuangchuang Tech Investment Center, are both investment companies ultimately controlled by Shanghai SASAC. Thus I identify Shanghai Wuyuefeng as a local government fund of Shanghai.

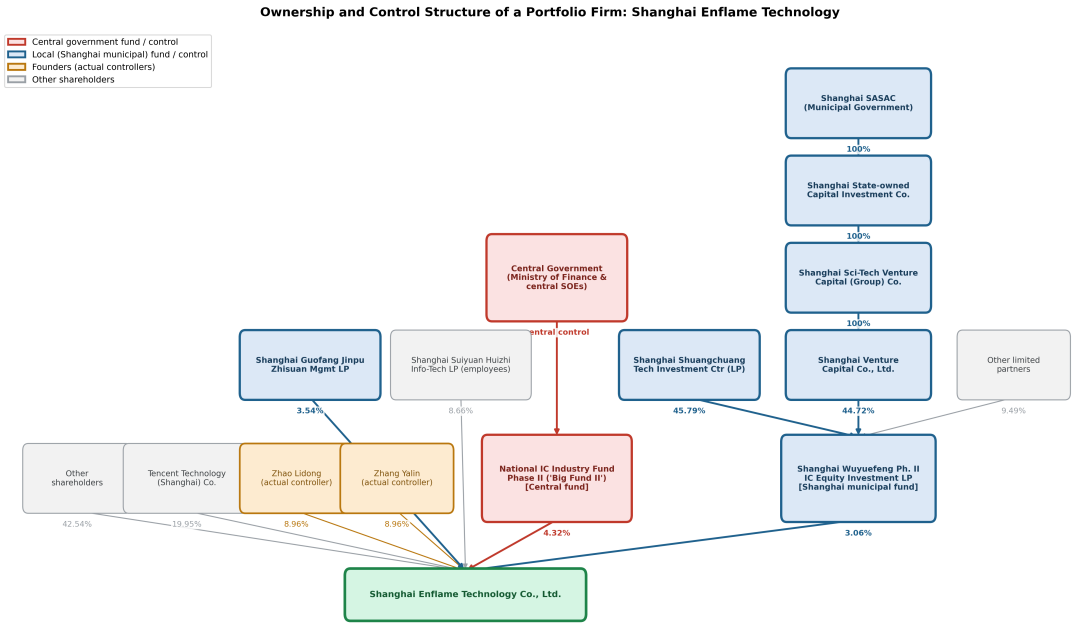


Figure 3: Shareholders and Shareholder Control Chain of Enflame

Figure 4 presents, by province and year, the count of firms invested by central, provincial, and city government funds. Central government funds concentrate their allocation on firms in affluent provinces with established technology industry clusters such as Jiangsu, Guangdong, Zhejiang, Beijing and Shanghai. Other provinces see a higher proportion of firms being invested by provincial and city government funds. Most invested firms are invested by local governments, again suggesting that focusing on the activities of the "Big Fund" misses a significant component of Chinese industrial policy in semiconductors.

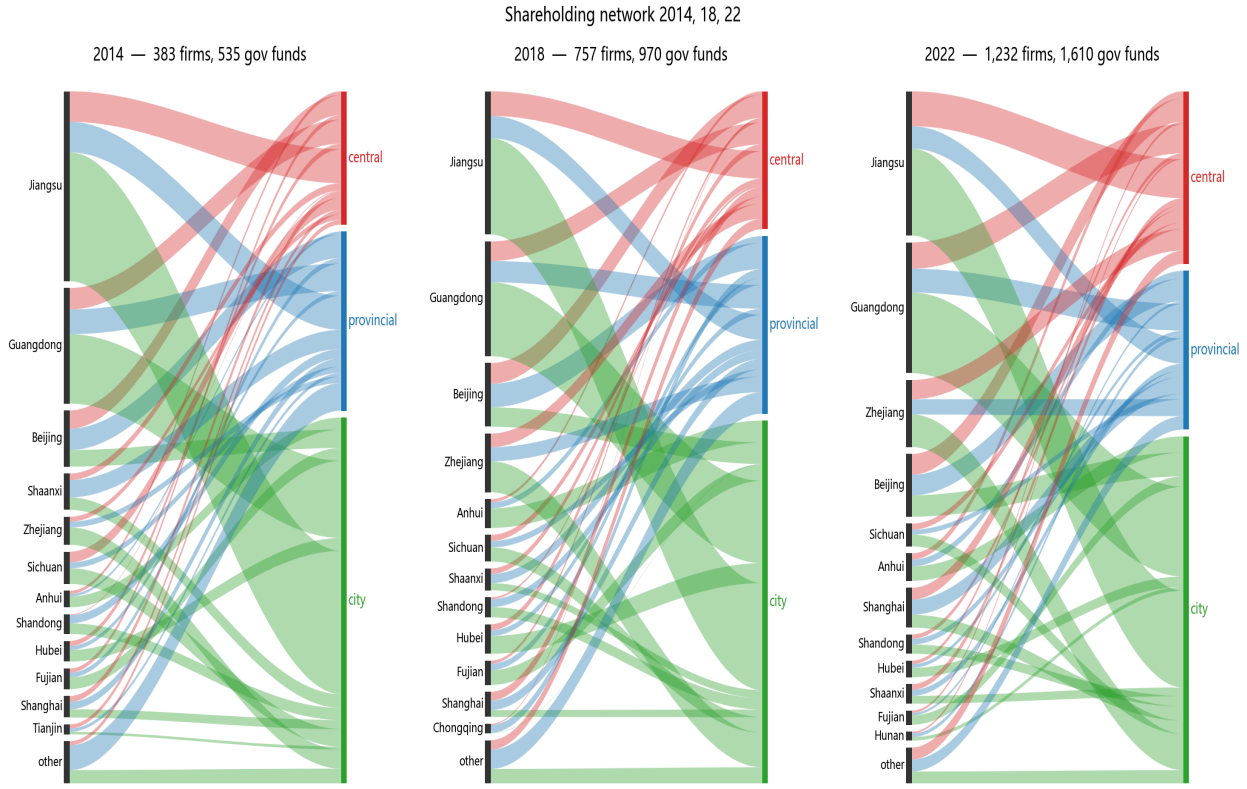


Figure 4: Count of firms invested by central & local funds across provinces

Personnel data. To characterize the people who run semiconductor firms and government investment funds, I collect from the same business registration platforms the board and management roster of every firm and government-fund general partner (GP) in the sample. For each person, the records list their name, position, and the start and end dates of each appointment, which allows me to construct a panel of director and executive term spells across firms and funds over time. The platforms additionally publish biographical profiles for these individuals, describing their education and prior career history. I further augment the data by collecting additional biographies using Anthropic Claude's web search tool. Because these biographies are unstructured free text, I use large language models (LLMs) to encode each profile into a consistent set of characteristics: the individual's highest degree and field of study, and indicators for prior experience in government, state-owned enterprises, finance, academia, research and development, and abroad. I further use the LLMs to parse each biography into a structured career history of dated education and employment stints with normalized institution names. This structured personnel data serves two purposes. First, it lets me measure how the educational and professional composition of a firm's board changes around government investment. Second, by matching the institutions that appear in firm directors' and fund managers' career and education histories, I identify personal "connections" between a pair of firm and fund personnel via a shared employer or alma mater. This allows me to link a government invested firm to its government fund beyond formal equity ties. Tables 1 and 2 present the most frequently observed institutions that link a person in a semiconductor firm with another person in a central or local government fund respectively. For each institution, the table

reports the count of qualifying (firm-person, fund-person) pairs and the share of pairs accounted for by each of the top three connection channels: undergraduate or postgraduate education at the institution (where the firm-side person was a student), and prior employment as faculty/research staff there (where the firm-side person was an academic). Pairs are dominated by ties through elite universities, with firm-side faculty and graduates accounting for the bulk of the cross-fund overlap.

Table 1: Top 10 institutions linking firm and central-fund personnel

#	Institution	Pairs	Top channels
1	Tsinghua U	5,437	academic 36% / postgrad 36% / undergrad 28%
2	Peking U	2,057	academic 50% / postgrad 41% / undergrad 9%
3	Renmin U	1,990	postgrad 53% / academic 32% / undergrad 14%
4	Fudan U	1,412	academic 53% / postgrad 31% / undergrad 16%
5	Zhejiang U	1,059	academic 69% / postgrad 16% / undergrad 15%
6	XJTU	720	academic 52% / postgrad 24% / undergrad 23%
7	SUFE	654	academic 37% / undergrad 35% / postgrad 25%
8	SJTU	639	academic 66% / postgrad 18% / undergrad 16%
9	Wuhan U	615	academic 43% / postgrad 32% / undergrad 25%
10	CEC	498	SOE 100%
Scope total unique pairs		35,030	

Table 2: Top 10 institutions linking firm and local-fund personnel

#	Institution	Pairs	Top channels
1	Tsinghua U	13,295	academic 40% / postgrad 34% / undergrad 26%
2	Fudan U	4,792	academic 61% / postgrad 25% / undergrad 13%
3	Peking U	4,749	academic 51% / postgrad 37% / undergrad 11%
4	Zhejiang U	4,055	academic 67% / undergrad 18% / postgrad 15%
5	SJTU	3,384	academic 63% / postgrad 20% / undergrad 17%
6	SUFE	2,712	academic 42% / undergrad 29% / postgrad 27%
7	Renmin U	1,958	academic 44% / postgrad 44% / undergrad 12%
8	XJTU	1,800	academic 64% / postgrad 19% / undergrad 16%
9	Nanjing U	1,765	academic 52% / postgrad 25% / undergrad 21%
10	Shenzhen Capital Group	1,589	Gov VC 100%
	Scope total unique pairs	90,836	

Industry data. The data is further supplemented with commercial datasets from industry providers focusing on manufacturers of integrated circuits, discrete semiconductors, and optoelectronics. SEMI's global semiconductor plant-level data on capacity, investment, product & process technologies (1996-2024) has quarterly estimates of each known semiconductor wafer plant's capacity and investment ($ US million) in equipment and construction, as well as the plant's product offerings and technology process node each quarter. According to SEMI, the capacity and spending estimates are from company contacts as well as various industry sources such as "news articles, capital spending plans, earning reports, SEC filings, presentations, announced fab plans, ramp schedules, and technology roadmaps." It also utilizes its network of equipment suppliers and uses its billing information to update and adjust quarterly data. I construct yearly measures of physical

capital stock using the perpetual inventory method with SEMI's construction and equipment investment data. A firm's technology process node (measured in units of microns or 1000 nanometers) is measured by the most advanced process node the firm can produce in the year across its fabs. A smaller process node indicates that the firm's manufacturing process can fit more transistors on a given area of semiconductor material and hence is more advanced. I link data across the datasets via firm name, past firm names, and the firms' Social Credit Identifiers.

Subsidy and Export Control data. I further collect data on other variables that may affect firm performance and influence government equity investment. To paint a fuller picture of the fiscal incentives provided to Chinese semiconductor firms, I obtain government grants received by firms from various sources. The ASIF has total firm-level government subsidies. Publicly listed firms also report the subsidies they received from the government, which I obtain from Wind, a China-focused financial database (Branstetter et al., 2023). Corporate information platforms including Baidu's Aiqicha and Qizhidao list publicly announced government grants and recognitions received by firms. The data includes details on the level of government that issued the grant and the subsidy type, categorized by whether the grant subsidizes R&D, fixed assets, tax, loans, labor talent, or incentives for performance. Firms could also be designated by government ministries as a "High Tech Enterprise", "Little Giant", or "Specialized & Innovative Small & Medium Enterprise" that come with tax incentives and one-time grants. I harmonize ASIF, Aiqicha, and Wind data to construct a firm-level measure of subsidies it receives every year. For private firms, it is likely a lower bound on the total fiscal support it receives from Chinese governments. 141 firms in the dataset are entities covered in the US Bureau of Industry and Security (BIS)'s Entity List. Exports of US technology by any global firms to entities in the Entity List are subject to licensing requirements with a presumption of denial. Semiconductor firms in the List are considered by the BIS to pose a significant threat to US national security, and thus are typically technologically advanced and often national champions (Crosignani et al., 2024).

Policy documents. Finally, industrial policy documents issued by central and local governments describe in detail the objectives and tools of semiconductor policy. I collected 323 major policy documents on semiconductors from PKU Law. Among them, 151 explicitly set industry revenue or scale as a policy goal, while 258 target productivity upgrading. Appendix Figure B.3 summarizes the frequency of major policy documents that feature these policy targets over time. These priorities motivate the paper's focus on revenue productivity as a core outcome, where government funds invest to maximize regional revenue via improving portfolio firms' revenue productivity and reducing input costs. Appendix Section A provides a formal model of central and local government investment that motivates my revenue productivity estimation and regression specifications.

4 Revenue Productivity Estimation

4.1 Estimation Strategy

Revenue productivity ω_{it} is my core measure of firm performance using balance sheet data. I estimate a Cobb-Douglas production function separately by each 4-digit semiconductor subsector using the Ackerberg et al. (2015) control-function approach with firm investment I_{it} as the proxy variable:

$$\ln R_{it} = \omega_{it} + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \epsilon_{it},$$

where R is deflated revenue, K is noncurrent assets constructed with the perpetual inventory method (Brandt et al., 2017), L is the number of employees, and ω_{it} is persistent productivity that follows a first-order Markov process. Out of 54,101 firm-year observations of which I have data on revenue, capital, employees, 36,030 of them have cost of goods sold recorded, which I take as a measure of intermediate input (cf. Syverson (2019)). With the subsample of firms with cost of goods sold, which includes larger firms of the whole sample, I construct value-added VA as revenue minus cost of goods sold, and estimate a value-added Cobb-Douglas production function:

$$\ln VA_{it} = \omega_{it} + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \epsilon_{it},$$

Standard production-function estimators such as Olley and Pakes (1996) and Ackerberg et al. (2015) require the firm's investment or intermediate-input policy to be strictly increasing in underlying productivity conditional on the capital stock. However, government-supported firms likely face lower input prices as discussed in the previous section. Let $I_t(\omega, K, z)$ be the firm's investment function given productivity ω, capital K, and other determinants of firm investment behavior z. If subsidized firms invest more than observationally similar private firms, inverting investment without accounting for latent government subsidy intensity to recover productivity may recover biased elasticities as investment is no longer monotonic in productivity:

$$I(\omega, K, \text{gov invested}) > I(\omega, K, \text{private}) \implies \omega^{-1}(I, K, \text{gov invested}) < \omega^{-1}(I, K, \text{private}).$$

One strategy common in the literature is to explicitly account for variables relevant to proxy variable decisions (Brandt et al., 2017; De Loecker and Warzynski, 2012; Ackerberg and De Loecker, 2024). Consider equation (A.15) in Appendix Section A that expresses revenue as a function of competition, demand, physical productivity, capital, labor inputs, and government investment, reproduced below:

$$\ln R_{it}(x^g_{it}, x^C_{it}) = \underbrace{\ln P_{st} + \frac{1}{\sigma} \ln Y_{st} + \rho(\ln A_{it} + \eta^g_A x^g_{it} + \eta^C_A x^C_{it})}_{\equiv \omega_{it}(x^g_{it}, x^C_{it})} + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \rho \ln \epsilon_{it} \quad (1)$$

where x^g_{it}, x^C_{it} are variables measuring local and central government investment, Y_{st} represents total demand of firm i's sector s in year t, and P_{st} the industry price index measuring the effect of competition.

This motivates the estimation of production function parameters β_k, β_L as follows:

1. For each sector s and year t, regress observed revenue R_{it} or value-added VA_{it} on a flexible third-order polynomial function of inputs $\ln K_{it}$, $\ln L_{it}$, government investment x^g_{it}, x^C_{it}, and the proxy variable investment $\ln I_{it}$, which is assumed to be strictly increasing in productivity conditioning on the other variables. With the resulting function $\Phi_{st}(K, L, I, x^g, x^C)$ that predicts output, termed by De Loecker and Syverson (2021) as the firm's "planned output" when it makes input decisions, we can then estimate mean-zero shocks $\ln \epsilon_{it} = \ln R_{it} - \Phi_{st}(K, L, I, x^g, x^C)$ which are estimated shocks to the firm's output that are assumed to be independent from firms' lagged input decisions.

2. Utilizing the assumption that productivity follows a Markov process, let $\hat{g}$ be a flexible 3rd degree polynomial function approximating $\mathbb{E}(\omega_{it}|\omega_{it-1}) = g(\omega_{it-1})$. For candidate β_K, β_L, the productivity residual is $\hat{\omega}_{it}(\beta_K, \beta_L) = \Phi_{st}(K_{it}, L_{it}, I_{it}, x^g_{it}, x^C_{it}) - \beta_K K_{it} - \beta_L L_{it}$. The productivity shock $\hat{\eta}_{it}(\beta_K, \beta_L) = \hat{\omega}_{it}(\beta_K, \beta_L) - \hat{g}(\hat{\omega}_{it-1}(\beta_K, \beta_L))$ is also independent of the firm's input choices. Thus we can utilize the moment

$$\mathbb{E}[\ln R_{it} - \beta_K K_{it} - \beta_L L_{it} - \hat{g}(\hat{\omega}_{it}(\beta_K, \beta_L))|K_{it-1}, L_{it-1}, I_{it-1}] \tag{2}$$

   to form the moment conditions to estimate (β_K, β_L) by the generalized method of moments.

As I am interested in what happens to private firms before and after government acquisition, I also estimate the production function on the not-yet invested domestic firms sample. This includes never-invested firms, and eventually-invested firms in years before any government investment occurs. An advantage of this approach is that we do not need to add government investment variables (x^g, x^C) to the first stage to account for government investment's impact on firm input decisions and productivity. Furthermore, the recovered structural production parameters characterize input elasticities for firms operating without direct government equity investment support, which may well differ from that of state-owned firms or foreign subsidiaries.

4.2 Production Function Results

Table 3 reports the estimated factor elasticities β_K, β_L across semiconductor subsectors with four different specifications. The first column reports elasticities estimated on the full sample without using a vector of government subsidy variables in the first stage, which includes indicators of central and local government investment, respective invested shareholder capital, and non-equity subsidies. The second column reports estimates where the first stage includes these government investment variables. The third column reports estimates from the sample of private domestic firms with no subsidy variables in the first stage. The fourth column reports results on the private sample with non-equity subsidies in the first stage. Government investment is by definition zero for firms in that sample. Table 4 reports estimates from the value-added specification.

Table 3: Revenue Production Function Estimates (Ackerberg et al., 2015)

ACF Gross Output Estimates without COGS

	Full			Full + Gov vars			Private Only			Private Only + Gov vars		
Sector	β_K	β_L	Obs.	β_K	β_L	Obs.	β_K	β_L	Obs.	β_K	β_L	Obs.
Assembly & Testing	0.393	0.600	1895	0.404	0.617	1895	0.361	0.563	1357	0.386	0.588	1357
	(0.037)	(0.047)		(0.037)	(0.059)		(0.032)	(0.055)		(0.033)	(0.051)	
Design	0.248	0.823	4495	0.189	1.468	4468	0.249	0.726	2832	0.235	0.756	2808
	(0.022)	(0.046)		(0.026)	(0.067)		(0.019)	(0.027)		(0.032)	(0.068)	
Discrete	0.337	0.607	4957	0.340	0.636	4957	0.272	0.589	3658	0.277	0.602	3658
	(0.022)	(0.025)		(0.024)	(0.028)		(0.021)	(0.030)		(0.017)	(0.027)	
Electronics	0.275	1.092	7956	0.297	0.922	7939	0.305	0.692	6420	0.307	0.711	6403
	(0.023)	(0.063)		(0.022)	(0.069)		(0.019)	(0.028)		(0.021)	(0.080)	
Equipment	0.292	0.763	2979	0.312	0.762	2979	0.301	0.733	2078	0.292	0.743	2078
	(0.049)	(0.123)		(0.038)	(0.098)		(0.027)	(0.040)		(0.026)	(0.038)	
IC Manufacturing	0.317	0.686	1440	0.365	0.689	1440	0.448	0.448	741	0.497	0.383	741
	(0.062)	(0.098)		(0.060)	(0.090)		(0.054)	(0.082)		(0.069)	(0.082)	
Materials	0.377	0.641	5176	0.380	0.650	5100	0.369	0.588	3782	0.365	0.606	3730
	(0.018)	(0.032)		(0.019)	(0.028)		(0.023)	(0.036)		(0.022)	(0.035)	
Optoelectronics	0.339	0.668	2330	0.327	0.724	2324	0.329	0.613	1564	0.303	0.667	1558
	(0.038)	(0.058)		(0.027)	(0.043)		(0.034)	(0.051)		(0.034)	(0.042)	

Table 4: Value-Added Production Function Estimates (Ackerberg et al., 2015)

ACF Value-Added Estimates

	Full			Full + Gov vars			Private Only			Private Only + Gov vars		
Sector	β_K	β_L	Obs.	β_K	β_L	Obs.	β_K	β_L	Obs.	β_K	β_L	Obs.
Assembly & Testing	0.290	0.885	470	0.429	0.406	470	0.284	0.565	272	0.337	0.441	272
	(0.133)	(0.215)		(0.100)	(0.163)		(0.153)	(0.248)		(0.189)	(0.307)	
Design	0.351	0.911	2334	0.340	0.926	2325	0.333	0.707	1408	0.327	0.994	1400
	(0.032)	(0.084)		(0.034)	(0.086)		(0.040)	(0.124)		(0.037)	(0.116)	
Discrete	0.458	0.460	1417	0.410	0.666	1417	0.241	1.117	1015	0.717	0.303	1015
	(0.049)	(0.094)		(0.035)	(0.085)		(0.056)	(0.110)		(0.053)	(0.119)	
Electronics	0.357	0.952	4014	0.386	0.796	3997	0.417	0.776	3089	0.378	0.848	3072
	(0.030)	(0.097)		(0.030)	(0.078)		(0.035)	(0.099)		(0.038)	(0.116)	
Equipment	0.334	0.762	1546	0.339	0.755	1546	0.366	0.921	1049	0.379	0.662	1049
	(0.037)	(0.062)		(0.030)	(0.070)		(0.036)	(0.076)		(0.044)	(0.078)	
IC Manufacturing	0.733	0.061	593	0.546	0.297	593	0.566	0.500	308	0.544	0.515	308
	(0.092)	(0.162)		(0.088)	(0.142)		(0.078)	(0.124)		(0.077)	(0.162)	
Materials	0.539	0.330	3568	0.570	0.625	3529	0.540	0.362	2645	0.541	0.689	2618
	(0.100)	(0.064)		(0.052)	(0.038)		(0.065)	(0.057)		(0.038)	(0.044)	
Optoelectronics	0.663	0.409	869	0.666	0.388	868	0.265	0.784	479	0.279	0.702	478
	(0.108)	(0.202)		(0.089)	(0.157)		(0.094)	(0.136)		(0.097)	(0.136)	

In the first table 3, coefficients across columns (1)-(2) are roughly similar to each other. The private-only subsample's elasticities in columns (3)(4) slightly differ from those of the full sample, especially for the integrated circuits manufacturing and design sectors. This suggests a motivation to use the private-only subsample's elasticity as the preferred specification to understand how productivity evolves with government investment for the initially private firms.

Value-added production function estimates in table 4 appear to be more sensitive to specifications, reflecting noise from sample truncation and potentially the sensitivity of cost of goods sold to government subsidies. Due to the loss of sample, I use the residual from the estimated revenue production function parameters in the last column of Table 3 *across all firms* as the core measure of firm productivity. I plot the correlation of estimated revenue productivity of 3 against value-added

productivity of Table 4 across all specifications in 5. Reassuringly, these two measures appear highly correlated across parameters estimated from different subsamples and first stage proxy variables.

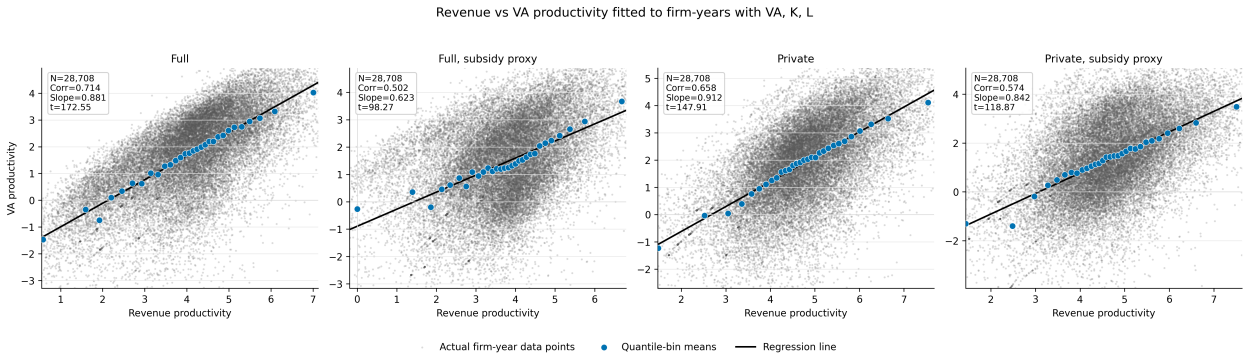


Figure 5: Correlation of Revenue and Value-added Productivity

The estimates suggest that firms exhibit roughly constant to mildly increasing returns to scale. The appendix Table B.1 reports correlates of the resulting productivity measure, which show positive correlation with intellectual property, employees, age, High Tech Enterprise designation, manufacturing capacity, central government procurement, and total non-equity subsidies received in the cross section without firm fixed effects. Capital is negatively correlated with productivity, indicating potential misallocation of capital. Interestingly, firms that share education or career connections with a central fund appear to be less productive, while local fund-connected firms are slightly more productive. If connection predicts investment controlling for productivity ranks, this suggests a mechanism that leads to central funds' negative selection on firm productivity.

Productivity is negatively correlated with the indicator of local investment in the first two specifications with only year fixed effects. This is consistent with our model where local governments invest in relatively productive firms in their province, without regard to the firm's ranking within the country. Controlling for firm fixed effects, both local and central government investment now return positive coefficients. This suggests that in the sample, a private firm became more productive after government equity investment.

5 What Predicts Government Investment?

5.1 Central vs. Local Selection on Productivity

The model in the appendix predicts that central and local investors prioritize investing in different firms because they maximize different jurisdictional objectives. Central funds target firms with higher national productivity rank, while local funds target firms that are relatively strong in the same province. If productivity is spatially concentrated in certain provinces, the two jurisdictions may prefer investing in different firms. To test this hypothesis, I construct a firm-year's productivity rank among the same sector firms (1) in the nation and (2) within its own province in that year, and normalize by firm count to arrive at the firm's productivity percentile in the whole country and

province within its sector-year. Figure 6 presents a scatter plot of these two variables in 2019, with firms in different provinces receiving a different color. It is apparent that while these two measures are highly correlated, there are provinces that are relatively more productive than other provinces on average: firms in provinces such as Guangdong and Shanghai are placed above the 45 degree diagonal. The median firm in these provinces is more productive than the median of the nation, and analogously for other percentiles. On the other hand, firms in less advanced provinces such as Fujian and Shaanxi are on average less productive.

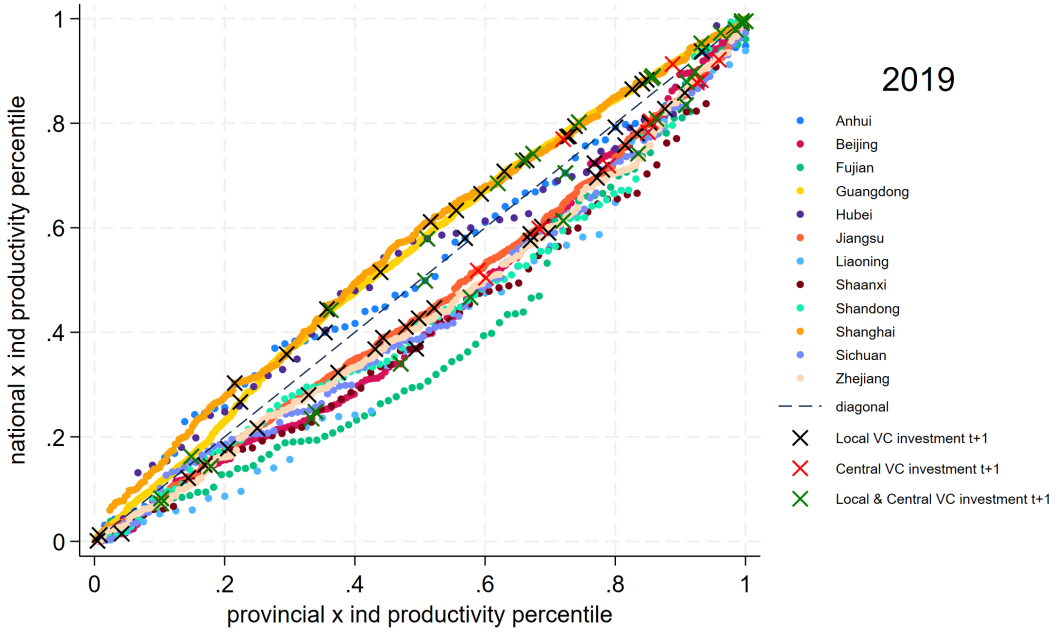


Figure 6: Local vs national productivity percentile

Figures 7 and 8 provide suggestive evidence that a wedge between central and local government incentives may be present. They plot the probability for private firms to receive government investment in the next year for each pair of national x provincial quartile groups. In the figures, the vertical axis is the firm's productivity quartile in the whole nation (the higher the more productive), the horizontal axis is the provincial quartile. The probability of central fund investment rises with a firm's national productivity quartile. Local investment probability, on the other hand, shifts more strongly with the provincial TFPR quartile. In particular, firms that are near the top of their provincial distribution but not at the top of the national distribution are much more likely to receive local government capital than central government capital.

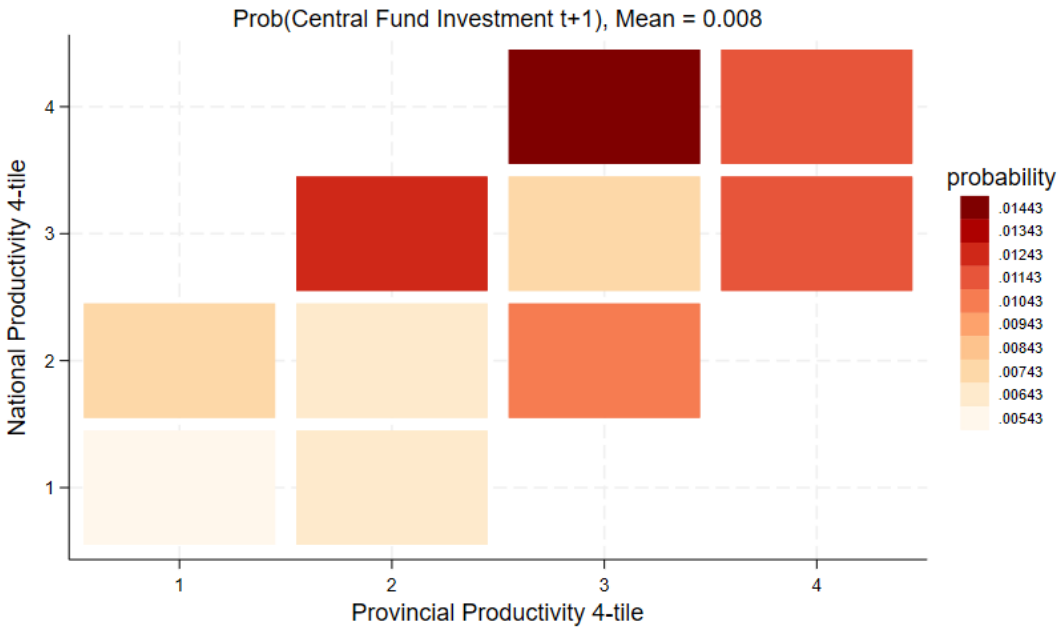


Figure 7: Central Fund Investment Probability and Productivity Percentiles

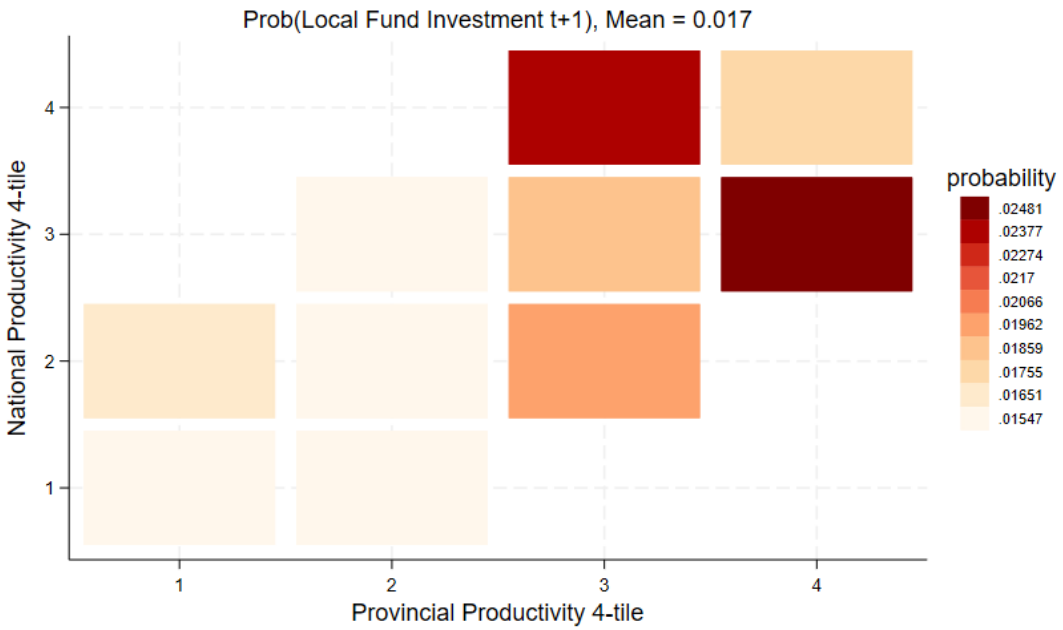


Figure 8: Local Fund Investment Probability and Productivity Percentiles

Tables 5 and 6 present the corresponding "horse-race" regressions benchmarking the effect of national versus provincial productivity percentile (0-1 scale, with 1 being the most productive) on the likelihood of next year central and local government investment respectively. I also jointly consider the effect of having any director or management connected to a person in a central or local government fund. Across specifications with extensive battery of firm characteristics as controls including intellectual property, firm balance sheet variables, board member characteristics, and other govern-

ment subsidy/procurement allocation, central investment is consistently positively correlated with national productivity rank. Provincial productivity percentile instead negatively predicts central selection holding fixed national productivity rank, suggesting that central government funds favor provinces with more productive firms. Local investment instead shows the opposite pattern: probability of local investment increases with provincial productivity rank and falls with national percentile. An interpretation of the negative national coefficient is that less productive provinces invest more aggressively.

Furthermore, board directors' or managers' ties to government funds predict government investment in the intuitive direction. Having any director/management with past education or work ties to a central fund GP's manager increases the probability of next year central government investment by 0.4 to 0.6 percentage points, about a 40% to 60% increase from the baseline probability of one percent. A tie to local funds significantly predicts a one percentage point increase in the probability of next year local investment, also about a 50% increase from the baseline two percent probability. This suggests that soft information and trust created by personal ties may facilitate investment, even controlling for various other measures of firm performance as predicted by the model.

Table 5: 1(Central Fund Investment in Year t+1), Private Firms

	(1)	(2)	(3)
nat TFPR percentile	0.040**	0.039**	0.037**
	(0.016)	(0.017)	(0.017)
prov TFPR percentile	-0.032**	-0.031*	-0.030*
	(0.016)	(0.016)	(0.016)
1(directors with edu/work ties to central fund)	0.006**	0.004*	0.004*
	(0.002)	(0.002)	(0.002)
1(directors with edu/work ties to local fund)	0.002	-0.001	-0.001
	(0.002)	(0.002)	(0.002)
Mean Outcome	0.01	0.01	0.01
N	27745	27745	27745
R-squared	0.19	0.20	0.20
N clusters (Prov x Ind)	123	123	123
Ind x Prov x Year FE	Y	Y	Y
tech, size, ownership & board controls	N	Y	Y
subsidy & procurement controls	N	N	Y

Table 6: 1(Local Fund Investment in Year t+1), Private Firms

	(1)	(2)	(3)
nat TFPR percentile	-0.057**	-0.055**	-0.054**
	(0.026)	(0.026)	(0.026)
prov TFPR percentile	0.057**	0.061**	0.059**
	(0.026)	(0.025)	(0.024)
1(directors with edu/work ties to central fund)	0.009**	0.001	0.001
	(0.004)	(0.004)	(0.004)
1(directors with edu/work ties to local fund)	0.019***	0.009**	0.009**
	(0.005)	(0.004)	(0.004)
Mean Outcome	0.02	0.02	0.02
N	27745	27745	27745
R-squared	0.19	0.21	0.21
N clusters (Prov x Ind)	123	123	123
Ind x Prov x Year FE	Y	Y	Y
tech, size, ownership & board controls	N	Y	Y
subsidy & procurement controls	N	N	Y

Relative to the baseline probability of investment, the most productive provincial firms are three times more likely to receive local investment, while the most productive firms in the national distribution are four times more likely to receive central investment. The selection evidence therefore motivates the rest of the paper: if local governments do not select the national frontier ex ante, any superior post-treatment performance suggests that it is not from simple cherry-picking of obvious national winners.

5.2 What Predicts Connections?

Given the results that connections to the government fund predict investment and that connections are dominated by ties formed in academia, this begs the question to what extent these connections proxy for measures of firm quality. Tables B.2 and B.3 in the Appendix show regressions of indicators of firm-fund connections on firm characteristics with the sample of private firms. They appear strongly positively correlated with the firm's intellectual property output, the amount of subsidies received, the number of board members, and in particular the number of directors with engineering degrees. They also have larger assets and employees. These firms thus appear to have high patent output, and to be well-resourced with higher number of employees and board/management members. However, connected firms do not appear to be particularly productive.

What motivates government funds' tendency to invest in connected firms, even when we control for the correlates of such connections? There are two competing hypotheses. The first is that government venture capitalists could learn soft information about the potential of the firms that is not visible on balance sheet data through their industry contacts. Government funds thus leverage these connections to invest in connected firms, understanding that they can profit more from the investment. This is plausible as the connections are mainly formed via ties in prestigious

universities, and that connected firms appear to be innovative and well-funded. Another competing hypothesis is that connection simply serves to facilitate doing business or outright favoritism. For similarly productive firms, government funds prefer those managed by connected persons without regard to their future potential. The next section turns to investigate the impact of government investment on productivity, and in particular the heterogeneity of such effects by whether the invested firm has a preexisting connection.

Category	**Number of Firms**
Local VC entry precedes Central VC entry	292
Central VC entry precedes Local VC entry	109
Joint (same-year) Local and Central VC entry	241
# firms central only	93
# firms local only	737
Never Invested Domestic Firms	3,721

Table 7: Firm Count by Government Fund Entry Type

6 Event Study Analyses

6.1 Joint Event-Study Specification

Table 7 and figure B.4 in the Appendix summarize the timing patterns of local and central investment at the firm level. They suggest that there is substantial variation in the timing of local and central government investment across firms: most firms receive local investment before central investment, but there are also substantial cases in the converse. Most invested firms are invested by local funds only, while some firms are central-invested only. This variation presents an opportunity to study heterogeneity in the effects of central and local government investments, given that they appear to invest based on different incentives. To study firm dynamics around two different types of government investment, I estimate a "joint event study" of the form

$$Y_{it} = \sum_{\substack{k=-5 \\ k\neq -1}}^{5} \beta_k^{LVC} \, \mathbb{1}(\text{local entry in year } t-k)_{i,t} \; + \; \sum_{\substack{k=-5 \\ k\neq -1}}^{5} \beta_k^{CVC} \, \mathbb{1}(\text{central entry in year } t-k)_{i,t} \\ + \; \mu_i \; + \; \lambda_{st} \; + \; \varepsilon_{it}, \tag{3}$$

where μ_i and λ_t are firm and sector-year fixed effects. The omitted period is $k = -1$. This specification compares the effects of local and central investment jointly by allowing firms to receive both types of "treatment" in a staggered fashion. Outcomes with many zeros—such as patents, government procurement counts, and board-member counts—are estimated using an analogous

Poisson pseudo-maximum likelihood specification:

$$\mathbb{E}[Y_{it} \mid X_{it}, \mu_i, \lambda_t] = \exp\Bigg(\sum_{\substack{k=-5 \\ k\neq -1}}^{5} \beta_k^{LVC} \, \mathbb{1}(\text{local entry in year } t-k)_{i,t} + \sum_{\substack{k=-5 \\ k\neq -1}}^{5} \beta_k^{CVC} \, \mathbb{1}(\text{central entry in year } t-k)_{i,t} + \mu_i + \lambda_t \Bigg)$$

However, the joint specification is subject to the critique of "forbidden comparisons" of comparing earlier treated with later treated firms if government investment at different times exhibits heterogeneous treatment effects (Baker et al., 2026). As government funds learn the efficacy of their investment decisions from experience, it is likely that the treatment effect on firms invested in different years will differ. I also estimate a modified Callaway and Sant'Anna (2021) design that estimates the primitive 2 by 2 event-time treatment effects of each government on the subsample with the same treatment history by the *other government fund* before aggregation. The following subsection introduces the design.

6.2 Modified Callaway-Sant'Anna with Two Staggered Treatments

The challenge in this setting is to jointly estimate the separate effects of two staggered treatments that may occur on the same unit. A firm can first receive local government investment in year G_L or central government investment in year G_C, with either treatment potentially never arriving. For the local treatment effect, I start from primitive conditional estimands of the form in the spirit of Callaway and Sant'Anna (2021):

$$ATT_L(g, t \mid G_C = c),$$

the effect at calendar time t for firms first invested by a local government fund in year g, *among* firms invested by the central government in year c, with $g < c$. I estimate the primitive object $ATT_L(g, t \mid G_C = c)$ by a simple 2 period differences-in-differences (DiD) on the subsample of firms in cohort $G_C = c$, i.e. firms invested by the central government fund in the same year c that have not yet by year g received local fund investment ($G_L = g' \geq g$). This includes $c = \infty$, that is firms that are not invested by a central fund. $ATT_L(g, t \mid G_C = c)$ is identified from post-treatment differences with not-yet-treated firms that have the same central treatment history, under the assumption that firms treated by a central government fund in the same year share the same dynamic treatment effect *pre-treatment* from the central fund. Such a design is especially useful in my setting, where government funds could select on trends in productivity and where support changes across treatment histories. The central-treatment effect is defined symmetrically by conditioning on the local investment cohort.

The estimator proceeds in two steps. First, within a fixed cohort of investees by the other government—including the "never treated by the other government" group—I aggregate over the treated cohorts of the treatment of interest, generating dynamic treatment effects conditional on being in a specific investment cohort by the other government. Second, I aggregate those condi-

tional dynamic effects across the other government's cohorts. The appendix section B.5 develops the notation in detail and presents the plots of the estimated 2×2 primitives that underlie the aggregation.

6.3 Productivity

Figure 9 reports the joint TWFE event-study coefficients for revenue productivity. Figure 10 presents the modified Callaway-Sant'Anna estimates, which show qualitatively similar patterns. Two patterns stand out: first, central-invested firms display stronger pre-treatment growth, which is exactly what one would expect from the selection results in Section 5. Second, local-invested firms exhibit larger post-treatment gains. After an investment event, estimated local dynamic treatment effects increase more strongly and remain above that of the central for several years. The estimates suggest that local governments do not select firms that are already obvious national winners, yet local-backed firms subsequently grow faster.

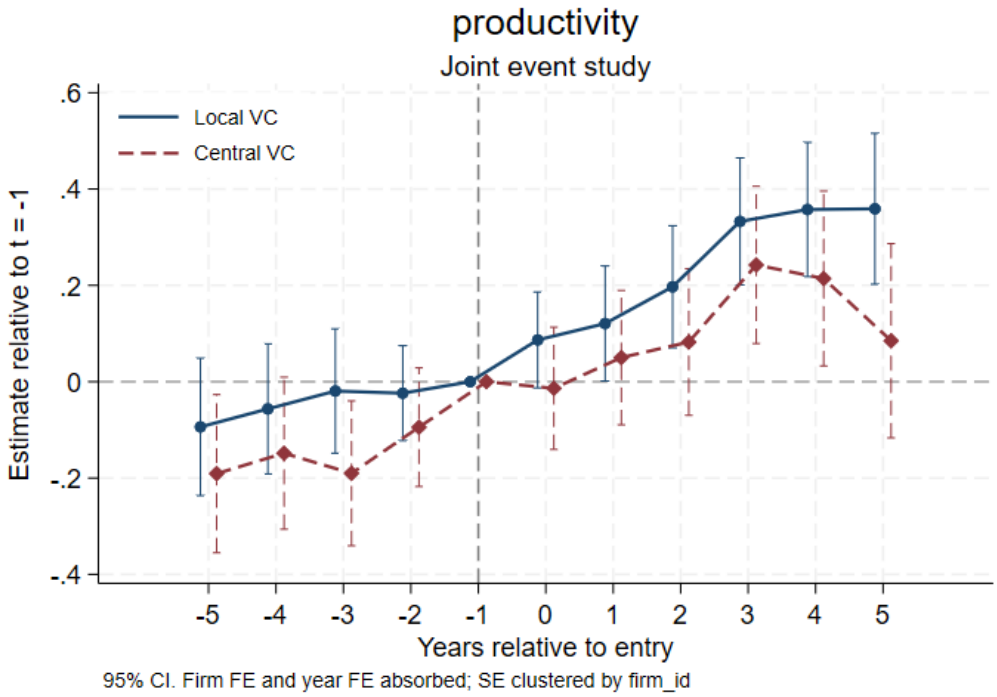


Figure 9: Joint event study, TWFE

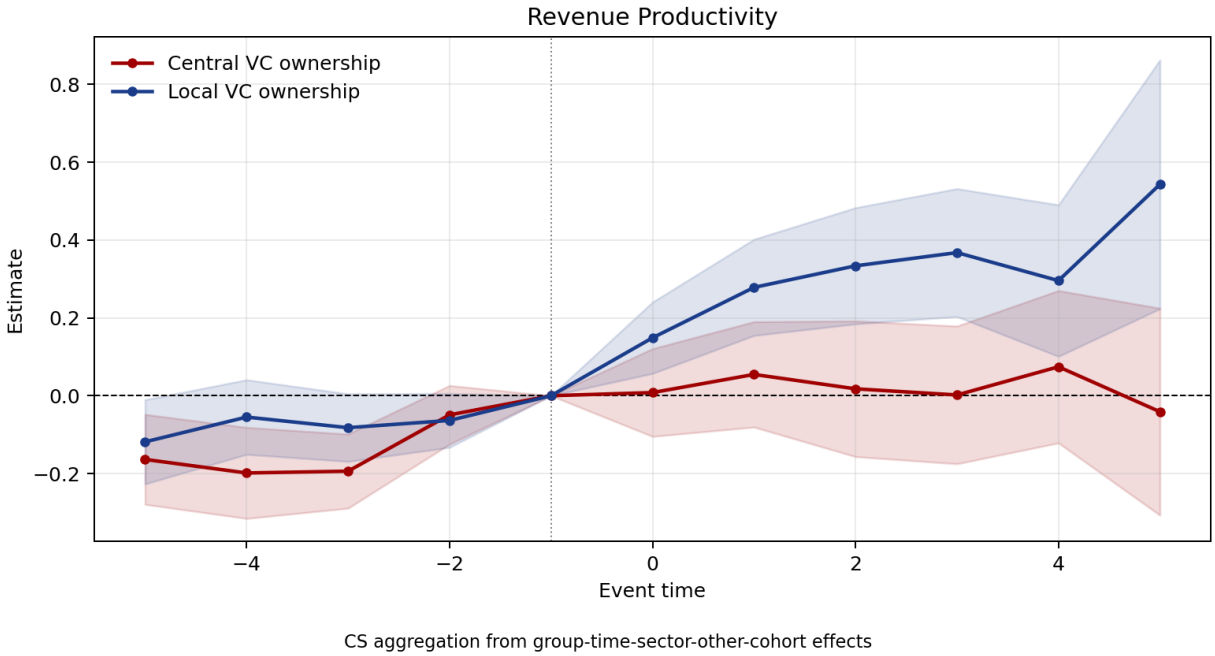


Figure 10: Joint event study, Callaway-Sant'Anna Aggregates

6.4 Innovation and Intellectual Property

Figures 11 and 12 compare the treatment effects of central versus local government investors on innovation outputs. Local-backed firms subsequently publish more higher-quality invention patents and more chip-design layouts, a special intellectual property right for chip designers' products introduced in China in 2000, than firms after central investment. The results suggest that the higher productivity residual after local investments is not merely reflecting higher market power or more intensive materials use after government investment, but actual process and product innovation.

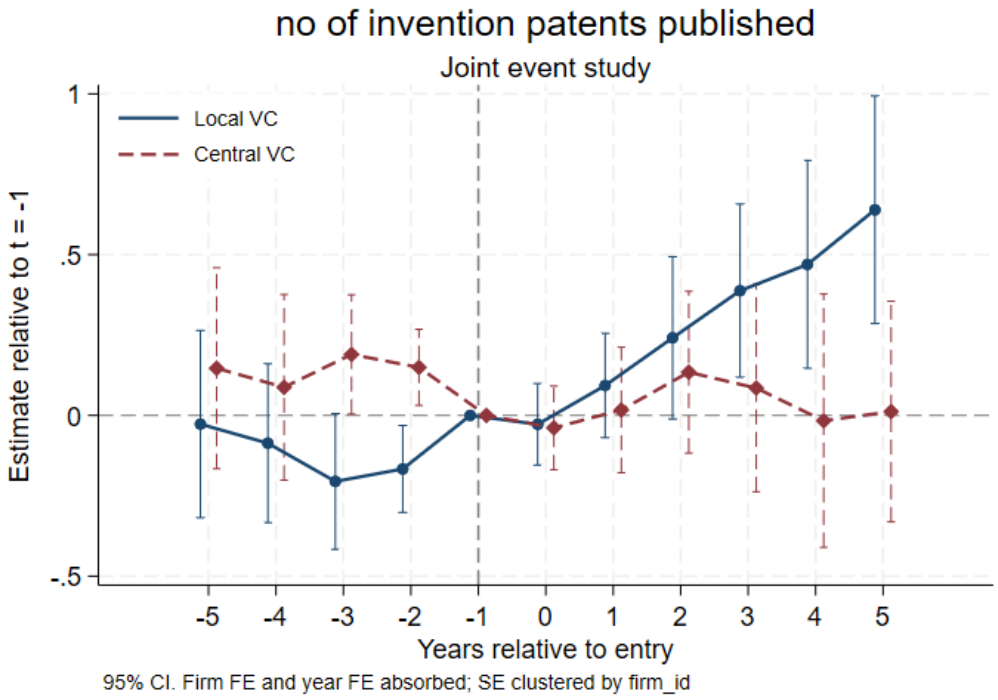


Figure 11: Joint event study, Published invention patents, Poisson TWFE

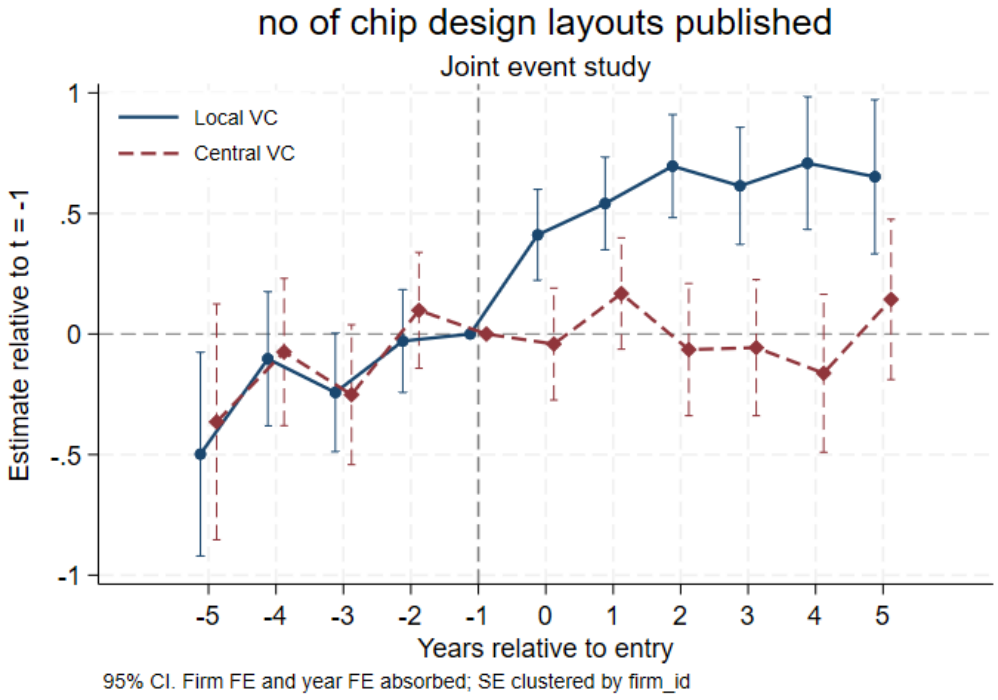


Figure 12: Joint event study, Published chip-design layouts, Poisson TWFE

6.5 Process Innovation and Capacity

One reasonable counter to the evidence on local investees' outperformance in productivity and innovation is that local and central governments pursue different objectives. Local governments simply want to maximize local industrial output within the constraint that their locality might not host the most advanced firms. The central government, on the other hand, is keen to push forward the nation's most advanced technological capability under the shadow of export controls, and hence is willing to eschew production efficiency to achieve such objectives.

I consider the plausibility of this thesis with the following exercise. Among manufacturing firms in the SEMI data, I construct the indicator of whether the firm made a process node innovation in the year, defined by whether the firm's most advanced manufacturing process node is more advanced than that in the previous year (the process node, measured in microns, is smaller/more intricate). However, figure 13 shows that albeit modestly, a local-invested manufacturing firm is more likely than a central-invested counterpart to make such advances. Figure 14 shows that local-backed firms also expand manufacturing capacity, measured in numbers of 200mm-equivalent wafers produced, faster in the SEMI data.

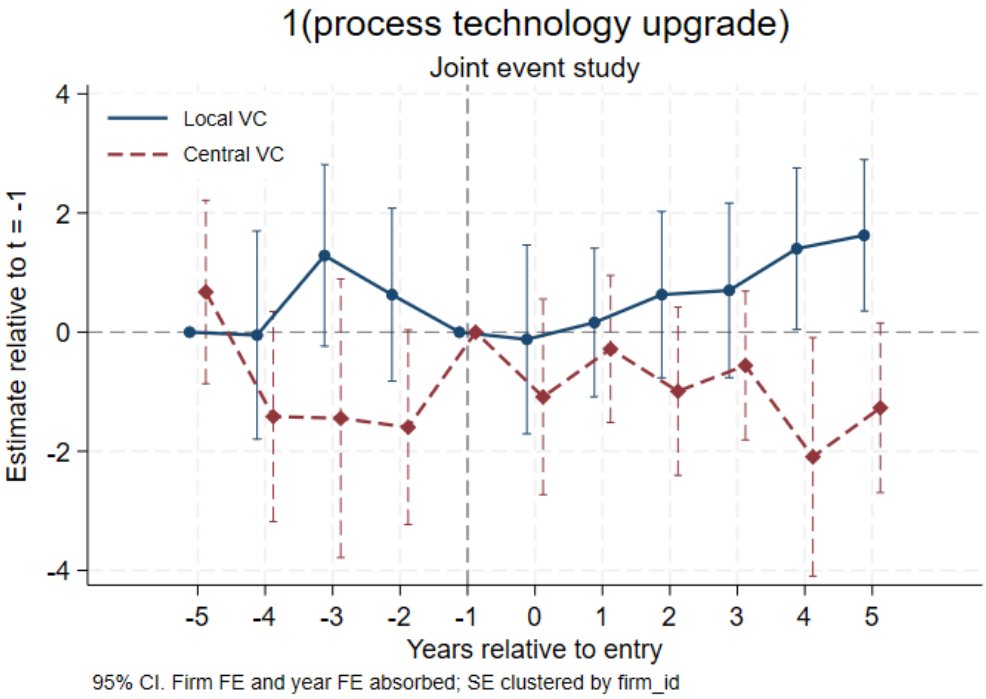


Figure 13: Joint event study, Process technology upgrade, Poisson TWFE

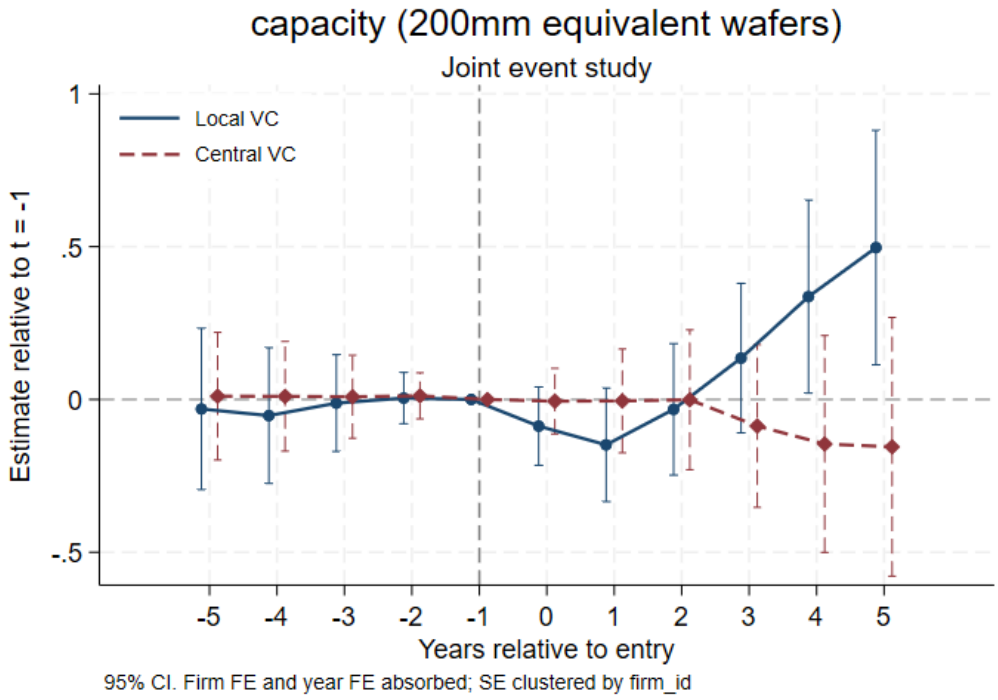


Figure 14: Joint event study, Total equipment capacity, Poisson TWFE

6.6 Procurement

Procurement is an important potential channel through which smaller firms without established demand for their untested products could grow via learning-by-doing dynamics. Figure 15 plots the number of procurement contracts won from central and local government-related buyers such as state-owned enterprises, government agencies, research institutes, and universities. Local-backed firms win more procurement contracts after investment, particularly from local buyers. Central government entities do not in particular increase procurement from central-supported firms. The procurement evidence suggests that local government funds not only provide initial equity injection but also subsequent market access via government procurement. One interpretation is that faster growth from local government investees is driven primarily by local government patronage rather than genuine market demand. Figure 16 shows however that the ratio of total procurement sales to revenue remains flat for local government-invested firms, suggesting that additional procurement opportunities come concurrently with other revenue sources and productivity growth.

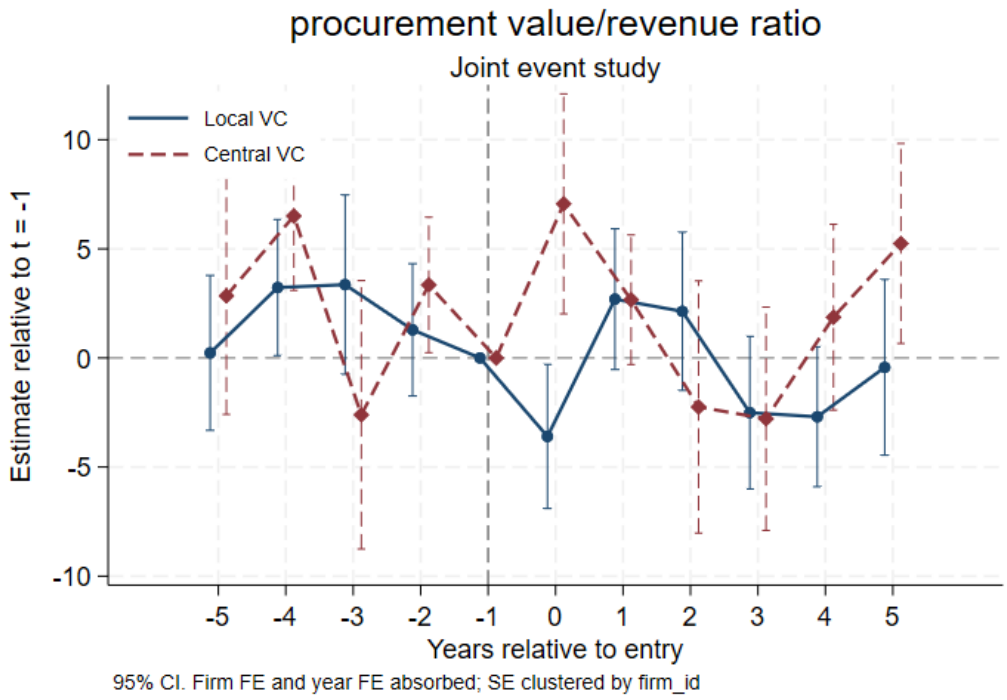


Figure 16: Procurement Value/Revenue, Poisson TWFE

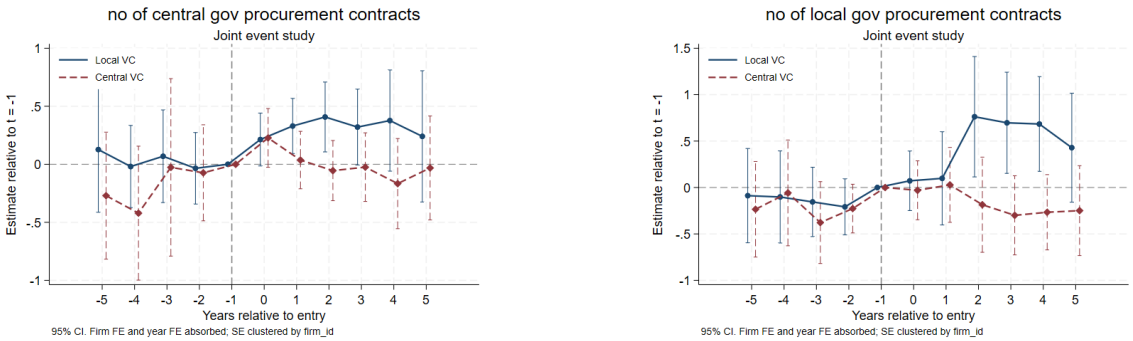


Figure 15: Procurement Contracts, Poisson TWFE

6.7 Personnel and Corporate Governance

This section presents how the composition of a firm's management and board changes before and after government investment. Figure 17 shows strikingly that firms' board size expands after government equity injections, in particular for local government-invested firms. Poisson estimates suggest that an average local government-invested firm's board expands in size by around 20-25% after investment. Figure 18 shows the results with respect to the number of firm board/management members that sit concurrently on the board or management of a local government fund and central government fund. Local government funds are more likely to bring government fund managers onto the board after investment. One would expect central-invested firms to have more central fund managers, but the effect appears modest. One plausible reason is that the average central fund has

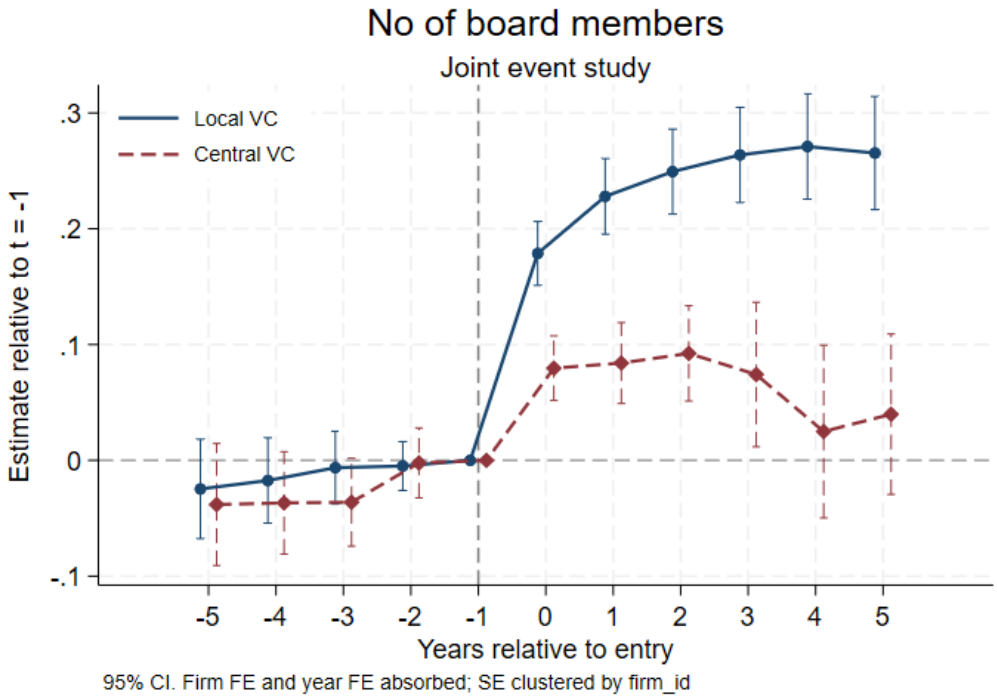


Figure 17: Persons in the Board, Poisson TWFE

more portfolio firms to attend to, and its portfolio firms are more geographically dispersed. Local fund managers could personally attend to affairs of their portfolio firms that are located in closer proximity. The next section formally presents evidence consistent with this hypothesis.

Figure 19 shows that the same firms add more directors with SOE or past government experience, in particular for local government portfolio firms. This in principle is suggestive of the state's "grabbing hand" extending its reach to innovative private companies, and in principle could be harmful for growth. Yet we have seen from previous results that local firms grow faster. Figure 20 and figures B.11, B.13b, B.14b in the Appendix suggest that local government funds also bring in postgraduate educated persons with foreign experience, finance expertise, and technical/engineering backgrounds. This additional provision of diverse experience and government/industry connections is a potential mechanism through which the local government fund as an investor could help smaller local firms grow. The event study results support the interpretation that local government funds are not simply providing funding to their investees in return for shares. Similar to Silicon Valley venture capital/private equity firms, they appear to actively participate in their portfolio firms' corporate governance. Furthermore, geographic proximity and tacit local knowledge seem to matter: local government funds could provide more of the monitoring that appears beneficial to firm growth.

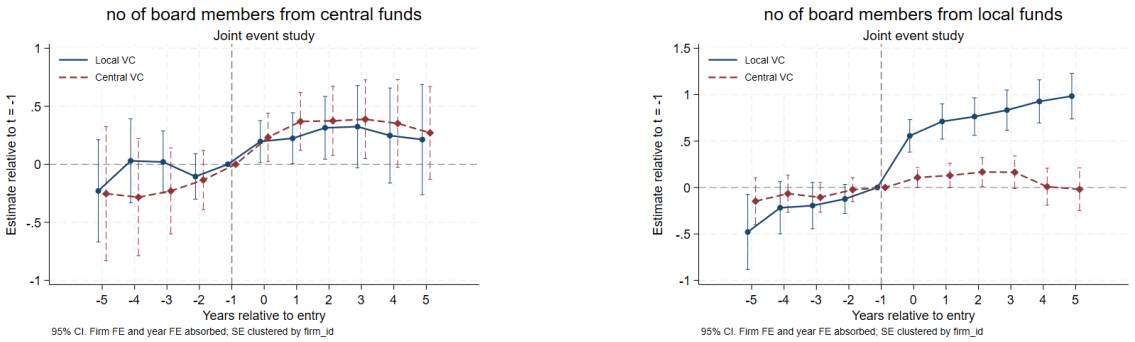


Figure 18: Fund-Manager Entry to Board/Management, Poisson TWFE

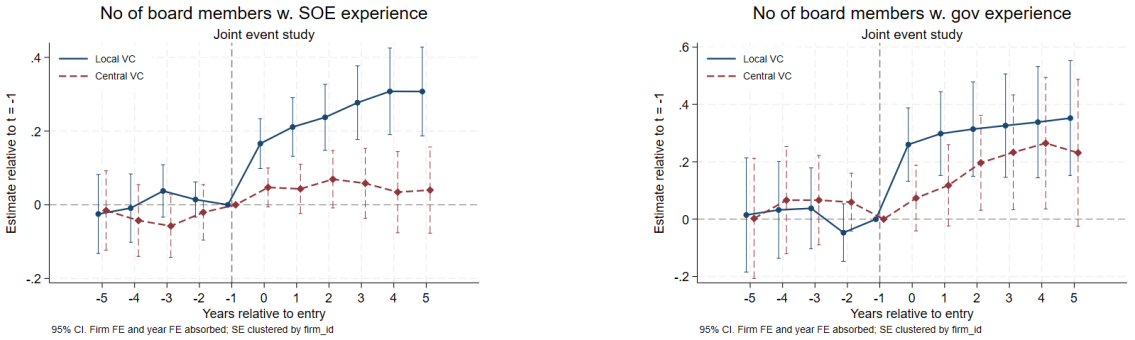


Figure 19: Board Composition: Government-Connected Backgrounds, Poisson TWFE

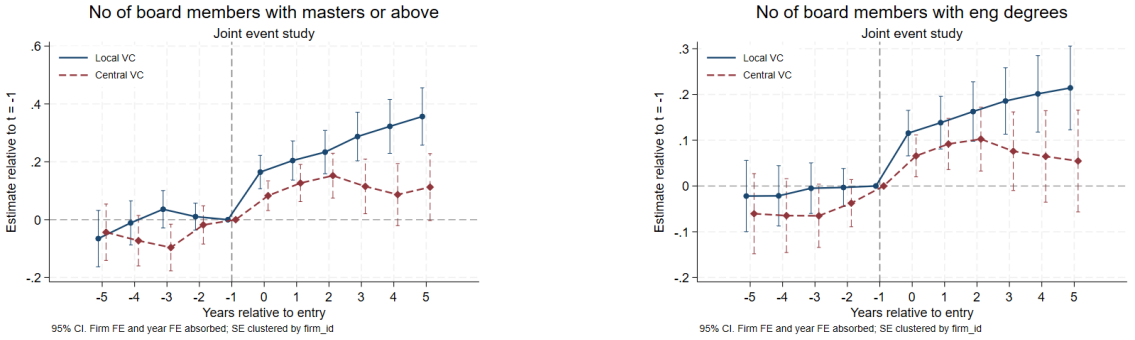


Figure 20: Board Composition: Education, Poisson TWFE

6.8 Summary

Across productivity, innovation, capacity, procurement, and personnel outcomes, the event study coefficients tell a consistent story. Pre-trends across outcomes two to three years before central investment events reflect selection on existing national productivity. Central fund managers in Beijing select portfolio firms based on commonly known metrics, and do not seem to provide additional value-add beyond capital. Flat pretrends for local investees suggest that local governments across provinces choose portfolio firms based not simply on observables but latent potential, consistent with observed treatment effects. Furthermore, I show that local governments could improve firm

productivity and innovation through a concrete treatment mechanism: the provision of managerial talent with higher education and foreign experience. This managerial turnover is particularly helpful for smaller, initially less productive local firms as opposed to central-invested firms that are already considered national champions. Faster ex-post firm growth suggests that there is value in delegating discretion and resources to local governments, and rationalizes China's decentralized economic policy institutions as documented in Luo et al. (2025). The next section further probes this mechanism: do larger, already more innovative firms with connections perform better after investment or the smaller ones that could benefit more from managerial turnover?

7 Mechanisms: Active Management and Preexisting Connections

7.1 Why Local Government Funds Participate in Firm Management More

Event study evidence suggests an organizational mechanism behind faster growth for local government invested firms: local government funds intervene in their firms' management more, bringing in state-connected and educated technical talent. Figures 21 and 22 provide some suggestive evidence. Consistent with event study evidence, figure 21 shows that the average local-fund-invested firm has 0.44 directors connected to its local-fund investors, almost twice the 0.23 directors found at the average central-fund-invested firm. The pattern carries through at the extensive margin: 29.5% of local-invested firm-years have at least one director linked to a local fund, versus 18.3% of central-invested firm-years. But why are local government funds more active in influencing their firms?

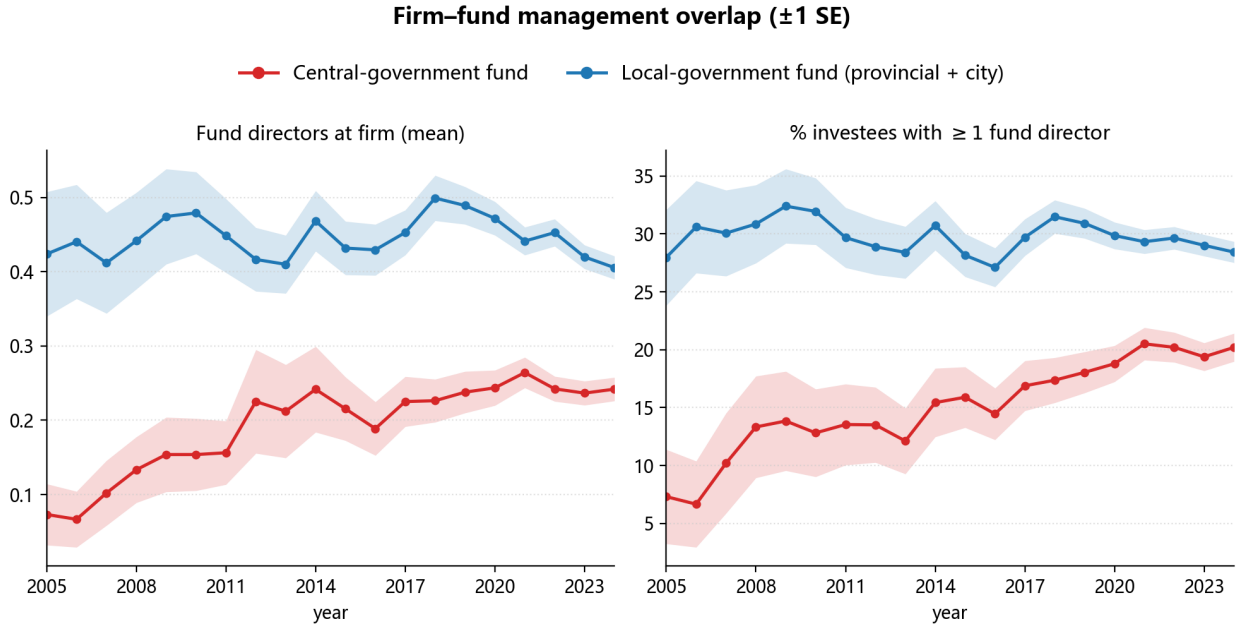


Figure 21: Firm-Fund Management Overlap

Figure 22 provides an intuitive explanation by plotting the average distance (and standard deviation) between a central/local fund and its invested firm across all years, as well as an average size

of the central/local fund's portfolio. The average central government fund is further away from its invested firm and has more firms in its portfolio after 2014. Thus, it is costlier for a central fund to intervene in the management of any given firm it invests in. Table 8 provides evidence consistent with this hypothesis.

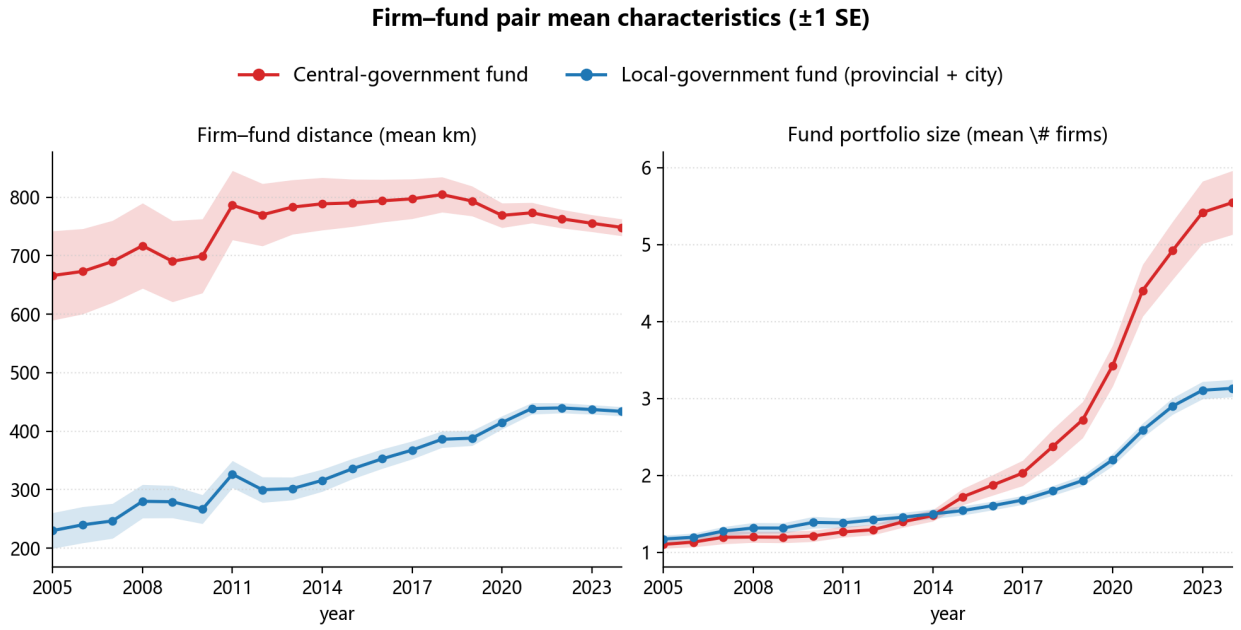


Figure 22: Firm-Fund Pair Characteristics

Table 8 estimates how pre-investment personnel ties, the distance between the invested firm and the fund, as well as other fund-firm characteristics affect the number of directors from the fund to the firm separately by fund type with a Poisson TWFE specification (firm + year FE). The effect is positive in both tiers but markedly more concentrated for central funds: an additional pre-investment tie between a firm and a central fund raises the expected number of central-fund directors at that firm by roughly 82% (exp(0.60) - 1), compared with only 13% (exp(0.12) - 1) for an additional tie between a firm and a local fund. The indicator panel tells the same story: central-fund pairs with at least one pre-investment tie carry on average roughly 3.7 times more directors than otherwise comparable pairs without, while the analogous ratio for local funds is closer to 2.2. Consistent with the intervention-cost hypothesis, central funds—facing greater geographic distance and broader portfolios—place directors selectively at firms where a pre-existing personnel tie has already established trust, while local funds, intervening at lower cost, place directors more uniformly across their portfolio and depend less on pre-investment networks for placement decisions. Thus we can arrive at two conclusions: first, as local government funds are on average closer in geographical distance to their invested firms and have fewer firms in their portfolio, they can place more directors on the firm's board or management more easily. Second, central government funds rely more on pre-existing connection ties. The next section investigates how the treatment effects could differ by initial pre-investment firm-fund connection ties. Do connected firms become more productive relative to unconnected firms, indicating private information transmission through

personal connections, or the reverse, indicating preferential bias for connected firms?

Table 8: Pre-investment ties across central and local (provincial + city) funds (Poisson; outcome: fund directors at firm)

	Central	Local (provincial + city)
Panel A: Poisson, focal = ***Any pre-connection tie*** *(indicator); year + firm FE*		
Any pre-connection tie	+1.3037	+0.7817
	(0.3613)	(0.1801)
Firm-fund distance (1000 km)	-0.4582	-0.3307
	(0.1945)	(0.1046)
No. of firms in portfolio	-0.0063	-0.0323
	(0.0061)	(0.0073)
Fund equity stake (%)	+0.2901	+0.4969
	(0.1399)	(0.0815)
Capital invested (M RMB)	+0.0024	+0.0000
	(0.0026)	(0.0007)
Fund dirs on other portfolio boards	+0.2330	+0.2795
	(0.0478)	(0.0245)
N	2,444	9,996
Panel B: Poisson, focal = ***# pre-connection ties*** *(count); year + firm FE*		
# pre-connection ties	+0.6050	+0.1232
	(0.1547)	(0.0520)
Firm-fund distance (1000 km)	-0.4723	-0.3090
	(0.1942)	(0.1055)
No. of firms in portfolio	-0.0052	-0.0323
	(0.0061)	(0.0073)
Fund equity stake (%)	+0.2561	+0.4836
	(0.1416)	(0.0789)
Capital invested (M RMB)	+0.0031	-0.0001
	(0.0029)	(0.0007)
Fund dirs on other portfolio boards	+0.2306	+0.2786
	(0.0466)	(0.0244)
N	2,444	9,996

Notes: Separate Poisson regressions per fund tier. Controls (in addition to the focal regressor shown): firm-fund distance, no. of firms in portfolio, fund equity stake in firm, capital invested, fund board size, fund directors on other portfolio boards, plus firm employees, capital, age, and board size. SEs clustered at firm.

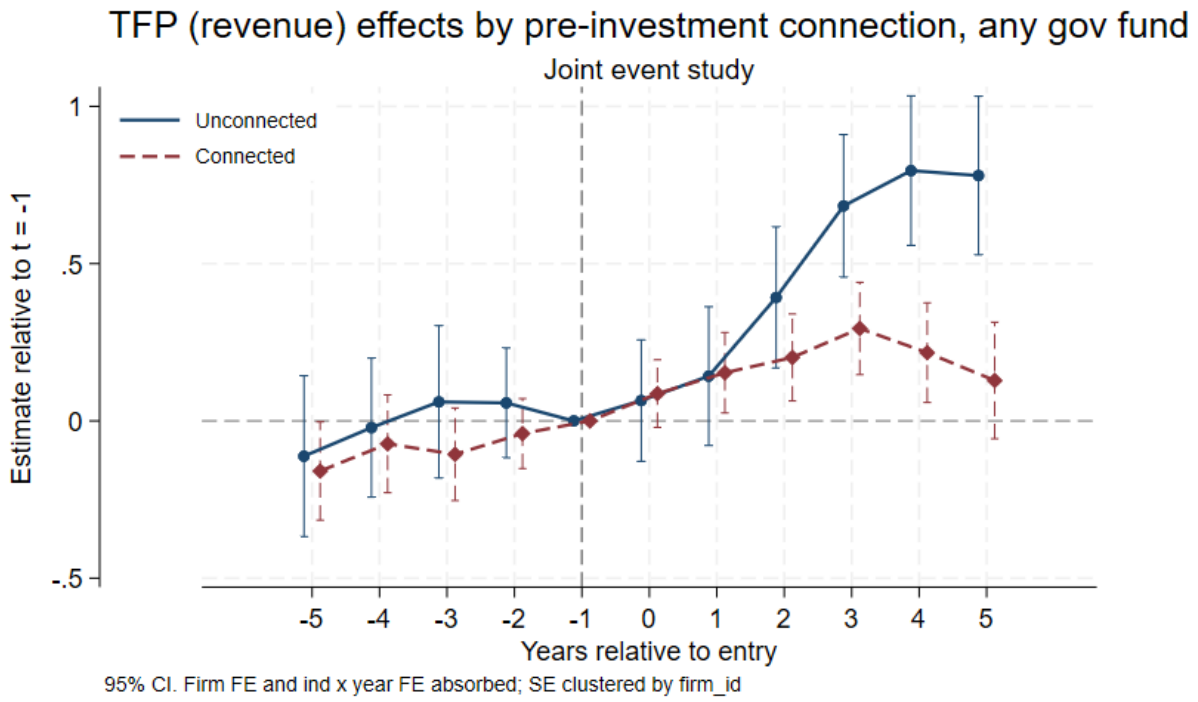


Figure 23: Productivity Effect Heterogeneity by Connection, TWFE

7.2 Do Preexisting Connections Impact the Treatment Effects of Government Investment?

From Section 5, we know that firms connected to government funds are more likely to be invested, controlling for productivity percentiles and other measures of performance. A natural question is whether such selection on connection is predictive of future firm productivity conditional on investment. I thus estimate another event study of this form:

$$\begin{aligned} Y_{it} = &\sum_{\substack{k=-5 \\ k\neq -1}}^{5} \beta_k^C \, \mathbb{1}(\text{gov entry in year } t-k)_{i,t} \mathbb{1}(\text{i has connection at t-k-1}) \\ &+ \sum_{\substack{k=-5 \\ k\neq -1}}^{5} \beta_k^{UC} \, \mathbb{1}(\text{gov entry in year } t-k)_{i,t} \mathbb{1}(\text{i has no connection at t-k-1}) \\ &+ \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{4}$$

β_k^C measures the dynamic effect of government investment on firms that have any managerial connection to a government fund the year before investment, while β_k^{UC} measures that of unconnected firms.

Figure 23 presents the striking result: unconnected firms grew significantly faster than connected firms, especially starting two years after initial investment. Figures 24 report similar results looking at central and local investees. These plots consistently suggest that unconnected firms benefit more

from government investment, contrary to the hypothesis that government funds select on connected firms due to private information about future performance. If anything, past connections predicts relative future underperformance in productivity, suggesting that funds choose connected firms due to biased preference and not statistical discrimination or private information.

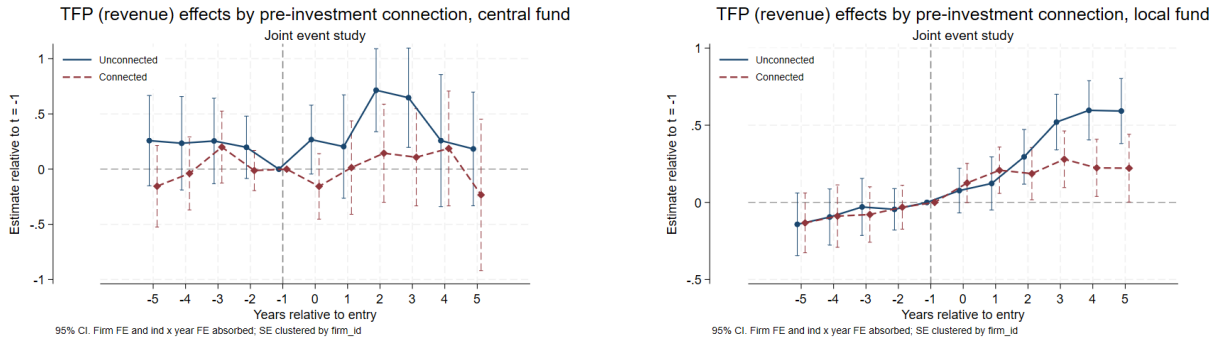


Figure 24: Productivity Effect Heterogeneity by Connection, Central/Local, TWFE

We further investigate heterogeneity in treatment effects on managerial composition. Figures 25, 26, and 27 all indicate that unconnected firms expand the number of people on boards and management teams much more than connected firms, and in particular board or management members with postgraduate or academic backgrounds in technical fields.

The overall picture thus points to the main mechanism on how government equity investment may improve firm performance. The provision of educated managerial talent to previously unconnected and less-resourced firms, likely managed and founded by people with backgrounds from less prestigious institutions, seems to be what generates productivity growth for government fund-invested firms, especially those invested by the local government. This further reinforces the notion that the observed change in firm performance comes not from selection on private information on future firm trajectory, but on actual treatment via intervening in firm management.

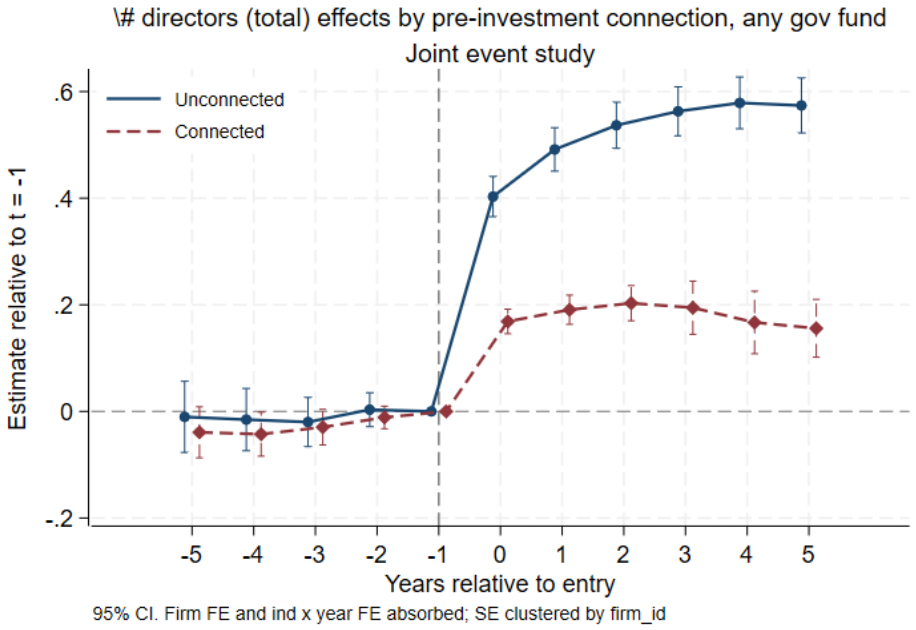


Figure 25: Board Size Effect Heterogeneity by Connection, Poisson TWFE

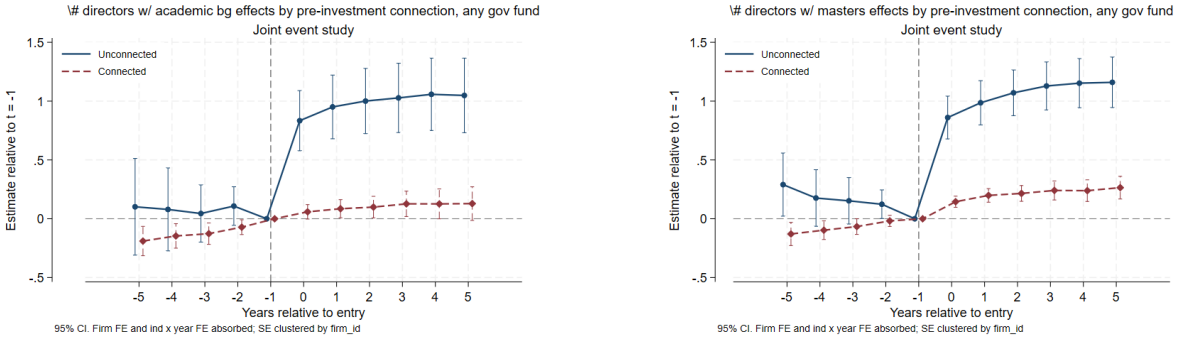


Figure 26: Board Effect Heterogeneity by Connection, Academic, Poisson TWFE

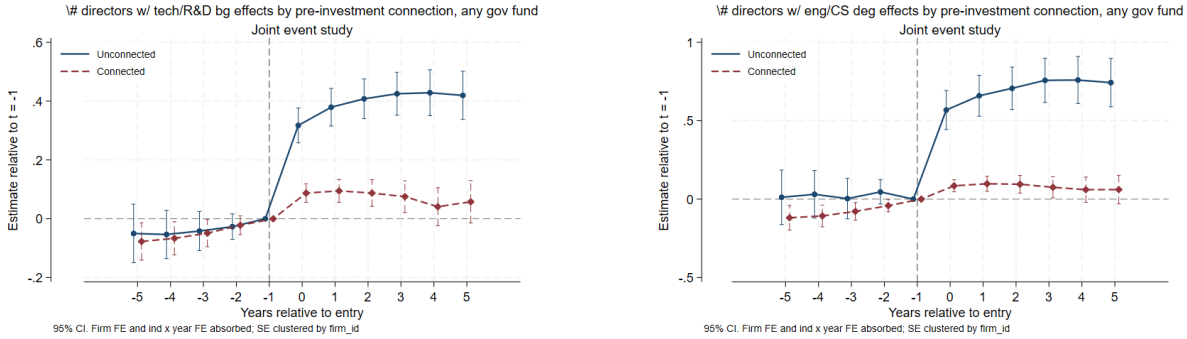


Figure 27: Board Effect Heterogeneity by Connection, Engineering Background, Poisson TWFE

8 Aggregate Productivity and Market Structure

The firm-level event study analysis may miss the mark as government policies do not target the average firm but aggregate industry size in the governments' respective jurisdictions. This section thus examines the relationship between government venture capital intensity, defined as the ratio of local or central governments' paid capital to total paid capital of firms, and aggregate market outcomes at the industry-city-year level.

8.1 Productivity and Government VC Intensity

Let $\theta_{i,t}$ be the industry share of revenue of firm i in year t. Revenue-weighted aggregate TFP at year t is $\overline{TFP}_t = \sum_i TFP_{i,t}\theta_{i,t}$. Table 9 documents the correlation between this aggregate productivity measure and government VC intensity, as well as the average firm productivity, variance of productivity, and the change in aggregate productivity. The results echo the firm-level event studies: the first two columns suggest that there is negative selection on productive firms on the part of local governments as higher local VC intensity is negatively correlated with aggregate or average productivity at the city level. Central government investment intensity instead is positively correlated with aggregate productivity. This largely reflects selection, however, as the change in aggregate productivity is positively and significantly predicted only by local investment intensity.

Table 9: Productivity and Government VC Intensity

GVC Investment and Productivity (Municipality)

	(1)	(2)	(3)	(4)
Dep. var.:	Agg. ω	Avg. ω	SD ω	Δ Agg. ω
Panel A: GVC Combined				
GVC capital share	0.161*	0.001	0.295***	0.161**
	(0.084)	(0.081)	(0.091)	(0.076)
N	14661	14661	5240	13392
Panel B: Central vs Local VC				
Central VC capital share	1.618***	1.200***	0.409**	0.087
	(0.209)	(0.203)	(0.205)	(0.191)
Local VC capital share	-0.283***	-0.363***	0.252**	0.184**
	(0.102)	(0.099)	(0.115)	(0.093)
N	14661	14661	5240	13392

FE: Municipality, Industry, Year. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Unit of observation: municipality × industry × year cell.

8.2 TFP Growth Decomposition

Following Foster et al. (2008), I decompose aggregate TFP growth into within-firm growth, reallocation (between and cross), entry, and exit components. The decomposition is:

$$\Delta\overline{\text{TFP}}_t = \underbrace{\sum_{i\in C_t} \theta_{i,t-1}\Delta\text{TFP}_{i,t}}_{\text{within}} + \underbrace{\sum_{i\in C_t} (\text{TFP}_{i,t-1} - \overline{\text{TFP}}_{t-1})\Delta\theta_{i,t}}_{\text{between}} + \underbrace{\sum_{i\in C_t} \Delta\theta_{i,t}\Delta\text{TFP}_{i,t}}_{\text{cross}}$$
$$+ \underbrace{\sum_{i\in E_t} \theta_{i,t}(\text{TFP}_{i,t} - \overline{\text{TFP}}_{t-1})}_{\text{entry}} - \underbrace{\sum_{i\in X_t} \theta_{i,t-1}(\text{TFP}_{i,t-1} - \overline{\text{TFP}}_{t-1})}_{\text{exit}} \tag{5}$$

where C_t denotes continuing firms, E_t entering firms, and X_t exiting firms.

Table 10 presents regressions of these decomposition components on lagged government VC intensity. The results suggest that aggregate productivity growth from local government investment comes largely from within-firm growth and productive firm entry, but less from reallocation. This points to a downside of decentralized competition in China: although competition drives firm growth, cross-regional trade and investment barriers of local protectionism may have deterred reallocation of resources and market share to more productive national firms, as provinces keep supporting their local champions. Recent central government attempts to promote consolidation in semiconductor equipment and mature semiconductors are examples of policies oriented towards tackling this concern.

Table 10: Productivity Decomposition and Government VC Intensity (Lagged)

GVC Investment and Industry Churning (Municipality, Lagged)

Dep. var.:	(1) Within	(2) Between	(3) Cross	(4) Entry contrib.	(5) Exit contrib.
Panel A: GVC Combined					
GVC capital share$_{t-1}$	0.210***	-0.030	0.018	0.066***	0.010
	(0.075)	(0.028)	(0.034)	(0.025)	(0.011)
N	13115	13115	13115	13220	13220
Panel B: Central vs Local VC					
Central VC capital share$_{t-1}$	0.065	0.063	-0.016	0.007	-0.026
	(0.183)	(0.068)	(0.083)	(0.061)	(0.026)
Local VC capital share$_{t-1}$	0.252***	-0.058*	0.028	0.083***	0.020
	(0.090)	(0.033)	(0.041)	(0.030)	(0.013)
N	13115	13115	13115	13220	13220

FE: Municipality, Industry, Year. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Unit of observation: municipality × industry × year cell.

9 Conclusion

This paper studies the appropriate institutional design of industrial policy: whether decisions should be concentrated in a national authority or delegated to local governments, and how governments as equity investors could generate growth. In Chinese semiconductors, local government funds do not target obvious winners, but have seen their invested firms grow more productive. The pattern holds

at both the firm-level and at the aggregate level, the latter of which is the focus of industrial policies.

Micro-evidence on the characteristics of personnel running the firms and the government investment funds generates further insights on the nature of Chinese state capitalism in the Xi Jinping era: professional state venture capitalists target productive and connected private firms, and could help the less connected firms in their portfolio grow more by actively intervening in firm management. In particular, local government-backed firms expand boards and management teams faster, especially by adding directors and managers with government, graduate, technical, and R&D backgrounds. Local government funds participate in invested firms' management more, as the funds on average invest in fewer firms and are geographically closer to the invested firms. Central government funds' portfolios include a larger number of firms dispersed across the country. These firms are typically already productive and well-endowed with managerial talent, thus there is less need and return for further intervention in management. This however, seems to result in little differential increase in productivity and innovation metrics for central government invested firms.

Preexisting alumni and career connections of elite high tech/venture capital networks seems also matter for government funds' selection and performance: government funds prefer connected firms conditioning on observables. Yet for invested firms that are connected to the government fund prior to investment, their outcomes improve less than that of unconnected invested firms after investment. This suggests that the observed post-investment increase in productivity is not simply coming from unobserved information of future firm trajectories, which should be transmitted more easily through alumni and career networks that my connection measure captures. Furthermore, initially unconnected firms see a larger increase in changes in the number and composition of management post investment. This further suggests that government equity investment operates not only through capital provision, but also by supplying managerial and relational resources to firms that previously lacked them.

These findings qualify the usual concern that decentralized industrial policy simply dissipates resources across local firms. Local governments do appear to support firms that are weaker initially, but they can create dynamic gains through active management. The policy problem is therefore not whether industrial policy should be centralized or decentralized in the abstract, but how to preserve the information and implementation advantages of local discretion while limiting local protectionism and politically connected allocation.

A A Model of Government Investment in Firms

A.1 Firm Production and Input Decisions

Within a semiconductor sector $s \in \mathcal{S}$ and year t, there is a set of firms $it \in \mathcal{I}_{st}$, each belonging to one province $g(i) \in \mathcal{G}$. Firm it is characterized by its (physical) productivity A_{it} and produces effective units of physical output q_{it} with capital K_{it} and labor L_{it} with the Cobb-Douglas technology with weakly decreasing returns to scale:

$$q_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} \epsilon_{it}, \qquad \gamma \equiv \alpha + \beta \leq 1, \tag{A.1}$$

where ϵ_{it} is an iid lognormal error term such that $\mathbb{E}(\ln \epsilon_{it}) = 0$ that represents unanticipated shocks to the firm's planned production.

Firms of sector s face demand from a representative final good producer that combines each firm's output to produce a final good with the CES production function $Y_{st} = (\sum_{i \in \mathcal{I}_s} q_{it}^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$. Cost minimization given final good demand Y_{st}

$$\min_{q_{it}} \sum_{i \in \mathcal{I}_s} p_{it} q_{it} \;\; \text{subject to } (\sum_{i \in \mathcal{I}_s} q_{it}^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} = Y_{st}$$

induces the demand function

$$q_{it} = Y_{st} \left(\frac{p_{it}}{P_{st}} \right)^{-\sigma} \iff p_{it} = P_{st} (\frac{Y_{st}}{q_{it}})^{\frac{1}{\sigma}}, \qquad \sigma > 1. \tag{A.2}$$

where $P_{st} \equiv (\sum_{i \in \mathcal{I}_s} p_{it}^{1-\sigma})^{\frac{1}{1-\sigma}}$ is the price index measuring the unit cost of the final good under cost minimization.

Substituting the inverse demand of equation (A.2) into the production function (A.1), we have the firm's revenue $R_{it} \equiv p_{it} q_{it} = P_{st} (Y_{st})^{\frac{1}{\sigma}} (A_{it} K_{it}^{\alpha} L_{it}^{\beta} \epsilon_{it})^{\frac{\sigma-1}{\sigma}}$. Taking logs, log revenue is expressed as

$$\ln R_{it} = \underbrace{\ln P_{st} + \frac{1}{\sigma} \ln Y_{st} + \rho \ln A_{it}}_{\equiv \omega_{it}} + \underbrace{\alpha\rho}_{\equiv \beta_k} \ln K_{it} + \underbrace{\beta\rho}_{\equiv \beta_L} \ln L_{it} + \rho \ln \epsilon_{it} \tag{A.3}$$

where $\rho \equiv \frac{\sigma-1}{\sigma}$. $\omega_{it} \equiv \ln P_{st} + \frac{1}{\sigma} \ln Y_{st} + \rho \ln A_{it}$ is the firm's *revenue productivity*, whose components include the firm's physical productivity, market demand Y_{st}, and competitors' pricing P_{st} that determines the elasticity of the firm's revenue to inputs.

Following the canonical literature on production functions (Olley and Pakes, 1996; Ackerberg et al., 2015; Levinsohn and Petrin, 2003; Wooldridge, 2009), revenue productivity evolves according to a Markov process ($\omega_{it} = g(\omega_{it-1}) + \eta_{it}, \mathbb{E}\,\eta_{it} = 0, \eta_{it} \perp \{\omega_{it-1}, I_{it}, K_{it-1}, L_{it-1}\}$). This follows from assuming demand Y_{st} and physical productivity A_{it} are Markov processes themselves. Firms observe their productivity at the beginning of period t, and use that information to choose investment in dynamic capital input K and static labor input L.

In a state-dominated economy like China, firms face capital and output wedges (τ_i^k, τ_i^y) that constrain their size and expected profit (Hsieh and Klenow, 2009). These wedges are reduced form representations of distortions in the economy. For example, state-owned lenders may discriminate against private firms and charge a higher interest rate $r_i = (1+\tau_i^k)r_{st}$ where r_{st} is the "optimal" cost of capital for sector s from the policymaker's viewpoint accounting for externalities such as learning-by-doing dynamics and supply chain spillovers (Juhász et al., 2024; Lashkaripour and Wu, 2024; Liu, 2019). The output wedge τ_i^y captures distortions that affect how much profit the firm receives from its value-added, such as tax and subsidy treatments, administrative costs, and red tape. The firm receives $(1-\tau_i^y)R_{it}$ when its sales are R_{it}.

Given predetermined capital K_{it}, the firm facing demand curve (A.2) chooses flexible labor input at wage rate w_{st} to maximize expected profit net of the output wedge

$$\mathbb{E}\,\pi_{it} = \max_{L_{it}} \; (1-\tau_i^y) \; \exp(\omega_{it}) \; K_{it}^{\beta_K} L_{it}^{\beta_L} \; \mathbb{E}(\epsilon_{it}^{\rho}) - w_{st} L_{it}$$

Thus, labor demand is $L_{it}^* = [\frac{(1-\tau_i^y)\beta_L D_{it}}{w_{st}}]^{\frac{\sigma}{\sigma(1-\beta)+\beta}}$ where $D_{it} \equiv \exp(\omega_{it}) K_{it}^{\beta_K} \, \mathbb{E}(\epsilon_{it}^{\rho})$ and thus expected revenue is

$$\mathbb{E}\,R_{it}^* = D_{it}^{\frac{\sigma}{\sigma(1-\beta)+\beta}} \left(\frac{\beta(\sigma-1)(1-\tau_i^y)}{\sigma w_{st}}\right)^{\frac{\beta(\sigma-1)}{\sigma(1-\beta)+\beta}} \tag{A.4}$$

Firm's capital K_{it} evolves according to the process $K_{it} = \delta K_{it-1} + I_{it-1}$, with I_{it-1} being investment and δ the depreciation rate. Firms choose investment I_{it} to maximize a value function that includes current capital K_{it}, own revenue productivity ω_{it}, output wedge τ_i^y, and capital cost $r_i = (1+\tau_i^k)r_{st}$ as well as an independently drawn scrap value $\phi_{it} \sim V_s$.

The value function is

$$V_t(\omega_{it}, K_{it}) = \mathbb{E}\,\pi_{it}(\omega_{it}, K_{it}) + \max\{\phi_{it}, \max_{I_{it}} -(1+\tau_i^k)I_{it} - \Phi(I_{it}, K_{it}) + \delta_f \mathbb{E}_t V_{t+1}(\omega_{t+1}, K_{t+1})\} \tag{A.5}$$

where $K_{it} = \delta K_{it-1} + I_{it-1}$, $\Phi(I_{it}, K_{it})$ is adjustment cost convex in investment. A firm exits after producing if the scrap value is higher than continuation value, i.e. $\phi_{it} > \max_{I_{it}} \; -(1+\tau_i^k)I_{it} - \Phi(I_{it}, K_{it}) + \delta_f \mathbb{E}_t V_{t+1}(\omega_{t+1}, K_{t+1})$. I denote exiting firms' investment decision as $I_{it} = -\infty$.

A first order condition characterizing interior optimal investment is:

$$(1+\tau_i^k) + \Phi_I(I_{it}^*, K_{it}) = \delta_f \frac{\partial}{\partial I} \mathbb{E}_t V_{t+1}(\omega_{t+1}, \delta K_{it} + I_{it}^*) \tag{A.6}$$

Via Cobb-Douglas production function and CES demand, we have that

1. capital K and productivity ω are complements ($\frac{\partial^2 \pi_{it}(\omega_{it}, K_{it})}{\partial \omega \; \partial K} > 0$), which implies
2. the value function exhibits increasing differences ($\frac{\partial^2 V_{t+1}(\omega_{it+1}, K_{it+1})}{\partial \omega \; \partial K} > 0$)

We make additional assumptions:

3. productivity ω_t follows a first order Markov process. Furthermore, the process exhibits positive stochastic monotonicity: higher productivity today predicts higher productivity next period in the first-order stochastic sense ($\omega_H > \omega_L \implies F_\omega(\cdot|\omega_H) \succ_{FOSD} F_\omega(\cdot|\omega_L)$)

4. investment cost $(1+\tau^k)I + \Phi(I,K)$ is increasing and convex in investment, and that

5. capital investment does not affect productivity.

(1)-(5) generate the monotonicity condition that $I^*_{st}(\omega_{it}, K_{it})$ is strictly increasing in productivity conditional on capital within a sector and year.

A.2 Government Investment Decisions and Timing

The government investment stage takes place at the beginning of period t after entry but before firms observe current productivity and choose inputs. The state variable of the economy at the end of $t-1$ is

$$\mathcal{F}_{t-1} = \{R_{i,t-1}, K_{it}, L_{i,t-1}, I_{i,t-1}, g(i), s(i), d^g_{i,t-1}, d^C_{i,t-1}\}_{i \in \mathcal{I}_{t-1}},$$

where $d^g_{i,t-1}, d^C_{i,t-1} \in \{0,1\}$ denote whether firm i has already received local or central government investment. At the beginning of t, potential entrants in sector s and province g are drawn from a sector-province distribution

$$\mathbf{v}_e = (A_0, K_0, \tau^y, \tau^k, \mathbf{v}) \sim G^e_{sg},$$

where $\mathbf{v}$ includes firm characteristics related to the government investment decision, such as connections between the firm's board or management and government fund GPs. A potential entrant observes $\mathcal{F}_{t-1}$ and enters if its expected value of entry exceeds an idiosyncratic entry cost. Denote the set of entrants in province g by $\mathcal{E}_{gt}$ and the set of all entrants by $\mathcal{E}_t$.

After entry, localities $g \in \mathcal{G}$ and the central government C observe the set of current firms, the lagged state $\mathcal{F}_{t-1}$, and the cost of investing in firms that have not yet been invested. I define the "local eligible set" as

$$\mathcal{I}^p_{gt} = \{it : g(i) = g,\ d^g_{i,t-1} = 0\} \cup \mathcal{E}_{gt},$$

which is the set of firms that have not received local government investment plus the set of entrants in province g. Analogously, the central eligible set is

$$\mathcal{I}^p_t = \{it : d^C_{i,t-1} = 0\} \cup \mathcal{E}_t.$$

For each eligible firm $it \in \mathcal{I}^p_{gt}$, local fund g observes an investment cost

$$\kappa^g_{it} \sim H^g(\mathbf{v}_{it}),$$

and for each eligible firm $it \in \mathcal{I}^p_t$, the central fund observes an investment cost

$$\kappa^C_{it} \sim H^C(\mathbf{v}_{it}).$$

The cost captures administrative, due-diligence, and transaction costs in bargaining with the firm's board and management. Being connected to a government fund GP reduces the cost of investment and therefore raises the probability of a finalized deal.

For each firm it has not invested in, a government fund makes a discrete investment decision:

$$x_{it}^g \in \{0,1\} \quad \text{for } it \in \mathcal{I}_{gt}^p, \qquad x_{it}^C \in \{0,1\} \quad \text{for } it \in \mathcal{I}_t^p. \tag{A.7}$$

Once an investment is made and announced, the fund is committed to be a patient investor and cannot exit or sell its stake. The treatment state therefore evolves according to

$$d_{it}^h = \max\{d_{i,t-1}^h, x_{it}^h\}, \qquad h \in \{g, C\}. \tag{A.8}$$

Government investment changes firm outcomes through three channels. First, the government investor may directly change the firm's physical productivity by improving management, certification, procurement access, or coordination with customers and suppliers. Second, the government investor may reduce output wedges that affect how much of sales revenue the firm receives after administrative costs, taxes, subsidies, and red tape. Third, the government investor may reduce capital wedges by lowering the firm's cost of capital. For analytical tractability, I parametrize these effects as

$$A_{it}(d_{it}^g, d_{it}^C) \equiv A_{it} \exp\left(\eta_A^g d_{it}^g + \eta_A^C d_{it}^C + \eta_A^{gC} d_{it}^g d_{it}^C\right), \tag{A.9}$$

$$\theta_{it}^y(d_{it}^g, d_{it}^C) \equiv (1 - \tau_i^y) \exp\left(\eta_y^g d_{it}^g + \eta_y^C d_{it}^C + \eta_y^{gC} d_{it}^g d_{it}^C\right), \tag{A.10}$$

$$\theta_{it}^k(d_{it}^g, d_{it}^C) \equiv (1 + \tau_i^k) \exp\left(-\eta_k^g d_{it}^g - \eta_k^C d_{it}^C - \eta_k^{gC} d_{it}^g d_{it}^C\right). \tag{A.11}$$

Here θ_{it}^y is the net-of-output-wedge payoff shifter and θ_{it}^k is the capital-cost shifter.

Conditional on predetermined capital K_{it} and treatment status (d_{it}^g, d_{it}^C), the firm chooses flexible labor to solve

$$\max_{L_{it} \geq 0} \theta_{it}^y(d_{it}^g, d_{it}^C) \exp\left(\omega_{it}(d_{it}^g, d_{it}^C)\right) K_{it}^{\beta_K} L_{it}^{\beta_L} \, \mathbb{E}(\epsilon_{it}^\rho) - w_{st} L_{it},$$

where

$$\omega_{it}(d_{it}^g, d_{it}^C) \equiv \ln P_{st} + \frac{1}{\sigma} \ln Y_{st} + \rho \ln A_{it}(d_{it}^g, d_{it}^C).$$

The optimal labor choice is

$$L_{it}^*(d_{it}^g, d_{it}^C) = \left[\frac{\theta_{it}^y(d_{it}^g, d_{it}^C) \beta_L \exp(\omega_{it}(d_{it}^g, d_{it}^C)) K_{it}^{\beta_K} \, \mathbb{E}(\epsilon_{it}^\rho)}{w_{st}} \right]^{\frac{1}{1-\beta_L}}.$$

Substituting optimal labor into sales revenue gives a closed form for expected optimized sales:

$$\mathop{\mathbb{E}}_t R_{it}^*(d_{it}^g, d_{it}^C; K_{it}) = \bar{R}_{it} \exp\left(m_i^g d_{it}^g + m_i^C d_{it}^C + m_i^{gC} d_{it}^g d_{it}^C\right), \tag{A.12}$$

where $\bar{R}_{it}$ is expected optimized sales absent government investment and

$$m_i^h = \frac{\rho\eta_A^h + \beta_L\eta_y^h}{1-\beta_L}, \qquad h \in \{g, C\}, \tag{A.13}$$

and

$$m_i^{gC} = \frac{\rho\eta_A^{gC} + \beta_L\eta_y^{gC}}{1-\beta_L}. \tag{A.14}$$

are the reduced form "treatment effects" of the two government types' investments on firm revenue. The effect comes from three channels:

1. the direct effect on productivity A via $\exp(\eta_A^g x_{it}^g + \eta_A^C x_{it}^C)$ as expressed below:

$$\ln R_{it}(x_{it}^g, x_{it}^C) = \underbrace{\ln P_{st} + \frac{1}{\sigma}\ln Y_{st} + \rho(\ln A_{it} + \eta_A^g x_{it}^g + \eta_A^C x_{it}^C)}_{\equiv\omega_{it}(x_{it}^g, x_{it}^C)} + \beta_K \ln K_{it} + \beta_L \ln L_{it} + \rho \ln \epsilon_{it} \tag{A.15}$$

2. conditioning on post-investment productivity $A_{it}(x_{it}^g, x_{it}^C)$, the effect on increased labor input via reducing the output wedge:

$$L_{it}^*(x_{it}^g, x_{it}^C) = [\frac{\tilde{\tau}_{it}^y(x_{it}^g, x_{it}^C)\beta_L \exp(\omega_{it}(x_{it}^g, x_{it}^C))K_{it}^{\beta_K}\,\mathbb{E}(\epsilon_{it}^\rho)}{w_{st}}]^{\frac{\sigma}{\sigma(1-\beta)+\beta}}$$

3. conditioning on post-investment productivity and capital, the effect on investment and future capital via reduced capital cost:

$$\phi_{it}^k(d_{it}) + \Phi_I(I_{it}^*, K_{it}) = \delta_f \frac{\partial}{\partial I_{it}} \mathop{\mathbb{E}}_t V_{t+1}(\omega_{i,t+1}, \delta K_{it} + I_{it}^*, d_{i,t+1}). \tag{A.16}$$

The government objective follows from the policy motivation that local government funds maximize regional revenue while the central government maximizes national revenue. I assume that each government can finance investments by raising tax or debt revenue and invests whenever the expected discounted benefit exceeds the investment cost.

Let $J_g = \{i : g(i) = g\}$ denote the set of firms in locality g and let $J_C = \mathcal{I}_t$ denote the set of firms relevant for the central government. For government $h \in \{g, C\}$, define the discounted jurisdictional benefit of investing in firm i as

$$\Delta_{it}^h(x_{it}^{-h}) \equiv \mathop{\mathbb{E}}_t \left[\sum_{s=t}^{\infty} \delta_h^{s-t} \sum_{j\in J_h} \left(R_{js}^*(x_{it}^h = 1, x_{it}^{-h}) - R_{js}^*(x_{it}^h = 0, x_{it}^{-h})\right)\right]. \tag{A.17}$$

This object includes the current effect on firm i's sales, the induced changes in private investment and future capital, the effects on survival, and, in markets with finite firms, any price-index effects on other firms in the same sector. The binary investment rule is

$$x_{it}^h = 1 \quad \Longleftrightarrow \quad \Delta_{it}^h(x_{it}^{-h}) \geq \kappa_{it}^h. \tag{A.18}$$

Taking expectation of equation (A.18), we can characterize the probability of government investment. Since

$$\kappa_{it}^{h} \sim H^{h}(\mathbf{v}_{it}),$$

the treatment probability is

$$\Pr(x_{it}^{h} = 1 \mid \mathcal{F}_{t-1}, \mathcal{E}_{t}, x_{it}^{-h}) = H^{h}\left(\Delta_{it}^{h}(x_{it}^{-h}) \mid \mathbf{v}_{it}\right). \tag{A.19}$$

Firms with high expected baseline productivity and sales $\bar{R}_{it}$ are likely to receive investment. Firms with low transaction costs are also more likely to receive investment. Therefore, connections to government fund GPs can affect selection by shifting the investment cost distribution, even holding expected firm returns fixed.

Central and local investment are strategic complements in the setting if the treatment effects on revenue are positive:

$$m_{i}^{g} \geq 0, \qquad m_{i}^{C} \geq 0, \qquad m_{i}^{gC} \geq 0,$$

From equation (A.12), the current-period local gain from investing in firm i is

$$\Delta_{it}^{g,\text{cur}}(d_{it}^{C}) = \bar{R}_{it} \exp(m_{i}^{C} d_{it}^{C}) \left[\exp(m_{i}^{g} + m_{i}^{gC} d_{it}^{C}) - 1\right], \tag{A.20}$$

while the current-period central gain is

$$\Delta_{it}^{C,\text{cur}}(d_{it}^{g}) = \bar{R}_{it} \exp(m_{i}^{g} d_{it}^{g}) \left[\exp(m_{i}^{C} + m_{i}^{gC} d_{it}^{g}) - 1\right]. \tag{A.21}$$

Both are increasing in the other government type's investment status. This captures the idea that the two levels of government relax different constraints and provide different types of support. Dynamic complementarity also arises when one government's investment raises future continuation values by lowering capital costs while the other raises productivity or reduces output wedges.

B Additional Results and Diagnostics

B.1 Size of Investments

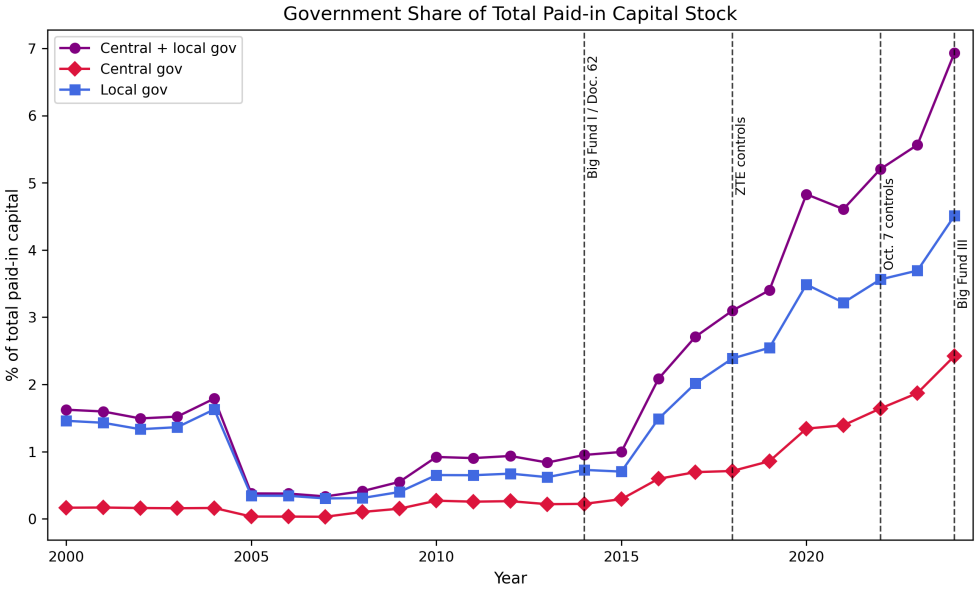


Figure B.1: Government funds' share of total paid-in capital stock

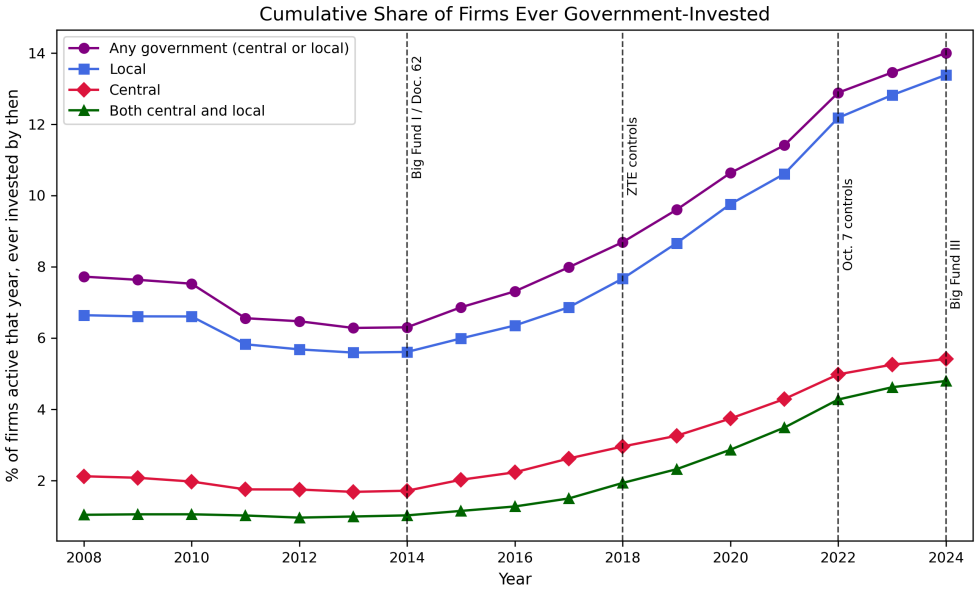


Figure B.2: Government venture capital invested firms as a share of all firms in the panel

B.2 Policy Targets in Semiconductor Industrial Policy

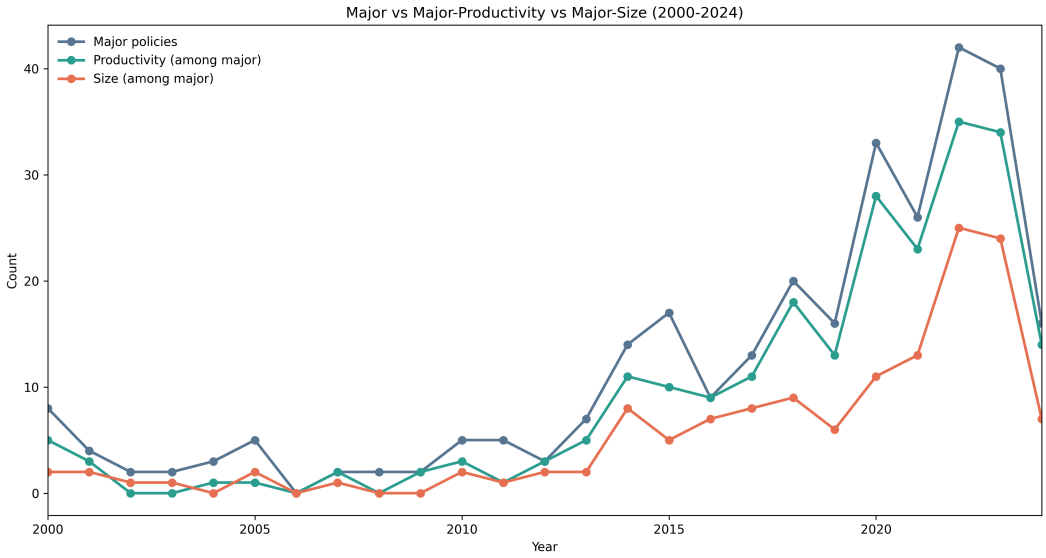


Figure B.3: Major Semiconductor Policies Targeting Revenue and Productivity

B.3 Correlates of Productivity and Connections

Table B.1: Correlates of Productivity

	(1)	(2)	(3)	(4)
1(local fund invested)	-0.417***	-0.272***	0.085**	0.034
	(0.052)	(0.069)	(0.034)	(0.040)
1(central fund invested)	0.086	0.125*	0.179***	0.150***
	(0.065)	(0.066)	(0.043)	(0.045)
1(directors tied to central GP, edu cohort + stint)	-0.136***	-0.103**	0.027	0.021
	(0.045)	(0.045)	(0.031)	(0.031)
1(directors tied to local-same-prov GP, edu cohort + stint)	0.071	0.083*	0.010	0.007
	(0.048)	(0.049)	(0.034)	(0.034)
firm age	0.028***	0.029***	0.000	0.000
	(0.003)	(0.003)	(.)	(.)
asinh(invention patent stock)	-0.020	-0.012	0.087***	0.097***
	(0.016)	(0.016)	(0.012)	(0.012)
asinh(IC layout stock)	0.246***	0.241***	0.071***	0.075***
	(0.017)	(0.017)	(0.017)	(0.017)
asinh(capacity)	0.003	0.001	0.089***	0.088***
	(0.010)	(0.010)	(0.025)	(0.026)
log(noncurrent assets)	-0.048***	-0.046***	-0.080***	-0.082***
	(0.013)	(0.013)	(0.010)	(0.010)
log(employees)	0.181***	0.178***	0.017	0.016
	(0.015)	(0.015)	(0.016)	(0.016)
High Tech Enterprise (3y)	0.294***	0.328***	0.245***	0.270***
	(0.039)	(0.042)	(0.021)	(0.022)
# directors (total)	-0.006	-0.001	0.008**	0.005
	(0.006)	(0.006)	(0.004)	(0.004)
# directors w/ eng/CS deg	0.011	0.066**	-0.010	-0.029
	(0.018)	(0.026)	(0.012)	(0.022)
# directors w/ fin/econ deg	0.041	0.079**	0.002	-0.008
	(0.028)	(0.033)	(0.020)	(0.022)
log total grants received	0.029***	0.033***	0.035***	0.034***
	(0.006)	(0.006)	(0.003)	(0.003)
# central gov procurements	0.017***	0.018***	0.003	0.006*
	(0.005)	(0.005)	(0.003)	(0.003)
# local gov procurements	-0.003**	-0.002*	-0.001	-0.000
	(0.001)	(0.001)	(0.000)	(0.001)
Mean Outcome	5.07	5.07	5.07	5.07
N	52385	52381	52244	52241
R-squared	0.12	0.12	0.71	0.71
N clusters (Firms)	6033	6032	5892	5892
Firm FE	N	N	Y	Y
Year FE	Y	Y	Y	Y
ownership, board, & subsidy controls	N	Y	N	Y

Table B.2: Correlates of Local Fund Connection

	(1)	(2)	(3)	(4)
TFP (revenue)	0.003	0.001	0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
firm age	-0.001	-0.000	0.000	0.000
	(0.001)	(0.001)	(.)	(.)
asinh(invention patent stock)	0.048***	0.026***	0.039***	0.028***
	(0.005)	(0.004)	(0.005)	(0.005)
asinh(IC layout stock)	0.018***	0.013**	0.003	0.002
	(0.006)	(0.006)	(0.007)	(0.006)
1(most advanced process in ind)	-0.012	-0.021	-0.003	0.015
	(0.121)	(0.077)	(0.075)	(0.048)
asinh(capacity)	-0.002	-0.001	-0.003	0.002
	(0.004)	(0.004)	(0.007)	(0.005)
log(noncurrent assets)	-0.001	-0.001	0.004***	0.003**
	(0.002)	(0.002)	(0.001)	(0.001)
log(employees)	0.012***	-0.000	0.007**	0.001
	(0.003)	(0.003)	(0.003)	(0.003)
High Tech Enterprise (3y)	0.029***	0.003	-0.003	-0.007
	(0.010)	(0.011)	(0.007)	(0.007)
# directors (total)	0.035***	0.001	0.025***	0.003
	(0.003)	(0.002)	(0.003)	(0.003)
# directors w/ eng/CS deg		0.047***		0.027**
		(0.008)		(0.012)
# directors w/ fin/econ deg		0.014		0.003
		(0.013)		(0.013)
log total grants received		0.004**		0.002
		(0.002)		(0.001)
Mean Outcome	5.03	5.03	5.03	5.03
N	37416	37416	37156	37156
R-squared	0.26	0.39	0.79	0.80
N clusters (Firms)	4835	4835	4575	4575
Firm FE	N	N	Y	Y
Year FE	Y	Y	Y	Y
ownership, board, & subsidy controls	N	Y	N	Y

Table B.3: Correlates of Central Fund Connection

	(1)	(2)	(3)	(4)
TFP (revenue)	-0.000	-0.002	0.003*	0.002
	(0.003)	(0.002)	(0.002)	(0.002)
firm age	-0.001	-0.000	0.000	0.000
	(0.001)	(0.001)	(.)	(.)
asinh(invention patent stock)	0.052***	0.032***	0.033***	0.026***
	(0.006)	(0.005)	(0.005)	(0.005)
asinh(IC layout stock)	0.020***	0.017***	-0.002	-0.002
	(0.007)	(0.006)	(0.007)	(0.007)
1(most advanced process in ind)	0.161	0.152	-0.026	-0.007
	(0.104)	(0.114)	(0.071)	(0.054)
asinh(capacity)	0.005	0.004	0.007	0.011
	(0.004)	(0.004)	(0.008)	(0.008)
log(noncurrent assets)	0.004*	0.003	0.001	0.000
	(0.002)	(0.002)	(0.001)	(0.001)
log(employees)	0.009***	-0.003	0.010***	0.005
	(0.003)	(0.003)	(0.003)	(0.003)
High Tech Enterprise (3y)	0.015	0.016	-0.011	-0.010
	(0.011)	(0.011)	(0.007)	(0.007)
# directors (total)	0.037***	0.001	0.028***	0.003
	(0.003)	(0.003)	(0.004)	(0.004)
# directors w/ eng/CS deg		0.052***		0.032**
		(0.007)		(0.014)
# directors w/ fin/econ deg		0.028**		0.004
		(0.012)		(0.013)
log total grants received		0.002		0.002**
		(0.002)		(0.001)
Mean Outcome	5.03	5.03	5.03	5.03
N	37416	37416	37156	37156
R-squared	0.25	0.36	0.79	0.80
N clusters (Firms)	4835	4835	4575	4575
Firm FE	N	N	Y	Y
Year FE	Y	Y	Y	Y
ownership, board, & subsidy controls	N	Y	N	Y

B.4 Treatment Histories

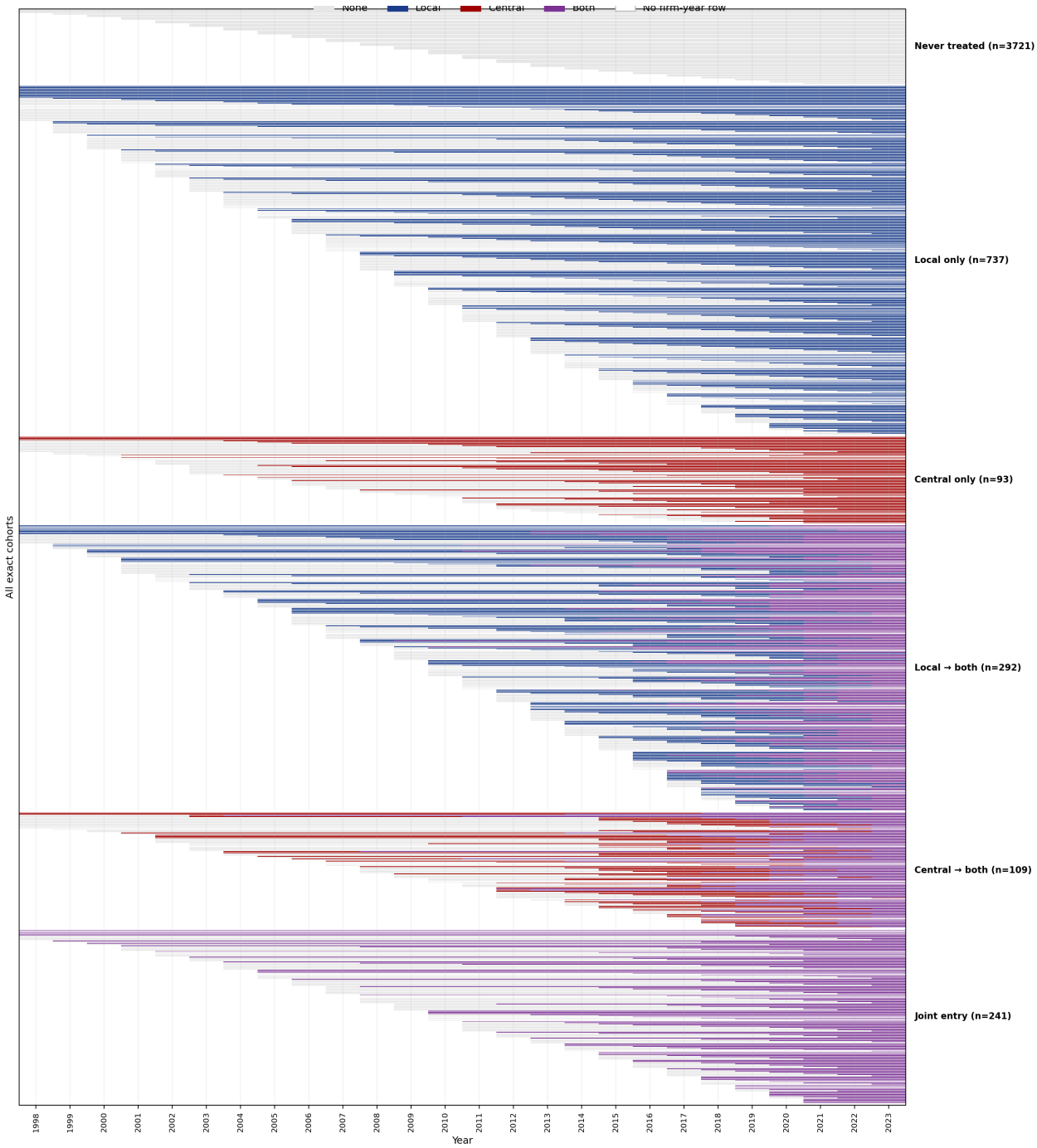


Figure B.4: Treatment Histories of Firms In Productivity Event Studies

B.5 Modified Callaway-Sant'Anna with Two Staggered Treatments

Let G_L denote the first year of local government investment and G_C the first year of central government investment, with either treatment allowed to be never realized. For local treatment, the primitive object is

$$ATT_L(g, t \mid G_C = c),$$

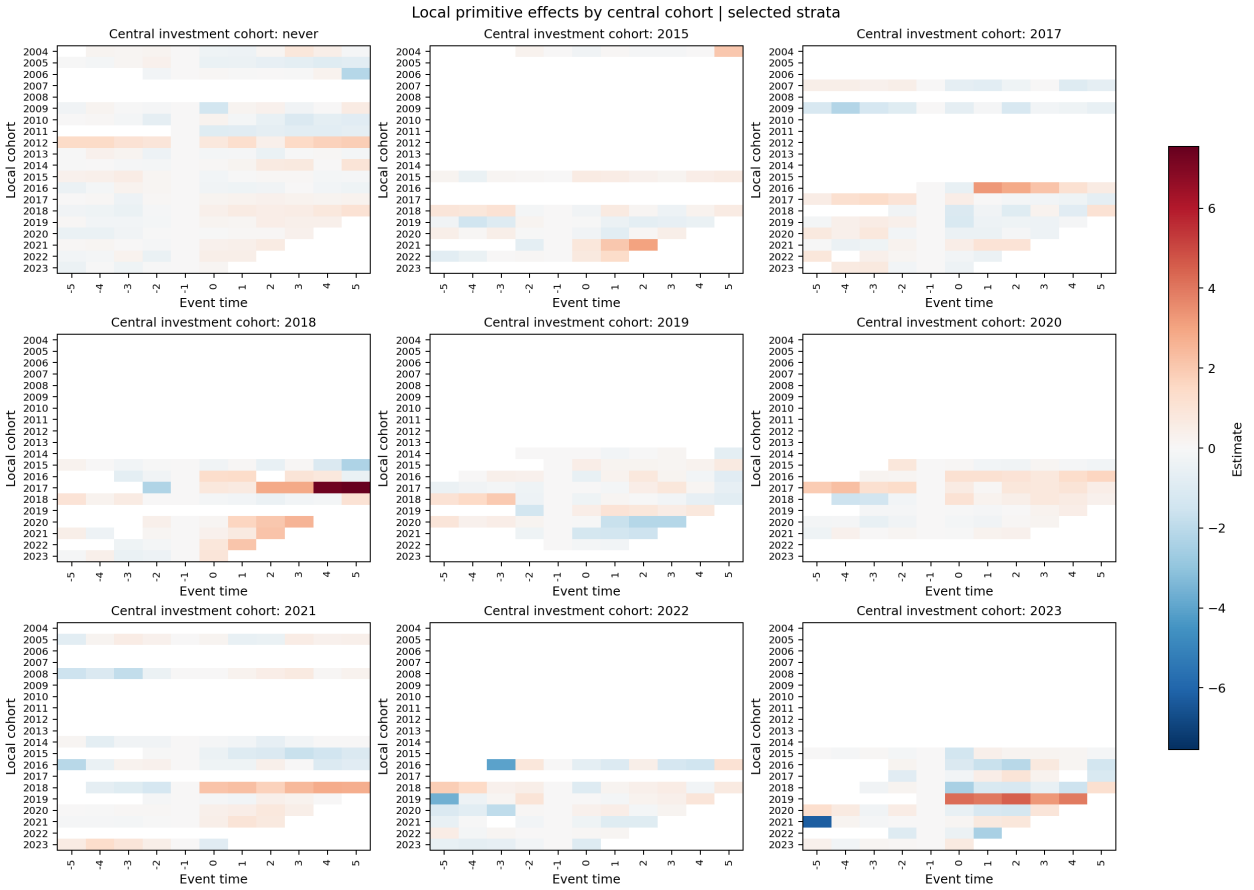


Figure B.5: Local Treatment Effects by Local Cohort, Event Time, and Central-Treatment Cohort

the group-time average treatment effect for firms first locally treated in year g among firms whose central-treatment cohort is fixed at c. The primitive central effect is defined symmetrically by conditioning on the local cohort.

For local treatment, event time is $\tau = t - g$. Within a fixed central-treatment cohort c, I first aggregate over local treatment cohorts:

$$\theta_L(\tau \mid c) = \sum_g \omega_{g|c,\tau}\, ATT_L(g, g+\tau \mid G_C = c).$$

I then aggregate across central-treatment cohorts, including the never-central-treated group:

$$\theta_L(\tau) = \sum_c \pi_{c,\tau}\, \theta_L(\tau \mid c).$$

The central dynamic effect is constructed analogously. In the exact-year specification used in the main text, the other treatment cohort is held fixed year by year. The following figures show the primitive cohort-by-cohort surfaces and the subsequent aggregation.

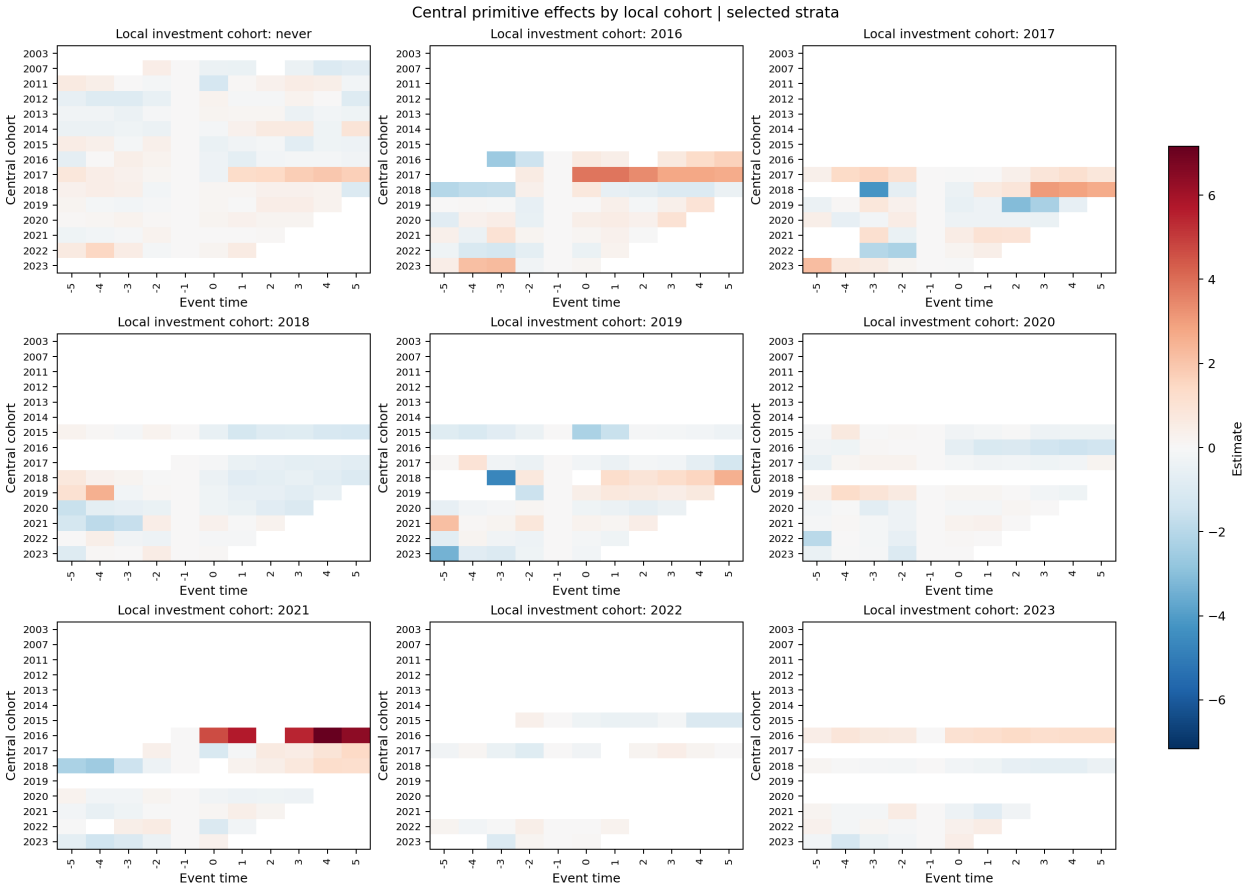


Figure B.6: Central Treatment Effects by Central Cohort, Event Time, and Local-Treatment Cohort

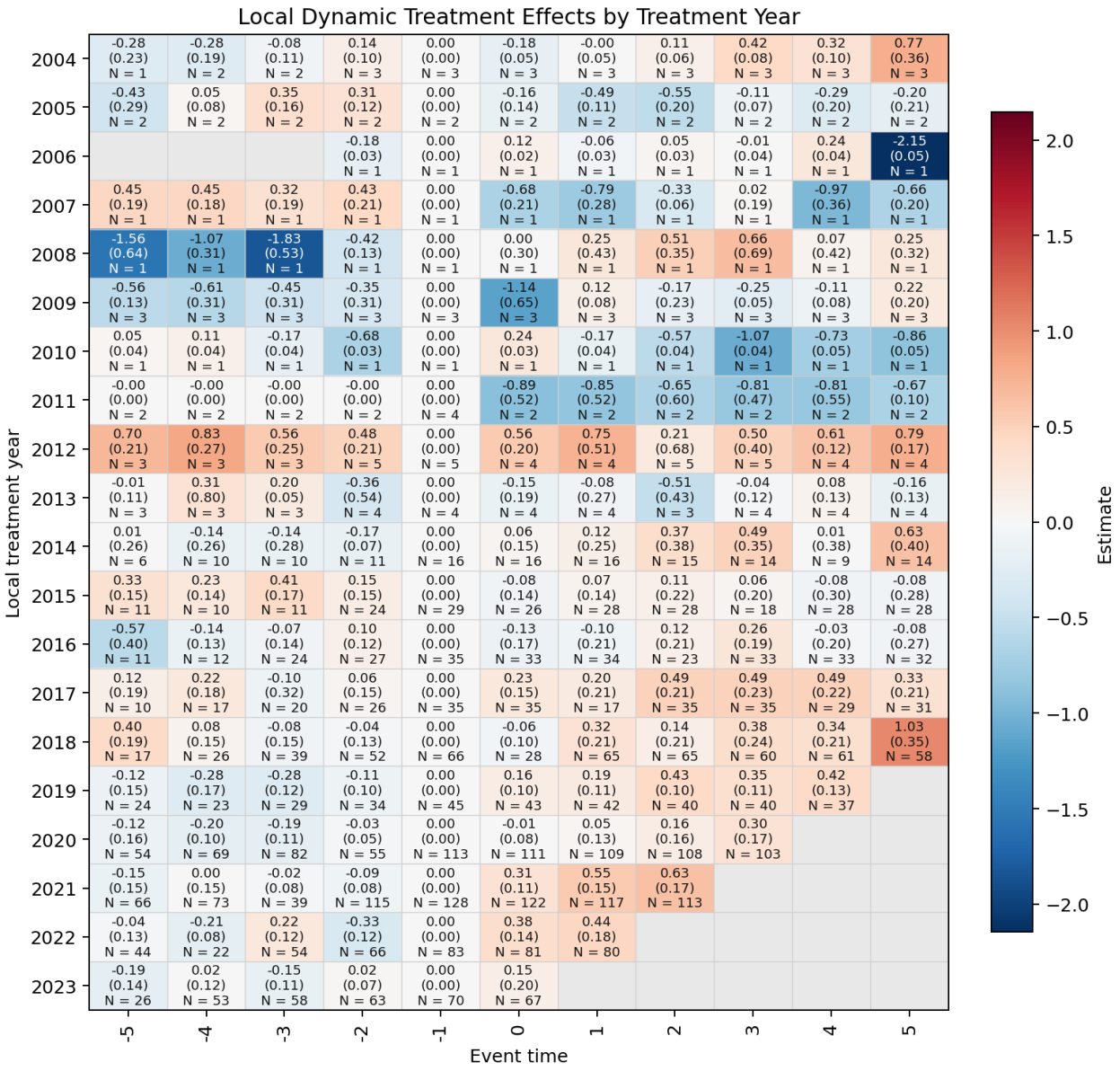


Figure B.7: Aggregated Local Treatment Effects by Local Cohort and Event Time

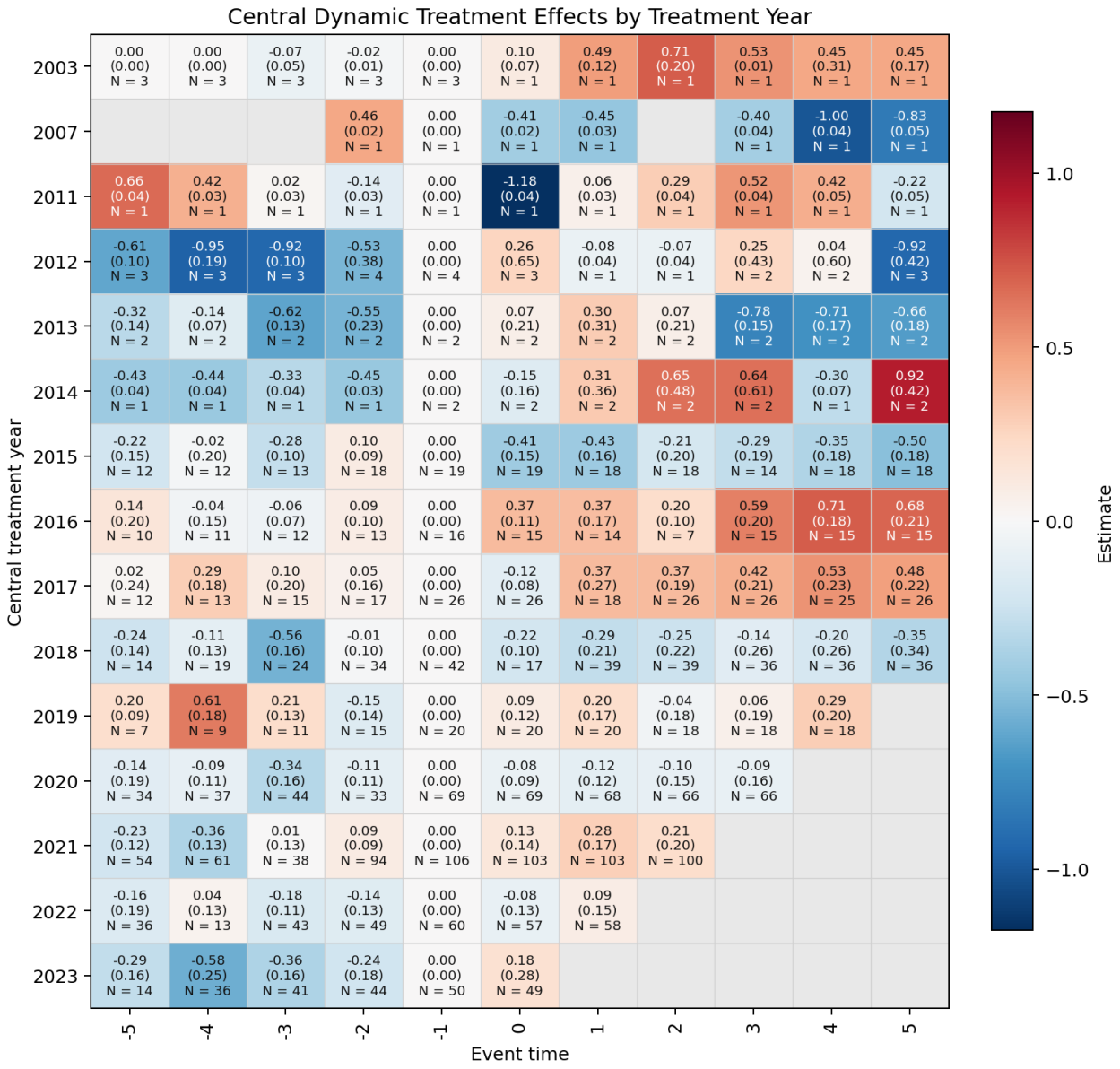
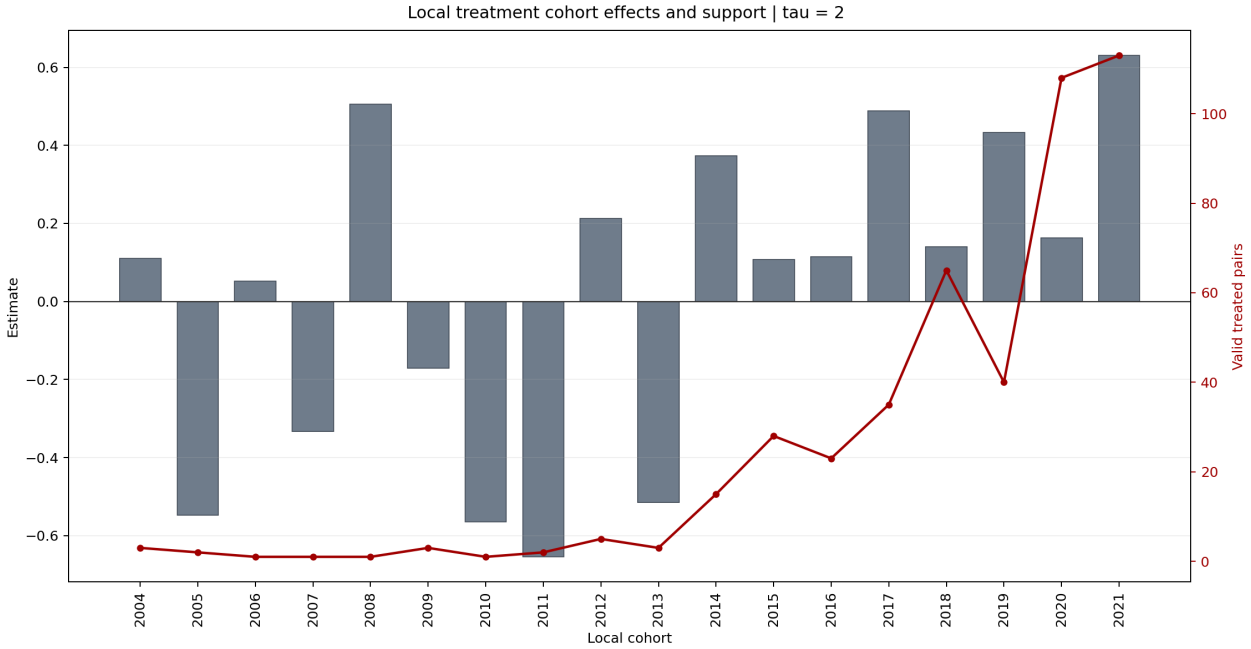
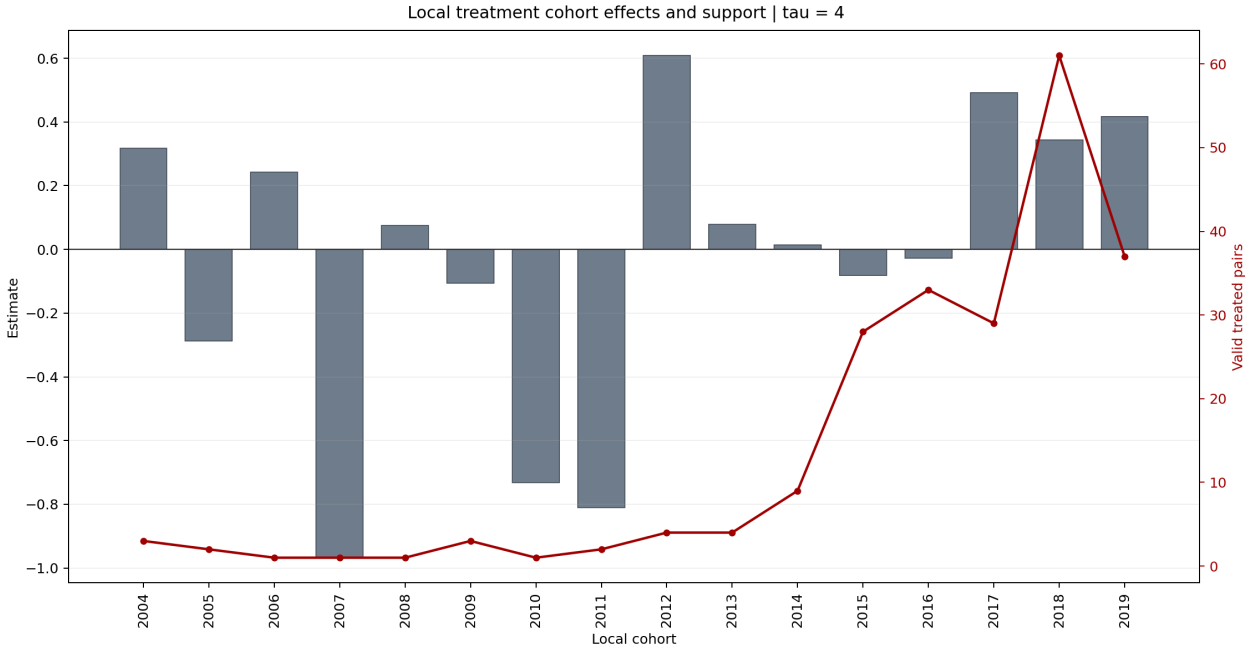


Figure B.8: Aggregated Central Treatment Effects by Central Cohort and Event Time



(a) Local treatment effect at $\tau = 2$ and support weights by cohort



(b) Local treatment effect at $\tau = 4$ and support weights by cohort

B.6 Additional Event-Study Results

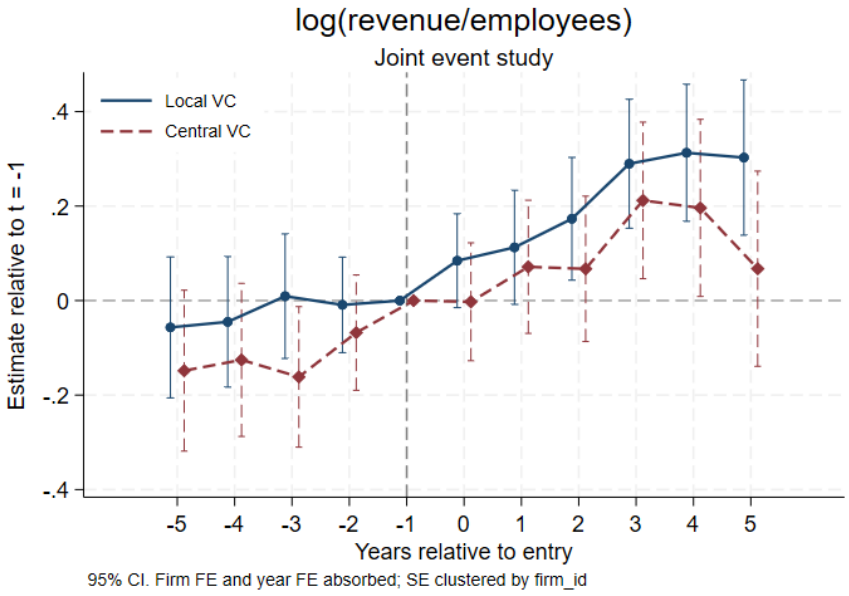


Figure B.10: Revenue per Worker

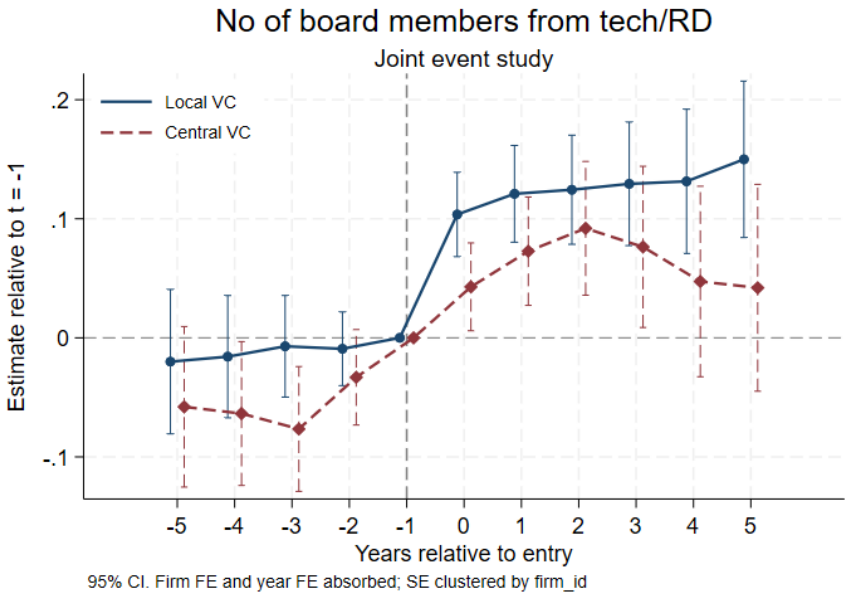
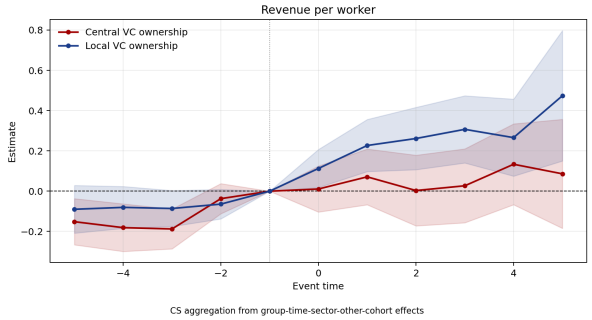
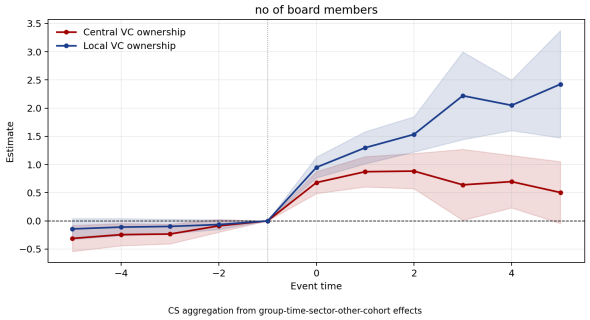


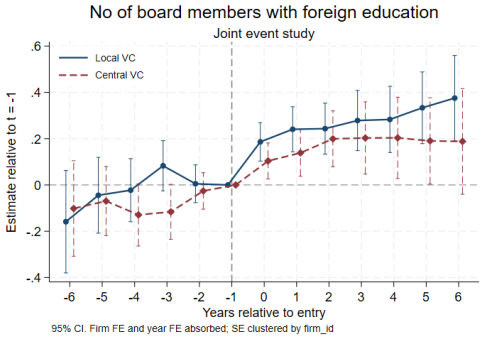
Figure B.11: Board members with Tech/R&D backgrounds



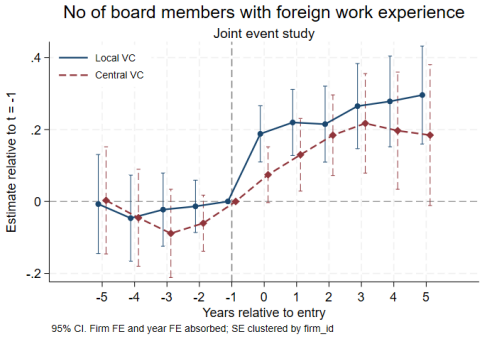
(a) Revenue per worker



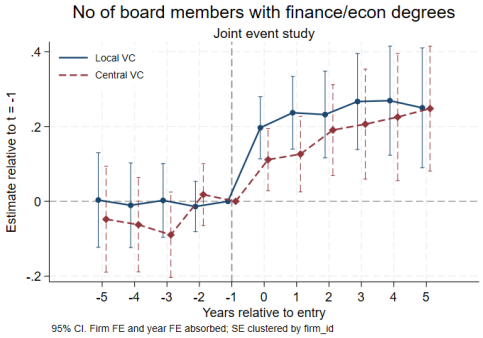
(b) Board size



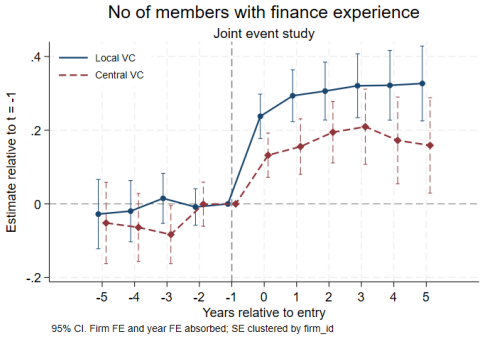
(a) Foreign education



(b) Foreign work experience



(a) Finance and economics degree



(b) Finance-sector background

C Chinese Semiconductor Industrial Policy

C.1 Central Government Policies: Tax Breaks, Guidelines, Equity Investments

The modern integrated circuits industry in China began with the "908 project" and "909 project" to create state-owned enterprises in semiconductor manufacturing, which became the predecessors of power semiconductor manufacturer CR Micro and China's 2nd largest foundry Huahong respectively. These SOEs were established to form joint ventures with foreign companies to exchange market access and state subsidies in return for foreign technologies. For example, Huahong partnered with Japanese manufacturer NEC to form HHNEC to build China's first commercial 200mm fab. These SOE-JVs did not have much success in advancing frontier technologies, while non-state-owned firms such as SMIC showed promise (Chu, 2013; Fuller, 2016). China's rapid economic

ascent to become the world's electronics manufacturing hub, rising domestic consumer demand, as well as the deemed failures of the 908 and 909 projects pushed the State Council to pivot away from central planning with state-owned enterprises to tax and subsidy incentives targeted towards privately-held enterprises.

In January 2000 the State Council announced "Several Policies to Encourage the Development of the Software Industry and IC Industry" ("Document No. 18") to cut the value added tax (VAT) from 17 percent to 3 percent for ICs fabricated or designed in China, regardless of firm nationality, while also offering the famous 2+3 income tax break (*liang mian san jian ban*: two years tax exemption and three years of 50% reduction in tax) for IC design firms and manufacturers with < 0.25 micron process and/or with investments over 8 billion RMB. Firms also would receive zero import duties on technology and IC capital equipment. The implementation of the policy was marred by the US government's complaints that these tax breaks violated WTO rules, which led to the rescinding of the VAT tax break in 2004, and a long administrative process of recognizing domestic design operations (Fuller, 2016). A new round of tax incentives, "Several Policies to Further Encourage the Development of the Software Industry and the Integrated Circuit Industry" ("Document No.4"), was announced in 2011, which extended the $2 + 3$ tax cuts to manufacturers of line-width technologies < 0.8 microns. Those of technologies < 0.25 microns or with investments of over 8 billion RMB would enjoy five years of tax exemption and five years of halved corporate income tax. Still, many state-owned IC design and fabrication firms primarily lived off state procurement, most notably the "Golden Card project" which designated state-owned firms such as Leadcore and CEC Huada to supply chips for ID, telephone, and transportation cards. These procurement projects typically relied on simpler technology processes and did not give state-connected firms incentives to engage in technology upgrading (Fuller, 2016).

The watershed moment of Chinese semiconductor industrial policy arrived in June 2014 when the central government promulgated the "National Integrated Circuit Industry Development Promotion Outline", with the stated goal for Chinese production to attain 70% of domestic demand by 2025 (15% in 2014). It established a "National Integrated Circuit Industry Investment Fund" that raised around 138.7 billion RMB in its initial funding round ("Phase I") in August 2014 from the Ministry of Finance, central SOEs like China Development Bank and China Tobacco, and local government funds and SOEs such as Beijing E-Town and Shanghai Guosheng Group. The fund is managed by Sino IC Capital and invested in minority stakes of both publicly-listed and private companies. "Phase I" of the fund invested primarily in notable national leaders in semiconductor manufacturing, design, and packaging & testing companies. In 2019, "Phase II" of the fund raised 204.5 billion RMB. In contrast to Phase I, the support previously provided to IC design firms was instead directed towards equipment and materials suppliers. The timing coincides with the United States' export sanctions towards SMIC and key telecommunications equipment manufacturers like Huawei and ZTE, depriving them access to critical semiconductor equipment and advanced node semiconductors (Crosignani et al., 2024). This and further restrictions during the Biden administration made salient the fact that China's vibrant electronic manufacturing still relied primarily on

imported semiconductor technologies. Integrated circuits remained the largest category of China's imports in terms of value as of 2025 [2].

On August 4, 2020, the State Council unveiled yet another major set of tax incentives to comprehensively exempt corporate income tax and import duties for semiconductor firms across the supply chain (Song and Wen, 2023). The strength of the tax incentives is contingent on the technology process of the firm, for example manufacturing projects with processes less than 28 nanometers with an operating period of more than 15 years now enjoy 10 years of exempted income tax, while those between 28 and 65 nanometers have 5 years exemption with 5 years of halved taxes. The standard "2+3" tax break was awarded to manufacturing firms with technologies between 65 and 130 nanometers as well as design, packaging & testing, equipment, and materials companies. Designated key IC design firms also receive a five-year exemption. This cemented the IC industry's status as a national priority, with state support now officially extended throughout all segments of the semiconductor supply chain.

In 2022, the Big Fund came under an anti-corruption probe. Many executives of Sino IC capital, including its former CEO Ding Wenwu, were investigated and detained. This partly reflected the central government's dissatisfaction with the fund's investment outcomes: some of the fund's portfolio firms had poor performance, most notably the conglomerate Tsinghua Unigroup that went bankrupt in July 2021 after a spree of semiconductor investments and acquisitions including chip designer UNISOC (formerly Spreadtrum) and NAND Flash maker YMTC. Consequently, Big Fund operations stayed dormant for months before resuming operations in early 2023. "Phase III" of the Big Fund was quietly established on 24 May 2024 with 344 billion RMB of registered capital. Shareholders include the Ministry of Finance, central government banks and SOEs, and guidance funds/SOEs of Beijing, Shanghai, and Guangdong. Notably, apart from the aforementioned three major clusters of China's semiconductor industry, participation from other provincial governments was absent, while in the previous two phases localities like Fujian, Wuhan, Jiangsu, Anhui, and Chongqing have actively participated. This could reflect a desire to strengthen central control of Big Fund's investments, as equity participation from local governments would require the Big Fund to return favors by investing in local firms. Big Fund Phase III has adopted a "fund of funds" approach by dividing its portfolio to three subfunds, with one fund apparently dedicated to the artificial intelligence industry.

[2] "China's Major Imports by Quantity and Value, Dec 2025 (in USD)". China Customs. http://english.customs.gov.cn/Statics/83fb6750-e095-47c6-9890-14979f5a22e8.html

C.2 Local Government Policies: Equity Investments, Subsidies, and Industrial Parks

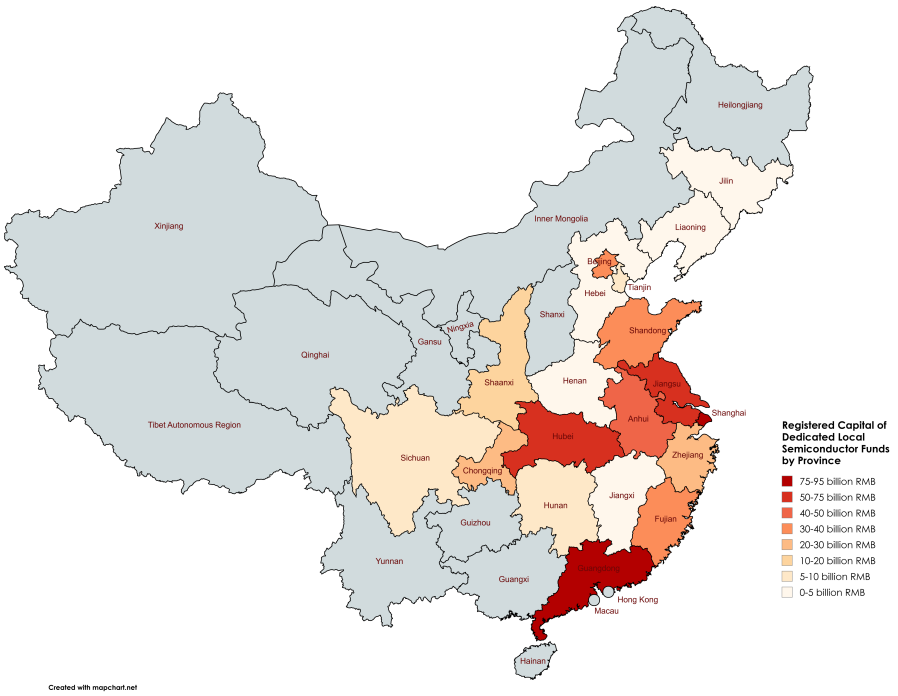


Figure C.1: Provincial Semiconductor Funds (numbers shown in RMB 0.1 billion units)

Much of direct subsidies and equity investments to semiconductor firms originate from provincial and municipal governments, who fund numerous government guidance funds with local fiscal revenue and debt. Shanghai and Shenzhen in particular pioneered the government venture capital model. The most successful government venture capital firm is the Shenzhen Capital Group (SCGC). Established in 1999 and with a total assets under management amounting to 489 billion RMB, it has invested in over 1580 companies and saw 272 portfolio firms going public. Focusing on investing in small and medium-sized young companies in emerging technology industries, the Shenzhen Capital Group has invested in semiconductor firms including SMIC, Empyrean, Montage, Biwin Storage, and Rockchip that have since become publicly listed. From 2016 to 2024 SCGC was named Top 1 VC firm in China from 2016-2024 by Zero2IPO. Shanghai instituted Shanghai Technology Venture Capital in 1992 with 150 million RMB to focus on integrated circuits, biomedicine, and AI early-stage companies. With an AUM of 88.6 billion RMB, it has supported 102 firms to get listed on Shanghai Stock Exchange Sci-Tech innovation board (the STAR market), the exchange dedicated to high tech companies. Notable semiconductor firms invested include AMEC, ACM Research, Enflame, Silergy, and 3Peak. Beijing E-town Capital was established in 2009 to primarily invest in targets in the Beijing Economic-Technological Development Area, an industrial park that became a cluster for semiconductor manufacturing in Beijing. Its mother fund and sub-funds now sprawl over 600 billion RMB. It has supported various critical projects including display panel maker BOE's Beijing line, SMIC Beijing's Phase II and III 28-14nm fabs, and CXMT Beijing. It also has participated in Chinese entities' acquisition of foreign semiconductor firms, including automotive/industrial memory maker Integrated Silicon Solution Inc., Swedish MEMS maker Silex,

American etching and thermal processing equipment supplier Mattson Technology, and American mixed signal designer Omnivision.

Following the promulgation of the 2014 National IC Industry Development Promotion Outline, local governments also instituted government guidance funds dedicated to semiconductors. In the Yangtze Delta region, China's most vibrant semiconductor manufacturing cluster, Shanghai established a series of IC funds in 2015, including a dedicated IC manufacturing fund with target size of 30 billion RMB, an IC design fund of 10 billion RMB, and a 10 billion fund dedicated to equipment and materials. Anhui in 2017 established a 30-billion RMB provincial IC fund, while at the municipal level Hefei introduced a 10-billion RMB manufacturing fund in conjunction with a 1 billion RMB IC design fund in 2015. In Jiangsu, Wuxi (10b), Nanjing (50b RMB), Suzhou (10b), and Nantong (8.5b) each have deployed IC funds. In other major semiconductor clusters, Beijing allocated 32 billion RMB also to IC funds dedicated to advanced manufacturing, equipment, and design, packaging & testing. Similarly, Guangdong (15b) and key city Guangzhou (10b), Hubei and its primary city Wuhan (30b), Sichuan (12b), Fujian (50b), and Shaanxi (30b) have established numerous dedicated IC funds. The flurry of enthusiastic local government IC investments had mixed results as many high-profile projects eventually went bust such as Wuhan Hongxin and Tacoma. These disappointments led to concerns that this rush of local government funding has resulted in misallocation of critical fiscal resources as funding was dissipated across many regions in uncompetitive ventures.

Apart from equity injections, local governments also directly provide grants to eligible firms. Summary analysis of more than 1000 policy documents implemented by provincial, municipal, and sub-municipal governments suggests that policy measures across regions exhibit a high degree of similarity. A common feature across localities' tools is that they focus on subsidizing IC design firms' fixed costs of design: EDA software and IP costs as well as photomask and tapeout costs (the costs of putting digital design into physical layers for lithography for test production with manufacturers). Policies ubiquitously set the maximum percentage (typically less than 50%) of the fixed costs of EDA/IP/photomask/tapeout with a grant ceiling per applicant. Other commonly seen policies include cost-based R&D subsidies and equipment/materials subsidies that directly subsidize a percentage of the costs, as well as performance-based subsidies that award grants to firms based on fixed percentage of their sales, capital investment, or R&D outcomes such as patent counts. Other "beggar-thy-neighbor" policies include subsidies to firms that relocate from other localities, and subsidies to firms that acquire other firms.

Shenzhen's "Measures for Promoting High-Quality Development of the Semiconductor and Integrated Circuit Industries" exemplifies a typical set of such policies. The policy subsidizes a maximum 20% of core IP procurement cost and 70% of the cost of purchasing domestic EDA tools. It also covers a maximum 50% of photomask cost and 70% tapeout cost of firms that are introducing a product with a full-mask tapeout for the first time. On investment, it subsidizes 10% of the capital investment cost of advanced packaging firms, 20% of the R&D cost of firms

engaging in RISC-V designs and 40% of material firms' R&D cost. In addition to subsidizing costs ex-ante, the policy also includes performance-based incentives, such as awarding firms that sold over 20 million RMB of a single product to Shenzhen firms a maximum of 15% of annual sales, 30% of first-time sales of materials and equipment to key manufacturing firms. The management team of enterprises that surpasses defined revenue benchmarks would also receive a one-time bonus.

Local governments also supply infrastructure, land, and energy to build industry clusters with special economic zones and industrial parks. Similar to the spirit of Taiwan's Science Parks, Chinese industrial parks exploit the agglomeration economy of firms along the electronics supply chain. By securing large-scale investments of key manufacturers through discretionary subsidies and equity joint ventures, these major project investments attract further investments of smaller-scale upstream equipment & materials suppliers as well as downstream IC design customers. Famous examples include Beijing Yizhuang, Wuhan Optics Valley, Wuxi Gaoxin, and Hefei Hi-tech Park that host the pillar semiconductor firms of the region as well as nascent startups. The parks attract firms through favorable loan policies, expedited land acquisitions and construction, cheap office and residential space, and public goods such as common software/IP platforms.

Following the Big Fund crackdown and reorganization, the Central Science and Technology Commission (CSTC) was established within the Chinese Communist Party with the intent for the CSTC to take over strategic science and technology policy. Commentators have suggested that this reflects the central government's desire to centralize and coordinate national R&D and industrial resources to focus on critical sectors and firms. CSTC's *2023 Notice on Management Measures for Central Guidance Funds for Local S&T Development* stipulates that central government guidance fund investment will prioritize (1) CSTC-approved major science and technology project and (2) regional science and technology innovation ecosystems, which are also now being reviewed and approved by the CSTC. This represents a significant step by which the central government is now actively stepping in to coordinate local governments' support policies to temper the perceived excesses of subsidy competition between localities.

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