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Does VC Investor Type Matter?
Determinants and effects of VC backing for new firms in Japan*

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Abstract

This study examines venture capital (VC) backing among new firms in Japan, exploring how the determinants and effects of VC backing vary depending on the VC investor type. We estimate the determinants of VC backing and find that new firms receiving investments from independent VCs tend to be larger, younger, and more innovative than non-VC-backed firms. However, the factors affecting investments from corporate, finance-affiliated, and government-funded VCs significantly differ from those affecting independent VCs. To explore the effect of VC backing, we construct a matched sample using propensity score matching. Furthermore, we estimate the average treatment effect of receiving VC investments to clarify whether new VC-backed firms achieve superior growth and innovation performance. The results indicate that investments from independent VC firms enhance the performance of new firms. However, we find no significant effect on new firm performance for other VC investor types.

Keywords: New firm, venture capital, VC investor type, firm growth, innovation, Japan.
JEL classification: L25, M13, G24.

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1 Introduction

Various studies have addressed the role of venture capital (VC) in the development of new firms, showing that VCs play a vital role in the growth process of new firms. While VCs tend to pick winners to maximize returns from their investments, they also have a coaching function for new firms (Colombo and Grilli, 2010). VC investors are heterogeneous. For example, the literature has discussed differences in behavior among VC investors, such as independent, corporate, and finance-affiliated VCs (e.g., Bertoni et al., 2013; Wang et al., 2002). However, which new firms are most likely to receive investments from VC investors, and what types of VC investors may help new firms perform better, remains underexplored. In addition, it is unclear how VC investors' investment decisions relate to the innovation activities of new firms and the impact of investments on innovation outcomes. Addressing these questions may provide some insights into the financing decision of new firms and the policy making of the government.

New firms promote competition in the marketplace and contribute significantly to innovation and productivity growth (e.g., Aghion et al., 2009; Wennekers and Thurik, 1999). In addition, young firms play a critical role in job creation (Haltiwanger et al., 2013). However, such firms face several challenges during their start-up phase. VCs may provide essential risk capital, supplying funds to new firms. However, new firms, especially high-tech firms, face severe financial constraints due to information asymmetry between companies and external finance providers (e.g., Carpenter and Petersen, 2002; Honjo et al., 2014). Consequently, new firms often cannot obtain the capital required for their activities. Due to imperfections in capital markets, supporting early-stage financing is crucial for developing new firms.

Japan provides a peculiar setting for research on new firms and VC investments. First, the start-up rate in Japan is relatively low, approximately 5 %, compared to other advanced countries such as the U.S. and the Netherlands. Global Entrepreneurship Monitor (GEM) reports show that total entrepreneurial activity levels in Japan are nearly the lowest among the countries surveyed (e.g., Honjo, 2015). Although the Japanese government has implemented numerous policies to promote entrepreneurship and support the growth of new firms, the start-up rate is sluggish, with very few high-growth firms called Gazelle. Second, the VC market is not well-developed in Japan. Although the Japanese VC market has been expanding in recent years, it is still small, roughly one-hundredth of the U.S. market and one-twentieth of the Chinese market in terms of transaction amounts. Although the direction of causality is unclear, the underdevelopment of the VC market in Japan seems to hinder the emergence and growth of new firms. Hence, a better understanding of the role played by various types of VC investors may help policymakers foster the development of new firms in countries with low levels of entrepreneurship, such as Japan.

This study identifies the determinants of VC investment in new firms differentiating by VC investor type. It examines whether new firms receiving VC investment perform better than those that do not. To this end, the study conducts empirical analyses using data from a unique panel dataset of new firms founded in Japan from 2012 to 2016, with data available up to 2021. This dataset includes firm-level financial data and information on growth and innovation performance, whether the new firm has received VC investment, the timing of VC investment, and VC investment type. The investment type includes independent and corporate VC investments, under-studied finance-affiliated VC, and government-funded VC investments. First, we show that the determinants of VC investment depend on the investor type by estimating a multinomial logit model. Then, following Chemmanur et al. (2014) and Colombo and Murtinu (2017), we employ a matching procedure to evaluate the treatment effect of receiving a specific VC investment on firm growth and innovation.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical foundation of this study and reviews the related literature. Section 3 describes the data and methods.

Section 4 presents empirical results. The final section discusses the implications and limitations of the study.

2. Background and related literature

2.1. Role of VC financing in new firms

New firms lack resources, experience, and track records; therefore, they face various difficulties associated with the liability of newness (Stinchcombe, 1965). In particular, it is not easy for new firms to raise capital. Adverse selection and moral hazard may occur due to the information asymmetry between new firms and external finance providers, such as financial institutions and investors (Stiglitz and Weiss, 1981). High-tech investments are not easy to evaluate and frequently embody new knowledge. Insiders have much better information than outsiders about the prospects of a firm's investments (Carpenter and Petersen, 2002). Hence, innovative firms may find external financing challenging. Previous studies show that new firms often face a funding gap at and after their founding (e.g., Colombo and Grilli, 2007; Honjo et al., 2014).

New firms tend to initially rely on funding from the founders or family and friends and acquire more funding options as they grow (Berger and Udell, 1998). VC financing is the form of equity financing currently best suited to address the capital market imperfections inherent in financing young high-tech companies (Carpenter and Petersen, 2002). VCs require a reasonable amount of time to efficiently carry out their initial screening of investments (Cumming and Johan, 2010). Generally, VCs target small companies with significant upside potential (Berger and Udell, 1998). Hence, VCs act as "scouts," aptly identifying future growth potential (Baum and Silverman, 2004). At the same time, VCs foster firms' growth by becoming deeply involved in their portfolio companies. Venture capitalists build close relationships with the entrepreneurs of the new firms they invest in, providing advice and guidance. Therefore, a new firm's ability to grow depends on the venture capitalist's abilities.

VC financing may be critical to the success of new firms. VC investors provide portfolio firms with various value-adding activities and the necessary financing (Bertoni et al., 2011; Colombo et al., 2010; Sapienza, 1992). In addition to providing capital and advice, VCs help the investee firm using their existing network of contacts (Cumming and Johan, 2010). Such a "coach" function by VC investors contributes significantly to the growth of portfolio companies (Bertoni et al., 2011; Colombo and Grilli, 2010). Further, VC investment may be a crucial signal of firm quality to a third party, providing a certification benefit that helps the new firm obtain resources (Baum and Silverman, 2004; Bertoni et al., 2011; Hsu, 2004).

The VC financing environment differs slightly in Japan compared to other countries. First, the scale of the Japanese VC market is small, approximately one-hundredth that of the U.S. market and one-twentieth that of the Chinese market in terms of the transaction amount. Second, as Figure 1 shows, the shares of VC investment in the seed, early, and late stages differ across countries. The share of VC investment in the seed phase in Japan is very high, more than twice that of the U.S. and Europe. In contrast, the share of VC investment in the early stage in Japan is not different from that in Europe but much higher than in the U.S. Conversely, the share of VC investment in Japan in the late phase is approximately the same as in Europe, but much lower than in the U.S. Third, the relative importance of VC investor types varies across countries. For instance, in the U.S., independent VCs dominate the VC industry. In other countries, including Japan, banks and securities firms have a more important presence in the VC industry (Hamao et al., 2000; Sun et al., 2013); many finance-affiliated VCs exist in Japan, such as Mizuho Capital, a subsidiary of Mizuho Bank, which has different investment objectives compared to independent VCs.

2.2. Different roles of VC investors

Different types of VC investors exist. First, independent VCs, as general partners (GPs), form investment limited partnerships called VC funds, collect funds from limited partners (LPs), such as business companies and institutional investors, and invest in unlisted firms. Independent VCs ultimately aim to maximize returns from their investments. For this purpose, independent VCs spend a great deal of time and effort scouting for new companies with high capabilities and growth potential. Studies have shown that factors such as founders' human capital, founding team, and intellectual property in new firms strongly influence VC investment (e.g., Baum & Silverman, 2004; Colombo and Grilli, 2010). New firms receiving investments from independent VCs not only receives funding, but also receives various coaching and can collaborate with related parties through the VC's own network.

Corporate VCs are structured as investment vehicles or business units of non-financial firms (Bertoni et al., 2013; Dushnitzky and Lenox, 2006). For example, the Sony Innovation Fund (SIF) in Japan is owned by Sony and invests in seed- and early-stage companies. Corporate VCs differ significantly from independent VCs in that they are funded by business companies. Corporate VCs have the strategic objective of acquiring new ideas and technologies rather than maximizing investment returns (Dushnitzky and Lenox, 2006). New firms receiving investments from corporate VCs may acquire complementary assets from the parent company providing funds, such as distribution channels that the VC firm does not have. Conversely, parents firms with corporate VCs as subsidiaries tend to achieve more innovation outcomes and higher valuations than those that do not have corporate VCs as subsidiaries (Chemmnanur et al., 2014; Dushnitsky and Lenox, 2005, 2006).

Finance-affiliated VCs have a strategic objective besides maximizing investment returns. Bank-affiliated VCs invest in new firms to increase the likelihood that their parent banks supply loans to the firm (Hellmann et al., 2008; Wang et al., 2002). Previous studies have shown that finance-affiliated VCs have the above strategic motive; hence, they avoid investing in young and small firms due to risk aversion (Bertoni et al., 2015; Wang et al., 2002). Some studies show that independent VCs add more value to new firms than finance-affiliated VCs (Sun et al., 2013; Wang et al., 2002).

Government-funded VCs firms complement the private VC market by investing in projects that cannot be pursued without public intervention (Grilli and Murtinu, 2015).[1] As a result, they are less risk-averse and invest in smaller firms than independent VCs (Grilli and Murtinu, 2014). It has also been noted that investments from government VCs have a "certification effect" and attract private VC investments (Grilli and Murtinu, 2015). However, government-funded VCs have limited involvement in coaching and value-adding activities (Colombo et al., 2016).

Captive VC firms (corporate, finance-affiliated, and government VC) owned by corporations, financial institutions (banks, securities companies, and insurance companies), and the government are strongly affected by the strategic goals of their parent organizations (Bottazzi et al., 2008). Previous studies show that captive VC firms behave differently than independent VC firms (Bottazzi et al., 2008; Hellmann, 2002; Hellmann et al., 2008).

Overall, the literature suggests that the reasons why a new firm receives investment from an independent VC firm differ from those of other VC investors. In addition, regarding the effect of VC investment on the performance of new firms, value-added activities, referred to as "hands-on" by independent VC firms, improve growth and innovation outcomes. However, the performance of new firms backed by other types of VC investors, subject to the strategic objectives of the parent organization, may not differ significantly from that of firms that do not receive VC investment.

[1] For example, government-funded VCs invest in projects that may not maximize investment return but have a positive social benefit to the community.

3. Data and method

3.1. Data

This study focuses on the first round of VC investment in new firms in Japan. Therefore, we need to collect data on new firms from the time of foundation. As a data source, we utilize the company database *Orbis* compiled by Bureau van Dijk (BvD), which covers many firms worldwide, including unlisted firms[2]. As of 2022, information is available from 2012 onward. There are some advantages to using this data source. First, while the coverage of *Orbis* differs across countries, it is relatively good for Japan. Corporate data are provided by a credit investigation company in Japan, which owns an extensive database of new and small firms. Second, this database allows linking company data to VC investment information provided by the same database company (BvD), with a unique identification number.

However, new holding companies are included when the sample is drawn based on the year of incorporation. Hence, firms featuring “holding” in the firm name are excluded from the sample. In addition, large firms are occasionally included as new firms. These companies are likely spin-offs from existing firms (subsidiaries or affiliated firms). To focus on new small companies, firms with sales of more than 1 billion yen or more than 1,000 employees in any year within three years of the year of incorporation and with more than 50 employees are excluded from the sample. As a result, we identify approximately 79,000 firms founded in Japan from 2012 to 2016, with data up to 2021.

We then merge these data with the VC investment information. We use VC investment data from *Zephyr* (compiled by the BvD) to verify whether new firms extracted from *Orbis* have received investments from VC firms. Based on the firms’ ID numbers, we identify the VC firms from which new firms receive investments (especially the first VC investment after their incorporation). However,

[2] We have considered using other databases. For example, there is a government statistic called the *Economic Census*, in which all firms, including new firms, are surveyed. However, this survey is only carried out every five years.

the coverage of VC investments from *Zephyr* in Japan is limited, partly because VC investment data capture information in English. To complement the information on VC investment from *Zephyr*, we use another data source, *STARTUP DB,* compiled by Startups Inc., which provides information on young firms in Japan (including VC investments) in Japanese.

Furthermore, we distinguish VC investments by VC investor type, such as independent, corporate, finance-affiliated, and government-funded VCs. However, no database provides comprehensive information on VC investor types. Therefore, we manually search several information sources to identify the investor type for each VC investment. For example, we search for information on VC investor type using *INITIAL,* compiled by Uzabase Inc., a publicly available web source. However, this data source provides no information on investor type for VC investments. In addition, while it provides information on VC investments from abroad, it does not include information on the VC investor type for foreign investors. Therefore, we collect further information on VC investors by accessing each company's official website. Different kinds of VC firms may syndicate VC investments. Although few, such cases are regarded as other VC investor types among VC-backed firms.

3.2. Determinants of VC backing

First, we estimate a logit model to identify the factors determining whether a new firm receives its first VC investment, using data on VC-backed and non-VC-backed firms. Next, we estimate a multinomial logit model to specify for each VC investor the determinants of whether a new firm received its first VC investment.

We use several variables related to the first round of VC investment. These variables are used as dependent variables in the model determining VC investment. First, we create a dummy variable (*VC*) that takes the value of one if the new firm receives VC investment in year *t* for the first time, regardless of the type of VC investor. Next, we create dummy variables that indicate whether the new firm receives investments from each VC investor type. We use a dummy variable that takes the value of one if a firm receives investment from independent VCs (*IVC*) in year *t*. Similarly, we use dummy variables that take the value of one if a firm receives investment from corporate VCs (*CVC*), finance-affiliated VCs (*FVC*), and government-funded VCs (*GVC*) in year *t*, respectively.

In addition, we create a dummy variable (*Captive VC*) by integrating investments from captive VC firms (corporate VCs, finance-affiliated VC, and government VC) owned by a corporation, a financial institution (banks, securities companies, and insurance companies), and the government. VC firms are strongly affected by their parent organizations' strategic goals (Bottazzi et al., 2008). Hence, this variable takes the value of one if the firm receives investment from these VCs in year *t*.

Firm-specific characteristics and other variables may also determine VC investments. First, firm size is included in the model. Several studies suggest that firm size, especially at the founding, is a crucial indicator of efficiency (e.g., Geroski, 1995; Geroski et al., 2010). Larger firms may operate efficiently, being closer to the minimum efficiency scale (Audretsch and Mahmood, 1994). In addition, larger firms may have substantial bargaining power in the product market and/or easy access to financing (Zingales 1998). Thus, firm size may affect the probability of receiving VC financing. We measure firm size as the logarithm of sales in year *t*-1 (Lagged size).

Second, previous growth is an independent variable affecting new firms' probability of receiving VC investments. Previous growth likely affects VC investment since growing fast may signal growth potential to external finance providers. As a result, venture capitalists may target new firms with high growth potential (Davila et al., 2003). We measure previous growth as the difference in the logarithm of sales between periods *t*-1 and *t* (lagged growth).

Third, firm age is included as an independent variable in the model, as it may affect the probability of receiving VC investment. New firms face the liability of newness (Stinchcombe, 1965).

Investing in younger companies may be risky for VC firms because their failure rate is exceptionally high (Levinthal, 1991). However, young firms grow faster (e.g., Coad et al., 2013). As a result, they have a higher probability of achieving radical innovation (e.g., Sørensen and Stuart, 2000). Hence, VC firms may earn higher returns by investing in younger firms. We measure firm age as the years since incorporation in period *t*-1 (Firm age).

Fourth, firms' previous experience with patent applications may affect the probability of receiving a VC investment. For new firms, patents are essential for protecting inventions and attracting customers and external capital providers (Cefis and Marsili, 2011; Holgersson, 2013). Patenting may also indicate a firm's growth potential to external stakeholders (Cotei and Farhat, 2018). Patenting is widely regarded as an entrepreneur's commitment to developing innovative ideas (Cefis and Marsili, 2011). Entrepreneurs without growth ambitions are unwilling to patent inventions since it takes time and resources to apply for patents, which require substantial examinations from patent offices. Under information asymmetry, patenting apprises potential lenders and investors, including venture capitalists, of a firm's technological capabilities (Audretsch et al., 2012; Conti et al., 2013; Hoenig and Henkel, 2015; Hottenrott et al., 2016; Hsu and Ziedonis, 2013; Veugelers and Schneider, 2018). Therefore, external capital providers value new firms with patents (Zhou et al., 2016). We measure previous experience with patent applications using a dummy variable equal to one if the firm experiences at least one patent application between the time of incorporation and period *t*-1.

Fifth, we use cohort dummies for different timings of incorporation since new firms founded in different years are included in the sample. Finally, we include sector dummies in the model (wholesale and retail trade, repair of motor vehicles and motorcycles, information and communication, real estate activities, professional, scientific, and technical activities, and administrative and support service activities).

Table 1 provides the definitions of the variables.

3.3. Performance effects of VC backing

Next, we investigate whether VC investments affect the performance of new firms. In line with previous studies (e.g., Caliendo and Künn, 2011; Chapman and Hewitt-Dundas, 2018), we resort to the potential outcome framework to estimate causal effects (Rubin, 1974). The proposed research question relates to how much sales growth and innovation are realized when the firm receives VC investment compared to the counterfactual situation of the same firm not receiving VC investment. This question can be illustrated as the average treatment effect on the treated (ATT), as follows:

$$E(ATT) = E(N^T|V = 1) - E(N^C|V = 1), \quad (1)$$

where V is the treatment status, V = 1 for the treatment group, and V = 0 for the control group. N^T refers to the outcome variable, and N^C is the potential outcome realized if the same firm has not been treated. However, N^C cannot be observed using nonexperimental data. Therefore, it is estimated from a control group that does not receive VC investment. However, estimating ATT by the difference in sub-population means of treated $E(N^T|V = 1)$ and non-treated firms $E(N^C|V = 0)$ generates selection bias. Therefore, we apply propensity score matching (one-to-one nearest neighbor matching) and rely on the conditional independence assumption (CIA), which states that conditional on observable characteristics, the counterfactual outcome is independent of treatment. This approach allows us to estimate the counterfactual outcome from a control group of non-treated firms that are similar in terms of their exogenous characteristics. We calculate the propensity score using a logit model, where the dependent variable is a dummy variable indicating whether a new firm receives VC investment. The independent variables are firm- and sector-specific characteristics affecting the probability of receiving VC investment. Based on the propensity score, we select a pair of treated firms (new firms receiving VC investment) and the closest firm from the control group (new firms not receiving VC investment).

To assess matching quality, we compare the balance of observable variables between the treated and non-treated firms. Tables A1 and A2 in the Appendix summarize the results. As shown in these tables, there is no significant difference in observable variables between treated and non-treated firms in the matched sample. In contrast, we observe significant differences in some of these variables for the pre-matched sample. Using a matched sample based on propensity score matching, we estimate the treatment effects of VC investment on firms' growth and innovation performance.

4. Results

4.1. Descriptive statistics

Table 2 shows the number of firms in the sample by sector, including the number of VC-backed firms by investor type. Among the 79,017 firms in the sample, 490 receive first-round VC investments during the observation period.

We address firms across all sectors in the sample. However, VC investment tends to concentrate on some sectors, such as information and communication (J), professional, scientific, and technical activities (M), and administrative and support service activities (N). This VC investment pattern is consistent with other countries. For example, a previous study based on data from Austrian firms shows that VC investment is more likely in knowledge-intensive business-related services, including software, IT services, and research and development (Peneder, 2010).

Regarding the differences among VC investor types (Table 1), the most significant number of investments is from independent VCs (239), followed by finance-affiliated VCs (96) and corporate VCs (67). Only 24 new firms receive investment from government-funded VCs. "Others" include cases where there is not enough information to identify the VC investor type or the firm receives syndicated investments from a fund co-created by various investor types. New firms receiving investments from these VCs are excluded from the analysis.

Figure 2 (a) and (b) show the number of firms receiving VC investment by observation year and firm age, respectively. As shown in Figure 2 (a), the number of firms receiving VC investment peaks around 2016–2018, regardless of the investor type. Figure 2 (b) shows how investment patterns change among VC investor types with firm age. The number of firms backed by independent VCs peaks a few years after their inception and then declines. In contrast, the number of firms backed by corporate and finance-affiliated VCs seems to peak in the fifth year after inception. However, we observe no such trend in the number of firms supported by government-funded VCs. This result suggests that independent VCs focus on seed or early-stage firms, while corporate or finance-affiliated VCs prefer early-stage or late-stage firms. This is consistent with previous studies suggesting that finance-affiliated VCs avoid young and small firms (Wang et al., 2002; Bertoni et al., 2015).

Table 3 provides the descriptive statistics and the correlation matrix of the variables used to analyze the determinants of VC backing.

4.2. Determinants of VC backing

Table 4 reports the determinants of VC backing in new firms. Column (i) shows the determinants of VC backing for any investor type. Firm age has a negative effect on VC, indicating that younger firms are more likely to receive investments from all kinds of investors. Previous patents positively impact VC investments, suggesting that firms with strong technological capabilities, such as those with patents, are more likely to receive VC investments.

Columns (ii)–(v) present the results for different VC investor types. First, we find that firm size positively affects the investment provided by independent VC (*IVC*) in column (ii). This result indicates that larger firms tend to be investment targets for independent VCs. In addition, firm age has a negative effect on *IVC*, indicating that younger firms are more likely to receive investments from independent VCs. Furthermore, previous patents positively impact *IVC*, meaning that innovative firms with patents are more likely to receive investment from independent VC firms. The results for captive VCs, such as corporate, financial, and government VCs, are shown in columns (iii)–(v), respectively. As indicated in column (iii), firm size has no significant effect on investments in *CVC, FVC,* and *GVC*. This result suggests that captive VC investors invest regardless of efficiency measures, such as firm size, because they have strategic objectives beyond expecting returns.

Previous growth has a negative effect on the *FVC*. This result implies that growing firms are less likely to receive investments from finance-affiliated VCs. For example, bank-affiliated VCs invest in new firms to increase their parent banks' chance to supply loans to the firm. Therefore, new firms struggling to raise capital may raise funds from finance-affiliated VCs to obtain loans from banks. Previous growth has no significant effect on the likelihood of new firms receiving investments from independent, corporate, or government-funded VCs.

Firm age has a negative effect on the probability of investment from independent VC firms, as shown in column (ii). This result indicates that younger firms tend to receive investments from independent VCs. They grow faster and achieve more radical innovation than older firms. Therefore, independent VCs may have a greater incentive to invest in riskier but younger companies to obtain a higher investment return. However, we observe no significant effect for investments from corporate- or finance-affiliated VCs or government-funded VCs.

As column (ii) shows, previous patents have a significant and positive effect on independent VC investments. In addition, the results in column (v) indicate that previous patents positively impact investment from government VCs. However, as shown in columns (iii) and (iv), there is no significant effect on investments from corporate and finance-affiliated VCs. The results indicate that independent

VCs target innovative firms and have high growth potential, since they aim to maximize returns from their investments. One possible interpretation of the finding that government VCs target innovative firms is that they intend to support firms that contribute to economic growth.

Overall, these results show that new firms receiving investments from independent VCs tend to be relatively large but young and apply for patents. In contrast, captive investors (corporate, finance-affiliated, and government-funded VCs) invest in new firms regardless of firm size and age. However, finance-affiliated VCs tend to invest in low-growth firms, while government-funded VC firms invest in new firms with patents. Hence, different VC investors invest in new firms based on different criteria.

4.3. Effects of VC backing

Table 5 shows the estimated ATT for the impact of VC investment when using firm growth (sales size in period t+1) as a performance measure. For comparison, the table also shows the difference in growth rates between the treated and control groups using samples before matching. Table 5 (a) shows the results when the VC investor type is not considered. While treated firms (firms that receive VC investment) exhibit slightly higher growth rates than non-treated firms (firms that do not receive VC investment), the difference is not statistically significant.

Tables 5 (b) and (c) report the estimation results of whether the growth performance of new firms invested by independent and captive VCs (corporate, finance-affiliated, and government-funded VCs) improve relative to non-treated firms. First, the ATT results obtained using the matched sample (Table 5b) show that the growth performance of new firms invested in by independent VCs significantly improves. Conversely, the ATT results obtained using the matched sample (Table 5c) show no evidence that new firms funded by captive VCs grow substantially more than non-treated firms.

Table 6 presents the estimated ATT for the impact of VC investment on innovation outcomes measured by the probability of patent applications in period t+1. Table 6 (a) shows the results when the VC investor type is not considered. In the pre-matched sample, the probability of patent applications for new firms that receive VC investments is higher than that for non-treated firms. However, we observe no significant difference between firms in the matched sample. This finding suggests that the effect of VC investment may be overestimated when VC investment selection is not considered.

Tables 6 (b) and (c) show that the innovation performance (whether patent applications are filed) of new firms invested by independent and captive VCs (corporate, finance-affiliated, and government-funded VCs) is significantly higher than that of non-treated firms. First, as shown in Table 6 (b), the ATT results in the matched sample indicate that the innovation performance of new firms receiving investments from independent VCs is significantly higher than that of non-treated firms. Conversely, regarding the effect of investment from captive VC, the results in the pre-matched sample show that VC-backed firms exhibit higher innovation performance than non-VC-backed firms. In contrast, the ATT results in the matched sample suggest no significant differences among these firms.

Overall, these results indicate that only investments by independent VCs improve the growth and innovation performance of the new firms in which they invest.

5. Discussion and conclusions

5.1. Summary and contributions

Using a unique panel dataset of new firms from Japan, this study identifies the determinants of VC investment in new firms by VC investor type and examines whether new firms receiving VC investment perform better than those that do not.

The study first shows that firm age and patent applications affect whether a new firm receives VC investment when VC investor type is not considered. Second, the determinants of VC investment in new firms tend to vary across VC investor types. We find that the factors affecting the probability of receiving investments from independent VCs differ significantly from those related to captive VCs, such as corporate, finance-affiliated, and government VCs. The likelihood of receiving an independent VC investment is higher when the new firm is larger, younger, and files a patent. However, the probability of receiving investments from captive VCs is less affected by these factors.

The study then constructs a matched sample based on propensity score matching to examine whether new firms' growth and innovation performance increase due to VC investment. Using the matched sample, we estimate the treatment effects of VC investment on firms' growth and innovation performance. The estimation results show that new firms do not perform significantly better after receiving VC investment when the VC investor type is not considered. In contrast, growth and innovation outcomes increase when independent VC investors back new firms. However, we observe no significant effect when captive VC investors, such as corporate, finance-affiliated, and government-funded VC, back new firms.

This study aims to determine which new firms receive investment from specific types of VC investors, and what effect VC investment has, by focusing on the different behavioral characteristics of each VC investor type. Doing so, the study contributes to the literature on new firms and VC investments in several ways. First, little evidence has been accumulated on different VC investors' criteria for investing in new firms. Although previous comparative studies address independent VCs and other VC investor types (corporate, finance-affiliated, and government VCs), very few studies analyze them together, and little is known about their differences.

Second, we clarify how VC investors' investment decisions are related to innovation activity (the criteria for VC investment and its effect on innovation outcomes). We find that the presence or absence of patent applications plays a vital role in new firms' investments by independent VCs. However, patent applications do not seem to play a significant role in the decisions of other VC investors. This study shows that independent VCs tend to enhance the innovation outcomes of new firms, unlike other VC investor types, suggesting that their value-adding activities are essential for developing new firms.

Third, the Japanese VC market is underdeveloped compared to other countries, such as the U.S., China, and Europe. Therefore, this study provides important implications for future government policies to promote VC investment in Japan and other countries with underdeveloped VC markets.

5.2. Practical implications

Some practical implications can be derived from this study. First, from the perspective of new firms, this study suggests that while receiving VC investment is a crucial post-entry milestone, subsequent outcomes may vary significantly depending on the type of VC investor. New firms often face difficulties due to the liability of newness; hence, they risk exiting the market. Their probability of achieving high growth and innovation outcomes may increase by receiving support from VCs early after entry. This study identifies various essential factors for receiving investments from different types of VC investors. For example, filing patent applications early in the post-entry stage is key to receiving investments from independent VCs, who engage in value-added activities.

This study has several policy implications. Governments support new firms in several ways. For example, in Japan, the government invests in VC through public and private funds (e.g., the Organization for Small and Medium Enterprises and Regional Innovation, Innovation Network Corporation of Japan). However, as previous studies have shown, while government VC investment serves as a call for private VC investment, its involvement in coaching and value-adding activities is limited (Colombo et al., 2016; Grilli and Murtinu, 2015). This study suggests that while government

VCs tend to invest in new firms with patents (i.e., picking winners), their involvement may not improve growth and innovation outcomes.

However, the government plays a vital role in creating an ideal environment for VC investment and providing direct support. This study suggests that investments in new firms by captive VC investors, such as corporate and finance-affiliated VC, may not have value-added effects on performance. In contrast, investment from independent VCs is likely to boost growth and innovation. Therefore, creating an environment that increases independent VC investment may be essential to promote economic revitalization through new innovative firms. Therefore, governments may need to consider policy measures to encourage independent VC investments. As discussed above, independent VC investors aim to maximize returns from their investments, unlike other VC investors. Therefore, creating an environment where independent VCs may quickly earn returns from their investment may be necessary.

In Japan, initial public offerings (IPOs) are the most common method of earning capital gains from VC investments, and the likelihood of realizing capital gains through M&As is very low[3]. The relatively low standards for conducting IPOs in Japan may explain this tendency. The time to exit is a key determinant of VC investment decisions (Espenlaub et al., 2015). Longer involvement results in higher costs. In the U.S., the costs to private firms to go public via IPO rather than to get acquired tend to rise over time (Bayar & Chemmanur, 2011). M&A as well as IPO is important as an exit route for VC firms (Smith et al., 2011; Amor & Kooli, 2020). Therefore, the government may need to focus on creating an environment that allows independent VCs to exit new firms through M&As to earn a quick return on their investment.

[3] One reason for the low number of exits via M&A may be that managers in Japan tend to prefer holding on to their businesses more than earning founders' profits from the sale of their companies (Coad and Kato, 2022).

5.3. Limitations and future avenues of research

Despite its contributions, this study has limitations. First, there may be concerns about the external validity of the study's results. For instance, this study focuses on newly incorporated firms in Japan; thus, it does not address sole proprietorships. In addition, the institutional context in Japan may differ from that of other countries, affecting the determinants and effects of VC investments. Further analysis using data from other countries may improve the current understanding of this topic.

Second, to analyze the performance effects of VC investments, we use the growth and innovation outcomes after one year of VC investment as performance indicators. However, measuring performance over a long period creates a survival bias since many new firms exit within one or two years after inception. In addition, new firms may try to signal the growth potential of their businesses to stakeholders, including investors, by showing high performance early on. Measuring short-term performance does not seem problematic. However, from the VC investor's perspective, the main goal is to earn a considerable return on investment through the realization of an IPO or M&A. In addition, captive VC investors, including corporate VCs, may privilege long-term investments. Therefore, future studies should examine the long-term effects of VC investments and clarify the impact of VC investment on exit routes for new firms receiving VC investments.

Third, since this study uses an extensive database of new firms in Japan, it exhibits less significant response bias and a higher number of observations than previous questionnaire-based studies. However, the information on new firms is limited, and this study does not consider founder characteristics (e.g., human capital). Further research considering founder characteristics may improve the current understanding of VC investment.

Finally, the limited number of observations for firms receiving investments from captive VC investors (due to substantial missing values in their financial information) does not allow disaggregating VC investor types in the proposed analysis of the effect of VC investments on the performance of new firms. Further research is required to investigate this issue in detail.

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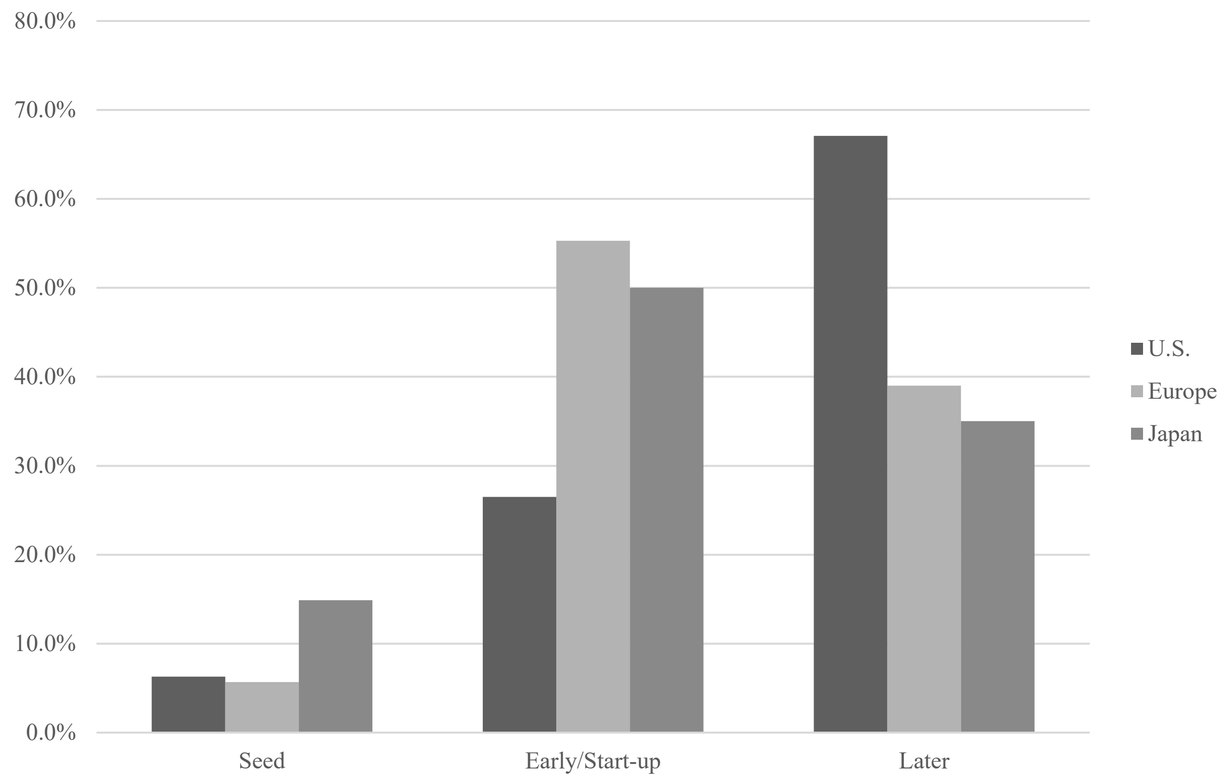
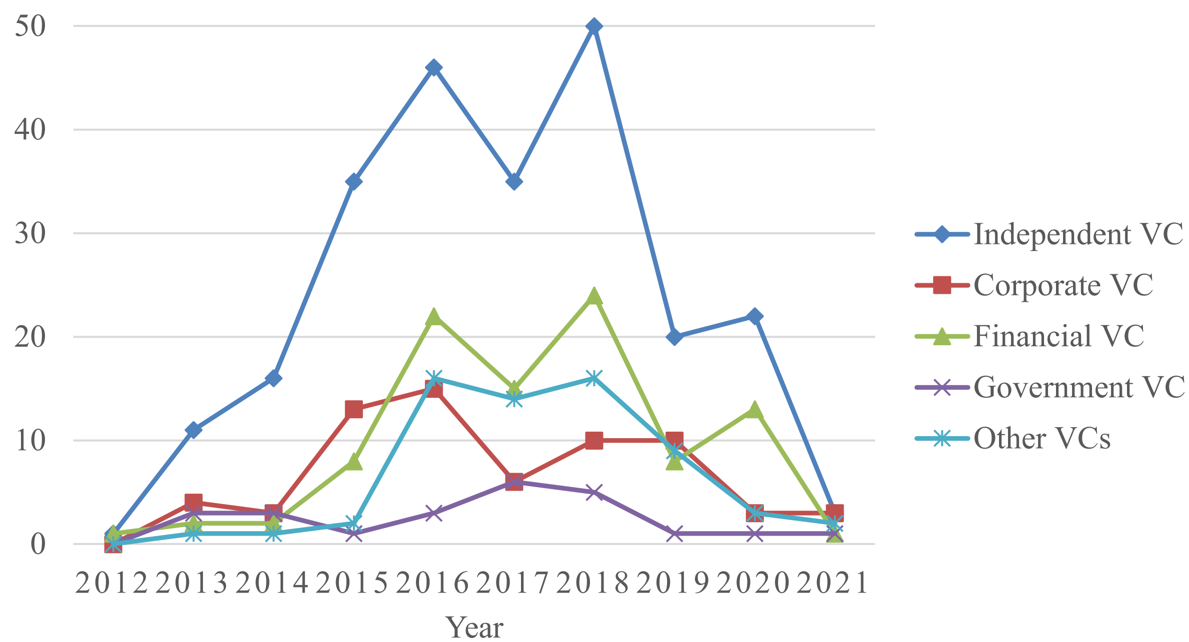


Figure 1. Share of VC investment by stage in the U.S., Europe, and Japan (2020).

Note: Figure for the Japanese later stage includes that for the expansion stage.
(Source: National Venture Capital Association Yearbook 2021 for the U.S.; Invest Europe, Investing in Europe: Private Equity Activity 2020 for Europe; Venture White Paper for Japan).

(a) **Occurrence of VC backing by observation year**



(b) **Occurrence of VC backing by firm age**

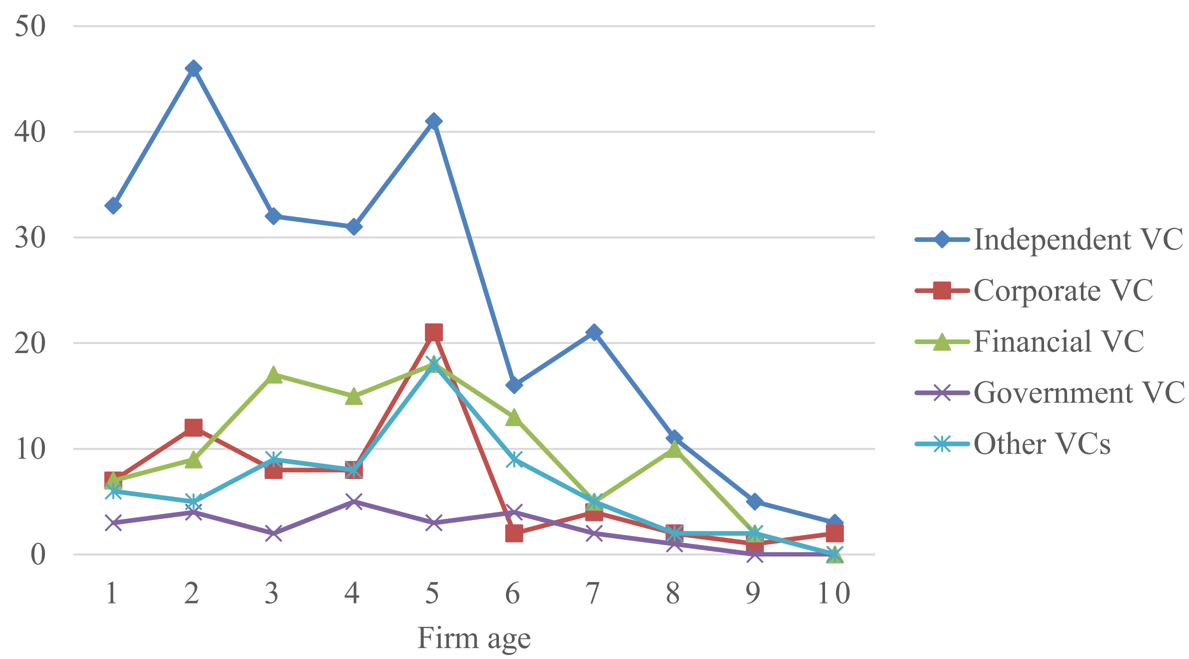


Figure 2. Occurrence of first-round VC backing according to investor type over time.

Table 1. Definitions of variables.

Variable	Definition
(VC backing)	
VC	Dummy variable: 1 if the firm is backed by venture capital firms in period *t*, 0 otherwise.
IVC	Dummy variable: 1 if the firm is backed by independent venture capital (IVC) firms in period *t*, 0 otherwise.
CVC	Dummy variable: 1 if the firm is backed by corporate venture capital (CVC) firms in period *t*, 0 otherwise.
FVC	Dummy variable: 1 if the firm is backed by finance-affiliated venture capital (FVC) firms in period *t*, 0 otherwise.
GVC	Dummy variable: 1 if the firm is backed by government venture capital (GVC) firms in period *t*, 0 otherwise.
Captive VC	Dummy variable: 1 if the firm is backed by captive venture capital firms (CVC, FVC, and GVC) in period *t*, 0 otherwise.
(Firm-specific characteristics)	
Lagged size	Logarithm of sales in period *t*-1.
Lagged growth	Differences in the logarithm of sales between periods *t*-1 and *t*.
Firm age	Number of years since incorporation in period *t*-1.
Previous patent	Dummy variable: 1 if the firm have experience of at least one patent application between the time of incorporation and period *t*-1.
(Other variables)	
Cohort dummies	Dummy variables for different years of incorporation.
Sector dummies	Dummy variables for different sectors (wholesale and retail trade; repair of motor vehicles and motorcycles, information and communication, real estate activities, professional, scientific and technical activities, and administrative and support service activities).
(Performance)	
Growth	Logarithm of sales in period *t*+1.
Innovation	Dummy variable: 1 if the firm applied at least one patent application in period *t*+1.

Table 2. Numbers of firms and VC-backed firms by the investor type.

Sector	*N* of firms	VC-backed firms					
		Any type	Independent VC	Corporate VC	Finance-affiliated VC	Government-funded VC	Other VCs
A - Agriculture, forestry and fishing	1,555	0	0	0	0	0	0
B - Mining and quarrying	30	0	0	0	0	0	0
C - Manufacturing	6,810	19	9	1	7	0	2
D - Electricity, gas, steam and air conditioning supply	512	2	2	0	0	0	0
E - Water supply; sewerage, waste management and remediation activities	460	0	0	0	0	0	0
F - Construction	24,285	21	10	1	4	1	5
G - Wholesale and retail trade; repair of motor vehicles and motorcycles	13,633	108	55	17	18	7	11
H - Transportation and storage	1,962	7	2	0	3	0	2
I - Accommodation and food service activities	2,632	17	9	3	1	0	4
J - Information and communication	3,467	81	39	11	19	3	9
K - Financial and insurance activities	917	13	9	0	2	0	2
L - Real estate activities	4,879	32	12	5	10	1	4
M - Professional, scientific and technical activities	6,611	66	29	9	12	4	12
N - Administrative and support service activities	5,197	93	42	16	18	6	11
O - Public administration and defence; compulsory social security	14	0	0	0	0	0	0
P - Education	546	5	2	1	1	1	0
Q - Human health and social work activities	3,360	12	8	2	0	1	1
R - Arts, entertainment and recreation	824	9	8	0	0	0	1
S - Other service activities	1,308	5	3	1	1	0	0
T - Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	15	0	0	0	0	0	0
Total	79,017	490	239	67	96	24	64

Table 3. Descriptive statistics and correlation matrix of variables (for the analysis of the determinants of VC investment).

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) VC	0.0007	0.026	1									
(2) IVC	0.0004	0.019	0.742**	1								
(3) CVC	0.0001	0.010	0.381**	0.000	1							
(4) FVC	0.0002	0.013	0.496**	0.000	0.000	1						
(5) GVC	0.00004	0.006	0.241**	0.000	0.000	0.000	1					
(6) Captive VC	0.0003	0.017	0.670**	0.000	0.568**	0.741**	0.359**	1				
(7) Lagged size	18.105	2.118	0.003	0.006**	-0.007**	0.004	-0.002	-0.002	1			
(8) Lagged growth	0.336	1.626	-0.002	-0.002	0.010**	-0.008**	-0.003	-0.001	-0.685**	1		
(9) Firm age	4.756	1.715	-0.002	-0.005	-0.004	0.006**	-0.001	0.002	0.243**	-0.173**	1	
(10) Previous patent	0.014	0.119	0.009**	0.010**	-0.001	-0.002	0.012**	0.003	-0.024**	0.013**	0.042**	1

Note: Number of observations is 105,022. ** p<0.01, * p<0.05.

Table 4. Determinants of probability receiving VC investment.

	Logit model	Multinomial logit model				Multinomial logit model	
Variable	(i) VC	(ii) IVC	(iii) CVC	(iv) FVC	(v) GVC	(vi) IVC	(vii) Captive VC
Lagged sales	0.111	0.449***	0.129	0.215	-0.092	0.449***	-0.079
	(0.090)	(0.146)	(0.249)	(0.202)	(0.141)	(0.146)	(0.074)
Lagged growth	-0.074	-0.071	0.259	-0.216***	-0.206	-0.070	-0.098
	(0.098)	(0.162)	(0.258)	(0.069)	(0.145)	(0.162)	(0.094)
Firm age	-0.170**	-0.379***	-0.267	0.269	-0.307	-0.379***	0.028
	(0.078)	(0.111)	(0.207)	(0.175)	(0.307)	(0.111)	(0.113)
Previous patent	1.019*	1.406**	-14.960	-15.320	2.884**	1.406**	0.297
	(0.523)	(0.616)	(4255.000)	(2992.000)	(1.230)	(0.616)	(1.026)
Constant term	-9.405***	-15.08***	-11.10**	-16.33***	-20.480	-15.08***	-8.127***
	(1.637)	(2.651)	(4.678)	(3.823)	(829.800)	(2.651)	(1.512)
Cohort dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	105,022	105,022				105,022	
Log pseudolikelihood	-533.833	-581.958				-569.764	
Pseudo R^2	0.071	0.107				0.084	

Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Average treatment effects on the treated: Growth.

(a) VC

Sample	Treated	Controls	Difference	S.E.	*t* value
Unmatched	18.977	18.644	0.333	0.207	1.610
ATT	18.977	18.859	0.118	0.309	0.380

(b) IVC

Sample	Treated	Controls	Difference	S.E.	*t* value
Unmatched	19.594	18.644	0.950	0.282	3.370***
ATT	19.594	18.802	0.793	0.383	2.070**

(c) Captive VC

Sample	Treated	Controls	Difference	S.E.	*t* value
Unmatched	18.253	18.644	-0.391	0.305	-1.280
ATT	18.253	18.308	-0.055	0.482	-0.110

Note: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Average treatment effects on the treated: Innovation.

(a) VC

Sample	Treated	Controls	Difference	S.E.	*t* value
Unmatched	0.058 (69)	0.007	0.051	0.010	5.170***
ATT	0.058 (69)	0.014 (69)	0.043	0.032	1.370

(b) IVC

Sample	Treated (38)	Controls	Difference	S.E.	*t* value
Unmatched	0.079	0.007	0.072	0.013	5.410***
ATT	0.079	0.000	0.079	0.044	1.780*

(c) Captive VC

Sample	Treated	Controls	Difference	S.E.	*t* value
Unmatched	0.032	0.007	0.025	0.015	1.730*
ATT	0.032	0.000	0.032	0.032	1.000

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix

Table A1. Mean comparison for pre-matched & matched samples: Growth.

(a) VC backed (treated) vs. non-VC backed firms (untreated).

Variable	Pre-matched sample			Matched sample		
	Treated (50)	Untreated (70568)	*p*-value	Treated (50)	Untreated (50)	*p*-value
Lagged size	18.364	18.102	0.405	18.364	18.275	0.847
Lagged growth	0.193	0.386	0.423	0.193	0.352	0.745
Firm age	4.560	4.483	0.738	4.560	4.500	0.867
Previous patent	0.060	0.015	0.010	0.060	0.080	0.697
Cohort1	0.320	0.221	0.092	0.320	0.440	0.219
Cohort2	0.200	0.189	0.849	0.200	0.120	0.278
Cohort3	0.160	0.181	0.699	0.160	0.140	0.781
Cohort4	0.220	0.300	0.219	0.220	0.160	0.447
Cohort5	0.100	0.109	0.843	0.100	0.140	0.540
Sector1	0.220	0.138	0.091	0.220	0.180	0.619
Sector2	0.260	0.051	0.000	0.260	0.220	0.641
Sector3	0.100	0.041	0.036	0.100	0.160	0.375
Sector4	0.100	0.084	0.683	0.100	0.120	0.751
Sector5	0.160	0.051	0.001	0.160	0.140	0.781

(b) IVC backed (treated) vs. non-VC backed firms (untreated).

Variable	Pre-matched sample			Matched sample		
	Treated (27)	Untreated (70,568)	*p*-value	Treated (27)	Untreated (27)	*p*-value
Lagged size	19.001	18.102	0.036	19.001	18.749	0.472
Lagged growth	0.197	0.386	0.564	0.197	0.007	0.517
Firm age	4.185	4.483	0.341	4.185	4.259	0.854
Previous patent	0.074	0.015	0.013	0.074	0.074	1.000
Cohort1	0.370	0.221	0.062	0.370	0.444	0.583
Cohort2	0.185	0.189	0.955	0.185	0.111	0.448
Cohort3	0.148	0.181	0.657	0.148	0.074	0.391
Cohort4	0.148	0.300	0.086	0.148	0.185	0.718
Cohort5	0.148	0.109	0.510	0.148	0.185	0.718
Sector1	0.259	0.138	0.067	0.259	0.259	1.000
Sector2	0.296	0.051	0.000	0.296	0.333	0.772
Sector3	0.074	0.041	0.390	0.074	0.111	0.642
Sector4	0.074	0.084	0.853	0.074	0.037	0.556
Sector5	0.148	0.051	0.023	0.148	0.148	1.000

(continued)

(c) Captive VC-backed (treated) vs. non-VC backed firms (untreated).

Variable	Pre-matched sample			Matched sample		
	Treated (23)	Untreated (70,568)	*p*-value	Treated (23)	Untreated (23)	*p*-value
Lagged size	17.615	18.102	0.294	17.615	17.840	0.799
Lagged growth	0.188	0.386	0.577	0.188	0.141	0.966
Firm age	5.000	4.483	0.127	5.000	4.609	0.436
Previous patent	0.043	0.015	0.271	0.043	0.174	0.160
Cohort1	0.261	0.221	0.646	0.261	0.174	0.480
Cohort2	0.217	0.189	0.733	0.217	0.261	0.732
Cohort3	0.174	0.181	0.929	0.174	0.174	1.000
Cohort4	0.304	0.300	0.961	0.304	0.261	0.746
Cohort5	0.043	0.109	0.315	0.043	0.130	0.301
Sector1	0.174	0.138	0.614	0.174	0.130	0.685
Sector2	**0.217**	**0.051**	**0.000**	0.217	0.261	0.732
Sector3	**0.130**	**0.041**	**0.031**	0.130	0.174	0.685
Sector4	0.130	0.084	0.422	0.130	0.087	0.639
Sector5	**0.174**	**0.051**	**0.008**	0.174	0.174	1.000

Note: '*p*-value' shows the results of significant tests for the mean difference between treated and untreated groups (*t* test for continuous variables and Wilcoxon rank-sum (Mann-Whitney) test for discrete variables).

Table A2. Mean comparison for pre-matched & matched samples: Innovation.

(a) VC-backed (treated) vs. non-VC-backed firms (untreated).

	Pre-matched sample			Matched sample		
Variable	Treated (69)	Untreated (104,953)	*p*-value	Treated (69)	Untreated (69)	*p*-value
Lagged size	18.361	18.105	0.316	18.361	18.267	0.784
Lagged growth	0.199	0.336	0.483	0.199	0.265	0.853
Firm age	4.609	4.756	0.475	4.609	4.841	0.468
Previous patent	0.058	0.014	0.003	0.058	0.014	0.366
Cohort1	0.275	0.208	0.170	0.275	0.319	0.578
Cohort2	0.261	0.184	0.098	0.261	0.319	0.455
Cohort3	0.145	0.180	0.444	0.145	0.145	1.000
Cohort4	0.217	0.310	0.096	0.217	0.101	0.064
Cohort5	0.101	0.118	0.678	0.101	0.116	0.785
Sector1	0.246	0.134	0.006	0.246	0.261	0.845
Sector2	0.203	0.049	0.000	0.203	0.203	1.000
Sector3	0.072	0.040	0.173	0.072	0.058	0.731
Sector4	0.130	0.087	0.197	0.130	0.058	0.147
Sector5	0.159	0.052	0.000	0.159	0.217	0.386

(b) IVC-backed (treated) vs. non-VC-backed firms (untreated).

	Pre-matched sample			Matched sample		
Variable	Treated (38)	Untreated (104953)	*p*-value	Treated (38)	Untreated (38)	*p*-value
Lagged size	18.786	18.105	0.048	18.786	18.608	0.574
Lagged growth	0.174	0.336	0.538	0.174	0.284	0.492
Firm age	4.316	4.756	0.113	4.316	4.474	0.669
Previous patent	0.079	0.014	0.001	0.079	0.132	0.458
Cohort1	0.342	0.208	0.042	0.342	0.289	0.624
Cohort2	0.211	0.184	0.670	0.211	0.211	1.000
Cohort3	0.132	0.180	0.434	0.132	0.132	1.000
Cohort4	0.158	0.310	0.043	0.158	0.132	0.746
Cohort5	0.158	0.118	0.440	0.158	0.237	0.390
Sector1	0.289	0.134	0.005	0.289	0.289	1.000
Sector2	0.237	0.049	0.000	0.237	0.263	0.792
Sector3	0.053	0.040	0.698	0.053	0.000	0.155
Sector4	0.105	0.087	0.684	0.105	0.158	0.500
Sector5	0.132	0.052	0.026	0.132	0.132	1.000

(continued)

(c) Captive VC-backed (treated) versus non-VC-backed firms (untreated).

	Pre-matched sample			Matched sample		
Variable	Treated (31)	Untreated (104,953)	*p*-value	Treated (31)	Untreated (31)	*p*-value
Lagged size	17.840	18.105	0.4859	17.840	17.444	0.6527
Lagged growth	0.230	0.336	0.7155	0.230	0.639	0.6693
Firm age	4.968	4.756	0.4923	4.968	5.290	0.5072
Previous patent	0.032	0.014	0.406	0.032	0.000	0.317
Cohort1	0.194	0.208	0.840	0.194	0.258	0.547
Cohort2	0.323	0.184	0.046	0.323	0.387	0.599
Cohort3	0.161	0.180	0.782	0.161	0.258	0.353
Cohort4	0.290	0.310	0.813	0.290	0.065	0.021
Cohort5	0.032	0.118	0.140	0.032	0.032	1.000
Sector1	0.194	0.134	0.333	0.194	0.290	0.378
Sector2	0.161	0.049	0.004	0.161	0.258	0.353
Sector3	0.097	0.040	0.109	0.097	0.065	0.644
Sector4	0.161	0.087	0.140	0.161	0.065	0.232
Sector5	0.194	0.052	0.000	0.194	0.129	0.493

Note: '*p*-value' shows the results of significant tests for the mean difference between treated and untreated groups (*t* test for continuous variables and Wilcoxon rank-sum (Mann-Whitney) test for discrete variables).