When Shadow Banking Retreats: The Effects of Financial Regulation on Venture Capital*

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Abstract

This paper documents a novel role of shadow banking in financing venture capital (VC) in a bank-dominated financial system. Our identification exploits China's 2018 New Regulations on Asset Management, which restricts banks' off-balance-sheet activities. Exploiting cross-sectional variation in pre-regulation shadow-banking exposure, measured by the share of shadow-banking limited partners, we find a sharp contraction in VC activity. A one-standard-deviation increase in pre-regulation exposure leads to a 16.4% investment decline afterward. Affected funds disproportionately retreat from early-stage financing. Portfolio firms experience significant decline in subsequent patenting. Our results highlight unintended consequences of shadow banking regulation on risk capital and innovation.

Keywords: Venture capital, shadow banking, innovation, financial regulation, China

JEL Codes: G21, G24, G28, O31

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1 Introduction

Banks' involvement in equity investments has long raised academic and policy concerns (e.g., Hellmann et al., 2008; Fang et al., 2013). These concerns are particularly relevant for venture capital (VC), which plays a central role in financing innovative startups and fostering technological progress (Kortum and Lerner, 2000; Lerner and Nanda, 2020). A large literature has shown that VC development depends critically on strong legal institutions and well-functioning capital markets (Black and Gilson, 1998; Lerner and Schoar, 2005). From this perspective, bank-dominated financial systems—common in developing economies—are generally viewed as less conducive to VC activity than market-based systems.

China—the largest bank-centric economy—therefore presents a striking puzzle. Despite its underdeveloped capital markets (e.g., Cong and Howell, 2021; Allen et al., 2024) and a predominantly bank-based financial system, China experienced rapid VC expansion during the 2010s. Specifically, China's share of global VC investments rose from less than 10% in 2010 to nearly 40% by 2016, while the U.S. share declined from 65% to 43% over the same period (Lerner et al., 2024). How did VC scale so quickly in a financial system seemingly ill-suited to supplying long-horizon risk capital?

This paper documents a novel channel through which venture capital can be financed in a bank-dominated financial system: shadow banking. China provides an important and useful setting. Its financial system is overwhelmingly bank-centric, with banks accounting for more than 80% of total financial sector assets. These banks have long been prohibited from making direct equity investments, which is similar to their U.S. counterparts under the post-Volcker Rule regulatory regime. To circumvent regulatory restrictions, banks move

risky assets off their balance sheets via partnership with non-bank financial institutions, including securities firms, trust companies, and mutual funds. Specifically, these shadow-banking intermediaries issue asset management products for banks to distribute, engaging in liquidity and maturity transformation by rolling over short-term products to finance long-term, illiquid assets, including VC and private equity investments.

We show that this bank-VC nexus is sharply disrupted by shadow banking regulation. Our empirical setting exploits the 2018 New Regulations on Asset Management (NRAM), which prohibited multi-layered product nesting, opaque asset holdings, and maturity mismatches in asset management products. The primary objective of the reform was to curb systemic risk arising from shadow banking activities, with no explicit intention to target VC. As such, the NRAM provides a clean laboratory to study how shadow banking facilitates the provision of risk capital in a bank-dominated financial system.

Identifying the causal impact of the NRAM poses a central challenge because the regulation was implemented nationwide, ruling out a simple treated-versus-control comparison across regions. Our identification hence exploits heterogeneity in pre-regulation exposure to shadow-bank funding that arises from differences in the limited partner (LP) composition of VC funds. VC funds that relied more heavily on shadow-banking intermediaries as LPs prior to 2018 experienced a larger contraction in funding supply and therefore should be more affected by the regulation.

Importantly, this exposure is determined by the industry affiliation of LPs, reflecting historical financing relationships that were contractually established before the regulation. As a result, our empirical design is conceptually closer to a Bartik-style or shift-share exposure design, in which a common regulatory shock interacts with predetermined differences

in funding structures across VC funds.

A further challenge is that shadow-bank investments in VC are difficult to observe directly, as asset management products typically disclose limited information about their underlying assets and often involve complex, multi-tiered ownership structures. To overcome this limitation, we construct novel fund-level linkages by combining VC and private equity transaction data with firm registration records to identify fund shareholders. This approach allows us to identify shadow-banking intermediaries acting as LPs and to measure VC funds' pre-policy exposure to shadow-bank funding.

We find that the NRAM has large, negative effects on VC activity. At the city level, VC investment declines sharply in locations with greater pre-policy exposure to shadow-bank-funded VC, in both deal counts and total investment amounts. At the VC-firm level, a one-standard-deviation increase in pre-regulation exposure is associated with an 11.82% decline in deal count and a 16.37% decline in aggregate investment. These findings indicate that VC firms are unable to fully substitute away from shadow-bank funding, implying that the regulation imposes binding financing constraints on the VC sector.

Beyond aggregate contraction, the regulation reshapes VC fundraising and investment behavior. Following the NRAM, average fund size declines, institutional participation falls, and the share of individual investors increases, suggesting a deterioration in investor quality and monitoring capacity. Constrained by reduced maturity transformation, VC firms with greater shadow-banking LP exposure delay capital deployment and reallocate investments away from the early phases of the fund life cycle toward later stages.

We further document a pronounced reallocation of VC investment across industries. Using the *Made in China 2025* industrial policy as a benchmark, we show that investment

contractions among highly exposed VC firms are concentrated in non-priority industries and non-manufacturing sectors, while investment in government-supported industries is relatively preserved. As a result, shadow banking regulation increases the policy sensitivity of private capital allocation, amplifying the role of industrial policy in shaping VC investment patterns.

Finally, we examine real effects on portfolio firms' innovation outcomes. Firms backed by VC firms with greater pre-regulation exposure to shadow banking experience significant declines in both total patent grants and invention patents following the NRAM. These effects are strongest in industries more dependent on external finance, consistent with the interpretation that tighter VC financing constraints disproportionately affect firms with greater funding needs.

This paper contributes to three strands of literature. First, we document a novel bank-VC nexus in a bank-dominated financial system. VC is more naturally supported by stock-market-centered financial systems, where active public equity markets and IPO exit opportunities facilitate VC development (Black and Gilson, 1998). Subsequent studies examine how banks support venture investing through direct participation as LPs (Hellmann et al., 2008; Fang et al., 2013) and on regulatory constraints on such investments (Chen and Ewens, 2025). We study a distinct setting in which commercial banks' direct equity investment in VC is constrained. In this environment, we show that banks' off-balance-sheet activities provide an indirect channel through which bank liquidity is transformed into VC funding. Our evidence therefore identifies a novel bank-to-VC transmission mechanism in developing economies where access to market-based risk capital is limited.

Second, we introduce a new LP-side exposure design that leverages funding heterogeneity to identify the effects of nationwide financial regulation, contributing to the growing literature

on LP heterogeneity and VC behavior (Lerner et al., 2007, 2022). Recent evidence further shows that LP horizons matter for VC intermediation: the entry of patient LPs can lead GPs to invest earlier, hold portfolio companies longer, and improve startup outcomes (Li et al., 2026). We complement and extend this literature by examining a contraction, rather than an expansion, in a specific type of LP-side capital. Exploiting the regulatory tightening of shadow-banking funding, we show that shocks to financial-institution LPs propagate through GPs' investment decisions and ultimately affect startup innovation.

Third, we contribute to the emerging literature on China's venture capital market, focusing on financial-institution LPs. Existing work on China emphasizes the role of government investors in shaping matching, capital allocation, and industrial resilience (Colonnelli et al., 2024; Chen et al., 2026), as well as the entrepreneurial spillovers generated by individual LPs (Lerner et al., 2023). We shift attention to a different class of capital providers: financial institutions operating through shadow-banking conduits. Exploiting an exogenous contraction in VC funding induced by shadow banking regulation in China,[1] we show that shadow-banking intermediaries can operate on the LP side of the VC market, channeling bank-related funding into long-horizon risk capital. This evidence sheds new light on how financial intermediation shapes the provision and allocation of risk capital that is critical for innovation and long-run growth. By linking LP-side financial regulation to startup innovation, our findings also speak to broader work on institutional change and innovation in China (e.g., Fang et al., 2017, 2023).

[1]Shadow banking in China often involves off-balance-sheet activities by banks, including wealth management products (Acharya et al., 2025), entrusted loans (Allen et al., 2019), and trust products (Allen et al., 2023). Tian et al. (2024) examines the impact of entrusted loans on innovation through the credit reallocation channel. We complement previous studies by documenting a novel channel through which shadow banking intermediaries serve as LPs and supply risk capital to the VC sector.

The remainder of the paper is organized as follows. Section 2 provides institutional background. Section 3 describes the data. Section 4 presents the empirical strategy. Section 5 shows the baseline results. Section 6 examines changes in VC fundraising and investment behavior. Section 7 analyzes real effects on firm innovation. Section 8 concludes.

2 Institutional Background

2.1 The Development of VC in China

When China became the world's second-largest economy in 2010, its VC industry was still relatively underdeveloped. According to Lerner et al. (2024), China accounted for less than 10% of global VC investment in 2010, while the United States contributed 65%. By 2016, however, China's global share had risen to around 40%, whereas the U.S. share had declined to approximately 42%.

Notably, the growth of China's VC industry has been driven primarily by domestic renminbi (RMB)-denominated funds. Figure 1 illustrates the evolution of VC/PE investment in China by currency. From 2010 to 2022, total VC/PE investment increased from RMB 104.38 billion to RMB 907.68 billion, with RMB investment accounting for an average of 65% of the total. RMB investment reached its historical peak in 2017 and has not surpassed that level ever since. Notably, during 2017-2019, the amount of RMB-denominated investment declined by 43.5%, while foreign currency investment remained largely unchanged.

In China, most VC investments are organized through limited-partnership funds. The key limited partners (LPs) typically include government-backed funds, state-owned enter-

prises (SOEs), listed and unlisted nonfinancial firms, as well as non-bank financial institutions. Banks are prohibited from directly investing in equity assets.[2] After fundraising, each limited-partnership fund is required to register with both the State Administration for Market Regulation (SAMR) and the Asset Management Association of China (AMAC). Information on the fund's LPs, GPs, and registered capital is publicly available through commercial business-information platforms. On average, the fund is liquidated following an investment period that typically lasts 5–8 years, and the partnership entity is subsequently deregistered.

2.2 The Asset Management Industry and Shadow Banking

The expansion of China's shadow banking sector is closely associated with the asset management industry, particularly through off-balance-sheet activities by commercial banks (Chen et al., 2020; Acharya et al., 2025). The top-down deregulation and financial liberalization since 2012[3] contributed to the rise of shadow banking in China.

Prior to 2012, trust companies functioned as the dominant channel for moving bank assets off-balance-sheet. A significant shift commenced in 2012 when securities regulators relaxed investment restrictions on the asset management divisions of securities firms, permitting them to establish customized investment structures negotiated directly with specific clients.[4] Mutual fund companies soon gained similar qualifications and established their

[2]These restrictions began to ease only recently, with pilot programs introduced in 2024 allowing banks to establish financial asset investment companies (AICs) to engage in equity investment.

[3]Since 2012, to address credit misallocation in China's financial system and the persistent financing constraints faced by small and medium-sized enterprises, the new Chinese government has implemented a series of financial liberalization measures. These policies included loosening regulatory restrictions on non-bank financial institutions and promoting the development of the asset management industry and various new financial business models. See `https://fund.sohu.com/20120608/n345100639.shtml`.

[4]See `https://finance.huanqiu.com/article/9CaKrnJxr85`.

own private-market asset management subsidiaries.[5] This regulatory evolution meant that these institutions could engage in private market investment by issuing asset management products.

However, a substantial portion of these products evolved into vehicles for repackaging banks' off-balance-sheet assets. From the banks' perspective, the most common way to move assets off balance sheet is through the issuance of wealth management products (WMPs), which grew at an average annual rate of nearly 50% after 2012 (Figure 2, Panel A). In practice, these WMPs are typically channeled into asset management products issued by non-bank financial institutions to circumvent regulatory restrictions on investment scope.[6] A typical example involves a bank commissioning a securities firm to set up an asset management product. The securities firm, following the bank's instructions, would then deploy the funds to purchase bank-specified assets, such as WMPs and commercial bills. This model of inter-institutional collaboration rapidly became a primary activity for asset management companies after the 2012 deregulation, giving rise to what is termed "conduit business". Common forms of the conduit business include bank-trust cooperation, bank-securities firm cooperation, bank–mutual fund cooperation, and various complex tripartite collaboration models. This created layered credit chains between banks and non-bank financial institutions, paralleling the U.S. experience of financial liberalization and securitization since the 1980s (He and Li, 2022). While such credit chains may improve efficiency through maturity transformation (Allen et al., 2023), they also generate systemic risk by increasing opacity and interconnectedness.

[5]See `https://www.gov.cn/gongbao/content/2012/content_2283047.htm`.

[6]For instance, 2009 regulations on commercial banks' personal wealth management business restricted direct investments in equities and unlisted assets.

The growth of this business was further propelled by constraints within the banking sector itself. Subject to investment capacity limits and regulatory boundaries, banks began increasingly outsourcing wealth management operations to third-party institutions from 2014 onward. This trend resulted in a deep intertwining of funds. By 2016, over 40% of the capital in trust products was sourced directly from banks. At the same time, approximately 70% of securities firms' asset management products were devoted to conduit services. For mutual fund subsidiaries, more than 50% of their funding originated from banks. Therefore, shadow banking in China has been described as the "shadow of the banks" (Ehlers et al., 2018).

2.3 Regulatory Tightening: The NRAM in 2018

Chinese regulators were deeply worried about the systemic risk posed by the excessive expansion of shadow banking. The China Shadow Banking Report[7] issued by the China Banking and Insurance Regulatory Commission (CBIRC) described the complexity of asset management products at the time:

> "Various asset management products invested in one another and became nested, forming large pools of assets; liabilities and assets could not be matched or identified, causing severe liquidity mismatches ... if follow-on funding cannot be raised in time, the funding chain will immediately break, and liquidity risk will spread through the industry like an epidemic in a short period."

In this context, the banking regulator launched a targeted banking industry rectification campaign in 2017.[8] In November 2017, multiple regulatory agencies jointly issued the draft

[7]See China Shadow Banking Report issued by CBIRC in 2020: `https://china.caixin.com/upload/ddd.pdf`.

[8]In May 2017, the CBRC started a special inspection program called "3-3-4-10 Action" to tighten

of the NRAM, which was formally implemented in 2018.[9] Chinese regulators explicitly required strict separation of products and the end of pooled, rolling, and maturity-mismatched structures. The NRAM states:

> "Each asset management product's funds must be managed, accounted for, and audited separately; participation in pooled-fund businesses with features such as rolling issuance, collective operation, or separate pricing is prohibited ... Asset management products that directly or indirectly invest in equity of unlisted firms must be closed-ended and must specify exit arrangements for such equity; the equity exit date may not be *later* than the product's maturity date."

Primarily addressing shadow banking risks such as multi-layer product nesting and the operation of pooled funds, the 2018 NRAM eliminates key practices that had linked short-term asset management products to long-term investments, thus adversely affecting the VC/PE industry. VC/PE commitments typically require long lock-ups (often well beyond seven years), whereas the maturity of bank-issued WMPs is typically 2–3 years. A common circumvention before the NRAM was rolling over short-term WMPs to raise long-term capital (See Figure A2). For example, banks issue a WMP (Product A) and invest its proceeds into a long-term PE project; before A matured, the issuer launch Product B and use B's proceeds to meet A's redemption; if still short, the issuer would offer an "A+1" rollover that converted A's principal and accrued interest into a new product under preferential terms. Such rolling issuance generated maturity mismatch and allowed separate pricing across products tied to the same underlying asset. By constraining these practices, the NRAM largely severs

regulation in the banking sector. See, for instance, `https://www.chinanews.com.cn/fortune/2018/01-10/8420478.shtml`.

[9] See `http://www.pbc.gov.cn/tiaofasi/144941/3581332/3730258/index.html`.

the conventional channel through which asset management products funded long-duration, equity-style investments.[10]

To curb multi-layer nesting and regulatory arbitrage, the NRAM imposed two key restrictions: a prohibition on "conduit business" used to evade supervision and a cap permitting at most one layer of fund nesting. Prior to the reform, banks commonly invested in private equity by nesting asset management products issued by other financial institutions (see Figure A1). The restrictions unintentionally affected the prevalent pre-reform use of fund-of-fund (FOF) structures in VC investments, which are classified as multi-layer nesting. Although a December 2019 clarification exempted VC and government-guidance funds from counting as an additional layer in FOF structures,[11] the NRAM had already sharply curtailed banks' ability to channel WMP proceeds into private equity through multi-tiered vehicles.

The NRAM had a large and immediate impact on the asset management industry, especially in private markets (including private credit and private equity). Figure 2 Panel B shows that asset under management (AUM) in private markets declined by 22.8% from 2017 to 2022, while its share fell from 62.7% to 42.8%. As part of the private-markets segment, the VC industry was also unintentionally dampened. The effect was especially pronounced on the fundraising side, where domestic RMB VC fundraising fell by 35.4% in 2018. Industry participants attribute this drop to the reform's disruption of shadow-banking funding. As noted in the Annual Report of the VC/PE Industry, in an environment short of long-term capital, banks' maturity-mismatched WMP pools had been a major source of commitments

[10]See `https://www.jdsupra.com/legalnews/2018-a-turbulent-transition-year-for-95482/` for detailed analysis.

[11]See `https://www.gov.cn/gongbao/content/2020/content_5477322.htm`.

to VC funds, and the NRAM largely cut off that funding channel.[12]

3 Data and Summary Statistics

3.1 VC Funds and VC Investment Deals

Our VC investment data are obtained from Zero2IPO, a leading professional VC/PE database in China. Its data have been widely used in previous studies on China's VC/PE industry (e.g., Lerner et al., 2023; Colonnelli et al., 2024). We obtain VC deal-level information, including the investors, target firm, deal date, and deal location. However, approximately 10% of portfolio firms' names are not publicly disclosed, and over 40% of investment amounts are missing. Therefore, in the subsequent analysis, we focus on the number of investment deals as the primary measure of VC activity.

We obtain each portfolio firm's and VC fund's founding date, registered capital, address, and industry classification by matching names to records in Tianyancha, a comprehensive Chinese business registration database. We then link fund names to shareholder lists and equity-change histories. Using these ownership records, we apply an ownership-tracing procedure to reconstruct each fund's partner composition, including both LPs and GPs, at the time of each investment. This procedure allows us to identify shadow-banking institutions acting as LPs.

As discussed above, China's shadow banking system includes several types of intermediaries, such as bank-affiliated entities, trust companies, securities-firm asset management units, and mutual-fund asset management subsidiaries. We compute the capital commit-

[12]See `https://finance.sina.com.cn/money/smjj/smgq/2019-05-06/doc-ihvhiqax6847580.shtml`.

ments of these institutions in a VC fund j and define *ShadowBankShare* as the ratio of capital committed by shadow banking conduits to (the fund j) for each deal i (invested in year t managed by GP g):

$$\text{ShadowBankShare}_{i(gjt)} = \frac{\#Funding from Shadow Banks_{i(gjt)}}{\#Total Funding_{i(gjt)}} \tag{1}$$

3.2 Shadow Banking Exposure

To identify the impact of nationwide shadow banking regulation on VC, we exploit cross-sectional variation in shadow banking activity along both city and GP dimensions.

At the city level, because VC fundraising and investment are highly localized, the involvement of shadow banking in a city's VC deals reflects its dependence on shadow banking funding. Following Chen and Ewens (2025), which measure the state-level VC exposure to banks using the U.S. data, we compute the city-level shadow banking exposure $ShadowBankExpo_c$ as the simple average share of shadow banking funding across all VC investment deals i in city c during 2010–2017:

$$ShadowBankExpo_c = \frac{\sum_{i=1}^{n} ShadowBankShare_{i(c)}}{n}$$

We do not weight by investment amount because investment-value data are missing for a large share of observations in our sample. Likewise, alternative weights such as a fund's registered capital are inappropriate here because a fund's fundraising and registration characteristics are often weakly correlated with the geographic location of its portfolio firms. By comparing the pre-policy frequency of shadow banking institutions acting as LPs in

investment deals across cities, we capture differential exposure to the NRAM.

At the GP level, we construct each GP's exposure to shadow banking as a registered-capital-weighted (ω_j) average of the shadow-banking capital commitment shares of the funds it manages. For VC firm g which manages funds $j = 1, ..., n$, we define a fund j's pre-policy shadow banking share, $ShadowBankShare_{j(g)}$, as the maximum share observed over the pre-policy period (i.e., 2010–2017). Then, the VC firm (GP)-level exposure $ShadowBankExpo_g$ is defined as the weighted average of fund-level shadow banking shares:

$$\omega_{j(g)} = \frac{\text{RegistCapital}_{j(g)}}{\sum_{j=1}^{n} \text{RegistCapital}_{j(g)}} \tag{2}$$

$$ShadowBankExpo_g = \sum_{j=1}^{n} \omega_{j(g)} \times \max_{t \in \{2010,...,2017\}} ShadowBankShare_{i(gjt)} \tag{3}$$

3.3 Patents of Portfolio Firms

In addition, we proxy firm-level innovation using patenting activity, drawing records from the China National Intellectual Property Administration (CNIPA). The CNIPA classifies patents as invention, utility model, or design patents. We match patents to portfolio firms by applicant name and aggregate ultimately granted filings by application year to construct firm-year panels.

3.4 Sample and Summary Statistics

Our sample spans between 2010 and 2022, which covers the period of the rapid expansion of shadow banking conduits in China and the implementation of regulatory tightening. We further restrict the sample to investments made by funds organized as limited partnerships,

the dominant organizational form for VC investments in China. We exclude investments in listed firms to focus on VC investments in startups. Our sample comprises 79,875 investment deals between 2010 and 2022.

Table 1 reports descriptive statistics from different levels. At the deal level, the average capital commitment percentage to the VC fund by shadow bank conduits ($ShadowBankShare$) is 2.4%. Panels B and C present aggregated measures at the city and GP levels. Across the 283 cities with VC activity, the mean of $ShadowBankExpo_c$ is 5.2%. Among 5,671 GPs with pre-policy VC investments, the mean $ShadowBankExpo_g$ is 3.2%. For the 22,133 portfolio firms in our sample, the average number of granted patents is 2.874 and the average number of granted invention patents is 0.853.

We also document geographic changes in shadow banking exposure before and after the NRAM. Figure 3 Panel (a) shows a substantial decline in exposure at the national level and across China's four major regions. Panel (b) maps pre-policy shadow banking exposure of VCs in our sample, which demonstrates large spatial heterogeneity: Northeast, Central, and Western regions exhibit substantially higher exposure than the Eastern coastal region. This pattern is consistent with the fact that the Eastern region has more developed VC markets and a larger pool of institutional investors, therefore less dependent on funding from shadow banks.

4 Identification Strategy

Our objective is to identify the causal effect of shadow banking regulation on VC activity. Because the 2018 NRAM applies to all regions simultaneously, identification cannot rely on

geographic variation in policy timing. Instead, our empirical strategy exploits heterogeneity in pre-regulation exposure to shadow-bank funding arising from differences in the funding structure of venture capital investors.

Conceptually, our design follows an exposure-based framework in which a common regulatory shock interacts with predetermined differences in reliance on shadow-banking intermediaries. In this sense, our approach is closely related to a Bartik-style (shift-share) design, where variation is generated by the interaction of a nationwide shock with cross-sectional differences in exposure that were determined prior to the policy change.

4.1 City-Level Exposure Design

We begin by estimating the impact of the NRAM at the city level using the following specification:

$$Y_{ct} = \alpha + \beta ShadowBankExpo_c \times Post_t + \gamma' X_c \times \lambda_t + \eta_c + \lambda_t + \varepsilon_{ct}, \tag{4}$$

where Y_{ct} denotes VC activity in city c in year t, measured by outcomes such as the number of VC deals or total investment amount. $Post_t$ is an indicator equal to one for years $t \geq 2018$ and zero otherwise. $ShadowBankExpo_c$ captures a city's pre-regulation exposure to shadow-bank-funded VC and is measured using data from the pre-2018 period.

The coefficient of interest, β, measures whether cities with greater ex ante reliance on shadow-bank-funded VC experience larger changes in VC activity following the nationwide regulatory shock. Identification comes from differential exposure to the same policy rather than differential policy implementation. To flexibly account for heterogeneous trends across

cities, we include interactions between baseline city characteristics and year fixed effects, $X_c \times \lambda_t$. These baseline covariates are measured in the first year of the sample (2010), including log GDP per capita ($lnGDPPC$), the share of secondary industry value added ($SecondIndust$), and GDP growth ($GDPgrowth$), all obtained from the China City Statistical Yearbook. City fixed effects, η_c, absorb time-invariant differences across locations, while year fixed effects, λ_t, capture aggregate shocks common to all cities.

4.2 GP-Level Exposure Design

We next estimate analogous specifications at the venture capital firm (GP) level, which allows us to exploit variation in exposure within cities and industries. The GP-level specification is:

$$Y_{gt} = \alpha + \beta ShadowBankExpo_g \times Post_t + \gamma' X_g \times \lambda_t + \eta_g + \lambda_t + \varepsilon_{gt}, \tag{5}$$

where Y_{gt} denotes investment outcomes of GP g in year t. $ShadowBankExpo_g$ measures the GP's pre-2018 reliance on shadow-banking intermediaries as limited partners. GP fixed effects, η_g, absorb time-invariant differences in investment strategy, quality, and network access, while year fixed effects capture aggregate shocks.

To account for heterogeneous trends across VC firms, we interact predetermined GP characteristics, X_g, with year fixed effects. These characteristics include the GP's founding year and registered capital as filed with the State Administration for Market Regulation (SAMR). By conditioning on GP fixed effects and flexible trend controls, identification is driven by within-GP changes over time that vary with ex ante exposure, rather than by

cross-sectional differences in GP quality.

4.3 Deal-Level Specification

Finally, we exploit deal-level data to study how exposure to shadow banking regulation affects investment behavior and deal characteristics. We estimate the following specification:

$$Y_{i(gfdt)} = \alpha + \beta ShadowBankExpo_g \times Post_t + \gamma' X_g \times \lambda_t + \delta' Z_f \times \lambda_t + \eta_g + \mu_d + \lambda_t + \varepsilon_{i(gfdt)}, \quad (6)$$

where $Y_{i(gfdt)}$ denotes outcomes for deal i involving portfolio firm f in industry d, backed by GP g, in year t. Outcomes include fund size, investment stage, timing of capital deployment and so on. In addition to GP-level controls, we include interactions between predetermined portfolio firm characteristics, Z_f, such as founding year and registered capital, and year fixed effects.

We also include GP fixed effects and industry fixed effects, μ_d. This specification ensures that identification comes from variation among deals undertaken by the same VC firm within the same industry and macroeconomic environment. As a result, the estimates are unlikely to be driven by demand-side shocks or industry-specific trends and instead reflect changes in financing constraints induced by the regulation.

5 Aggregate Impact on VC Investment

5.1 Baseline Results

First, we examine the impact of the NRAM on city-level VC investment activities using Equation 4. Table 2 show that the coefficients of interest are negative and statistically significant at the 1% level. As shown in Columns (1) and (2), cities with higher pre-regulation shadow banking exposure experienced a significant decline in both the number and the value of VC investment deals following the NRAM. These results remain robust after including city-level control variables, as shown in Columns (3) and (4). Regarding economic magnitude, a one-standard-deviation increase in shadow banking exposure is associated with a 25.7% decrease in the number of VC deals and a 14.6% reduction in the total investment amount. This evidence suggests that the contraction in funding supply materially reduced VC investments.

Next, we examine the effects of the NRAM at the GP level. Table 3 presents the results of Equation 5. Again, we find that both the number of deals and total investment amounts decrease significantly following the NRAM. Specifically, a one-standard-deviation increase in a GP's shadow banking exposure is associated with a 11.8% decrease in the number of deals and a 16.4% reduction in total investment amount. These findings reveal that VC firms with greater reliance on funding from shadow banks experience more constrained financing after the regulatory tightening.

5.2 Dynamic Effects and Pre-trend Analysis

Our interpretation of the DID coefficient β as a causal impact is subject to standard endogeneity concerns. In particular, cities may also differ in unobserved local economic conditions, industry composition, or anticipatory adjustments. If cities or VC firms with greater pre-policy exposure to shadow banking were already on differential trajectories in VC activity prior to 2018, then the estimated post-regulation effects could reflect these confounding trends rather than the regulatory shock itself.

To assess this possibility, we examine the dynamic evolution of VC investment around the implementation of the NRAM using an event-study framework. Figure 4 reports estimates at both the city and VC-firm (GP) levels. Consistent with the identifying assumption underlying our difference-in-differences design, we find no evidence of differential pre-trends in VC investment across cities or VC firms with varying degrees of exposure to shadow banking prior to 2018. The estimated coefficients in the pre-regulation period are economically small and statistically indistinguishable from zero, which helps rule out alternative explanations of unobserved differential trends.

In contrast, following the NRAM, VC investment declines sharply in cities and among VC firms with greater pre-policy reliance on shadow-banking funding. The absence of pre-trends combined with the abrupt post-2018 divergence supports a causal interpretation in which the NRAM drives the observed contraction in VC investment.

5.3 Robustness Checks

We conduct several robustness checks to assess the sensitivity of our main findings. First, we implement a placebo test to rule out alternative explanations. As shown in Figure 1, domestic RMB VC funds had already played a dominant role in China's VC market before 2018. By contrast, foreign VC funds primarily raise capital from foreign investors and therefore do not rely on shadow banking. We thus use foreign capital exposure as a placebo measure, defined as the pre-2018 share of USD-denominated capital commitments in each VC firm's total capital commitments. Table A1 shows that foreign capital exposure does not have a negative effect on VC firms' investments in or after 2018. This suggests that our main results are driven by firms' dependence on shadow banking. Alternative explanations, such as China–U.S. economic tensions or tighter regulation on foreign investors, are therefore unlikely to account for our findings. By contrast, the coefficients on GP investment deals are positive and marginally significant, with p-values close to 0.1, suggesting that foreign capital exposure may have a substitution effect following the regulatory shock.

We also conduct several other tests. First, we replace the baseline exposure measures with alternative definitions. At the GP level, the treatment group is defined as VC firms whose shadow banking exposure exceeds 20%. As shown in Table A2, the results in Columns (1) and (2) remain quantitatively and statistically similar. Second, to rule out potential confounding effects from the COVID-19 pandemic, we restrict the sample period to 2010–2019. Finally, given that VC activity in China is highly concentrated in four first-tier cities (i.e., Beijing, Shanghai, Shenzhen, and Guangzhou), which together account for more than half of all VC transactions, we re-estimate the baseline specification excluding VC firms based in these

cities. The results remain robust. Overall, these exercises confirm that the suppressing effect of regulating shadow banking on VC holds across alternative specifications and sample restrictions.

6 Changes in VC Fundraising and Investments

6.1 Funding Contraction

We next examine how the NRAM affects VC fundraising. We expect constraints on shadow banking funding make it more difficult for VC firms to raise capital, resulting in smaller fund sizes. Table 4 presents the results. Due to data limitation, we use each fund's registered capital to proxy for fundraising. Column (1) shows that funds managed by GPs with higher pre-policy reliance on shadow banking financing are significantly smaller. This effect remains statistically significant after controlling for characteristics of the portfolio firms, as shown in Column (2).

Furthermore, to examine heterogeneity by investment horizon, we split the sample into early-stage and non-early-stage investment deals in Columns (3) and (4), respectively. We find that the reduction in fund size is primarily concentrated in early-stage investments. This suggests that funds focusing on more risky projects are more severely affected by the regulatory tightening.

6.2 LP Composition Shift

The NRAM imposes strict criteria on financial institutions that pool capital from investors. According to these rules, asset management entities are prohibited from raising and investing pooled funds without obtaining prior regulatory approval. Consequently, we expect these regulatory measures to reduce VC participation from institutional investors, who are more sensitive to compliance risks and regulatory constraints.

Table 5 examines how the NRAM reshapes the composition of LPs in VC funds. Panel A compares institutional and individual LPs. We find a pronounced shift away from institutional investors toward individual investors among VC funds managed by GPs with greater pre-policy exposure to shadow banking. These effects are highly statistically significant and remain stable after controlling for VC-backed firm characteristics, GP characteristics, industry fixed effects, and GP fixed effects. The coefficient estimates imply that a one-standard-deviation increase in the shadow banking exposure (0.127) reduces the share of institutional LPs by about 2.45 percentage points after 2018, with a nearly symmetric percentage increase in the share of individual LPs.

Panel B further decomposes institutional LPs into financial institutions and nonfinancial corporate investors. We find that the post-regulation decline is driven primarily by financial institutional LPs, as shown by the negative and statistically significant coefficients in Columns (1) and (3). That is, VC funds more exposed to shadow banking experience a large and significant reduction in the share of financial institutional investors following the NRAM. In contrast, the estimated impact on the share of corporate LPs is economically small and statistically insignificant (Column (2)) or marginally significant (Column (4)). These re-

sults strengthen our argument that the changes in the LP composition are attributed to the NRAM, which targets the financial industry.

Taken together, these results indicate that the tightening of shadow banking regulation disproportionately constrained regulated financial institutions' participation in VC funds, consistent with the NRAM's restrictions on pooled investment vehicles and maturity-mismatched products. As institutional capital retrenched, VC funds substituted toward individual investors, who face fewer regulatory constraints but typically provide smaller, less stable, and less professionally monitored capital. This compositional shift helps explain the observed contraction in fund size and the subsequent changes in investment behavior and innovation outcomes documented in later sections.

6.3 Investment Horizon

Next, we examine how the NRAM influences VC investment horizon choices. A key provision of the NRAM is the strict prohibition of maturity mismatch in asset management products. Since such products were a major source of shadow banking funding, this rule is expected to shorten the effective investment horizons of funds reliant on such capital, potentially altering their investment behavior. Prior literature supports this mechanism; for instance, Barrot (2017) show that younger funds with longer horizons tend to favor growth-stage firms, which subsequently exhibit higher patent growth, whereas funds nearing liquidation become more risk-averse.

Table 6 examines how VC firms with greater reliance on shadow-bank funding adjust their investment horizons following the 2018 NRAM. GPs with higher pre-policy shadow

banking exposure invest at later stages of their fund life cycles after the regulation, as indicated by the negative and statistically significant coefficients in Columns (1) and (3). A one-standard-deviation increase in shadow-banking exposure is associated with a 5.21% increase in fund age at the time of investment. Although we do not observe a statistically significant change in the age of investee firms, the results suggest that restricting maturity mismatch disproportionately reduced VC activity in the earlier phases of the fund life cycle.

To directly identify the effects of regulations on the investment behaviors of VC funds backed by shadow bank conduits, we also run the following deal-level cross-sectional regression:

$$\begin{aligned} Y_{i(gfdt)} = \alpha + \beta ShadowBankShare_i \times Post_t + \phi ShadowBankShare_i \\ + \gamma' X_g \times \lambda_t + \delta' Z_f \times \lambda_t + \eta_g + \mu_d + \lambda_t + \varepsilon_{i(gfdt)} \end{aligned} \tag{7}$$

where $ShadowBankShare_i$ denotes shadow bank conduits' capital commitment percentage to the VC fund (backed by GP g) in deal i in year t. Other specifications remain consistent with Equation 6.

Table A3 examines how VC funds with greater reliance on shadow-bank funding adjust their investment horizons following the 2018 NRAM. Prior to the regulation, funds with a higher shadow-bank share tend to invest earlier in their life cycles, as indicated by the negative and statistically significant coefficients on *ShadowBankShare* in Columns (1) and (3). However, following the implementation of the NRAM, this investment pattern reverses sharply. We find the interaction term *ShadowBankShare* × *Post* is positive and statistically significant across all specifications, indicating that shadow-bank-backed funds shift toward investing at later stages of the fund life cycle. Economically, a one-standard-deviation increase in shadow bank share is associated with an increase of approximately 0.13 year in fund

age at the time of investment after 2018. This estimate is economically meaningful compared to the fund age average of 1.884 years, translating into a 7.2% increase. Consistent with this shift, the age of portfolio firms at investment also increases significantly in the post-NRAM period (Columns (2) and (4)), suggesting a reallocation away from early-stage firms toward more mature targets.

These changes in investment horizon is closely aligned with the NRAM's strict prohibition of maturity mismatch in asset management products. Under the regulation, products allocating to equity in unlisted firms must specify an exit date no later than the product's contractual maturity, effectively eliminating the widespread practice of using rolling short-term products to support long-term VC investments. Although commercial banks subsequently established wealth management subsidiaries to manage these products more professionally after the NRAM, few closed-end WMPs targeting private equity have been introduced. Their maturities remain far shorter than the multi-year horizon required for early-stage VC investments. Data from *chinawealth.com.cn* show that newly issued closed-end WMPs in the first half of 2025 had average maturities of only 377–489 days, whereas a typical VC investment cycle often exceeds seven years. This persistent maturity mismatch makes early-stage investing incompatible with shadow-bank-based funding and incentivizes a reallocation of capital toward later-stage investments with higher exit certainty and shorter horizons, such as pre-IPO financing.[13]

[13] `https://finance.sina.com.cn/money/bank/bank_hydt/2023-09-08/doc-imzkynyn2472290.shtml`

6.4 Shifts in Industry Focus of VC Investment

Furthermore, we examine changes in the industry focus of VC investments. In China, the government actively implements industrial policies to guide VC investment and promote strategic sectors. A particularly important example is the "Made in China 2025" initiative, launched in 2015, which aims to enhance China's autonomous technological innovation and manufacturing capabilities, with a strong emphasis on advanced manufacturing.[14] Columns (1) and (2) in Panel A of Table 7 show that the decline in VC investments following the regulatory shock primarily occurs in non-prioritized industries, while industries favored by government policy remain largely unaffected. Panel B further shows that VC investment in manufacturing industries did not experience significant reductions, whereas non-manufacturing industries saw a notable decline in deals. The contraction in risk capital was uneven and more concentrated outside policy-prioritized sectors, indicating that China's VC market has become more policy-aligned in its investment allocation.

7 Real Impacts on Firm Innovation

Next, we examine the real effects of the NRAM on portfolio firms. Given VC's central role in promoting innovation, we focus on how the innovation output of portfolio firms changed following the implementation of the NRAM in 2018.

[14] See `https://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm`.

7.1 Post-VC-investment Innovation Changes

We begin by analyzing firm-level innovation outcomes after a firm receives its first round of VC investment. Our analysis focuses primarily on two measures: the total number of granted patent applications and the number of granted invention patents. The latter serves as a better quality indicator of innovation.

Table A4 presents the impact of VC investment on firm-level innovation and its attenuation following the 2018 regulatory shock. The positive and highly significant coefficient on $AfterInvest$ shows that VC funding robustly stimulates patenting activity among portfolio firms. However, the negative and significant coefficient on the interaction term $AfterInvest \times Post$ indicates that this positive effect was materially weakened after the NRAM. Quantitatively, the innovation premium associated with VC investment dropped substantially post-2018. For instance, the marginal effect on total granted patents fell by nearly half. This demonstrates that the regulation, by constricting the shadow banking channel that supplied long-term capital to VCs, impairs the core function of venture capital in fostering innovation.

7.2 Regulation Impacts on Firm Innovation

To more rigorously identify the NRAM's impact on innovation, we analyze portfolio firm-level panel data in the DID framework. We focus on the first round of investment. Since many first-round investments are syndicated, we use the maximum shadow banking exposure across all investing GPs for firms receiving joint investments. The regression results are presented in Table 8. As shown in Columns (1) and (3), portfolio firms with higher pre-policy

shadow banking exposure exhibit significantly fewer granted patent applications following the NRAM. A similar pattern is observed for granted invention patents in Columns (2) and (4). Specifically, a one-standard-deviation increase in VC firms' shadow banking exposure is associated with a 4.8% decrease in granted invention patents for their portfolio firms.

We provide two explanations for the decrease in innovation output. As shown in Section 6, on the one hand, fundraising difficulties and a rising share of individual investors reduce fund size and the availability of patient, professional capital. On the other hand, investment activity became constrained by maturity-mismatch restrictions and regulatory compliance, leading funds to shorten investment horizons. Together, these factors likely reduce the level of support for portfolio firms or prompted VCs to avoid riskier, more innovative investments.

7.3 Heterogeneous Effects Across Industries

We further examine whether the regulatory shock affects industries differently. We test whether the decline in innovation is more pronounced in sectors inherently more vulnerable to credit supply shocks, we examine the heterogeneous impact of the regulatory shock based on industry-level external finance dependence (EFD). Building on Hsu et al. (2014), we use data from A-share listed firms and calculate each firm's EFD as their capital expenditures plus R&D expenses minus cash flow from operations, all divided by the sum of capital expenditures and R&D expenses. We classify industries as having "High EFD" or "Low EFD" based on whether their median EFD in the pre-policy period (i.e., 2010-2017) is above or below the sample median.

Table 9 shows clear heterogeneity. The interaction term $ShadowBankExpo \times Post$ is

negative and statistically significant in high-EFD industries for both total patents and invention patents. A one-standard-deviation increase in a VC firm's shadow banking exposure is associated with a 7.2% decline in invention patents. By contrast, the corresponding estimates for low-EFD industries are close to zero and statistically insignificant.

This heterogeneity underscores the mechanism through which a financial shock transmits to the real economy. The 2018 NRAM did not merely reduce the aggregate pool of VC capital; it selectively incapacitated the funding for the most financially vulnerable sectors. The significant decline in high-quality invention patents in high-EFD industries is particularly concerning, as it implies the regulation stifled precisely the type of groundbreaking, long-horizon innovation that venture capital is meant to champion. These findings reinforce the conclusion that the regulatory tightening had acute unintended consequences for the allocation of risk capital and the composition of innovative activity.

8 Conclusion

We study how shadow banking regulation affects the supply of VC and its real consequences in a bank-dominated financial system. Focusing on China, the largest bank-centric economy, we document a previously unexplored channel through which banks indirectly fund VC through off-balance-sheet asset management products that engage in maturity transformation. Exploiting cross-sectional variation in pre-regulation reliance of VCs on shadow-banking funding, we construct city-level and GP-level exposure measures to identify the causal impact of the 2018 NRAM. We document a large and persistent contraction in VC supply following the regulatory tightening. VC firms with greater pre-policy exposure

experience significant declines in both deal counts and total investment amounts after 2018. These results are robust across alternative specifications and exposure measures.

Beyond aggregate effects, the shadow banking regulation induces systematic changes in VC fundraising and investment behavior. VC funds are smaller post-regulation, with institutional participation declining and individual investors accounting for a larger share of capital. Funds more exposed to shadow-bank funding shift away from early-stage, long-horizon investments toward later-stage and more mature firms, consistent with tighter liquidity constraints and reduced capacity for maturity transformation. In addition, VC investments become more concentrated in government-prioritized industries, indicating that private capital allocation has become increasingly sensitive to industrial policy.

These funding and behavioral changes have meaningful real effects on portfolio firms. While VC investment is generally associated with stronger innovation outcomes, this effect weakens after the NRAM. Portfolio firms backed by highly exposed VC funds experience significant declines in patenting activity, particularly in industries more dependent on external finance. These results indicate that shadow banking regulation curtails the supply of long-term, risk-bearing capital to VC, with downstream consequences for firm-level innovation.

Our findings highlight an important trade-off between financial stability and the provision of risk capital in bank-centric financial systems. In the absence of well-developed alternative financing channels, shadow banking serves as a *de facto* mechanism for supplying long-term capital to the VC sector. Regulatory efforts that restrict such channels without facilitating substitutes may inadvertently dampen innovative activity. Overall, our results underscore how financial regulation affects not only credit provision but also the allocation of risk capital and the dynamics of innovation.

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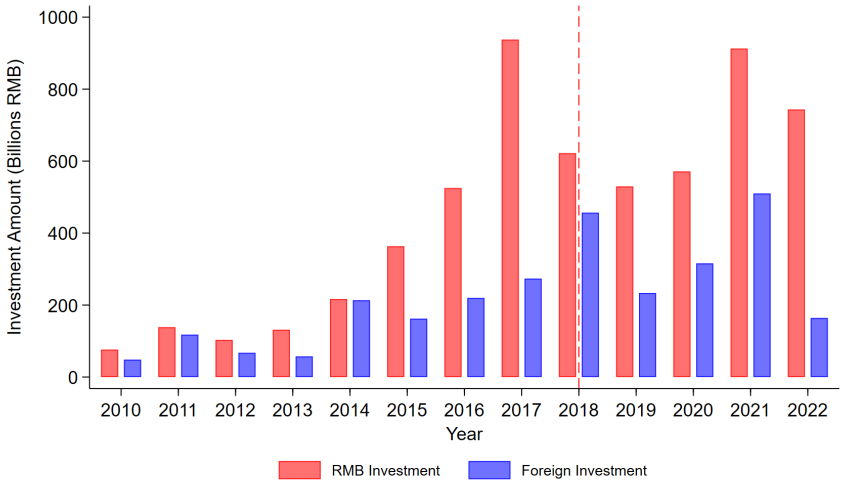
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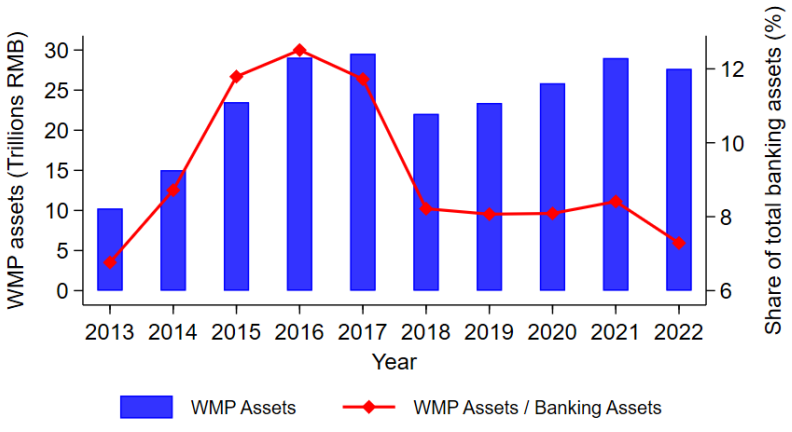
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Figure 1: VC/PE Investments in China

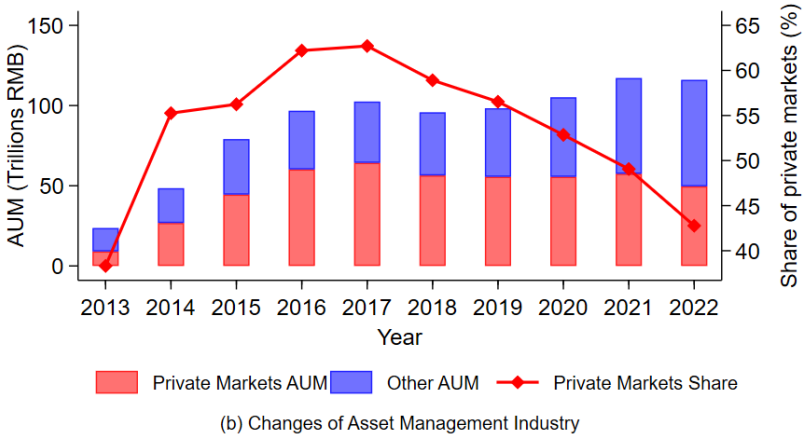


Notes: This figure illustrates the time trends of VC/PE investment amounts in China by currency. Data source: Zero2IPO.

Figure 2: Asset Management Industry in China



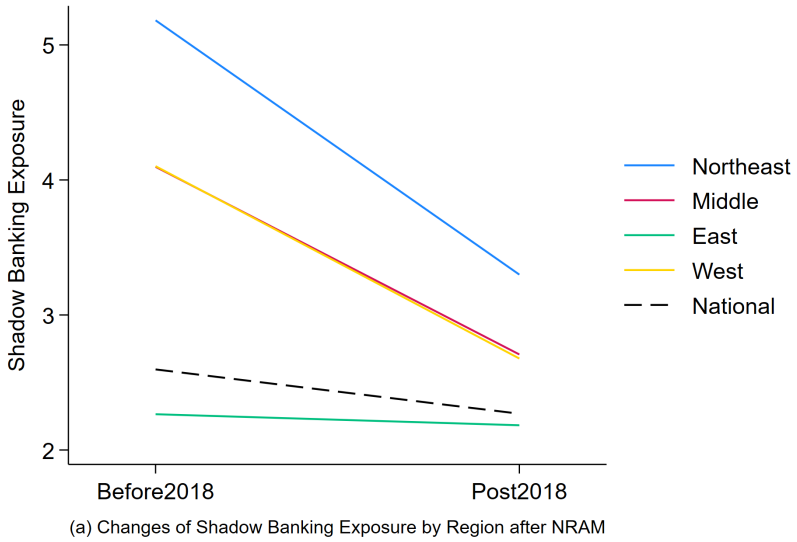
(a) Changes of Bank-issued Wealth Management Products



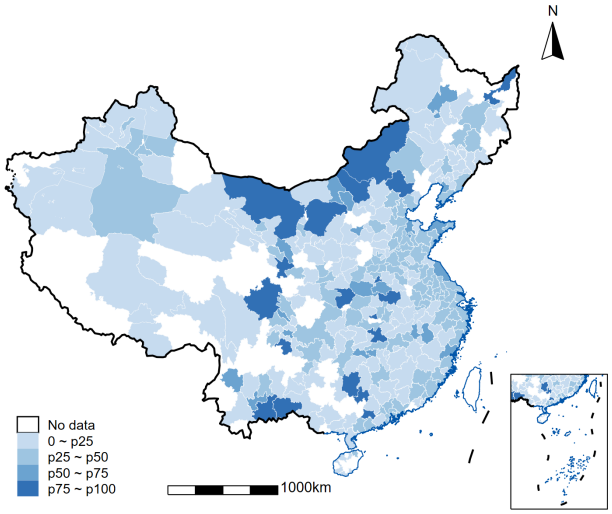
(b) Changes of Asset Management Industry

Notes: This figure illustrates the evolution of China's asset management industry from 2013 to 2022. Panel (a) shows changes in bank-issued wealth management products, including their total assets and their share of total banking assets. Panel (b) presents changes in total assets under management (AUM) in the asset management industry. Private-market AUM includes assets managed by securities firms, trust companies, mutual fund subsidiaries, and similar institutions. We exclude WMPs here because they primarily gain exposure to private markets by investing in products issued by other institutions. Data source: Banking Wealth Management Registration and Custody Center, Asset Management Association of China.

Figure 3: VCs' Exposure to Shadow Banking



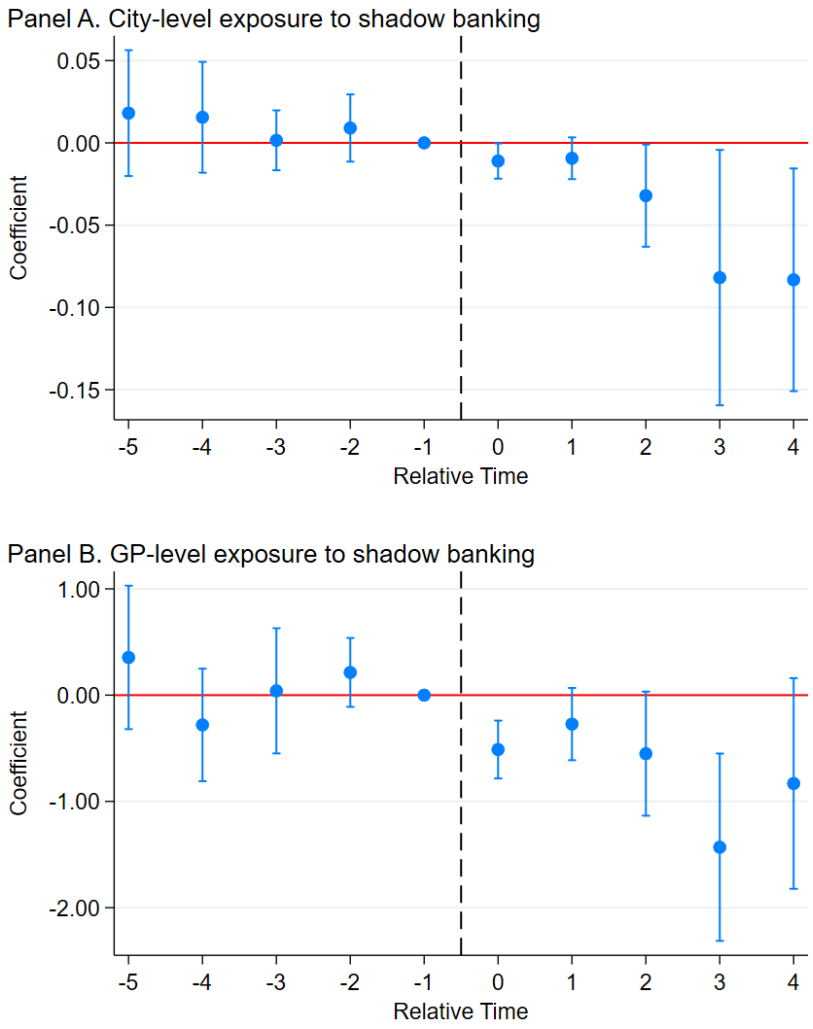
(a) Changes of Shadow Banking Exposure by Region after NRAM



(b) City-level VCs' Shadow Banking Exposure before NRAM

Notes: This figure illustrates VCs' exposure to shadow banking. Panel (a) shows changes in shadow-banking exposure across China's four major geographic regions following the implementation of the NRAM in 2018. The horizontal-axis variable, $Before2018$, is constructed using VC investment deals from 2010–2017 and equals the average shadow-banking funding share across all deals. Similarly, $Post2018$ is constructed using VC investment deals from 2018–2022. Panel (b) presents the geographic distribution of shadow-banking exposure prior to 2018.

Figure 4: Dynamic Effects of Impacts on VC Investment Deals



Notes: This figure presents the dynamic effects of shadow banking regulation on VC investment deals at the city- and GP-level respectively. The specification mirrors the baseline regression but is augmented with year dummies for 2010–2022 (2017 omitted) and interactions between those year dummies and $ShadowBankExpo$). Point estimates are plotted with 95% confidence intervals.

Table 1: Summary Statistics

Panel A: Deal-level Data						
VARIABLES	N	Mean	SD	Min	p50	Max
ShadowBankShare	79875	0.024	11.72	0	0	1
Early stage (angel, seed or A rounds)	78726	0.503	0.5	0	1	1
Firm capital (RMB, millions)	70493	344	2016	0.001	49.22	60193
Firm age (when invested)	70866	6.285	5.582	0	5	48
Fund size (RMB, millions)	79736	1156	3724	0.001	211.7	80001
Fund age (when investing)	79787	1.82	1.73	0	1	14
Panel B: City-level Data						
VARIABLES	N	Mean	SD	Min	p50	Max
CityInvest (per 10,000 people)	3679	0.026	0.119	0	0.003	2.556
CityInvest amount (per 10,000 people, millions)	3258	0.864	12.21	0	0.007	670.9
$ShadowBankExpo_c$	3679	0.052	0.122	0	0	0.849
Panel C: GP-level Data						
VARIABLES	N	Mean	SD	Min	p50	Max
GPinvest	53044	1.011	4.396	0	0	231
GPinvest amount (millions)	49273	0.021	0.112	0	0	5.034
$ShadowBankExpo_g$	52877	0.032	0.146	0	0	1
GP capital (RMB, millions)	52890	137.4	1327	0.001	10	67045
GP founding year	53044	2013	3.474	1984	2013	2022
Panel D: Portfolio-firm-level Data						
VARIABLES	N	Mean	SD	Min	p50	Max
Patent	309862	2.874	47.864	0	0	8647
InventPatent	309862	0.853	15.525	0	0	2637

Notes: This table reports summary statistics for variables at different levels used in the analysis. In Panel A, *ShadowBankShare* is the share of shadow-banking funding in a VC fund's total capital. *Early stage* is an indicator equal to one if the investment is at the seed, angel, pre-A, or Series A stage. In Panel B, *CityInvest* is the annual number of VC deals in a city scaled by city population, and *CityInvest amount* is the annual VC investment amount in a city scaled by city population. $ShadowBankExpo_c$ measures VCs' exposure to shadow banking at the city level. In Panel C, *GPinvest* is the annual number of investment deals undertaken by a VC firm (as a GP), and *GPinvest amount* is the annual total VC investment amount of the VC firm (as a GP). $ShadowBankExpo_g$ measures VC firms' exposure to shadow banking. In Panel D, *Patent* is the number of granted patents applied for by the portfolio firm in the reference year, and *InventPatent* is the number of granted invention patents applied for by the portfolio firm in the reference year.

Table 2: Impact on VC Investment across Cities

	(1) CityInvest	(2) CityInvest amount	(3) CityInvest	(4) CityInvest amount
ShadowBankExpo×Post	-0.067***	-1.241***	-0.056*	-1.073**
	(0.019)	(0.433)	(0.030)	(0.504)
lnGDPPC×Year	No	No	Yes	Yes
SecondIndust×Year	No	No	Yes	Yes
GDPgrowth×Year	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
N	3679	3258	3679	3258
R2	0.515	0.180	0.622	0.224
Mean of DV	0.026	0.864	0.026	0.864

Notes: This table examines the impact of regulation on VC investment. The sample consists of a city–year panel of cities with VC activity over the period 2010–2022. *CityInvest* is the number of VC investment deals in a city scaled by city population. *CityInvest amount* is the total value of VC investments in a city scaled by city population. City-level control variables include $lnGDPPC$, $SecondIndust$, and $GDPgrowth$, each interacted with year fixed effects. Specifically, $lnGDPPC$ is the log of GDP per capita in 2010, while $SecondIndust$ and $GDPgrowth$ denote the share of secondary industry and the GDP growth rate in 2010, respectively. Regressions are weighted by city population in 2010. Standard errors are clustered at the city level. *, **, and ***, denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Impact on VC Investment across GPs

	(1) GPinvest	(2) GPinvest amount	(3) GPinvest	(4) GPinvest amount
ShadowBankExpo×Post	-0.588**	-0.025*	-0.820***	-0.024*
	(0.270)	(0.013)	(0.308)	(0.013)
ShadowBankExpo	-0.119	0.035***		
	(0.129)	(0.010)		
lnGPcapital×Year	Yes	Yes	Yes	Yes
GPfoundedyear×Year	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	No	No	Yes	Yes
N	52801	49036	52797	49030
R2	0.046	0.035	0.480	0.435
Mean of DV	1.013	0.021	1.013	0.021

Notes: This table examines the impact of regulation on VC firms' investment activity. The sample consists of a GP–year panel covering GPs with VC investments over the period 2010–2022. *GPinvest* is the number of VC investment deals made by a GP. *GPinvest amount* is the total value of VC investments made by a GP. *lnGPcapital* is the log of a GP's registered capital, and $GPfoundedyear$ denotes the GP's founding year. Standard errors are clustered at the GP level in all regressions. *, **, and ***, denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Impact on Fund Size

	All Investments		Early-stage Investments (Series A and before)	Non-Early-Stage Investments
	(1) lnFund size	(2) lnFund size	(3) lnFund size	(4) lnFund size
ShadowBankExpo×Post	-0.540***	-0.533***	-0.878***	-0.315
	(0.208)	(0.207)	(0.273)	(0.226)
FirmControls	No	Yes	Yes	Yes
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	No	Yes
N	45483	45258	23097	20808
R2	0.688	0.688	0.714	0.663
Mean of DV	10.076	10.077	9.937	10.333

Notes: This table examines the impact of shadow banking regulation on the size of VC investment funds. *lnFundSize* is the log of a fund's registered capital. Columns (1)–(2) use all investment deals. Column (3) restricts the sample to early-stage investments (Series A and earlier), while Column (4) focuses on non–early-stage investments. $FirmControls$ include interactions between $lnRegistCapital$ and $FoundYear$ with year fixed effects, where $lnRegistCapital$ is the log of the VC-backed firm's registered capital and $FoundYear$ denotes the firm's founding year. GP-level controls include $lnGPcapital$ and $GPfoundedyear$. Standard errors are clustered at the GP level and reported in parentheses. *, **, and ***, denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Impact on the Composition of LP Types

	Panel A: Institutional LPs versus Individuals			
	(1) Institution LP	(2) Individual LP	(3) Institution LP	(4) Individual LP
ShadowBankExpo×Post	-0.205***	0.204***	-0.193***	0.191***
	(0.040)	(0.041)	(0.040)	(0.041)
FirmControls	No	No	Yes	Yes
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	45488	45488	45263	45263
R2	0.617	0.622	0.619	0.623
Mean of DV	0.657	0.325	0.657	0.326
	Panel B: Financial Institutional LPs versus nonfinancial corporate LPs			
	(1) Financial LP	(2) Corporate LP	(3) Financial LP	(4) Corporate LP
ShadowBankExpo×Post	-0.167***	-0.052	-0.161***	-0.055*
	(0.041)	(0.033)	(0.040)	(0.032)
FirmControls	Yes	Yes	Yes	Yes
GPControls	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	45488	45488	45263	45263
R2	0.611	0.633	0.612	0.635
Mean of DV	0.346	0.137	0.346	0.137

Notes: This table examines the impact of regulation on the composition of LP types in VC investments. Panel A presents the changes between institutional and individual LPs. *Institutional LP* is defined as the number of institutional investors divided by the total number of LPs in the investing fund, while *Individual LP* is defined as the number of individual investors divided by the total number of LPs. Panel B presents the changes between financial institutional LPs and nonfinancial corporate LPs. *Financial LP* is defined as the number of financial institutional investors (i.e., those classified as financial industries or with four-digit industry codes corresponding to asset management) divided by the total number of LPs, and *Corporate LP* is defined as the proportion of LPs that are non-financial corporations (i.e., those whose industry classification falls outside of finance, leasing, and commercial services). $FirmControls$ include $lnRegistCapital$ and $FoundYear$, each interacted with year fixed effects,, where $lnRegistCapital$ is the log of the VC-backed firm's registered capital and $FoundYear$ denotes the firm's founding year. *Industry FE* denotes fixed effects for the VC-backed firm's industry. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects. Standard errors are clustered at the GP level and reported in parentheses. *, **, and ***, denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Impact on Investment Horizons

	(1) Fund age	(2) Firm age	(3) Fund age	(4) Firm age
ShadowBankExpo×Post	0.802***	-0.065	0.812***	-0.024
	(0.250)	(0.658)	(0.242)	(0.029)
FirmControls	No	No	Yes	Yes
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	45503	45517	45278	45296
R2	0.421	0.389	0.423	0.997
Mean of DV	1.983	6.083	1.981	6.081

Notes: This table examines the impact of regulation on investment horizon of VC firms. *Fund Age* is calculated as the investment year minus the fund's founding year. *Firm Age* is calculated as the investment year minus the firm's founding year. $FirmControls$ include $lnRegistCapital$ and $FoundYear$, each interacted with year fixed effects, where $lnRegistCapital$ is the log of the VC-backed firm's registered capital and $FoundYear$ denotes the firm's founding year. $IndustryFE$ denotes fixed effects for the VC-backed firm's industry. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects. Standard errors clustered at the GP level are used in all the regressions. *, **, and ***, respectively, indicate significance at the 0.1, 0.05, and 0.01 levels.

Table 7: Impact on VC Investments of Different Industries

	Panel A: Government Prioritized Industries Based on "Made in China 2025"			
	Industries in "Made in China 2025"		Other Industries	
	(1) GPinvest	(2) GPinvest amount	(3) GPinvest	(4) GPinvest amount
ShadowBankExpo×Post	-0.184	0.002	-0.469***	-0.021**
	(0.122)	(0.006)	(0.136)	(0.008)
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
N	52187	49958	52187	49088
R2	0.453	0.361	0.480	0.335
Mean of DV	0.383	0.008	0.516	0.011
	Panel B: Divisions between Manufacturing Industries and Others			
	Manufacturing Industries		Non-Manufacturing Industries	
	(1) GPinvest	(2) GPinvest amount	(3) GPinvest	(4) GPinvest amount
ShadowBankExpo×Post	-0.060	-0.003	-0.593***	-0.016*
	(0.104)	(0.004)	(0.159)	(0.010)
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
N	52187	50415	52187	48927
R2	0.439	0.337	0.479	0.352
Mean of DV	0.293	0.008	0.607	0.011

Notes: This table examines the impact of regulation on VC investments across different industries. Panel A presents the differences between industries prioritized by "Made in China 2025" and other industries. Panel B presents the differences between manufacturing and non-manufacturing industries. $FirmControls$ include $lnRegistCapital$ and $FoundYear$, each interacted with year fixed effects, where $lnRegistCapital$ is the log of the VC-backed firm's registered capital and $FoundYear$ denotes the firm's founding year. $IndustryFE$ denotes fixed effects for the VC-backed firm's industry. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects. Standard errors are clustered at the GP level and reported in parentheses. *, **, and ***, denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8: Impact on Innovation of VC-backed Firms

	(1) Patent	(2) InventPatent	(3) Patent	(4) InventPatent
ShadowBankExpo×Post	-0.704*	-0.935**	-0.635*	-0.887**
	(0.399)	(0.427)	(0.344)	(0.414)
FirmControls	No	No	Yes	Yes
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	106134	90799	105597	90376
Pseudo R2	0.769	0.713	0.775	0.719
Mean of DV	6.862	2.442	6.876	2.444

Notes: This table examines the impact of regulation on the innovation outcomes of VC-backed firms. All regressions are estimated using Poisson pseudo–maximum likelihood (PPML). The dependent variable *Patent* is the number of granted patents applied in the reference year, while *InventPatent* is the number of granted invention patents applied in the reference year. *ShadowBankExpo* measures the investing VC firms' exposure to shadow banking at the time when the VC-backed firm receives its first VC investment. For syndicated investments, *ShadowBankExpo* is defined as the maximum exposure across all participating VC firms. $FirmControls$ include *lnRegistCapital* and $FoundYear$, each interacted with year fixed effects. GP-level controls include *lnGPcapital* and $GPfoundedyear$, each interacted with year fixed effects; for syndicated investments, GP-level controls correspond to those of the VC firm with the highest exposure. Standard errors are two-way clustered at both the GP and portfolio-firm levels. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

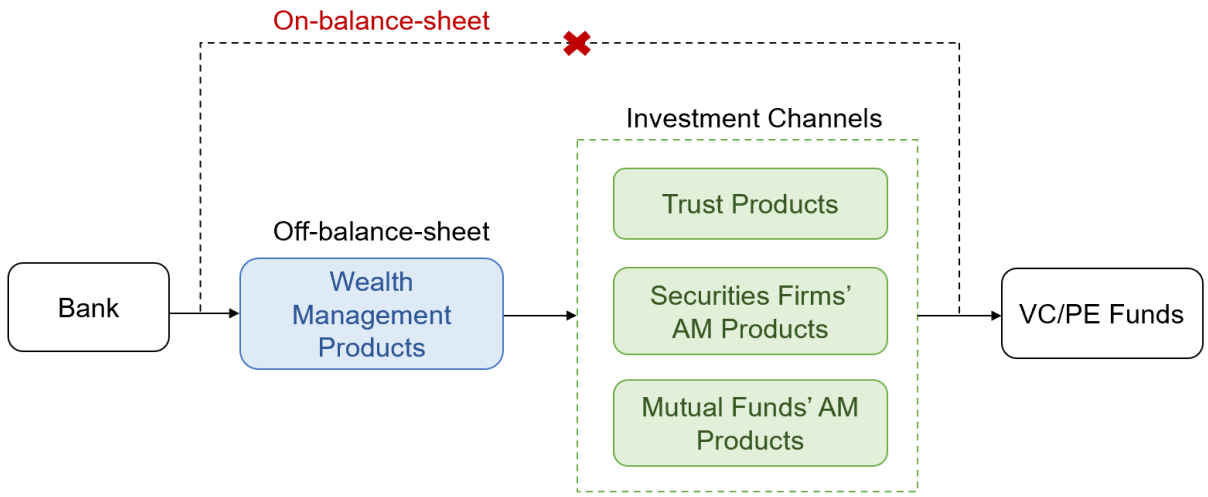
Table 9: Heterogeneous Effects on Innovation of VC-backed Firms

	High EFD industries		Low EFD industries	
	(1) Patent	(2) InventPatent	(3) Patent	(4) InventPatent
ShadowBankExpo×Post	-1.110**	-1.506***	0.082	0.237
	(0.448)	(0.496)	(0.266)	(0.424)
FirmControls	Yes	Yes	Yes	Yes
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
N	52188	46251	52836	43637
Pseudo R2	0.809	0.760	0.699	0.665
Mean of DV	9.076	2.765	4.729	2.113

Notes: This table examines the heterogeneous impact of regulation on the innovation outcomes of VC-backed firms by external finance dependence. Columns (1)–(2) restrict the sample to industries with above-median external finance dependence, while columns (3)–(4) restrict the sample to industries with below-median external finance dependence. All regressions are estimated using Poisson pseudo–maximum likelihood (PPML). The dependent variable *Patent* is the number of granted patents applied for in the reference year, while *InventPatent* is the number of granted invention patents applied for in the reference year. $ShadowBankExpo$ measures the investing VC firms' exposure to shadow banking at the time when the VC-backed firm receives its first VC investment. For syndicated investments, $ShadowBankExpo$ is defined as the maximum exposure across all participating VC firms. $FirmControls$ include $lnRegistCapital$ and $FoundYear$, each interacted with year fixed effects. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects; for syndicated investments, GP-level controls correspond to those of the VC firm with the highest exposure. Standard errors are two-way clustered at both the GP and portfolio-firm levels. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

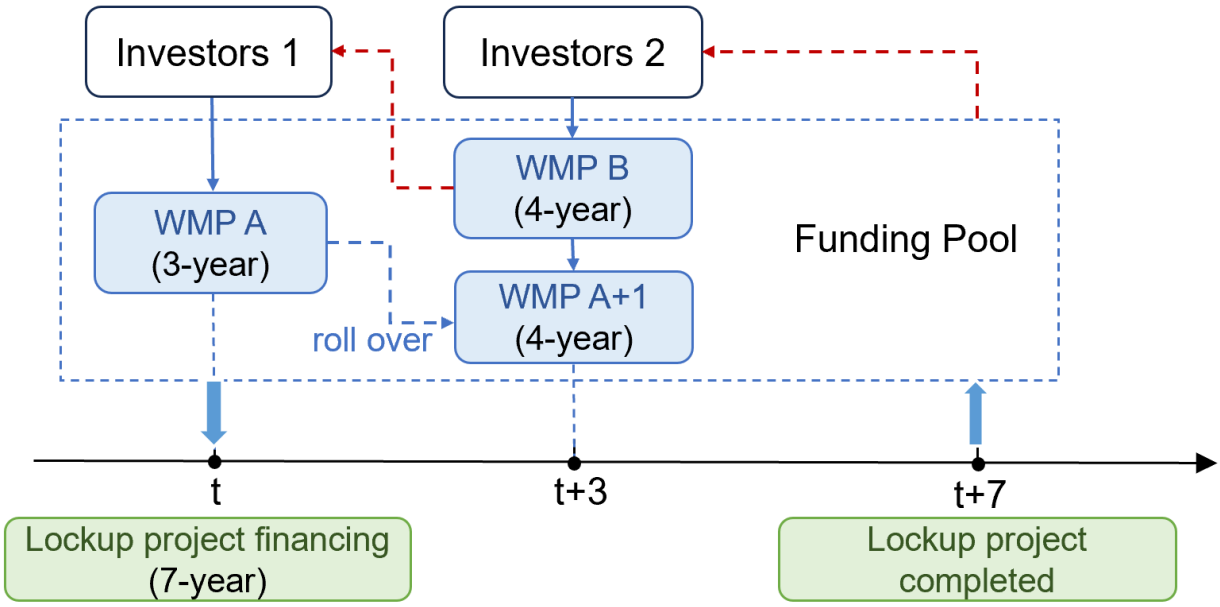
Appendix A

Figure A1: Banks' VC Investment Channels



Notes: This figure illustrates the VC investment channels of banks in China. Legally, banks are not permitted to directly engage in private equity investments. Instead, they typically issue wealth management products, which subscribe to asset management products offered by non-bank financial institutions, thereby channeling funds into VC/PE funds.

Figure A2: Banks' WMPs and Funding Pool



Notes: This figure illustrates how banks' WMP funding pools created maturity transformation before the 2018 New Regulations on Asset Management. Short-term WMPs were pooled and rolled over to finance long-term lock-up projects, allowing bank-related asset-management capital to support investments with much longer horizons.

Table A1: Placebo Test Using Foreign Capital Exposure

	(1) GPinvest	(2) GPinvest amount	(3) GPinvest	(4) GPinvest amount
ForeignExpo×Post	2.057	0.015	2.642	0.011
	(1.370)	(0.036)	(1.687)	(0.046)
ForeignExpo	-0.175	0.017		
	(0.275)	(0.021)		
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	No	No	Yes	Yes
N	52801	49036	52797	49030
R2	0.046	0.034	0.480	0.435
Mean of DV	1.013	0.021	1.013	0.021

Notes: This table reports a placebo test examining the effect of foreign capital exposure on VC firms' investment activities. The sample comprises GP-year panel data covering GPs that had VC investment between 2010 and 2022. $ForeignExpo$ is defined as the pre-2018 share of total capital commitments from non-RMB funds managed by each GP. *GPinvest* is the number of VC investment deals of the GP. *GPinvest amount* is the total VC investment amount of the GP. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects. Standard errors clustered at the GP level are used in all the regressions. *, **, and ***, respectively, indicate significance at the 0.1, 0.05, and 0.01 levels.

Table A2: Other Robustness Checks

	Alternative Treatment Definition		Sample Period: 2010–2019		Excluding GPs Based in First-Tier Cities	
	(1) GPinvest	(2) GPinvest amount	(3) GPinvest	(4) GPinvest amount	(5) GPinvest	(6) GPinvest amount
ShadowBankExpo×Post			-0.402***	-0.015	-0.584*	-0.024*
			(0.148)	(0.014)	(0.316)	(0.013)
Treat×Post	-0.595***	-0.016*				
	(0.231)	(0.009)				
GPControls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes	Yes	Yes
N	52886	49118	35861	33098	24632	22871
R2	0.480	0.435	0.533	0.423	0.484	0.355
Mean of DV	1.013	0.021	0.830	0.021	0.851	0.016

Notes: This table reports robustness checks for the impact of regulation on VC investment activity. The dependent variables are *GPinvest* and *GPinvest amount*, respectively. In Columns (1)–(2), the treatment variable is redefined as a dummy, *Treat*, equal to one if a GP's pre-policy exposure to shadow banking exceeds 20%, and zero otherwise. Columns (3)–(4) restrict the sample to the pre-pandemic period, 2010–2019. Columns (5)–(6) exclude GP firms based in first-tier cities. Standard errors are clustered at the GP level and reported in parentheses. *, **, and ***, respectively, indicate significance at the 0.1, 0.05, and 0.01 levels.

Table A3: Impact on Shadow-bank-backed Funds' Investment

	(1) Fund age	(2) Firm age	(3) Fund age	(4) Firm age
ShadowBankShare×Post	1.113***	1.443**	1.135***	1.480**
	(0.211)	(0.666)	(0.212)	(0.657)
ShadowBankShare	-0.412**	-0.312	-0.416**	-0.616
	(0.180)	(0.545)	(0.178)	(0.543)
GPControls	Yes	Yes	Yes	Yes
FirmControls	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	63315	63367	62972	63027
R2	0.464	0.402	0.465	0.436
Mean of DV	1.886	6.157	1.884	6.157

Notes: This table examines the impact of regulation on investment horizon of VC funds with shadow banking as their LPs. *Fund age* is calculated as the investment year minus the fund's founding year. *Firm age* is calculated as the investment year minus the firm's founding year. $FirmControls$ include $lnRegistCapital$ and $FoundYear$, each interacted with year fixed effects, where $lnRegistCapital$ is the log of the VC-backed firm's registered capital and $FoundYear$ denotes the firm's founding year. *Industry FE* denotes fixed effects for the VC-backed firm's industry. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects. Standard errors clustered at the GP level are used in all the regressions. *, **, and ***, respectively, indicate significance at the 0.1, 0.05, and 0.01 levels.

Table A4: Impact of VC Investment on Firm-Level Innovation

	(1) Patent	(2) InventPatent	(3) Patent	(4) InventPatent
AfterInvest×Post	-0.382***	-0.289***	-0.409***	-0.335***
	(0.059)	(0.077)	(0.064)	(0.081)
AfterInvest	0.827***	0.755***	0.836***	0.772***
	(0.096)	(0.093)	(0.068)	(0.080)
FirmControls	No	No	Yes	Yes
GPControls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
GP FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	122216	103630	121621	103181
Pseudo R2	0.766	0.709	0.770	0.715
Mean of DV	6.748	2.402	6.763	2.403

Notes: This table examines the impact of VC investment on the innovation outcomes of portfolio firms and the changes following the 2018 regulation. All regressions are estimated using Poisson pseudo–maximum likelihood (PPML). The dependent variable *Patent* is the number of granted patents applied in the reference year, while *InventPatent* is the number of granted invention patents applied in the reference year. $AfterInvest$ is a dummy equal to 1 if the firm receives its first VC investment. *Post* is a dummy equal to 1 for the year 2018 and afterwards. $FirmControls$ include $lnRegistCapital$ and $FoundYear$, each interacted with year fixed effects. GP-level controls include $lnGPcapital$ and $GPfoundedyear$, each interacted with year fixed effects. Standard errors are two-way clustered at both the GP and portfolio-firm levels. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Appendix B: Data Appendix

B1 Detailed Sample Construction Procedure

Our VC investment data are obtained from Zero2IPO, which records detailed information for each transaction, including the investing VC fund, investing VC firm, portfolio firm, the investee firm's location, investment date, and investment stage. However, Zero2IPO does not provide information on the LPs of VC funds. To recover LP information, we merge the investment data with business registration records.

In China, a limited-partnership fund is required to register with the State Administration for Market Regulation (SAMR) upon establishment. Similar to other registered entities, VC funds must disclose basic information such as their founding year, registered location, industry classification, investors (i.e., LPs), and legal representatives (typically GPs). These records are publicly available and can be accessed through several commercial business information databases. Accordingly, we first collect business registration data from Tianyancha.com to obtain fundamental information on VC funds, VC firms, and VC-backed firms.

The most challenging part of the data construction process is identifying capital commitment originating from shadow bank conduits. To address this issue, we first collect the equity ownership information and historical ownership change records for all VC funds involved in our sample. Using the investment date of each transaction, we determine the relevant ownership structure of the VC fund at the time of investment. We then identify shadow banking participants through equity tracing. Given the often multi-layered and complex ownership structures of firms, we conduct ownership penetration to trace upstream shareholders as thoroughly as possible, thereby identifying VC funds with shadow banking participation.

B2 Identification of Shadow Banking

We classify shadow banking conduits in China into four categories: trust firms, banks and their affiliated entities, securities firms, and the asset management subsidiaries of mutual funds.

(1) Trust firms

Trust firms are the most straightforward category to identify. As of 2025, there are 66 trust firms in China, as officially listed by the National Association of Financial Market Institutional Investors (NAFMII).[15] We identify all trust firms as shadow banking conduits.

(2) Banks and bank-affiliated firms

[15]See `https://www.nafmii.org.cn/hyfw/hyflmd/hyflmd_701/fyxljrjg/xtgs/`

Commercial banks in China are legally restricted from direct VC/PE investments, resulting in minimal direct deal participation. Their primary engagement in such activities occurs through affiliated or special purpose vehicles, which are frequently established in jurisdictions like Hong Kong. Post-2018, domestic commercial banks were permitted to establish wealth management subsidiaries authorized for asset management and equity investments. We classify these bank-affiliated subsidiaries as part of the shadow banking system.

(3) Securities firms

Securities firms constitute the third category of conduits. As of 2025, there are 151 securities firms regulated by the China Securities Regulatory Commission (CSRC). Following regulatory liberalization post-2010, many of these firms conduct asset management activities either through in-house departments or by establishing dedicated asset management subsidiaries. A crucial distinction for our classification lies in separating two functionally different entities within securities firms: asset management subsidiaries/divisions, which pool and manage external client funds through investment products and serve as classic conduits, and proprietary investment subsidiaries, which engage in direct investments using the parent firm's own capital and do not perform a channel function for external funds. A representative example is Huatai Securities, which operates both Huatai Asset Management Co., Ltd. (engaged in asset management business) and Huatai Zijin Investment Co., Ltd. (focused on equity investments using proprietary capital). In this study, we classify only the activities of the former—investments made by securities firms through asset management plans or products on behalf of external clients—as shadow banking conduits. Direct investments made by the firms or their subsidiaries using proprietary capital are excluded from this scope.

(4) Mutual fund subsidiaries

We classify the private-market asset management subsidiaries established by mutual fund companies as shadow banking conduits. This designation is based on their regulatory foundation and business scope. Their establishment was authorized by the CSRC's 2012 Interim Provisions on the Administration of Subsidiaries of Securities Investment Fund Management Companies, which allowed fund companies to set up subsidiaries specifically for asset management businesses focused on private market transactions. As of 2025, there are 62 such subsidiaries operating in China,[16] and we incorporate them into our shadow banking framework.

[16]See `https://www.csrc.gov.cn/csrc/c101900/c1029658/content.shtml`.