Coming to the Rescue: the Role of Government Venture Capital in the U.S.-China Trade War *

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Abstract

Based on a novel dataset of venture capital (VC) funds and startups in China, we study the impact of the U.S.-China trade war on China's VC market and the role of government-funded VCs (GVCs). Employing a difference-in-differences strategy, we document that independent venture capital funds (IVCs) invested less in industries with higher exposure to the trade war, partially due to reduced likelihood of successful exits. GVCs, in contrast, do not respond to the trade war shocks in terms of investment rates. Further analysis shows that GVCs' investment behaviors are likely to be policy-driven: GVCs supplied more follow-on financing for technology-intensive startups exposed to the trade war shocks. We demonstrate that the presence of government capital in the VC market promotes startup innovation, as startups located in prefectures with a stronger presence of GVCs produced more patents in response to the trade war shocks. We thus argue that GVC investments create a "compete-for-financing" effect, which helps mitigate the problem of underinvestment of innovation under adverse economic shocks.

Keywords: Trade War, Venture Capital, Innovation, Industrial Policy, China

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1 Introduction

Long recognized as a primary source of financing for entrepreneurship and innovation, venture capital (VC) has attracted substantial governmental involvement around the world (Bai et al. 2021). The effects of those endeavors, however, are subject to extensive debate. While some argue that government financing is plagued by bureaucratic inefficiency and flaws in program design and implementation (Lerner 2009), others find that government VCs can augment private financing and that syndicates between government and independent VCs have higher success rates (Brander, Du and Hellmann 2015; Cumming, Grilli and Murtinu 2017).

An important function of government VCs is missing from the discussion: the provision of stable external financing to startups in order to counter negative economic shocks. For example, the European Investment Fund (EIF), one of the largest government VCs in the European Union, claimed that its major objective throughout the COVID-19 crisis was "to ensure that Europe's small businesses survive and can grow further after the pandemic."[1] To what extent government VCs could fulfill the responsibility as stated is still ambiguous due to lack of empirical evidence.

In this paper, we examine the role of government VC financing in the context of the U.S.-China trade war, which imposed high tariffs on a wide range of Chinese exports and inflicted a heavy blow on China's high-tech manufacturing industries such as automobiles, electronics, and mechanical appliances. The trade war is a meaningful setting for two reasons. First, many of the targeted high-tech industries are VC-intensive, and the response of the Chinese VC market to U.S. trade policies can produce important repercussions for entrepreneurship and innovation. Second, government-funded VCs (GVCs) play an integral role in financing the technology-intensive sectors targeted by the U.S. tariffs. Under the "Made-in-China 2025" initiative designed to strengthen China's industrial competitiveness, GVCs function as policy instruments for directing investments into those chosen industries. Therefore, the trade war provides an ideal setting to examine the role of GVCs in supporting high-tech startups to counter negative economic shocks.

[Figure 1]

To empirically assess the above question, we compile a unique and comprehensive dataset

[1]See Coronavirus: The EIB Group's initiatives to address its economic consequences.

of independent and government VCs in China using both administrative and commercial data sources. The combined dataset contains the majority of Chinese VC funds and their general partners (VC firms), limited partners, and portfolio companies. We link this data with U.S. tariff revisions and construct a measure of trade war exposure for each 2-digit Chinese industry. Variations in trade war exposure at the industry level enable us to identify the effects of the trade war shocks on the outcomes of VC funds and their portfolio companies, and to examine heterogeneity across IVCs and GVCs using difference-in-differences (DID) and triple-differences (DDD) strategies.

We begin our analysis by documenting substantial heterogeneity across the investment activities of IVCs and GVCs in response to the trade war. We show that IVC funds reduce their investments in industries more exposed to the trade war shocks: the probability of investment decreases by 2.3 to 2.4 percentage points, compared with an average rate of 2.6%. In contrast, GVC investments in the high-exposure industries are much less affected as their investment rate only reduces by 0.7 percentage points, compared with an average rate of 3.7%. A triple-differences analysis further reveals that the investment rates of GVCs are significantly higher than IVCs in the high-exposure industries during the trade war. We show that the heterogeneous responses of GVC and IVC investments cannot be explained by differences in their exit opportunities, as the trade war reduces the likelihood of a successful exit (via IPO) by equal magnitudes for IVCs and GVCs. These findings suggest that, when facing similar negative shocks in exit opportunities, IVCs respond by cutting back their investments while GVCs maintain stable investment activities.

We next investigate why GVC investments are less responsive to the trade war shocks compared to IVCs. We hypothesize that GVCs' investment strategies become more policy-driven than profit-driven during the trade war. Our hypothesis finds empirical support in our analysis of GVCs' investment patterns. First, GVCs participate less in the initial round of startup financing when exposed to the trade war, but consistently invest in follow-on rounds. Second, GVCs increases their involvement in the follow-on rounds of the more innovative startups: for a high-exposure startup, a 100% increase in innovation (measured by patent applications) in the previous period raises its probability of receiving GVC financing during the trade war by around 3.6 percentage points. Echoing the conventional wisdom that GVC financing should target projects that generate positive technological externalities (Lerner 2002), our findings suggest that GVCs function as crucial policy instruments and substitutes for IVCs in financing innovative startups during the trade war, or more generally, any similar

macroeconomic downturns.

The last part of our study concerns the broader economic consequences of GVC financing during the trade war. We find that the impact of GVC presence extends beyond the scope of their own portfolio companies: VC-backed companies located in prefectures with higher levels of *ex-ante* GVC activities also undertake more innovation when exposed to the trade war shocks. A one standard deviation increase in local GVC intensity improves the high-exposure startups' patent applications by about 3.6 percentage points, and the effect is mostly concentrated on IVC-backed startups. This suggests that GVCs' investment strategy generates a "compete-for-financing" effect among startups: faced with a significant decline in IVC activity during the trade war, there emerges greater competition for GVC financing among startups. GVCs' growing focus on the technological competence of their portfolio companies would incentivize startups to conduct more innovation as a signal of quality to GVC investors. Consequently, the presence of GVCs during economic downturns is socially beneficial as it narrows the gap between private and socially optimal levels of innovation.

Our paper primarily contributes to a growing literature that studies public efforts in the venture capital markets. Lerner (2002) outlines two main rationales for the existence of GVCs: first, the award of GVC funding may serve as a signal that conveys information about startup quality, hence leading to a certification effect (Lerner 1999); second, similar to other innovation-promoting programs, GVC investments may encourage innovation activities that generate positive technological externalities (Bloom, Schankerman and Reenen 2013). However, ample evidence suggests that GVCs as stand-alone investors are often ineffective at promoting innovation and supporting startup growth, potentially due to a lack of expertise and political distortions (Cumming and MacIntosh 2006; Lerner 2009; Brander, Egan and Hellmann 2010; Grilli and Murtinu 2014; Bertoni and Tykvová 2015). Consequently, it is more likely that GVCs would complement rather than substitute private entrepreneurial finance (Grilli and Murtinu 2014; Bertoni and Tykvová 2015; Cumming, Grilli and Murtinu 2017; Bai et al. 2021).

Existing scholarship has paid little attention to how GVCs may mitigate one prominent drawback of IVCs: the pro-cyclicality of their investment activities. The VC industry is known for being highly volatile and sensitive to public market signals (Gompers et al. 2008), and private investors are only willing to invest in riskier and more innovative startups in hot markets (Nanda and Rhodes-Kropf 2013). IVCs' pro-cyclical behavior may result in a shortage of financing during economic downturns, and undermine both the quantity and

quality of innovative output (Huang et al. 2020). Findings in our paper point to a new rationale for the provision of government capital: GVCs, as vehicles of government policies, provide stable financing for innovative startups during economic downturns and alleviate the problem of underinvestment in innovation. In other words, GVCs serve as crucial substitutes instead of complements to IVCs in cold markets. More importantly, the availability of GVC financing under negative economic shocks may stimulate innovation among startups through a "compete-for-financing" effect, thus generating greater positive externalities.

Our study sheds new light on understanding how the ongoing trade war, or more broadly, the global rise of protectionism, affect entrepreneurial and innovation activities. Recent work in the trade literature mainly focuses on how trade war tariffs affect trade flows and price levels in the United States (Fajgelbaum et al. 2020; Amiti, Redding and Weinstein 2020; Cavallo et al. 2021).[2] A few other studies also examine how stock returns (Huang et al. 2020; Egger and Zhu 2020; Wang et al. 2020) or corporate investments (Amiti, Kong and Weinstein 2020; Benguria et al. 2020) respond to the trade war. However, little is known about the broader implications of the trade war. Notably, the current trade war, which differ from the conventional tariff-based policies as they specifically target technology-intensive sectors and impose barriers on high-tech products, is likely to create substantial and long-lasting consequences on the entrepreneurial and innovative landscapes in both China and the U.S. By focusing on high-tech startups and their investors in China, our study is one of the first to investigate such consequences.

Lastly, our study also contributes to the long-standing discussion of innovation policies. Among various forms of policies to promote innovation (Bloom, Van Reenen and Williams 2019), our study focuses on a particular trending type of public effort—government participation in the venture capital market. Our study echoes the discourse on public policies that foster startup growth (Lerner 1999; Wallsten 2000; Da Rin, Nicodano and Sembenelli 2006; Howell 2017), and complements the vast literature on R&D policies or public R&D programs (David, Hall and Toole 2000; Bloom, Griffith and Van Reenen 2002).

This paper is organized as follows. Section 2 introduces the institutional background, data and empirical strategies. Section 3 presents findings on the impact of the trade war on Chinese VCs. Section 4 outlines heterogeneities in the investment behavior of IVCs and GVCs. Section 5 discusses the economic implications of GVC financing in the trade war. Section 6 concludes.

[2]See Fajgelbaum and Khandelwal (2020) for a review of recent literature.

2 Data and Empirical Strategy

2.1 Government as Venture Capitalist

The Chinese government had consistently played an active role in the domestic VC market since its conception. From 2006 onwards, the national government introduced a series of policies to encourage the establishment of government-guided funds, which are mostly financed by central and local governments and state-owned enterprises. By the end of 2018, over 1,600 government-guided funds had been created, with more than 4.05 trillion RMB in total capital.[3] The main objective of these funds is to attract investments from private capital and financial institutions and to "guide" them to specific sectors (Huang and Tian 2020). To achieve this aim, they collaborate with existing VC firms to set up VC funds, contribute capital to the VC funds as a limited partner, and meanwhile encourage private investors to also participate as limited partners. In other words, these VC funds are managed by existing VC firms, and contain a mixture of government and private capital.

A crucial distinction between GVCs and their independent counterparts is that GVCs must fulfill investment requirements stated by the supporting government-guided fund. While the actual terms vary across cases, they generally stipulate that GVCs must invest no less than a specified fraction of their capital into startups, and those established by the local governments might also limit targets to startups operating in specific locations, industries and development stages. Table 1 provides examples of investment requirements that are typical of funds established by the central and local (in this case prefecture-level) governments.[4] Among the three, the China SME Development Fund is a central government VC fund (CGVC) and both the Shenzhen Government Guidance Fund and the Chongqing Industry Guidance Fund are local government VC funds (LGVCs). It is noteworthy that LGVC funds demand greater control over the investment activities of its affiliated GVCs, and display a strong preference for GVCs to comply with local policy goals. In contrast, CGVC funds usually place fewer restrictions on GVCs' investments.

[Table 1]

GVCs serve as financing vehicles of the state's industrial policies under the schemes outlined above. A typical example in the recent years is the *Advanced Manufacturing Industry*

[3]See PIIE Report.
[4]Information is directly extracted from the funds' official websites.

Investment Fund (AMIIF), a GVC established in 2016 under the management of the State Development Investment Corporation (SDIC). Its primary objective is to facilitate "the implementation of national strategic goals" under the Made-in-China 2025 Initiative.[5] Interestingly, AMIIF has dramatically changed its investment portfolio after the onset of the trade war. In 2017 and the first half of 2018, 80% of AMIIF's manufacturing investments were in chemical and bio-pharmaceutical industries. Starting from 2018Q3, its investment focus shifted to electric motor and industrial machinery industries, which are all subject to the trade war tariffs. The case of AMIIF illustrates that GVC investments during the trade war may be predominantly driven by policy objectives to direct much-needed capital to industries harmed by the rising tariffs. We systematically investigate this hypothesis in our empirical analysis.

2.2 The Chinese VC Database (2010-2019)

We construct a unique and comprehensive database that covers the majority of venture capital funds in China. Using both administrative and commercial sources, we identify VC funds and their investors, including the general partners (GPs, commonly referred to as VC firms) and the limited partners (LPs); and VC-backed companies, or the portfolio companies of VC funds.

2.2.1 VC Funds and Investors

VC Firms. We begin our data construction process by compiling a list of VC firms based on three data sources. We extract records of VC firms that are registered at the Asset Management Association of China (AMAC).[6] We complement those records with a commercial database provided by the Zero2IPO Group, which is the most comprehensive professional VC/PE database in China, as well as information from the official VC industry reports and yearbooks.[7]

VC Funds. We then use the list of VC firms to identify the VC funds that they manage.

[5]See article from the official website of the Chinese government: China Founds AMIIF.

[6]The AMAC is a semi-official securities investment industry association supervised by the Ministry of Civil Affairs and the China Securities Regulatory Commission (CSRC). In China, private equity firms are required by law to register with the AMAC and put their funds on record.

[7]These reports and yearbooks are compiled annually by the Chinese Academy of Science and Technology Development Strategy, an institute under the Ministry of Science and Technology, and the China Venture Capital Research Institute.

Publicly registered funds can be directly identified using the three data sources mentioned above. To identify the funds that remain private, we match VC firms with companies in the Chinese Business Registration Database (CBRD),[8] and extract all investment companies with which the firms have equity relationships or executive partnerships. For the purpose of this study, We focus exclusively on Renminbi (RMB) funds, which account for a great majority of total capital raised in the Chinese VC market (Huang and Tian 2020). We also exclude corporate VC funds, which are owned by non-financial firms and behave differently from traditional VCs as they usually serve the strategic goals of their owners (Ma 2020).

Limited Partners. Last, we use shareholder information from the CBRD to obtain a list of the LPs, or the underlying external investors, of each VC fund.

Our analysis utilizes the subset of 5,518 VC funds that have made investments in manufacturing industries. For each of the VC fund and its general and limited partners, we observe the registration information (e.g. legal name, date of establishment/liquidation, location and registered capital).[9] We define a VC fund to be a *government-funded* VC (GVC) if 20% or more of its shares are held by the government, and *independent* otherwise.[10] In the robustness checks, we also use 10% as an alternative threshold.

2.2.2 VC-Backed Companies

We use investment and equity records in CBRD and the Zero2IPO Database to identify companies backed by VC funds. The resulting sample contains 5,202 unique portfolio companies in the manufacturing industries. For each company, we observe its registration information (date of establishment, location and registered capital), and the industry it operates in. By construction, we are able to link the company to its VC investors and acquire information on the investment dates and whether and when the VC funds made successful exits through

[8] This administrative database is maintained by the State Administration of Industry and Commerce of China and covers every business entity registered in mainland China from 1949 to 2019.

[9] We determine each fund's shareholder structure using the shareholder information contained in CBRD. Specifically, we identify the ultimate shareholders of each VC firm and VC fund, and the percentage of shares owned by each of the ultimate shareholders.

[10] We select 20% as the threshold based on our collection of 187 policy documents issued by provincial, prefecture and county or district-level governments since 2006. These documents generally require that capital contribution from government-guided funds in the newly established VC funds cannot exceed a certain percentage of total contributions, with 79% of the percentage choices falling in the range of 20% to 30%. Our private interviews with a number of industry practitioners confirm that contributions made by government-guided funds to VC funds are usually very close to the percentages specified by the affiliated governments.

IPO or M&A events. We further extract patent grant records from the China National Intellectual Property Administration (CNIPA) and match them to VC-backed companies based on the applicant or owner's name to construct measures of the companies' innovation output.[11]

[Figure 2]

Figure 2 displays the quarterly trends of new venture investment deals in manufacturing companies between 2010 and 2019. The number of VC deals in manufacturing reaches its peaks in 2015 and 2017. Starting from 2018, we observe a rapid decline of venture investment activities in the manufacturing sector, potentially due to the onset of the U.S.-China trade war. We also document that, the percentage of investments initiated by GVCs grow rapidly since 2018, from below 20% to above 30%. This trend indicates that GVCs perform an increasingly important role in the venture capital market during the trade war.

[Table 2]

Table 2 displays the summary statistics of main characteristics of VC funds and their portfolio companies in our sample. GVC funds are typically smaller in size and more recent in the order of establishment under GP, but similar to IVCs in terms of age and number of portfolio companies. While the average portfolio company is large (average registration capital of 25.9 million dollars) and mature (average age of 13.5 years), the majority do not appear to be innovative: more than half do not have any patents filed before the sample period (2015Q3 to 2016Q4).

2.3 Exposure to Trade War

We collect tariff data for the 2018-2019 U.S.-China trade war from the United States International Trade Commission (USITC). There are four major revisions of American tariffs on Chinese imports between 2018 and 2019: (1) a 25% tariff on $34 billion Chinese products since July 6, 2018; (2) a 25% tariff on $16 billion Chinese products since August 23, 2018;

[11] For each patent in the database, we observe its applicant, application date, grant date, classification code and so on. For the purpose of this study, We focus on invention patents rather than utility model or design patents. We use the log number of patent applications in a given year to measure each company's innovation capacity.

(3) a 10% tariff on $200 billion Chinese products since September 24, 2018;[12] and (4) a 7.5% tariff on $112 billion Chinese products since September 1, 2019.

We use the tariff data to construct a measure of each 2-digit Chinese industry's exposure to the trade war. We first compute tariff burden at the HS 8-digit level by multiplying the tariff rate with Chinese firms' initial level of total exports to the U.S. We then aggregate tariff burden to the 2-digit industry level, and define each industry's exposure to the trade war as the ratio between the tariff burden and Chinese firms' initial level of total exports to the world. Export values used in the computation come from the 2017 Chinese Customs Trade Statistics (CCTS), which covers the universe of export transactions in China. More specifically, the formula for trade war exposure (TWE) is written as:

$$\text{Exposure}_{st}^{\text{trade}} = \frac{\sum_{j \in \Omega(s)} \tau_{jt} \times X_j^{U.S.}}{\sum_{j \in \Omega(s)} X_j^{World}}, \tag{1}$$

where s denotes each Chinese 2-digit industry, j denotes each HS 8-digit product, and t denotes each quarter. $\Omega(s)$ is the set of all HS 8-digit products matched to industry s, τ_{jt} is the tariff rate on product j in quarter t, $X_j^{U.S.}$ is the total export value of product j from China to the U.S. in 2017, and X_j^{World} is the total export value of product j from China to the world in 2017.[13] Conceptually, the TWE measure reflects the approximate share of U.S. tariff burden in the export value of each Chinese industry.

We use this measure to compute the average level of TWE for each industry between 2018Q3 and 2019Q4. We then divide all Chinese 2-digit industries in the manufacturing sector into high exposure (treated) groups and low exposure (non-treated) groups, separated by the median value.[14]

[Table 3]

As shown in Table 3, the list of high-exposure (treated) industries includes several typical technology-intensive sectors, such as automobiles, electrical equipment and computers. In contrast, low-exposure industries include the large consumer goods industries with low

[12] This tariff rate was later raised to 25% on May 10, 2019.

[13] Our results are robust to using export values in 2013.

[14] Throughout this paper, we use the discrete trade war exposure indicators instead of the continuous weighted tariff rates for the following reasons. First, the analysis of VC investment is based on the specification of Ewens, Nanda and Rhodes-Kropf (2018), which uses discrete industry clusters. Second, as the concordances among HS, ISIC, and CIC systems contain substantial measurement errors, the continuous TWE measure may cause attenuation bias in our estimates. We demonstrate that our main results are robust to using quartiles or continuous measures of trade war exposures in Section 3.3.

technology intensity, such as food and textiles. Figure 3 further illustrates that industries related to the Made-in-China 2025 (MIC 2025) initiative are mostly high-exposure industries. Among the eight 2-digit industries related to MIC 2025,[15] six are categorized as treated, and two as non-treated.[16] This confirms that U.S. trade war policies purposely targeted the technology-intensive industries that are supported by China's industrial policies.

[Figure 3]

2.4 Empirical Strategy

Similar to Ewens, Nanda and Rhodes-Kropf (2018), we apply a difference-in-differences framework to assess the overall impact of the trade war on outcomes related to exit, investment and innovation activities. We further apply a triple-differences strategy to compare the responses of GVCs and IVCs. We conduct our analysis at two levels of observations: the VC fund-portfolio company-period level (hereafter the VC-company level), and the VC fund-industry group-quarter level (hereafter the VC-industry level).[17]

2.4.1 VC-Company Level Regression

Our VC-company level analysis utilizes the full sample of pre-existing VC fund-portfolio company pairs prior to 2017, and examines how the trade war impacts VC exits, companies' follow-on financing and innovation activities. We apply a specification similar to Bernstein, Giroud and Townsend (2016) as follows:

$$Y_{ijt} = \beta_1 \text{Treat}_j \times \text{Post}_t + \beta_2 \text{Treat}_j + \beta_3 \text{Post}_t + \gamma X_{ij} + \rho_i + \nu_{ijt}, \tag{2}$$

where i denotes VC fund, j denotes portfolio company (startup), and t denotes period.[18] Y_{ijt} is the outcome of interest (e.g., IPO, follow-on investment, log number of patents). Treat_j

[15] MIC-2025 has the following key industries: Information Technology, Robotics, Green energy and green vehicles, Aerospace equipment, Ocean engineering and high-tech ships, Railway equipment, Power equipment, New materials, Medicine and medical devices, Agriculture machinery.

[16] The treated industries are automobile (including new energy vehicles), general purpose machinery (including robotics), transportation equipment (including railway equipment, high-tech ships, and aerospace equipment), electrical machinery and equipment (including renewable power equipment), computers and other electronic equipment (including IT equipment and robotics), and special purpose machinery (including ocean engineering and agricultural equipment). The non-treated are drugs and chemicals.

[17] The purpose of the second specification is twofold: first, it accounts for initial rounds of VC financing; second, it allows for pre-trend tests as is standard in difference-in-differences analysis.

[18] We collapse our data into two periods. The pre-period is from 2017Q1 to 2018Q2, and the post-period is from 2018Q3 to 2019Q4.

is an indicator variables equal to 1 if company j belongs to the high-exposure industries; X_{ij} is the set of company- and fund-level controls, which include log registration capital and log number of patent applications prior to 2017Q1 for company i, and log registration capital and order of establishment under its GP for fund i. We also include a VC fund fixed effect ρ_i to control for any unobserved, time-invariant VC characteristics that may affect the outcomes, such as monitoring ability or networks.[19]

Our coefficient of interest is β_1, which captures the treatment effect of the trade war. For our triple-differences analysis, we add a GVC_i indicator which equals 1 if fund i is a GVC. Coefficient on the triple-interaction term $\text{Treat}_j \times \text{GVC}_i \times \text{Post}_t$ therefore represents the heterogeneous effect of the trade war on the outcomes of companies that received investments from GVCs compared to ones that received investments from IVCs.

2.4.2 VC-Industry Level Regression

The second set of our empirical analysis consists of VC-industry level regressions that aim to examine the impact of the trade war on the overall investment activities of VCs. We focus on the sample of every active VC that has made at least one investment in the manufacturing sectors before the end of our sample period. Following Ewens, Nanda and Rhodes-Kropf (2018), we collapse VC investment records to the VC fund-industry group-quarter level, where industry groups are either the treatment or control group as defined in section 2.3. We then estimate the following equation:

$$\mathbb{1}(\text{Inv}_{igt}) = \beta_1 \text{Treat}_g \times \text{Post}_t + \beta_2 \text{Treat}_g + \lambda X_i + \mu_t + \epsilon_{igt}, \tag{3}$$

where i denotes VC fund, g denotes industry group (treatment or control), and t denotes year-quarter. $\mathbb{1}(\text{Inv}_{igt})$ is an indicator variable equal to 1 if VC fund i invests in companies that belong to industry group g in year-quarter t;[20] Treat_g denotes the treated industry group; X_i is the vector of VC fund controls that include log fund size, order of establishment under the parent VC firm, number of portfolio companies, and indicators of investment activity in the manufacturing sector and in treated industries in the previous quarter. We include a year-quarter fixed effect to control for time shocks that are common to all VCs. The

[19] In some extended specifications, we also include a company fixed effect to control for any unobserved, time-invariant company characteristics.

[20] In our decomposition analysis, we divide deals into syndicated and solo deals, early and late deals, first-time and follow-on deals, and GVC-IVC joint deals and non-joint deals respectively.

coefficient of interest is β_1, which captures the treatment effect of the trade war on investment activity. In a similar fashion, we add a GVC_i variable for our triple-differences analysis, where $\text{Treat}_g \times \text{GVC}_i \times \text{Post}_t$ represents the heterogeneous response of GVC investments to the trade war.

Equation 3 differs from Equation 2 in two ways. First, Equation 3 facilitates a VC-industry level analysis that includes both first-time and follow-on investments, and hence accounts for the impact of the trade war on the overall investment activities of VC funds. In contrast, the VC-company level analysis under Equation 2 examines only VC-company pairs that have already been formed before the sample period. The second difference is the time dimension: the VC-industry data sample aggregates observations at a quarterly level, while the VC-company sample is aggregated at a two-period level (pre and post). The reason for using quarterly, rather than a two-period, time intervals in Equation 3 is that VC investment is a much more frequent event compared to VC exits. Moreover, a quarterly panel allows us to assess the validity of our estimation assumptions.

The key assumption underlying our difference-in-differences design is the parallel trend assumption: companies and VC funds in the low-exposure industry group provide an appropriate counterfactual of companies and VC funds in the high-exposure industry group had they not been exposed to the trade war shock. The parallel trends assumption might be violated in our setting, as the trade war tariffs mainly target the MIC-2025 industries, which had been backed by a number of national industrial policies since 2015. Although this assumption cannot be proven, our VC-industry level specification allows us to use the event study design to examine whether treated and control industry groups exhibit similar patterns in VC investment prior to the trade war:

$$\mathbb{1}(\text{Inv}_{igt}) = \sum_{k=-5}^{6} \beta_k \text{Treat}_g \times \mathbb{1}(t = k) + \beta_2 \text{Treat}_g + \lambda X_i + \mu_t + \epsilon_{igt}, \tag{4}$$

in which k represents quarters from 2017Q1 to 2019Q4, and $k = 0$ corresponds to 2018Q2. Figure 4 displays the point estimates and 95% confidence intervals of the β_k's. We find no evidence of pre-trends, as the β_k's are not statistically different from zero for all quarters prior to 2018Q3.

[Figure 4]

3 Impact of the U.S.-China Trade War on VC Activities

3.1 Investment Activities of IVCs and GVCs

We begin our analysis by assessing the effects of the U.S.-China trade war on VC funds' likelihood of investing in high-exposure industries. We estimate Equation 3, and report our results in Table 4. In all columns, the dependent variable is an indicator equal to one if a given VC fund invested in treated/non-treated industries in a given quarter. Columns (1)-(4) present results for IVC investments, and Columns (5)-(6) present results for GVC investments. In Columns (7) and (8), we pool the sample of IVCs and GVCs together and estimate a triple-differences version of Equation 3 to examine heterogeneities across IVCs and GVCs. Year-quarter fixed effects are included in all columns to account for time trends common to all VC investments. Column (1) includes VC fund fixed effects and industry group fixed effects to control for any VC specific characteristics and time-invariant industry characteristics. Column (2) adds a set of time-varying fund-level controls. Columns (3), (5) and (7) replace VC fund fixed effects and industry group fixed effects with VC fund-by-industry fixed effects altogether, which control for any fund-industry group pair-specific characteristics (for example, a fund may be more specialized in a particular industry). Columns (4), (6) and (8) restrict the sample to pre-existing VC funds (ones that were established before 2017Q1) to address concerns on the endogenous entry of VC funds.

[Table 4]

We first note that the interaction term, Treat×Post, is negative and statistically significant at the 1% level across all specifications for the sample of IVCs, as shown in Columns (1) to (4). On average, the trade war shocks reduce IVCs' likelihood of investing in high-exposure industries by 2.08% to 2.24%. However, these point estimates become visibly different in magnitude and statistical significance for the sample of GVCs: they lie between 0.34% and 0.57%, and are statistically insignificant. Column (7) and (8) quantify the difference between IVCs and GVCs. Estimated coefficients on the triple-differences term (Treat×Post×GVC) indicate that, compared to IVCs, GVCs are 1.65% to 1.87% more likely to invest in companies in high-exposure industries during the trade war. Given that the average investment rate of the full sample is only around 3%, both the reduction in IVC investments and the

GVC-IVC difference in investment propensity represent sizable economic effects. In summary, the trade war shocks substantially reduce IVCs' investment rates in the high-exposure industries. In contrast, GVCs remain unaffected in absolute terms, and display a higher investment propensity in high-exposure industries compared to IVCs since the onset of the trade war.

The decrease in IVC investment in the high-exposure industries could be driven by public market factors. First, the trade war harms stock returns of listed firms in the targeted industries in China (Egger and Zhu 2020; Wang et al. 2020), which in turn changes the public market signals of investment opportunities to the IVC investors (Gompers et al. 2008; Nanda and Rhodes-Kropf 2013; Howell et al. 2020). Second, the trade war shocks may directly affect IPOs of the VC-backed startups in the high-exposure industries. We test the second hypothesis in the next section.

3.2 VC Exit Through IPOs

We estimate variants of Equation 2 to examine the impact of the trade war shocks on VC funds' likelihood of making successful exits from their portfolio companies in the exposed industries through IPOs.[21] Table 5 reports the coefficient estimates. The dependent variable is an indicator variable of the portfolio company's successful IPO in China's A-shares market. Column (1) includes a set of control variables for VC funds and portfolio companies. Column (2) replaces these controls with VC fund fixed effects and portfolio company fixed effects. From column (3) onwards, we include VC fund-portfolio company fixed effects to account for any unobserved time-invariant differences between each fund-company pair. To separately examine the effects of the trade war on VC exit for IVCs and GVCs, Columns (4) and (5) limit the sample to IVCs and GVCs respectively. Finally, we apply a triple-differences specification to examine whether GVCs experience different changes in exit likelihoods compared to IVCs in Column (6).

[Table 5]

Coefficient estimates in Columns (1) to (3) of Table 5 have an absolute size of around 2.51 and are statistically significant at the 1% level, suggesting that the trade war decreases the probability of VC funds successfully exiting a portfolio company through IPO by around

[21] The regression is at VC fund-portfolio company-period level, where the period is either pre-2018Q3 or post-2018Q3 (inclusive).

2.51%. The treatment effect is about 94% of the sample average IPO/exit rate (2.65%), indicating a sizable reduction. The reduction in VCs' exit likelihood may arise from the negative impact of the trade war on the market value of public companies, which can pass onto nonpublic companies by diminishing those companies' likelihood of filing and completing IPOs (Bernstein 2015).

It is possible that the GVC-backed startups respond differently in their IPO decisions due to better political connections (Fan, Wong and Zhang 2007; Zhifeng 2013; Piotroski and Zhang 2014). To address this concern, we estimate Equation 2 for the sample of IVC and GVC pairs separately in Column (4) and (5), and further estimate a triple-differences version of Equation 2 in Column (6) where we interact the Treat×Post term with an indicator variable equal to one if the fund is a GVC. Corresponeding point estimates are statistically significant at the 5% level and quantitatively similar for both IVC-backed and GVC-backed companies. In addition, the interaction term Treat×Post×GVC in Column (6) is quantitatively small and statistically indistinguishable from zero, suggesting that the effect of trade war on exit probability is not significantly weaker for the GVC-backed companies. Hence, there is little evidence that GVC funds select higher quality portfolio companies, monitor more effectively, or facilitate faster pathways to IPOs when the trade war hits. Taken together, estimates in Table 5 confirm that the trade war reduces the exit rate, and hence the expected financial returns, of VC investments in the high-exposure industries, regardless of whether the VC funds are funded by the government. Political connections, if any, do not appear to mitigate the negative impact on IPO activities.

The decline in IPO opportunities may partially account for the reduction of IVCs' investment rate in the high-exposure industries, but it fails to explain the investment behavior of GVCs. When faced with the same negative shocks in the public equity market, GVCs' investment rate remains stable and is significantly higher compared to IVCs' investment rate. In Section 4, we attempt to disentangle this puzzle by examining how GVCs and IVCs adjust their investment targets in response to the trade war.

3.3 Robustness Checks

This subsection describes several robustness checks for our baseline results.

First, our standard DID analysis that clusters industries into treatment and control groups cannot quantify the impact of unit-level increases in tariffs on VC exit and investment.

To address this concern, we first estimate alternative specifications of Equations 2 and 3 with quartile indicators of the TWE. Estimates are presented graphically in Figure A1. We find that the reduction in VC investment is mostly concentrated in the fourth quartile of industries that suffer the highest tariff exposure. The effect on GVC investment in the fourth quartile industries is also significantly negative, but the point estimate is quantitatively smaller than the corresponding estimate for IVCs. As for VC exits, the negative impact appears to be nonlinear: it is mostly concentrated in the third, not the fourth quartile.

One explanation for the discrepancy in VC exit and investment in Figure A1 is that the majority of the MIC-2025 industries (5 out of 8) belong to the fourth quartile while only one belongs to the third quartile, and Chinese authorities (namely the China Securities Regulatory Commission, or CSRC) may encourage the listing of companies in the MIC-2025 industries on purpose. To examine this possibility, we split our treated industries into two categories—MIC-related and non-MIC-related—and compare them to the control industries.

As shown in Figure A2, the trade war has a statistically insignificant and smaller impact on the IPO rates of IVC-backed companies in the MIC industries than the non-MIC industries. In contrast, the trade war has a significant negative impact on IVCs' investments in MIC industries, but the effect is statistically insignificant for non-MIC industries. The negative effects on the IPO rates of GVC-backed companies are similar in magnitude and statistically significant across both MIC and non-MIC industries, while the effects on GVCs' investment rates remain statistically insignificant for both groups.

These results, together with anecdotal evidence from official government documents,[22] support the hypothesis that China's stock market authorities provide preferential treatment to IPO cases in the MIC-2025 industries. In addition, the introduction of the Science and Technology Innovation Boardthe STAR market) at the Shanghai Stock Exchange in July 2019 also provide easier capital market access for the technology-intensive firms. The decline of IVC investments in MIC industries thus cannot be fully explained by reduced exit opportunities, and may be associated with lower stock market returns in the highest exposed industries (Egger and Zhu 2020; Wang et al. 2020).[23]

[22] For example, a notice published by the State Council of the People's Republic of China in 2015 proposed "perfecting financial support policies" for MIC-2025 industries, including supporting IPOs of the targeted firms in the domestic or foreign markets.

[23] In Tables A1 and A2, we directly use the continuous TWE measures. Similar to the analysis using quartiles of TWEs, we find increases in TWE negatively impact IVCs' investment rates, and GVCs invest significantly more compared to IVCs under higher TWE shocks. The TWE shocks also reduces IPO rates in general, but the effect is insignificant for IVC-backed startups.

The conventional measure of VC exit in the literature combines both IPO and high-return merger and acquisition events (e.g. Gompers et al. 2010; Bernstein, Giroud and Townsend 2016). In the main regressions, we examine only IPO events for two reasons: first, return multiples of acquisition events are missing for a substantial fraction of the data; second, acquisition as an exit channel is relatively rare in China's VC market (Huang and Tian 2020). In Table A3, we define VC exit as either an IPO event or a M&A event with non-missing return multiple larger than 2 (under this definition, acquisition events only account for about 10% of all exit events). Estimates of Treat×Post are quantitatively similar to the ones in Table 5 across all specifications, suggesting that the effects of trade war on IPO/M&A exit rates are similar for GVCs and IVCs.

Last, we examine whether our results are sensitive to the ownership cutoffs in the definition of GVC funds. Throughout our main analysis, we define GVCs as funds with more than 20% government capital contribution. The definition is based on the observation that 20% is the most common required government capital share in the official documentats of government-guided funds. In Tables A4 and A5, we reproduce our main results, redefining GVCs as funds that have more than 10% government capital contribution. The sample of GVC funds increases by more than one fourth while the sample of IVCs is reduced by a similar amount.

In Table A4, the coefficients of interest for IVCs are comparable in size to their counterparts in Table 4. For GVCs, the coefficients become statistically significant at the 10% level (Columns 5 and 6), though they remain smaller in magnitude compared to the IVC sample. This is not surprising because the GVC sample now includes funds with smaller government capital contribution, which would behave more like IVCs. Nonetheless, we still find that GVCs have a significantly weaker investment response compared to IVCs (Columns 7 and 8). Results of Table A5 are also similar to Table 5: the trade war shocks significantly reduce the exit probabilities of both IVCs and GVCs in similar magnitudes. We thus conclude that our findings in Table 4 and 5 are robust to the alternative definition of GVCs.

4 Investment Patterns of GVCs and IVCs

This section aims to explain why GVCs respond differently to the trade war compared to IVCs in their investment activities. We propose two competing hypotheses to explain the higher investment rates of GVCs compared to IVCs.

Our first hypothesis is that GVCs' investment decisions are driven by the policy goal of stabilizing startup financing in the high-exposure industries. Unlike IVCs which are purely profit-driven, GVCs also need to fulfill the policy objectives of the government entities that supplied funding to them (Lerner 2002; Bertoni and Tykvová 2015). Therefore, they are less responsive to the negative public market signals caused by the trade war, and may even invest more in the industries supported by government policies to compensate for the decline in IVC funding. Alternatively, GVC's weak response to the trade war shocks can also be explained by differences in the financial resources owned by GVCs and IVCs. As investors, government entities usually have deep pockets (Fan, Wong and Zhang 2005, 2013) and are more resilient to negative economic shocks. Thus, GVCs' higher investment rates may purely reflect their greater funding-raising capacity.

We investigate whether the lack of responsiveness of GVC investment is policy-driven or resource-driven by examining GVCs' and IVCs' investment portfolio adjustments as well as innovation activities of the startups receiving GVC and IVC investments. We present two pieces of empirical evidence consistent with the policy-driven hypothesis. First, GVCs make fewer first-round investments but continue to make follow-on investments in the high-exposure industries. Second, GVCs investments are concentrated in startups with more patenting activities in the high-exposure industries. These findings imply that GVCs systematically adjusted their investment targets during the trade war to finance projects that were more likely to generate technological externalities.

4.1 Investment Portfolios of IVCs and GVCs

We first examine how IVCs and GVCs reshuffle their investment portfolios by decomposing investment deals into mutually-exclusive pairs: syndicates and solo deals, GVC-IVC mixed syndicates and non-mixed deals, early deals and late deals, and first-time deals and follow-on deals.[24] We estimate a variant of Equation 3 based on the VC fund-industry panel. Dependent variables are dummy variables equal to 1 if VC fund makes a certain type of deal in a given industry group in that quarter. We control for VC fund-industry group fixed effects, year-quarter fixed effects, and fund-level controls in all columns.

[24]Syndicates are deals with more than one investor, and solo deals only have one investor. We further isolate a special type of syndicated deals, GVC-IVC mixed syndicates, from the remainder which only have IVC or GVC investor(s). Early deals refer to financing rounds prior to round B (Seed, Pre-A or round A financing), while late deals are refer to financing rounds post round B. First-time deals refer to the very first investment deal that a startup receives, while follow-on deals refer to all later deals.

[Table 6]

As shown in Panel A of Table 6, IVCs reduce investments uniformly across all types of deals in response to the trade war shocks, and all estimates are statistically significant at the 1% level. Columns (1) to (4) report that IVCs not only invest less as solo investors, but also participate less in syndicated deals and mixed syndicates with GVCs. IVCs also reduce investment across all stages of VC financing (early and late, or first-time and follow-on) as shown in Columns (5) to (8). In contrast, Panel B of Table 6 suggests that GVCs' adjustments are limited to certain types of deals. GVCs participate significantly less in mixed syndicates and first-time deals, while their activities in non-mixed deals and and follow-on investments are relatively insulated from the trade war shocks.

The decrease in GVC investments in mixed syndicates rather than non-mixed deals can be easily interpreted: since IVCs uniformly pulled out from high-exposure industries after the trade war began, the number of mixed syndicates would also decrease by definition. There are two explanations for GVCs' responses in first-time and follow-on investments. First, the decline in GVCs' first-time investments may be driven by the overall reduction in GVC-IVC syndication. Syndication of venture investments, especially GVC-IVC syndication, are positively correlated with better investment decisions and likelihood of positive exits (Lerner 1994; Cumming, Grilli and Murtinu 2017). Thus, GVCs may be inclined to avoid first-round investments as they lack the screening abilities to select promising targets among the early-stage startups (Gompers et al. 2020). Second, the persistence in GVCs' follow-on deals may be driven by shifts in policy goals: the government places a greater emphasis on the more mature and technologically advanced startups during downturns because of their reliance on foreign markets and the greater R&D spillovers they may generate (Lerner 2002).

4.2 Follow-on Investments of GVCs and IVCs

To further gauge GVCs' investment patterns in follow-on deals, we examine how the trade war shocks impacted the probability for VC-backed companies to receive follow-on financing from GVCs and IVCs respectively. Following Equation 2, we conduct a VC-portfolio company level analysis that regresses the follow-on investment indicator on Treat, Post, and their interaction term. We then differentiate the companies by their innovation capacity, measured using the log number of patent filings in the previous period, to investigate how GVCs and IVCs select follow-on investments. The dependent variable in Columns (1) and (2)

is an indicator of whether the portfolio company (the VC-backed startup) receives follow-on investments from any VCs. The indicator variable is further decomposed into an indicator of receiving follow-on IVC financing in Columns (3) and (4), and receiving follow-on GVC financing in Columns (5) and (6). All columns include fund-portfolio company fixed effects to control for any fund-company pair level unobserved characteristics. Columns (2), (4), and (6) estimate the triple-differences version of Equation 2, where we interact the original DID term with the portfolio company's innovation capacity.

[Table 7]

Estimation results are displayed in Table 7. Columns (1) shows that the effect of the trade war on the overall follow-on rates in the high-exposure startups is negative but statistically insignificant. Column (4) further shows that startups with more innovation activities in the previous period has higher but statistically insignificant probability of receiving follow-on financing. Columns (3) to (6) demonstrate that GVCs and IVCs adopt different strategies in their follow-on investments in the high-exposure startups. According to Columns (3) and (4), the startups' probability of raising IVC financing is not affected by the trade war shocks, and there are no differential effects for startups with different innovation capacities. In contrast, Columns (5) and (6) suggest that the trade war produced a significantly positive effect on startups' probability of receiving follow-on financing from GVCs, and the probability is increasing in the startup's innovation capacity. A 100% increase in lagged patenting applications raises the probability of receiving follow-on financing from GVCs by 3.61%, which is around one-third of the sample average.

Recall from Table 1 that GVCs affiliated with local governments (LGVCs) face more stringent investment requirements compared to GVCs established by the central government (CGVCs), in terms of the industries and locations of their portfolio companies. Therefore, if shifts in GVCs' investment targets were largely driven by policy considerations, then LGVCs, which are more industry- and location-constrained than CGVCs, should be more selective of their portfolio companies along the dimensions of quality and technological competence. In Table A6, we decompose follow-on GVC investments into investments made by CGVCs and LGVCs respectively. In line with our prediction, more innovative companies are significantly more likely to receive follow-on financing from LGVCs, but not from CGVCs. These findings suggest that LGVCs are the major providers of follow-on funding for innovative startups

during the trade war, possibly because they shoulder a heavier responsibility to fulfill policy goals.

Findings in Table 6 and Table 7 demonstrate that GVCs shift their investment targets to the more mature and technology-intensive startups. This reflects that GVC investments are more likely to be policy driven rather than profit driven, in that GVCs increasingly focus on projects that generate technological externalities during downturns in the VC market. The rationale for this particular investment strategy during the trade war emerges from the literature on the pro-cyclicality of VC investment: IVC are less likely to make experimental investments in riskier, more innovative startups in cold markets (Nanda and Rhodes-Kropf 2013). The drop-off of IVCs during downturns may be socially detrimental as it undermines the novelty of startup innovation (Howell et al. 2020). GVC financing thus serves as a crucial substitute for IVC financing for the more mature and innovative startups, as they can supply stable capital flows without IVC participation.

4.3 Alternative Explanations

Our primary explanation for the heterogeneous responses of IVCs and GVCs in their investment activities is that GVCs are obliged to implement industrial policy goals. While our empirical results are consistent with this hypothesis, we still need to examine alternative explanations.

The first alternative story is that GVCs invest more intensively in the high-exposure industries because they have preferential access to better investment opportunities, especially during economic downturns. For example, investment contracts offered by local government-backed VCs often include clauses for tax deductions or priority in acquisition. To rule out this possibility, we examine a critical difference in GVCs' organizational forms: whether the GVC is managed by independent VC firms (IGP-GVC) or government entities (GGP-GVC). Generally, the latter type (GGP-GVC) has more connections to the government and is therefore in a better position to grant preferential treatment to its portfolio companies. If GVCs' higher investment rates were entirely driven by the preferential access of some GVCs, we would expect IVCs and IGP-GVCs to respond to the trade war shocks similarly in terms of investment rates.

To test whether IGP-GVCs and GGP-GVCs behave differently, we re-estimate the triple-differences version of Equation 3, with the addition of interaction terms that indicate GVC

types. As shown in Table A7, the coefficient estimate on IGP-GVCs is positive and statistically significant at the 5% level. Moreover, even though the investment rate of the government-managed VCs is 0.646 percentage points higher than IGP-GVCs, this difference is tested to be statistically insignificant. In sum, we do not find evidence that GVCs' stronger tendency to invest in high-exposure industries is driven by preferential access.

The second alternative explanation is that GVCs respond less to the trade war shocks due to poor management: decision-makers of GVC funds may lack the necessary managerial skills to adjust their investment strategies timely to prevent further losses amid the trade war shocks. Previous studies have shown that government-backed VCs perform worse than their private peers on average (Kovner and Lerner 2015; Calder-Wang and Li 2021). To test this hypothesis, we separate the sample of VC funds by whether the managing GPs have had successful exits, and compare the differences in investment rates between GVCs and IVCs within each group. If the GVCs' higher investment rates mainly reflect their managerial incompetence, then the gap in investment rates should diminish when the sample is restricted to VCs with success experience. Table A8 shows that, even within the sample of experienced and successful VCs, GVCs still make more investment in the affected industries compared to IVCs. Thus, we conclude that GVCs' weaker response to the trade war shocks is not driven by a lack of managerial capacity.

5 The Economic Impact of GVC Financing

This section discusses the economic consequences of GVC investments in the trade war. The fact that IVCs became reluctant to make new investments under the trade war shocks suggests that innovative companies would not be able to raise sufficient funds from private investors. Even though GVCs can be a substitute for IVCs in financing startup innovation as shown in the previous section, it is still necessary to evaluate their overall impact since only around 10% of the VC-backed startups received follow-on investments from GVCs in the sample period.

We hypothesize that GVC investments would lead to a "compete-for-financing" effect that encourages startup innovation in the high-exposure industries. Due to a shortage of IVC funding in high-exposure industries, companies in need of VC financing now have to compete for GVC funding that is in more stable supply. Meanwhile, GVCs seek to select firms based on their technological competence, as shown in Table 7. In accordance with

GVCs' selection criteria, companies are encouraged to pursue more innovative ventures as a quality signal to attract GVC funding.[25] Hence, the impact of GVC investments are not limited to their portfolio companies; other startups in need of GVC financing may also undertake more innovation.

In Table 8, we provide empirical evidence in support of our "compete-for-financing" hypothesis. We re-estimate Equation 2, using as dependent variable the log number of companies' patent applications in the pre- and post-period of the trade war. We then construct a measure for the pre-existing local supply of GVC funding: the logarithm of the total registration capital of active GVCs divided by the total number of VC-backed companies in each prefecture between 2013 and 2016.[26] We conduct a triple-differences analysis using standardized local GVC intensity to examine the heterogeneous responses of startup innovation across prefectures with different levels of local GVC activity prior to our sample period.

[Table 8]

Results in columns (1) to (3) indicate that VC-backed companies in the high-exposure industries file more patent applications after the onset of trade war, despite tightening financial constraints. Patent applications of companies in the high-exposure industries are about 6.7% higher compared to those in the low-exposure industries. The point estimates are highly stable across different specifications. Columns (4) and (5) further suggest that, the trade war shocks improves innovation activities of both IVC-backed and GVC-backed companies, but the effect is much larger in magnitude for IVC-backed companies.

Starting from column (6), we add interaction terms with prefecture-level GVC intensity and VC intensity measures to examine the role of GVC presence in stimulating innovation under the trade war. Column (6) shows that a one standard deviation increase in local GVC intensity increases companies' patent applications by about 3.6%, while an increase in local VC intensity, if anything, reduces patent applications insignificantly, perhaps because cities with higher VC intensities are in general more developed and thus more exposed to the trade

[25] The role of patents as signals to VC investors has been extensively discussed in previous research. See Czarnitzki, Hall and Hottenrott (2016) for a summary. A recent study by Farre-Mensa, Hegde and Ljungqvist (2020) demonstrates that winning the first patent "lottery" increases startups' likelihood of obtaining follow-on funding from venture capitalists.

[26] We measure the local supply of VC funds in a similar way, using the standardized log value of total registration capital of active VCs divided by the total number of VC-backed companies in each prefecture between 2013 and 2016. We include interaction terms between Treat, Post and standardized local VC intensity as controls.

war shocks. Column (7) restricts the sample to IVC-backed companies, and the estimated coefficient on $Treat \times Post \times GVCIntensity$ becomes quantitatively larger: a one standard deviation increase in the local GVC intensity increases companies' patent applications after the trade war by about 5.4%. In contrast, when the sample is limited to only GVC-backed startups in column (8), local GVC intensity no longer drives company innovation. Results in columns (7) and (8) also point to the importance of pre-existing GVC relations: as GVC-backed startups have already established connections with some GVC investors, their innovation decisions are less sensitive to the presence of other local GVCs.

As previously shown in Table A6, the more innovative startups have significantly higher probabilities of receiving follow-on financing from LGVCs, but not CGVCs. If our "compete-for-financing" hypothesis is true, then the response of company innovation to the trade war should vary with local LGVC intensity, but not local CGVC intensity. In Table A9, we include separate interaction terms for LGVC intensity and CGVC intensity in the regressions. We find that, consistent with our prediction, the effect of trade war shocks on startup innovation is increasing with LGVC intensity but not CGVC intensity. In other words, the "compete for financing" effect is mainly driven by LGVCs' investment activities rather than CGVCs'.

Last, we show that our findings are robust to different measures of GVC presence. In Table A10, we replace the GVC intensity terms by indicators equal to 1 if the prefecture had GVC activities between 2013 and 2016. Similar to Table 7, we find that companies in prefectures with pre-existing GVC activities innovate more in response to the trade war shocks, and the effect is mainly driven by the presence of LGVCs.

6 Concluding Remarks

Our paper studies the role of government-funded venture capital in sponsoring innovation and entrepreneurship in the setting of the U.S.-China trade war. Based on a unique and comprehensive dataset of the Chinese VC market, our difference-in-differences analysis show that the trade war exerted a negative impact on industries that are more exposed to the tariff increases: it narrows the probability of VC funds successful exiting from their portfolio companies. In response, independent VC funds (IVCs) refrain from making new investments into companies in the high-exposure industries. In comparison to IVCs, however, GVCs make relatively more investments into the high-exposure industries when faced with similar

reductions in exit opportunities.

We then examine GVCs' investment patterns to understand its investment responses to the trade war shocks. We find that, while IVCs uniformly reduce investments in all types of deals, GVCs only avoid first-time deals but maintain their presence in follow-on rounds of startup financing. Moreover, their follow-on investments in the high-exposure industries become more concentrated on startups that have better innovation capacities. Our findings suggest that GVC investments are likely to be predominantly driven by the policy objective of stabilizing the supply of funds for innovative companies that suffered the trade war shocks. Finally, we argue that the presence of GVCs during the trade war could lead to socially beneficial outcomes: startups competing for GVC financing are motivated to invest in more innovation in order to demonstrate their innovation capability. As supporting evidence, we show that VC-backed companies located in prefectures with greater GVC presence filed more patent applications when exposed to the trade war.

Our paper sheds a positive light on the provision of government capital in the VC market. Since private investment is pro-cyclical, the market would experience a shortage of capital during economic downturns. Government participation in the form of GVCs can thus serve as a financing vehicle that stabilizes the supply of capital for innovative startups under negative macroeconomic shocks. Furthermore, the presence of GVC capital provides additional incentives for startups to undertake innovation through the "compete-for-financing" channel. Therefore, government involvement in the VC market may help mitigate the problem of underinvestment in private innovation during economic downturns.

Our paper points towards important questions that deserve closer scrutiny in the future. While we highlight a positive role of government capital in stabilizing investments during negative macroeconomic shocks, previous literature finds that GVC investments are often less effective at promoting innovation or boosting startup performance (Bertoni and Tykvová 2015; Cumming, Grilli and Murtinu 2017). Thus, the optimal level of government capital provision in the VC market should depend on the trade-off between these two effects. In addition, the welfare implications of government capital during economic downturns are open to much debate. On the one hand, if GVCs lacked the capacity to evaluate the quality of innovation, then companies may invent patents of low economic value as their signaling device to obtain GVC funding. On the other hand, if GVCs selected projects based on their social rather than private returns during the trade war,[27] companies in need of GVC capital

[27]Many of the early studies have estimated the private and social returns of R&D. See Griliches (1992).

could be incentivized to undertake innovation that have higher technological externalities. When more data becomes available, we expect to examine the welfare implications of the "compete-for-financing" effect by assessing the relative importance of those two mechanisms.

Recently, Kogan et al. (2017) introduce a new method for estimating the private value of patents based on stock market performance.

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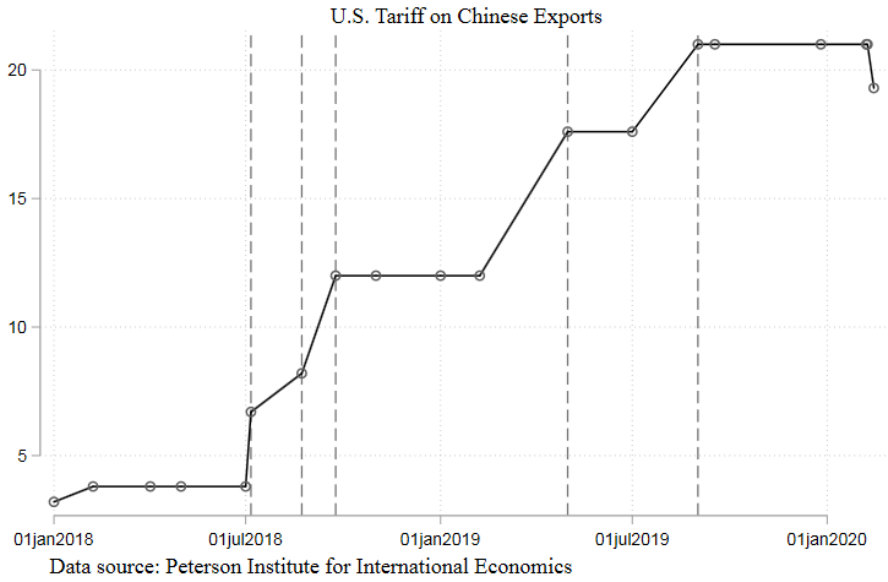
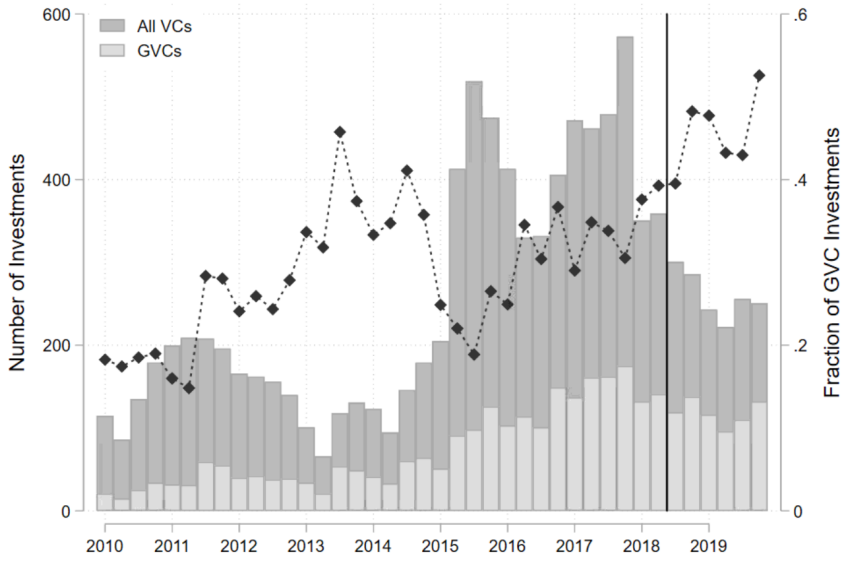
Figure 1: U.S. Tariff Schedule, 2018 to 2020



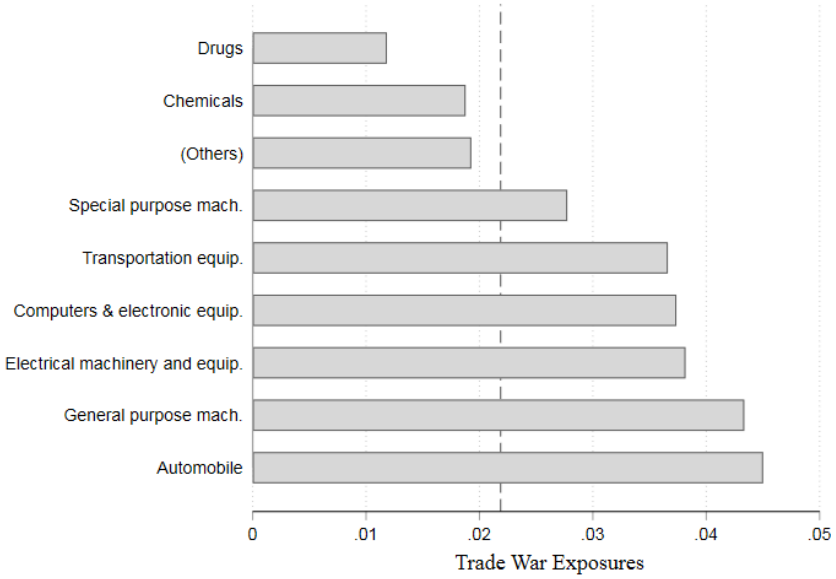
Note: The figure presents the average tariff imposed by the U.S. on Chinese exports from 2018 to 2020. Data source: Peterson Institute for International Economics.

Figure 2: Number of Deals in Manufacturing Industries



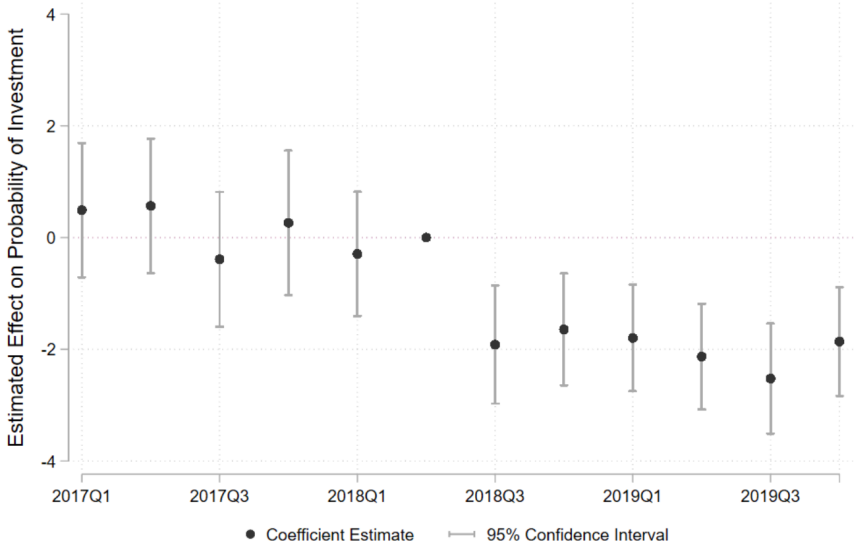
Note: The figure shows the count of deals between venture capital funds and target manufacturing companies in each quarter from 2010 to 2019. Light bars represent the count of GVC deals, and dark bars represent the count of non-GVC deals. The connected line represents the share of GVC deals in all deals.

Figure 3: Trade War Exposures of MIC2025-related Industries



Note: The figure presents the exposure of MIC2025-related Industries to the trade war tariff shocks. The exposure is calculated by the ratio of U.S. tariff burdens in total Chinese exports, based on the export data in 2017 and the tariff schedule revision on September 1, 2019.

Figure 4: Event Study: Effects of the Trade War on VC Investments



Note: This figure plots the coefficients for the interaction terms of each quarter and the treated dummy. The underlying regression controls for quarter and VC firm-treat fixed effects. 2018Q2 is set as the base period. Standard errors are clustered at VC fund level.

Table 1: Example Requirements for GVCs

	China SME Development Fund	**Shenzhen Government Guidance Fund**	**Chongqing Industry Guidance Fund**
Registration	None	Shenzhen	Chongqing
Local Investment	None	No less than 60% of its capital	No less than 80% of its capital
Industry	None	Industries supported by the Shenzhen government	Industries supported by the Chongqing government
Investment Stage	No less than 60% of its capital in seed and initial stage companies	No less than 60% of its capital in initial, early and medium stage companies	None
Share of Government Capital	No more than 30%	No more than 30% for startup funds, and no more than 25% for industrial funds	No more than 33%
Government Has Veto Power	No	Yes	Yes
Deal Needs Government Approval	No	Yes	Yes
Conditions of Termination	1. Non-compliance with requirements on policy goals, investment stages and industries; 2. major changes in the board of the managing VC firm; 3. no deals made within six months/one year of founding; 4. insufficient contribution from other LPs.		

Notes: This table summarizes the investment requirements for GVCs supported by three government-guided funds: China SME Development Fund, Shenzhen Government Guidance Fund, and Chongqing Industry Guidance Fund. The first is a national fund, and the latter two are city-level funds established by the Shenzhen and Chongqing governments respectively.

Table 2: Summary Statistics

Panel A. Summary Statistics of VC Funds (Sample Size: 5,518)

Variable name	Mean	s.d.	p10	p50	p90
Independent VCs (3,881)					
Registration capital (million USD)	28.24	157.19	1.01	8.40	51.69
Fund age (as of 2019Q4)	5.81	4.32	2	4	11
Order of establishment under GP	2.03	3.64	1	1	4
Number of portfolio companies	6.95	25.22	1	2	12
Government-funded VCs (1,637)					
Registration capital (million USD)	25.83	107.85	0.81	7.24	48.10
Fund age (as of 2019Q4)	5.45	4.92	2	4	10
Order of establishment under GP	3.32	5.25	1	1	7
Number of portfolio companies	6.98	23.15	1	4	13

Panel B. Summary Statistics of Portfolio Companies (Sample Size: 5,202)

Variable name	Mean	s.d.	p10	p50	p90
Registration capital (million USD)	25.87	134.54	1.30	8.19	41.98
Treatment	0.70	0.46	0	1	1
Firm age (as of 2019Q4)	13.49	6.23	5	13	21
Number of investors	1.86	1.91	1	1	4
Number of patents (15Q3 to 16Q4)	1.74	11.58	0	0	4

Notes: The table presents the summary statistics of the main characteristics of VC funds and portfolio companies. Panel A shows the summary statistics of VC funds, and Panel B shows the summary statistics of portfolio companies. Registration capital is the total assets of VC funds and portfolio companies in their establishment years. Fund age and Firm age are computed as the numbers of years between their establishment years and 2019Q4. Order of establishment under GP is the rank of funds established by the GP. Number of portfolio companies refers to the total number of portfolio companies invested by the fund. Number of patents is the total number of invention patents filed by the portfolio company.

Table 3: Trade War Exposures of All Industries

Rank	2-digit code	Industry name	Trade war exposure (%)	Treatment
1	21	Furniture	5.95	1
2	36	**Automobiles**	4.63	1
3	34	**General purpose machinery**	4.23	1
4	38	**Electrical machinery and equipment**	4.08	1
5	37	**Transportation equipment**	3.79	1
6	23	Printing and recorded media	3.69	1
7	33	Metal products	3.36	1
8	39	**Computers and other electronic equipment**	3.32	1
9	20	Timber and wood products	3.02	1
10	29	Rubber and plastic products	2.97	1
11	35	**Special purpose machinery**	2.55	1
12	14	Food	2.23	1
13	22	Paper and paper products	2.23	1
14	41	Other manufacturing	2.22	1
15	30	Non-metallic mineral products	2.17	1
16	24	Articles for culture, education, art, sports, and entertainment	2.13	0
17	13	Processing of agricultural products	2.12	0
18	40	Measuring instruments	2.11	0
19	26	**Chemicals**	1.89	0
20	19	Leather, fur, feather and related products	1.61	0
21	15	Beverage	1.46	0
22	25	Processing of petroleum	1.43	0
23	28	Chemical fibers	1.28	0
24	27	**Drugs**	1.09	0
25	17	Textiles	1.07	0
26	18	Apparels	0.59	0
27	32	Processing of non-ferrous metals	0.53	0
28	31	Processing of ferrous metals	0.41	0
29	16	Tobacco	0.34	0

Notes: This table reports the measured trade war exposures for all 2-digit Chinese manufacturing industries. The trade war exposures are computed following equation 1, based on tariff data between 2018-2019 from USITC and Chinese Customs Trade Statistics (CCTS). We define a 2-digit Chinese industry as treated if and only if its trade war exposure is above or equal to the median value. The industry names in bold are MIC2025-related industries.

Table 4: Effects of Trade War on VC Investment

Dependent variable: indicator of VC investment								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	-2.083***	-2.083***	-2.169***	-2.241***	-0.337	-0.570	-2.169***	-2.241***
	(0.228)	(0.228)	(0.227)	(0.227)	(0.396)	(0.402)	(0.227)	(0.227)
Treat×Post×GVC							1.832***	1.671***
							(0.457)	(0.462)
Post×GVC							0.359	0.133
							(0.277)	(0.277)
Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC fund FE	Yes	Yes	No	No	No	No	No	No
Industry group FE	Yes	Yes	No	No	No	No	No	No
VC-industry FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	IVC	IVC	IVC	Pre-existing IVC	GVC	Pre-existing GVC	All	Pre-existing all
Mean of dep. var. (p.p.)	2.575	2.575	2.575	2.446	3.855	3.695	2.998	2.855
Observations	78,746	78,746	78,746	74,976	38,882	36,480	117,628	111,456
R-squared	0.051	0.087	0.130	0.130	0.125	0.125	0.127	0.126

Notes: This table reports the effects of trade war on VC investment in the high-/low-exposure industry group. A unit of observation is a VC fund-industry group pair in a given quarter between 2017Q1 and 2019Q4. The dependent variable is an indicator variable equal to 1 if and only if a VC fund makes any investment in the corresponding industry group in a quarter. *Treat* is an indicator variable equal to 1 if and only if the industry group is highly exposed to the trade war. *Post* is an indicator variable equal to 1 if and only if the quarter is after 2018 Q2. *GVC* is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. The control variables include the fund's order under GP's management, the fund's portfolio size, an indicator of whether the fund has invested in manufacturing, and an indicator of whether the fund has invested in the high-exposure industry group. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 5: Effects of Trade War on VC Exits through IPOs

Dependent variable: indicator of exit through IPO						
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post	-2.509***	-2.509***	-2.509***	-2.359***	-2.794***	-2.359***
	(0.653)	(0.780)	(0.653)	(0.870)	(0.941)	(0.870)
Post	7.048***	7.048***	7.048***	7.965***	5.409***	7.965***
	(0.615)	(0.735)	(0.615)	(0.833)	(0.879)	(0.833)
Treat×Post×GVC						-0.435
						(1.281)
Post×GVC						-2.556**
						(1.211)
Controls	Yes	No	No	No	No	No
VC fund FE	No	Yes	No	No	No	No
Portfolio company FE	No	Yes	No	No	No	No
Fund-company FE	No	No	Yes	Yes	Yes	Yes
Sample	All	All	All	IVC	GVC	All
Mean of dep. var. (p.p.)	2.652	2.652	2.652	3.161	1.735	2.652
Observations	13,878	13,878	13,878	8,920	4,958	13,878
R-squared	0.055	0.515	0.515	0.517	0.511	0.517

Notes: This table reports the effects of the U.S.-China trade war on VC exits through IPOs in China. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is an indicator equal to 1 if and only if the portfolio company successfully goes public in the given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). *GVC* is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 6: Decomposition of Trade War's Effects on VC Investment

Panel A. Decomposition of IVC investment

	Syndicated	Solo	Mixed Syndicates	Non-Mixed	Early	Late	First-time	Follow-on
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×post	-1.298***	-0.922***	-0.389***	-1.791***	-0.766***	-1.456***	-1.133***	-1.123***
	(0.164)	(0.161)	(0.113)	(0.199)	(0.154)	(0.167)	(0.167)	(0.154)
Mean of dep. var. (p.p.)	1.299	1.304	0.624	0.965	1.170	1.424	1.405	1.195
Observations	78,746	78,746	78,746	78,746	78,746	78,746	78,746	78,746
R-squared	0.111	0.117	0.100	0.124	0.113	0.115	0.118	0.108

Panel B. Decomposition of GVC investment

	Syndicated	Solo	Mixed Syndicates	Non-Mixed	Early	Late	First-time	Follow-on
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×post	-0.308	-0.116	-0.481**	0.088	-0.234	-0.146	-0.689**	0.289
	(0.258)	(0.303)	(0.226)	(0.331)	(0.285)	(0.274)	(0.303)	(0.256)
Mean of dep. var. (p.p.)	1.566	2.356	1.196	2.713	2.153	1.762	2.423	1.494
Observations	38,882	38,882	38,882	38,882	38,882	38,882	38,882	38,882
R-squared	0.114	0.122	0.107	0.123	0.119	0.115	0.113	0.116

Notes: This table reports the effects of trade war on each type of VC investment on the high-/low-exposure industry group. A unit of observation is a VC fund-industry group pair in a given quarter between 2017Q1 and 2019Q4. The dependent variable is an indicator equal to 1 if and only if a VC fund makes any investment deals in the given category in the high-/low-exposure industries in a quarter. *Treat* is an indicator variable equal to 1 if and only if the industry group is highly exposed to the trade war. *Post* is an indicator variable equal to 1 if and only if the quarter is after 2018 Q2. *GVC* is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. All columns control for a VC fund-industry fixed effect, a quarter fixed effect, and a list of control variables, including the fund's order under GP's management, the fund's portfolio size, an indicator of whether the fund has invested in manufacturing, and an indicator of whether the fund has invested in the high-exposure industry group. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 7: Effects of Trade War on Portfolio Companies' Follow-on Financing

Dependent variables: indicator of follow-on investment

	Made by all VCs		Made by IVCs		Made by GVCs	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post	-1.069	-1.685	-1.636	-1.308	2.616**	1.860
	(1.244)	(1.387)	(1.181)	(1.316)	(1.032)	(1.155)
Post	-16.651***	-12.297***	-15.090***	-11.310***	-10.927***	-7.864***
	(1.083)	(1.182)	(1.024)	(1.132)	(0.900)	(0.994)
Treat×Post×Lagged Patent Applications		3.199		0.986		3.611**
		(2.042)		(1.959)		(1.792)
Post×Lagged Patent Applications		-10.154***		-8.687***		-7.015***
		(1.758)		(1.720)		(1.568)
Fund-company FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dep. var. (p.p.)	17.65	17.65	15.28	15.28	10.56	10.56
Observations	13,878	13,878	13,878	13,878	13,878	13,878
R-squared	0.617	0.623	0.619	0.626	0.601	0.606

Notes: This table reports the effects of trade war on startups' follow-on financing. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is an indicator equal to 1 if and only if the portfolio company receives a follow-on investment from a given type of VC funds in a given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). *Patents* is the log number of patent applications filed by the company during 2017 Q1 to 2018 Q2. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

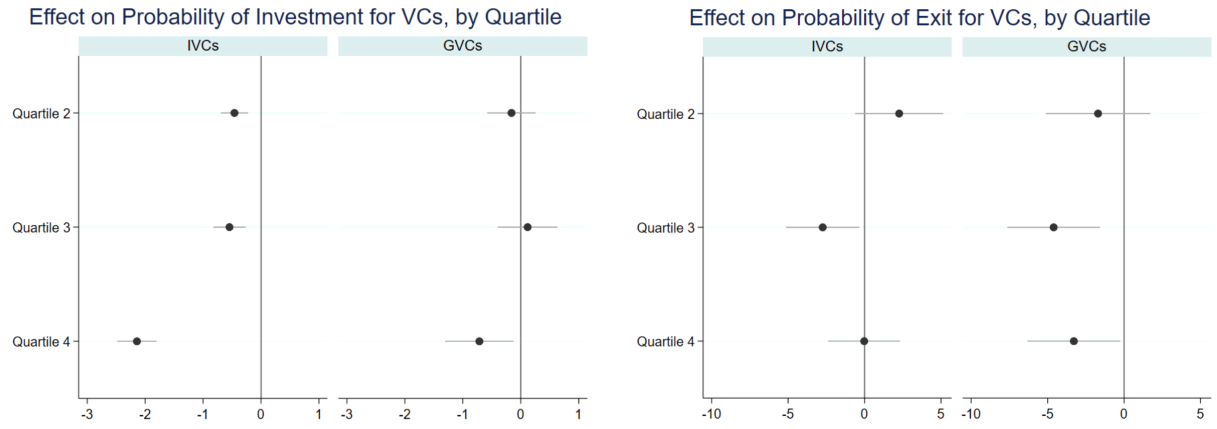
Table 8: Effects of Trade War on Portfolio Companies' Innovation

Dependent variable: Log patent applications								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	0.067***	0.067***	0.067***	0.079***	0.044*	0.068***	0.083***	0.046*
	(0.016)	(0.019)	(0.016)	(0.020)	(0.026)	(0.016)	(0.020)	(0.025)
Post	-0.178***	-0.178***	-0.178***	-0.208***	-0.123***	-0.179***	-0.212***	-0.124***
	(0.014)	(0.016)	(0.014)	(0.017)	(0.022)	(0.014)	(0.017)	(0.022)
Treat×Post×GVC Intensity						0.036***	0.054***	-0.005
						(0.013)	(0.015)	(0.026)
Post×GVC Intensity						-0.030***	-0.048***	-0.004
						(0.011)	(0.012)	(0.018)
Treat×Post×VC Intensity						-0.015	-0.050**	0.029
						(0.014)	(0.022)	(0.022)
Post×VC Intensity						0.009	0.037**	-0.022
						(0.010)	(0.017)	(0.014)
Controls	Yes	No	No	No	No	No	No	No
VC fund FE	No	Yes	No	No	No	No	No	No
Portfolio company FE	No	Yes	No	No	No	No	No	No
Fund-company FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	IVC	GVC	All	IVC	GVC
Mean of dep. var. (p.p.)	0.339	0.339	0.339	0.363	0.296	0.339	0.363	0.296
Observations	13,878	13,878	13,878	8,920	4,958	13,878	8,920	4,958
R-squared	0.104	0.801	0.801	0.803	0.788	0.798	0.803	0.789

Notes: This table reports the effects of trade war on portfolio companies' innovation. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is log number of patent applications in a given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). GVC Intensity (VC Intensity) is defined as the standardized log of total registration capital of active GVCs (VCs) divided by the total number of VC-backed companies within each city where the startup locates between 2013Q1 and 2016Q4. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

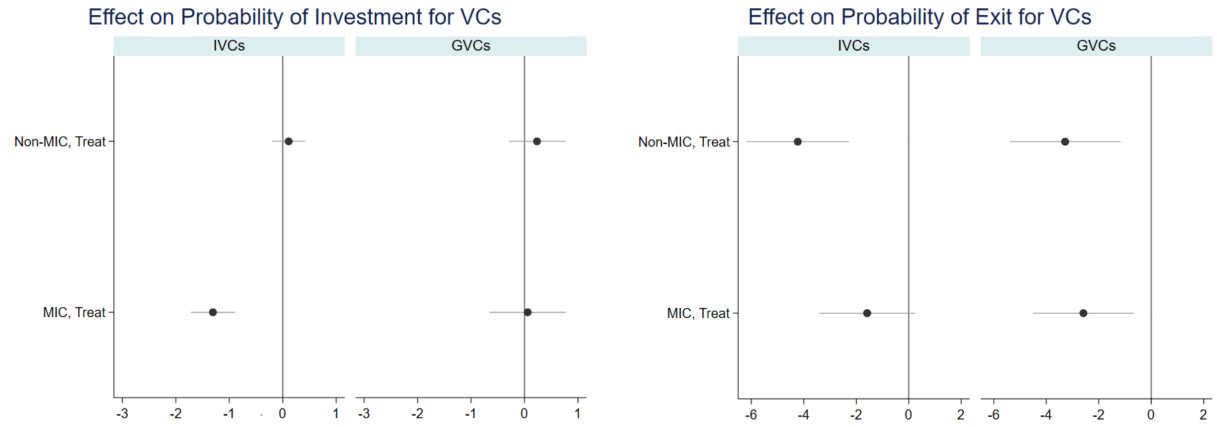
Appendix A Additional Figures and Tables

Figure A1: Estimated Coefficients of Trade War Exposure Quartiles



Note: The graphs show the estimated coefficients of TWE quartiles. The left panel reports the coefficients of regressing investment indicator on TWE quartiles, for IVC and GVC samples separately, following the VC-industry group-quarter level specification. The right panel reports the coefficients of regressing exit indicator on TWE quartiles, for IVC and GVC samples separately, following the VC-portfolio company-period level specification. Standard errors are clustered at VC fund level.

Figure A2: Estimated Coefficients of on MIC and non-MIC Treated Industries



Note: The graphs show the estimated coefficients of TWE by MIC2025 and Non-MIC2025 Industries. Specifically, we separate industries into 3 groups: treated-MIC2025, treated-non MIC2025, and control. The left panel reports the coefficients of regressing investment indicator on the group indicators, for IVC and GVC samples separately, following the VC-industry group-quarter level specification. The right panel reports the coefficients of regressing exit indicator on the group indicators, for IVC and GVC samples separately, following the VC-portfolio company-period level specification. Standard errors are clustered at VC fund level.

Table A1: Effects of Trade War on VC Investment (VC-2 digit Industry-Quarter Level Analysis)

Dependent variable: indicator of VC investment								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TWE(%)×Post	-0.057***	-0.057***	-0.058***	-0.059***	-0.023**	-0.026***	-0.058***	-0.059***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.010)	(0.010)	(0.005)	(0.005)
TWE(%)×Post×GVC							0.035***	0.033***
							(0.011)	(0.011)
Post×GVC							0.006	-0.014
							(0.030)	(0.030)
Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC fund FE	Yes	Yes	No	No	No	No	No	No
Industry group FE	Yes	Yes	No	No	No	No	No	No
VC-industry FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	IVC	IVC	IVC	Pre-existing IVC	GVC	Pre-existing GVC	All	Pre-existing all
Mean of dep. var. (p.p.)	0.189	0.189	0.189	0.180	0.293	0.281	0.224	0.213
Observations	1,102,444	1,102,444	1,102,444	1,049,664	544,348	510,720	1,646,792	1,560,384
R-squared	0.004	0.007	0.097	0.095	0.102	0.100	0.099	0.097

Notes: This table reports the effects of trade war on VC investment in each 2 digit industries. A unit of observation is a VC fund-2digit industry pair in a given quarter between 2017Q1 and 2019Q4. The dependent variable is an indicator variable equal to 1 if and only if a VC fund makes any investment in the corresponding industry group in a quarter. $TWE(\%)$ is the measured 2 digit industry level trade war exposures (ranging from 0 to 100). *Post* is an indicator variable equal to 1 if and only if the quarter is after 2018 Q2. GVC is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. The control variables include the fund's order under GP's management, the fund's portfolio size, an indicator of whether the fund has invested in manufacturing, and an indicator of whether the fund has invested in the high-exposure industry group. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A2: Effects of Trade War on VC Exits (Continuous Measure of TWE)

Dependent variable: indicator of exit through IPO						
	(1)	(2)	(3)	(4)	(5)	(6)
TWE(%)×Post	-0.532**	-0.532*	-0.532**	-0.384	-0.789**	-0.384
	(0.258)	(0.309)	(0.258)	(0.343)	(0.375)	(0.343)
Post	0.0677***	0.0677***	0.0677***	0.0738***	0.0565***	0.0738***
	(0.00815)	(0.00974)	(0.00815)	(0.0108)	(0.0120)	(0.0108)
TWE(%)×Post×GVC						-0.405
						(0.509)
Post×GVC						-0.0173
						(0.0169)
Controls	Yes	No	No	No	No	No
VC fund FE	No	Yes	No	No	No	No
Portfolio company FE	No	Yes	No	No	No	No
Fund-company FE	No	No	Yes	Yes	Yes	Yes
Sample	All	All	All	IVC	GVC	All
Mean of dep. var. (p.p.)	2.623	2.623	2.623	3.088	1.926	2.623
Observations	13,762	13,762	13,762	8,258	5,504	13,762
R-squared	0.055	0.515	0.515	0.517	0.512	0.516

Notes: This table reports the effects of the U.S.-China trade war on VC exits through IPOs in China. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is an indicator equal to 1 if and only if the portfolio company successfully goes public in the given period. $TWE(\%)$ is the measured 2 digit industry level trade war exposures (ranging from 0 to 100). *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). GVC is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 10%. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A3: Effects of Trade War on VC Exits through IPOs or Acquisitions

Dependent variable: indicator exit through IPO or acquisition						
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post	-2.514***	-2.514***	-2.514***	-2.300***	-2.915***	-2.300**
	(0.672)	(0.803)	(0.672)	(0.896)	(0.967)	(0.896)
Post	7.758***	7.758***	7.758***	8.776***	5.937***	8.776***
	(0.622)	(0.743)	(0.621)	(0.833)	(0.907)	(0.833)
Treat×Pos×GVC						-0.615
						(1.318)
Post×GVC						-2.839**
						(1.231)
Controls	Yes	No	No	No	No	No
VC fund FE	No	Yes	No	No	No	No
Portfolio company FE	No	Yes	No	No	No	No
Fund-company FE	No	No	Yes	Yes	Yes	Yes
Sample	All	All	All	IVC	GVC	All
Mean of dep. var. (p.p.)	3.005	3.005	3.005	3.587	1.956	3.005
Observations	13,878	13,878	13,878	8,920	4,958	13,878
R-squared	0.061	0.517	0.517	0.519	0.512	0.519

Notes: This table reports the effects of the U.S.-China trade war on VC exits in China. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is an indicator equal to 1 if and only if the portfolio company successfully goes public or is acquired through an M&A with a return multiple larger than 2 in the given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). GVC is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A4: Effects of Trade War on VC Investment (Alternative Definition of GVCs)

Dependent variable: VC investment								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	-2.119***	-2.119***	-2.203***	-2.286***	-0.529	-0.732**	-2.186***	-2.260***
	(0.236)	(0.236)	(0.235)	(0.234)	(0.365)	(0.370)	(0.227)	(0.227)
Treat×Post×GVC							1.849***	1.690***
							(0.457)	(0.462)
Post×GVC							0.404	0.174
							(0.278)	(0.277)
Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC fund FE	Yes	Yes	No	No	No	No	No	No
Industry group FE	Yes	Yes	No	No	No	No	No	No
VC-industry FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	IVC	IVC	IVC	Pre-existing IVC	GVC	Pre-existing GVC	All	Pre-existing all
Mean of dep. var. (p.p.)	2.549	2.549	2.549	2.417	3.728	3.572	2.993	2.850
Observations	73,004	73,004	73,004	69,456	44,126	41,544	117,130	111,000
R-squared	0.052	0.089	0.132	0.131	0.123	0.123	0.127	0.126

Notes: This table reports the effects of trade war on VC investment in the high-/low-exposure industry group. A unit of observation is a VC fund-industry group pair in a given quarter between 2017Q1 and 2019Q4. The dependent variable is an indicator variable equal to 1 if and only if a VC fund makes any investment in the corresponding industry group in a quarter. *Treat* is an indicator variable equal to 1 if and only if the industry group is highly exposed to the trade war. *Post* is an indicator variable equal to 1 if and only if the quarter is after 2018 Q2. $GVC(10\%)$ is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 10%. The control variables include the fund's order under GP's management, the fund's portfolio size, an indicator of whether the fund has invested in manufacturing, and an indicator of whether the fund has invested in the high-exposure industry group. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A5: Effects of Trade War on VC Exits (Alternative Definition of GVCs)

Dependent variable: indicator of exit through IPO						
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post	-2.494***	-2.494***	-2.494***	-2.371***	-2.672***	-2.371***
	(0.651)	(0.779)	(0.651)	(0.889)	(0.932)	(0.889)
Post	6.977***	6.977***	6.977***	7.820***	5.707***	7.820***
	(0.613)	(0.733)	(0.612)	(0.859)	(0.850)	(0.859)
Treat×Post×GVC						-0.301
						(1.288)
Post×GVC						-2.112*
						(1.208)
Controls	Yes	No	No	No	No	No
VC fund FE	No	Yes	No	No	No	No
Portfolio company FE	No	Yes	No	No	No	No
Fund-company FE	No	No	Yes	Yes	Yes	Yes
Sample	All	All	All	IVC	GVC	All
Mean of dep. var. (p.p.)	2.623	2.623	2.623	3.088	1.926	2.623
Observations	13,762	13,762	13,762	8,258	5,504	13,762
R-squared	0.055	0.515	0.515	0.517	0.512	0.516

Notes: This table reports the effects of the U.S.-China trade war on VC exits through IPOs in China. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is an indicator equal to 1 if and only if the portfolio company successfully goes public in the given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). *GVC* is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 10%. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A6: Effects of Trade War on Portfolio Companies' Follow-on Financing

Dependent variables: indicator of follow-on investment						
	Made by GVCs		Made by State GVCs		Made by Local GVCs	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×Post	2.616**	1.860	1.996***	1.570**	3.121***	1.491
	(1.032)	(1.155)	(0.620)	(0.619)	(0.987)	(1.082)
Post	-10.927***	-7.864***	-3.737***	-2.739***	-9.981***	-6.693***
	(0.900)	(0.994)	(0.511)	(0.514)	(0.859)	(0.926)
Treat×Post×Lagged Patent Applications		3.611**		1.806		5.863***
		(1.792)		(1.149)		(1.689)
Post×Lagged Patent Applications		-7.015***		-2.664***		-7.643***
		(1.568)		(0.871)		(1.542)
Controls	No	No	No	No	No	No
VC fund FE	No	No	No	No	No	No
Portfolio company FE	No	No	No	No	No	No
Fund-company FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of dep. var. (p.p.)	10.56	10.56	2.904	2.904	9.021	9.021
Observations	13,878	13,878	13,878	13,878	13,878	13,878
R-squared	0.601	0.606	0.509	0.511	0.593	0.599

Notes: This table reports the effects of trade war on startups' follow-on financing. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is an indicator equal to 1 if and only if the portfolio company receives a follow-on investment from a given type of VC funds in a given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). *Patents* is the log number of patent applications filed by the company during 2017 Q1 to 2018 Q2. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A7: Effects of Trade War on VC Investment (by GVC Types)

Dependent variable: indicator of VC investment				
	(1)	(2)	(3)	(4)
Treat×Post	-2.169***	-0.788	-0.073	-2.169***
	(0.227)	(0.655)	(0.498)	(0.227)
Treat×Post×GGP-GVC				2.096***
				(0.547)
Treat×Post×IGP-GVC				1.381**
				(0.693)
Post×GGP-GVC				0.137
				(0.314)
Post×IGP-GVC				0.736*
				(0.445)
Controls	Yes	Yes	Yes	Yes
VC-industry FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Sample	IVC	IGP-GVC	GGP-GVC	All
Mean of dep. var. (p.p.)	2.575	3.977	3.784	2.998
Observations	78,746	14,356	24,526	117,628
R-squared	0.130	0.116	0.132	0.127

Notes: This table reports the effects of trade war on VC investment in the high-/low-exposure industry group. A unit of observation is a VC fund-industry group pair in a given quarter between 2017Q1 and 2019Q4. The dependent variable is an indicator variable equal to 1 if and only if a VC fund makes any investment in the corresponding industry group in a quarter. $Treat$ is an indicator variable equal to 1 if and only if the industry group is highly exposed to the trade war. $Post$ is an indicator variable equal to 1 if and only if the quarter is after 2018 Q2. GVC is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. $GGP - GVC$ is an indicator variable equal to 1 if and only if the VC firm (GP) is founded by the government. The control variables include the fund's order under GP's management, the fund's portfolio size, an indicator of whether the fund has invested in manufacturing, and an indicator of whether the fund has invested in the high-exposure industry group. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A8: Effects of Trade War on VC Investment, by VCs' Success Experience

Dependent variable: indicator of VC investment					
	(1)	(2)	(3)	(4)	(5)
Treat×Post	-1.836***	-2.155***	-0.079	-0.259	-2.169***
	(0.487)	(0.262)	(0.781)	(0.477)	(0.227)
Treat×Post×GVC w/ success					2.047**
					(0.802)
Treat×Post×GVC w/o success					1.942***
					(0.526)
Post×GVC w/ success					-0.593
					(0.506)
Post×GVC w/o success					0.833***
					(0.313)
Controls	Yes	Yes	Yes	Yes	Yes
VC-industry FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Sample	IVCs w/ success	IVCs w/o success	GVCs w/ success	GVCs w/o success	All
Mean of dep. var. (p.p.)	1.878	2.756	3.014	4.143	2.998
Observations	15,854	62,470	9,796	28,912	117,628
R-squared	0.173	0.138	0.182	0.125	0.127

Notes: This table reports the effects of trade war on VC investment in the high-/low-exposure industry group. A unit of observation is a VC fund-industry group pair in a given quarter between 2017Q1 and 2019Q4. The dependent variable is an indicator variable equal to 1 if and only if a VC fund makes any investment in the corresponding industry group in a quarter. *Treat* is an indicator variable equal to 1 if and only if the industry group is highly exposed to the trade war. *Post* is an indicator variable equal to 1 if and only if the quarter is after 2018 Q2. *GVC* is an indicator variable equal to 1 if and only if share of government capital in the VC fund exceeds 20%. A VC firm is considered to have success experiences if it has exited successfully from any VC investment (through IPOs or M&As) between 2013Q1 and 2016Q4. The control variables include the fund's order under GP's management, the fund's portfolio size, an indicator of whether the fund has invested in manufacturing, and an indicator of whether the fund has invested in the high-exposure industry group. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A9: Effects of Trade War on Portfolio Companies' Innovation
(Local and Central GVC Intensities)

Dependent variable: Log patent applications					
	(1)	(2)	(3)	(4)	(5)
Treat×Post	0.079***	0.067***	0.079***	0.098***	0.054***
	(0.016)	(0.016)	(0.016)	(0.021)	(0.026)
Post	-0.179***	-0.188***	-0.188***	-0.221***	-0.132***
	(0.014)	(0.014)	(0.014)	(0.017)	(0.022)
Treat×Post×CGVC Intensity	0.009		0.008	-0.020	0.050**
	(0.015)		(0.015)	(0.020)	(0.024)
Treat×Post×LGVC Intensity		0.035***	0.032**	0.058***	-0.008
		(0.013)	(0.013)	(0.016)	(0.025)
Post×CGVC Intensity	-0.055***		-0.054***	-0.054***	-0.055***
	(0.011)		(0.011)	(0.015)	(0.018)
Post×LGVC Intensity		-0.024**	-0.021*	-0.039***	-0.011
		(0.011)	(0.011)	(0.013)	(0.014)
Treat×Post×VC Intensity	0.008	-0.012	-0.010	-0.030	0.017
	(0.013)	(0.013)	(0.014)	(0.023)	(0.021)
Post×VC Intensity	0.007	0.003	0.019*	0.048***	-0.011
	(0.010)	(0.010)	(0.011)	(0.018)	(0.014)
Fund-company FE	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	IVC	GVC
Mean of dep. var. (p.p.)	0.339	0.339	0.339	0.363	0.296
Observations	13,878	13,878	13,878	8,920	4,958
R-squared	0.799	0.798	0.800	0.805	0.789

Notes: This table reports the effects of trade war on portfolio companies' innovation. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is log number of patent applications in a given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). GVC Intensity (VC Intensity) is defined as the standardized log of total registration capital of active GVCs (VCs) divided by the total number of VC-backed companies within each city where the startup locates before the trade war starts. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and log registration capital. Robust standard errors, clustered by VC fund, are shown in parentheses. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table A10: Effects of Trade War on Portfolio Companies' Innovation
(Indicators of GVC Presence)

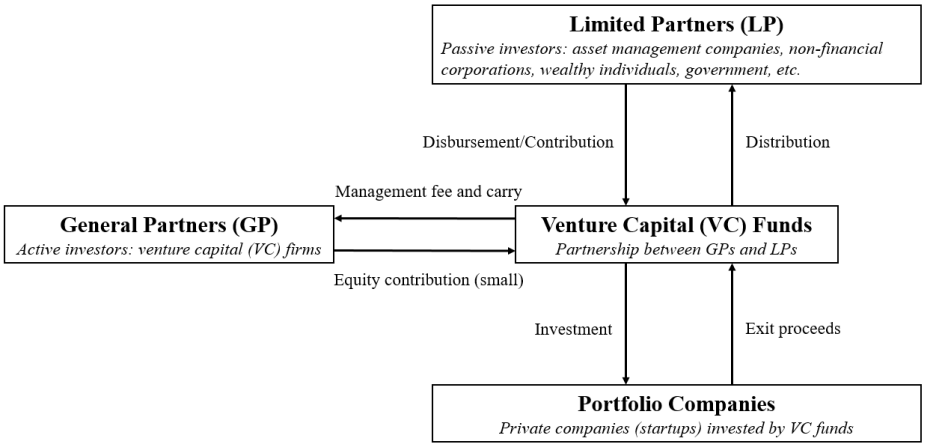
Dependent variable: Log patent applications								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	-0.079	-0.158	0.222*	-0.080	0.051	-0.070	-0.079	-0.022
	(0.087)	(0.105)	(0.129)	(0.081)	(0.035)	(0.083)	(0.099)	(0.142)
Post	-0.051	-0.030	-0.085	-0.046	-0.080***	-0.005	-0.010	0.038
	(0.071)	(0.087)	(0.089)	(0.071)	(0.025)	(0.071)	(0.085)	(0.117)
Treat×Post×Active GVC	0.150*	0.244**	-0.178					
	(0.090)	(0.109)	(0.135)					
Post×Active GVC	-0.131*	-0.184**	-0.040					
	(0.074)	(0.090)	(0.094)					
Treat×Post×Active CGVC					0.034	0.026	-0.033	0.122*
					(0.040)	(0.041)	(0.053)	(0.063)
Treat×Post×Active LGVC				0.151*		0.131	0.208**	-0.025
				(0.085)		(0.086)	(0.102)	(0.147)
Post×Active CGVC					-0.130***	-0.125***	-0.128***	-0.126***
					(0.030)	(0.030)	(0.039)	(0.047)
Post×Active LGVC				-0.137*		-0.082	-0.105	-0.068
				(0.074)		(0.074)	(0.087)	(0.125)
Treat×Post×VC Intensity	-0.002	-0.027	0.036**	-0.002	0.006	-0.002	-0.015	0.017
	(0.013)	(0.020)	(0.018)	(0.013)	(0.012)	(0.013)	(0.021)	(0.019)
Post×VC Intensity	-0.002	0.015	-0.022*	-0.002	0.002	0.007	0.024	-0.010
	(0.009)	(0.015)	(0.012)	(0.009)	(0.010)	(0.010)	(0.016)	(0.012)
Fund-company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	IVC	GVC	All	All	All	IVC	GVC
Mean of dep. var. (p.p.)	0.339	0.363	0.296	0.339	0.339	0.339	0.363	0.296
Observations	13,878	8,920	4,958	13,878	13,878	13,878	8,920	4,958
R-squared	0.798	0.803	0.789	0.798	0.799	0.799	0.804	0.789

Notes: This table reports the effects of trade war on portfolio companies' innovation. A unit of observation is a VC fund-portfolio company pair in a given period (pre or post). The dependent variable is log number of patent applications in a given period. *Treat* is an indicator variable equal to 1 if and only if the portfolio company belongs to the high-exposure industry group. *Post* is an indicator variable equal to 1 if and only if the observation is in the post-period (after 2018 Q2). *Active GVC* is defined as an indicator with value 1 if and only if the prefecture has any GVC activities between 2013Q1 and 2016Q4. VC Intensity is defined as the standardized log of total registration capital of active VCs divided by the total number of VC-backed companies within each city where the startup locates between 2013Q1 and 2016Q4. The control variables include the portfolio company's log registration capital and log number of patent applications prior to 2017Q1, and the fund's order under GP's management and

Appendix B A Brief Introduction of Venture Capital Market

Major participants in a typical VC market include VC firms, VC funds, limited partners, and portfolio companies (see Figure A3). VC firms are investment firms that focus on early-stage, high-potential startups. To organize its investments, a VC firm establishes a limited partnership contract (called a "VC fund") with external investors. Inside a VC fund, venture capitalists from the VC firm serve as the general partner (GP) that actively manages the fund, while external investors, such as financial institutions, non-financial corporate, wealthy individuals and government capital, participate as limited partners (LPs) that provide capital without involving in the fund's operations. A VC fund's portfolio companies are the startups that receive equity financing from the fund. In addition to contributing capital, a VC fund also monitors and supports the growth of its portfolio companies. A VC fund makes a profit by exiting its investments in the portfolio companies through IPOs or M&A's. The GP will receive a predetermined share of the profit, called carried interests (or carry), and the rest of the profit is distributed among the LPs.[28]

Figure A3: Structure of VC Market



Note: The figure presents the structure of the VC market. It is a replicate of Figure 1 in Da Rin, Hellmann and Puri (2013).

[28]See Da Rin, Hellmann and Puri (2013) for a detailed description.