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## Positive effects of portfolio financing strategy for startups

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## ABSTRACT

Based on the startup investment database, we empirically examine the positive effects of a portfolio financing strategy for startups. It is known that some investment banks or venture companies have supplied risky and patient capital to U.S. startups of all financial corporations. They provide differentiated debt financing to startups who already received equity financing and invest more in equity when the startup is younger. Empirical analysis shows that the core risk management is to have a dynamic financing ratio between equity and debt as well as varied equity cost of capital, lending rate and investment horizon based on the age, technology, and financial soundness of a startup. We also find that optimal portfolio financing strategy can help startups raise funds with ease, but also it provides investors with higher expected return on investment, which can facilitate financing for startups and furthermore small and medium enterprises.

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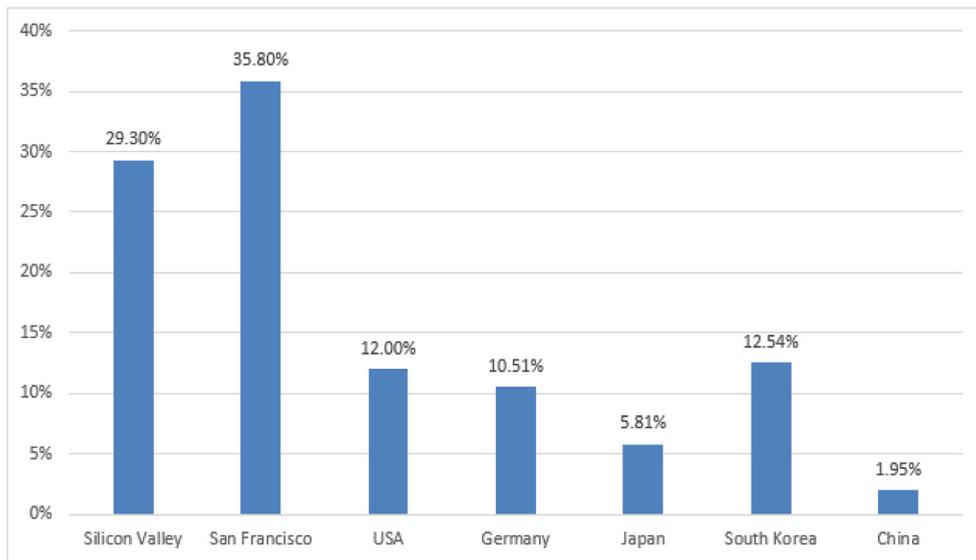
## 1. Introduction

Startups play a significant role in economic growth. First, they create many jobs in various industries. If a startup drives technological innovation, new industries are created, resulting in various new jobs. After David Packard and William R. Hewlett set up their audio oscillator business in Silicon Valley in 1939, radio and telegraph technology grew rapidly, providing jobs to many young people. Over the years, innovative startups have emerged in the semiconductor and information technology industries, such as Apple, Facebook, Google, IBM, Microsoft, and Uber. Furthermore, as a startup grows into a large company, it also inspires workers to establish their own startups by taking inspiration from entrepreneurs who have already experienced success. Simply put, just as startups create jobs, an entrepreneur with a created job establishes a new startup, causing a positive feedback loop in job creation. As shown in Fig. 1, the job growth in Silicon Valley and San Francisco rose by 30%–35% from 2010 to 2018, which is much higher than the average job growth rates of the USA, Germany, Japan, South Korea, and China.

Second, startups help to increase total factor productivity (TFP), which is usually measured through technology innovation, or the portion of output growth not explained by the measured inputs of labor and capital. Harada (2004) investigated Japan's small firms and showed that an entrepreneur's age and experience before creating a startup affects TFP negatively and positively, respectively, implying that young startups can contribute to productivity. Erken et al. (2018) analyzed the data of 20 Organisation for Economic Cooperation and Development countries and found a positive relationship between TFP and entrepreneurship. Cardarelli and Lusinyan (2015) explained the USA's slowdown in TFP

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**Fig. 1.** Job growth during 2010–2018 in different regions.  
 Source: Statista.com, Silicon Valley, Indicator.org.

based on the decline in the number of young startups. They found that the proportion of young firms – those aged less than 5 years – decreased from 52% to 37% over 1982–2011, with TFP proportionally decreasing during that period.

Third, startups efficiently utilize resources by accessing both “risky” and “patient” capital. Startup entrepreneurs can raise risky capital through the capital markets. In the early stages, startups can raise long-term (patient) capital in the private market. If a startup shows the potential to scale up, entrepreneurs are likely to raise more capital in the next stage of investment. After entrepreneurs exit a merger and acquisition (M&A) or initial public offering (IPO), they usually invest in other startups or create a different startup with a new business model. Startup entrepreneurs who acquire a lot of capital, technology, and information are able to allocate economic resources more efficiently.

Although startups play a central role in facilitating economic growth, they usually face liquidity constraints. Venture capital is an important funding source for startups that do not have access to capital markets. Moreover, startups must secure an appropriate amount of capital for driving growth. The issue of financing startups has, therefore, attracted much interest in the literature on finance, entrepreneurship, and management. Many theoretical studies suggest that equity financing can address the financing challenges faced by startups with negative cash flow, few tangible assets, but high growth potential. In line with the pioneering work of [Jensen and Meckling \(1976\)](#), the literature on capital structure has used agency models to show that a firm’s reliance on debt increases with the level of free cash flows and decreases with growth opportunities and the cost of investigating the firm’s prospects. Corporate finance literature provides further theoretical arguments for the dominance of equity financing over debt financing from the perspective of startups ([Berger and Udell, 1998](#); [Carpenter and Petersen, 2002](#); [Tykvová, 2007](#); [Winton and Yerramilli, 2008](#)). Meanwhile, venture debt, defined as loans to high-growth startups at the pre-revenue stage, is a rapidly emerging field of study whose findings contradict the traditional corporate finance literature.

In the past, startups were difficult to finance with debt, since startups had a low portion of tangible assets that can be used as a collateral. Nowadays, venture debt defined as loans to high-growth startups at the pre-revenue stage have emerged rapidly. [Chua et al. \(2011\)](#) introduces an increasing trend in debt financing for venture related to family involvement. In the mid-to-late stage of the venture’s growth stage, startups have an incentive for large-scale debt financing. [Rassenfosse and Fischer \(2016\)](#) states that startups have valuable intangible assets that are tradable in the market, and startups can offer a warrant option to venture debt lenders in return for lending money for a long investment horizon. Although the volume of venture debt is growing rapidly, there are not many academic studies related to venture debts. This paper is the first study to show why the venture debt is important to the growth of startups and how the venture debt financing affects startups profitability.

This paper is organized as follows: First, we examine why both venture debt and venture capital are needed for startups, paying attention to the different aspects of both financing vehicles, because many startups still suffer from liquidity constraints. Then, we will consider some of the issues that startups grapple with in acquiring venture debt. This will be followed by an examination of Silicon Valley Banks (SVBs), among the many active venture debt providers. This analysis may provide, in some instances, implications for Asia, which faces difficulties in developing a well-functioning ecosystem of the venture capital and venture debt industry. The final section concludes the study.

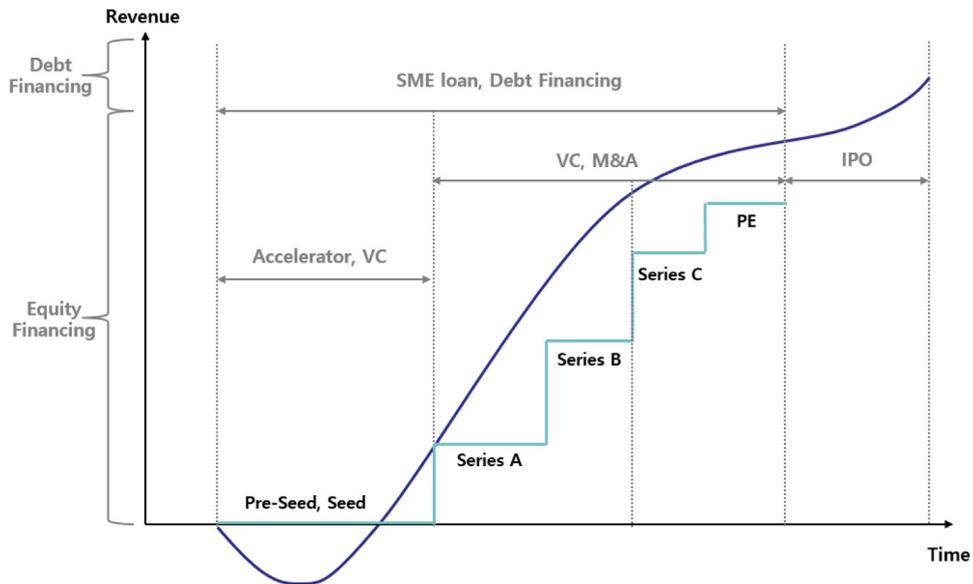


Fig. 2. Startup's life-cycle funding scheme.  
Source: Lee (2019).

## 2. Theoretical background for venture debt

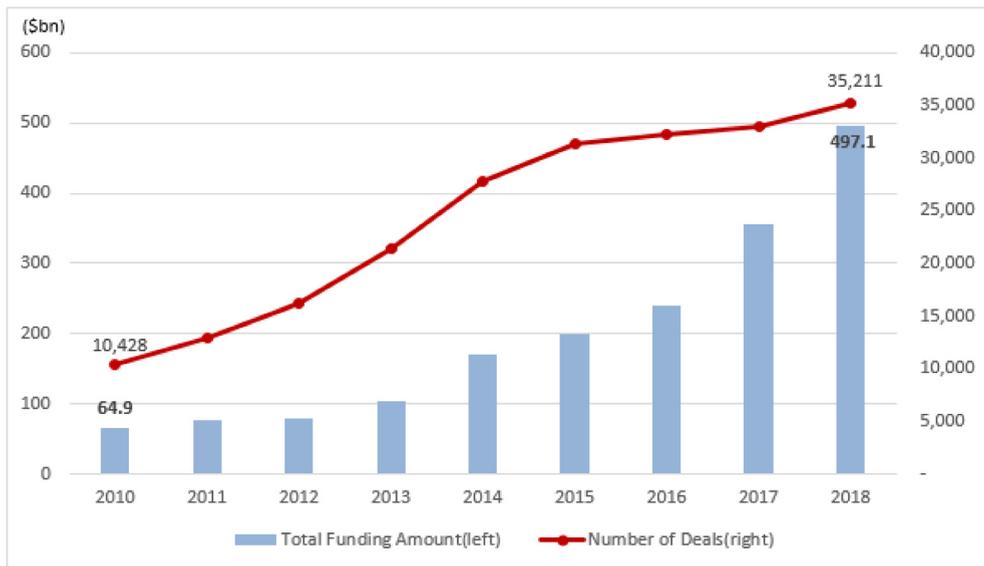
In the very early stages of investment, such as the seed or pre-seed stages, many startups find it necessary to borrow a small amount of seed money from friends, relatives, and angel investors, while preparing a business plan or developing a prototype for the product. After startups have developed a business plan, they seek investment from a venture capitalist (VC). At the Series A stage, the business plan should set a demonstrable risk-reducing milestone, such as having a working product ready for production. In the first round of venture capital financing, the company should try to raise sufficient capital to fund product development. At the next stage of Series B, as startups begin to run out of cash, they may seek a second round of venture capital to start working toward the next milestone in the company's business plan. As the company grows, they may seek additional rounds of venture capital to reach new milestones.

If a startup exhibits the potential for long-term growth or high profits, many investors will be interested in investing in the firm's equity; however, only 5% of seed-funded startups typically exit via an M&A or IPO. Venture capitalists and accelerators aggressively invest in promising startups, because the expected return on exit is much more than 20 times. In the early stages, such as Series A or Series B, VCs usually invest in startups to promote scale-up. In this stage, the expected return on equity (ROE) investment is lower than that at the very early stage of investment (seeding stage). However, the probability of exit with an M&A or IPO is increased, and there is less time until exit compared to the seeding stage. In the late stage of VCs, such as Series C or private equity (PE), the expected ROE investment is much lower than at the seeding stage or the early stage. Instead, the probability of exit becomes even higher, with more right to claim the remaining assets after liquidation (see Fig. 2).

Due to startups' positive effects on economic growth, global investments in the private market are rapidly growing. According to Fig. 3, the global VC-backed funding in startups amounted to 497.1 billion US dollars (USD), more than seven times higher than in 2010 (CAGR: 28.9%). In the same period, the number of deals increased 3.4 times from 10,428 to 35,211. Startup investments comprise most of the investments in the private market. Pre-seed or seed investments account for 41.7% of the total investment in the private market. The total exit amount of M&As and IPOs has also rapidly increased; in 2018, it was about 127.6 billion USD, which is more than double the exit amount of M&As or IPOs in 2010. Summarily, the more active the M&A and IPO markets, the greater the initial investment in startups that can be expected.

Venture debt (loan) refers to any debt instrument that meets a start-up's funding needs; it is an additional source of funds generally provided by banks or dedicated venture debt firms that complements equity financing. Although venture debt is available to startups that do not meet the traditional loan conditions imposed by debt providers, it is generally considered to be a non-traditional source of growth capital for startups. By contrast, venture debt providers with different lending models are willing to support startups with negative cash flow, to seek higher returns on debt investment.

In literature, it is widely accepted that startups rely heavily on equity financing because of the unpredictability of success. This traditional assumption results from the incompatibility between traditional debt providers and their risk-averse nature and startups with their relatively higher risk of failure. Traditional debt providers such as banks generally lend based on a borrower's repayment capacity, that is, their sources of loan repayment. When banks screen their



**Fig. 3.** VC-backed funding amounts.

Source: Crunchbase.

borrowers, they are highly cautious about making new loans, to avoid potential losses owing to borrowers' defaults. Therefore, they require borrowers to satisfy the loan repayment standards, which serve to mitigate the funding risk, prior to approving a loan.

As expected, startups in the early stages of growth are typically unable to meet these criteria because of a lack of future cash flows or liquid tangible assets. Consequently, debt providers are unable to evaluate the creditworthiness of startups. Therefore, startups represent a risky investment opportunity, albeit with higher expected returns on investment. Unlike VCs, debt providers cannot take on many loan defaults, because the yields on loans repaid from other debt deals could be insufficient to offset the incurred loan losses. Venture capitalists can take on higher risk because of the multiple returns generated by successful investments; consequently, they can afford to have a majority of the firms in their portfolio fail, owing to the oversized returns in the case of successful firms.

Traditional lenders primarily care about the future cash flow of a borrower, as this is the main source to service the borrower's debt. Therefore, banks are keen to estimate a borrower's future cash flow during the due diligence process of loans. In addition to positive cash flow, lenders require the borrower to possess tangible assets, such as real estate and equipment or inventory, which can be used as collateral to secure loan repayment. In summary, startups do not satisfy the requirements of traditional banks because they lack a proven track record, positive cash flow, or tangible assets. Furthermore, due to the high probability of startups' default, it is unlikely that its founders will offer any personal guarantees in return for debt. Consequently, it is very rare for startups to receive debt funds. Therefore, it is critical for startups to attract more equity investment to establish their creditworthiness.

Venture debt was introduced in the 1960s in the USA via specialized equipment leasing companies that offered leasing options for technology startups that were not eligible for traditional bank loans. Venture debt, therefore, was structured as a venture lease for purchasing specific equipment. Particularly, venture leasing emerged to satisfy the needs of hardware manufacturers, especially semiconductor companies. Venture debt began to evolve in the 1990s, when traditional leasing companies observed substantial growth in the life science and IT industries as new business opportunities. Today, venture debt seeks to back high-growth startup companies. However, firms providing venture debt tend to charge higher interest rates compared to traditional banks, to compensate for the higher risk inherent in venture debt financing.

Unlike traditional lenders, venture debt providers assess the creditworthiness of startups by using different criteria that substitute for positive cash flow and liquid tangible assets. In other words, venture debt firms typically provide debt to startups that are already backed by VC companies. The engagement of VCs in financing startups plays a crucial role throughout the venture lending process. Venture capital is one of the critical determinants of startups' creditworthiness.

From the perspective of venture debt, venture capital serves as a primary source for debt repayment. In other words, the capital provided by VCs in future equity rounds substitutes for negative cash flow. Venture debt providers lend based on the probability of follow-on equity investment, either from existing or new investors. Typical lending transactions involve informational asymmetries between informed intermediaries, VCs, uninformed outsiders, and debt providers. The provision of venture capital signals to the lender that the VC has strong incentives to monitor and guide the startups.

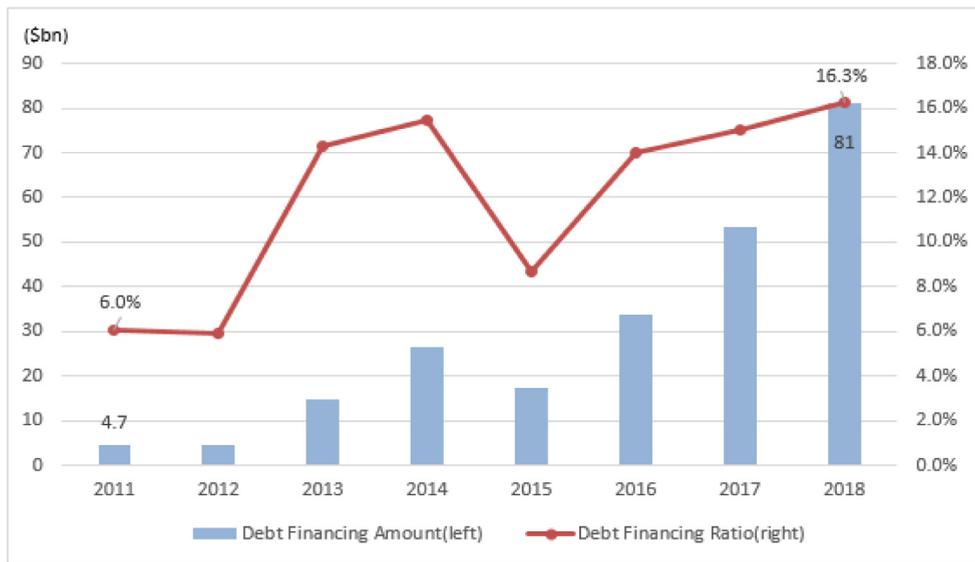


Fig. 4. Debt financing amount in the private market.  
Source: Crunchbase

### 3. Portfolio balancing strategy: Case study of Silicon Valley bank

In addition to equity financing, the number of investors who invest in startups through debt financing is steadily increasing. As shown in Fig. 4, in 2018, the total amount of debt financing in the private market was 81 billion USD, an increase by 17 times compared to 2011. The more risk averse a startup is, the more desirable debt investment is – given the lower risk and lower expected return – compared to equity investment. Debt financing can be helpful for startups. With debt investment, startups can borrow money at a low cost for longer periods than with equity financing. Hence, large commercial banks, investment banks, and private debt funds have been lending to startups. Interestingly, some special investment companies have implemented portfolio financing strategies for startups. Among them, SVB is a leading investment company that uses a portfolio investment strategy with equity investment and debt financing. Portfolio investment companies for startups can benefit from both equity and debt financing.

SVB was established in 1983 and was listed on NASDAQ in 1987; since then, it has helped fund more than 30,000 startups. After witnessing the growth of Silicon Valley in the early 1980s, Roger Smith (the first CEO of SVB), Bill Biggerstaff, and Robert Medearis (Stanford professor) established SVB and opened its first office in San Jose, California, starting off as a state bank. SVB provides financial services mainly to high-tech startups in Silicon Valley in the USA, as well as venture capital and PE. Many successful startups are known SVB customers, such as Airbnb, Uber, and Twitter. SVB continues to communicate with startups, VCs, and PEs, which can be seen as companion financial firms providing the necessary financial services to startups.

SVB has also invested in equity through a subsidiary, SVB Capital. SVB Capital has provided equity funding in different stages of investments, such as pre-seed, seed, Series A–D, and PE. In addition to lending and venture capital services, SVB provides PE and private banking services to individuals with high net worth. At the end of 2018, SVB's clients accounted for 50% of all venture capital-backed tech and life companies in the USA and 67% of U.S. venture capital-backed companies with an IPO in 2018. Recently, SVB has expanded its business worldwide—it has 20 offices in the United States and nine offices in Canada, China, Germany, India, Israel, and the United Kingdom.

The SVB Financial Group seeks to establish a portfolio financing strategy comprising both debt and equity financing. In principle, SVB provides debt financing to startups that receive equity financing from SVB Capital or prominent VC firms. When the startup is young with the potential for growth, SVB Capital invests more in equity. When startups experience scale-up with long-term sustainability, SVB Capital reduces the equity investment and increases debt financing instead. Since SVB owns the collateral of the startup, it is possible to claim the remaining assets in case the startup faces liquidation.

SVB's business model is different from that of other financial groups that own commercial banks and venture investment companies as affiliates. The Korea Development Bank (KDB) can undertake both lending and venture investment, while the Korea Credit Guarantee Fund (KODIT) can provide both equity and debt financing to a company. However, KDB and KODIT find it difficult to provide both equity and debt financing to the same company. The Korea Banking Act and Financial Investment Services and Capital Markets Act do not allow a financial company to lend money to a firm that has already been invested in by that financial company or its affiliates. For example, KDB and KODIT can provide equity financing to Samsung Electronics and provide debt financing to Hyundai Motors, but KDB cannot provide both equity

**Table 1**

Major VC and PE exit ratio.

Source: Authors' calculation, svb.com, Crunchbase.

	SVB	Accel	Andressen Horowitz	Benchmark	Sequoia Capital	Tiger Global
Number of exits	197	285	123	153	268	61
Number of investments	582	1365	747	590	1293	388
Exit ratio	34%	21%	16%	26%	21%	16%

financing and debt financing to Samsung Electronics. Additionally, SVB's model is distinguished from that of banking groups that own venture investment companies as a subsidiary. In general, the money that can be loaned is subject to a certain limit, especially for firms owned by affiliates. However, the SVB can provide portfolio financing and implement a rebalancing strategy between equity and debt financing.

The ability to select technologies and firms that can be commercialized out of numerous ideas from research institutes and laboratories is a comparative advantage over banks. SVB has developed a network through long-term financial transactions with VC and PE firms, using various strategies to secure excellent venture investment deals based on information. Venture firms with initial capital investment by top-tier VC or PE firms not only demonstrate some technical skills and growth potential, but also have a high probability of subsequent investment. In this regard, SVB provides loans to startups already backed by VCs. Normally, startups are unlikely to receive loans because they do not have stable cash flow or collateral before they earn full profits from their business. The most representative product of SVB's business model is "venture debt", which is working capital for startups firms that have already received initial investment from a VC. It is a loan that is provided for funding equipment purchases and is repaid with the funds obtained through subsequent capital investments.

Through this business model, startups limit the dilution of stock value from additional capital infusion; consequently, they can secure low-cost funds. Venture capital and PE will enable the stable growth of VC-funded firms with lower investment costs, and banks will be able to lower their risk of making loans to venture firms. This trilateral collaboration is beneficial for all parties—VC, PE, and SVB. In this trilateral collaboration, there is a cooperative relationship between VC, PE, and SVB, which is different from other financial institutions, such as traditional banks.

Table 1 shows the summary statistics of the exit ratios for major venture companies. SVB's exit rate, 34% (= 197/582), is the highest among investment companies in the USA, even after including top-ranked VC companies such as Sequoia Capital, Tiger Global Investment, Andressen Horowitz, and Benchmark. Based on the outstanding performance of exits, the ROE of SVB has risen sharply in recent years. SVB's average ROE in the last three years is approximately 21%, which is twice the average ROE of all commercial banks in the USA.

#### 4. Success factors of portfolio balancing strategy

The first success factor of portfolio financing strategy is a dynamic rebalancing between debt and equity financing. The portfolio financing strategy has the advantages of both debt and equity financing. Traditionally, one financial corporation cannot provide both bank loans and equity investments because of conflicts of interest. Since the 1933 Glass–Steagall Act was introduced, all investment banks and commercial banks were separated from one body. The U.S. 1956's Bank Holding Act allows the banking group to own a security company as an affiliate or a subsidiary. Regulations of information sharing between affiliates were strong under the 1956 Bank Holding Act. Since the deregulation had spread in 1908, the 1999 Gramm–Leach–Bliley (GLB) Act, known as the Financial Services Modernization Act of 1999, was introduced and the barriers of commercial banks, securities companies (investment banks), and insurance were removed. However, a global financial crisis occurred in 2008. To prevent its recurrence, the Dodd–Frank Act was adopted in 2010; the Act limits universal banking from being performed by both commercial and investment banks in one body. Currently, a bank owns an investment company as an affiliate or a subsidiary, and the financial group run a separate business for both debt and equity financing, with internal controls to prevent conflicts of interest. The SVB financial group is an example of portfolio financing that arranges both debt and equity financing.

The advantage of debt financing for investors is that it prioritizes the remaining assets of a firm over equity holders if a firm liquidates. Debt investors efficiently manage the risk of firm default probability. The higher the default probability of a firm, the more secure the collateral or the higher the interest rates the financial company will be. In addition, debt investors can maintain their long-term business strategy based on the relationship model with a firm. The advantage of equity financing for investors is that they expect high returns compared to the initial value of the investments. If the investing company exits through M&A or IPO, equity investors can achieve a 100 times higher return on investment. Moreover, equity investors can effectively monitor a company's management status.

The advantage of debt financing is the disadvantage of equity financing, and vice versa. For example, debt investors can minimize their losses, but they cannot expect a high return on investment. Similar equity investors can anticipate huge profits, but they are at risk of losing all of their investment. Hence, a mixture of both debt and equity financing can lead to more benefits than choosing only one financing strategy. The SVB has properly integrated financing strategies including debt (commercial banking model) and equity financing (venture capital investment).

**Table 2**

Exit ratio by the investment method (2010~2019).

Source: Authors' calculation, svb.com, Crunchbase.

	Seed investment	Equity only financing	Portfolio financing
Number of investment deals	101,580	145,536	10,635
Number of exits	6566	14,476	2165
Exit ratio	6.5%	9.9%	20.3%

**Table 3**

Summary statistics of investment deals at each stage (2010–2019).

Source: Authors' calculation, svb.com, Crunchbase.

	Seed stage	Series A–B	Series C–J	Debt financing
Average funding rounds	2.93	3.91	6.74	5.34
Average funding amount	16.9k	87.1k	330.7k	142.1k
Average firm revenue	0.53M	1.15M	2.34M	1.55M

Notably, portfolio financing has led to a high success rate, which is measured by the ratio of the number of exits to the number of investment deals. We consider the number of exits as the total number of M&As or IPOs. We examine all investment deals and measure the exit ratio using investment methods, such as seed investment, equity-only financing, and portfolio financing (both debt and equity financing). The exit ratio of portfolio financing is 20.3%, which is more than double the ratio of equity-only financing (9.9%). Compared to the stage of seed investment, firms that experience both debt and equity financing can have more than three times the exit ratio. Portfolio financing strategy brings about outstanding investment performance because it has the advantages of both equity and debt financing (see Table 2).

The second reason for the success of portfolio financing strategy is its sophisticated risk management. The core of risk management strategy is the dynamic financing ratio between equity and debt based on the firm's age, technology, financial soundness, and long-term business model. According to traditional portfolio theory, such as Merton (1969), the optimal equity investment in a life cycle is proportional to the expected return on investment and is inversely proportionate to the risk (variance of expected return) of investment and the risk-averseness of the investor. From this point of view, the younger and more high-tech the firm is, the higher the likelihood of the investor increasing equity financing instead of debt financing. Conversely, the investor increases debt financing for older firms with lower expected return on investment and lower default probability.

Table 3 shows the summary statistics of the investment deals at each stage. The average number of funding rounds at the stage of debt financing is 5.34, which lies between the early equity stage (Series A–B) and the late equity stage (Series C–J). Consistent with the theoretical approach, when firms are younger, financial corporations invest more in equity. As firms age, debt financing increases. The average funding amount of debt financing (142.1 US dollar) is also located between the early equity stage (87.1 K US dollar) and the late equity stage (330.7 K US dollar). Similarly, the average firm revenue with debt financing is 1.55 million US dollar, which is greater than that of firms at the early equity stage and less than that of firms at the late equity stage. Considering these empirical analyses, financial corporations optimally invest in equity when the firm is young and decrease equity financing as the firm ages or matures.

In addition to the two success factors, the investor effectively manages the loans. For example, SVB has provided loans to startups located mainly in Silicon Valley. The SVB's risk management team consists of experts who have worked for high-tech industries in Silicon Valley and can accurately measure the startup's risk and profitability. Furthermore, SVB has the principle of setting the maximum loan amount of 50 million US dollar. Owing to the expertise of credit risk, SVB has adequately managed the probability of loss of loans.

## 5. Empirical analysis

### 5.1. Main findings

Against these backdrops, we collected deal transaction data from Pitchbook from January 2010 to April 2020, to test the following three hypotheses for startups, focusing especially on startups with debt financing.

Hypothesis 1: The financial performance of a company that receives debt financing in the first round of funding is high.

We used the sales growth rate as the dependent variable and used the debt financing dummy (1 for debt financing, 0 otherwise), funding size (log value), sales size (log value), and firm age (year of business after establishment) as independent variables.<sup>1</sup> Table 4 indicates that firms that received debt financing in the first round did not show good performance in terms of sales size. The coefficients of most of the variables were not statistically significant.

<sup>1</sup> We exclude companies older than 20 years. Among the dependent or independent variables, any of the total 1000 samples with missing data were excluded. The total number of samples remaining was 291.

**Table 4**  
Debt financing and financial performance.

	Debt financing	Sales size	Firm age	First funding size	Constant
Coefficient	−0.5041	0.0078	0.0018	−0.0038	0.4619
T-statics	−0.4958	0.0561	0.0592	−0.0443	0.5733
P-value	0.6203	0.9553	0.9546	0.9546	0.5668
R square			0.0009 <sup>1</sup>		

**Table 5**  
Debt financing and exit from the first round of funding.

	Debt financing	Sales size	Firm age	First funding size	Constant
Coefficient	−0.1906	−0.0043	0.0062	0.0096	0.2023
T-statics	−1.2632	−0.2074	1.3054	0.7496	1.6906
P-value	0.2075	0.8358	0.1928	0.4541	0.0919
R square			0.1292		

**Table 6**  
Debt financing and debt financing in the last round of funding.

	Last funding size	Sales size	Firm age	First funding size	Constant
Coefficient	−0.0579	0.0436	0.0042	0.1315	0.1315
T-statics	− <b>5.8587</b>	<b>3.1777</b>	<b>2.4133</b>	1.5905	1.5905
P-value	<b>0.0000</b>	<b>0.0016</b>	<b>0.0163</b>	0.1126	0.1126
R square			0.3293		

Hypothesis 2: The probability of exit from the first round of funding for firms that received debt financing is high.

We use the exit at the last funding round (1 if exit, 0 otherwise) as a dependent variable and use debt financing in the first funding round (dummy variable), funding size (log value), sales size (log value), and firm age (year of business after establishment) as independent variables.<sup>2</sup> Table 5 shows that firms that received debt financing did not increase the probability of exit from the first round of funding. The coefficients of most of the variables were not statistically significant.

Hypothesis 3: The older the company age, the larger the company, and the more likely it is to receive debt financing.

We use debt financing in the last funding round as the dependent variable and use funding size (log value), sales size (log value), and firm age (year of business after establishment) as the independent variables.<sup>3</sup> Table 6 shows that firms that received debt financing in the last funding round were positively related to sales size (firm performance) and firm age. This supports hypothesis 3 that, the older the company's age, the more likely it is to receive debt financing.

Our main empirical findings are summarized as follows. First, the larger the size of the company, the more preferred debt financing is. Second, older companies prefer debt financing. Third, in the PE market, the amount of debt financing is significantly smaller than that of equity financing.

## 5.2. Robustness tests

For the empirical analysis of the above three hypothesis, we perform robustness test in various ways. Some robustness tests are included in Appendix. First, we cannot observe serial correlation of the explanatory variables. Second, there is no multicollinearity between explanatory variables. Third, to control the time-varying effect, we performed several empirical analysis excluding samples from the recent 1 to 5 years. The coefficient of empirical analysis is not different from the main analysis even after controlling time effect.

## 6. Conclusion and implications

Startups drive economic growth by creating jobs, increasing TFP, and allocating resources efficiently. A portfolio financing strategy can help activate startups. Some investment banks, such as the SVB, have adopted a differentiated portfolio financing strategy for both debt and equity financing. They invest more in equity when the firm is young and invest more in debt as the firm ages. They also manage the credit risk of loan portfolios.

It is critical to analyze the parameters for evaluating the creditworthiness of startups, as they do not meet the traditional loan conditions of lenders. First, venture debt providers must consider venture capital as a primary source

<sup>2</sup> We exclude companies older than 20 years. Among the dependent or independent variables, any of the total 1000 samples with missing data were excluded. The total number of samples remaining was 291.

<sup>3</sup> We exclude companies older than 20 years. Among the dependent or independent variables, any of the total 1000 samples with missing data were excluded. The total number of samples remaining was 326.

of debt repayment since they lend against the likelihood of a follow-on round of equity financing based on the implicit promise made by existing VCs. Second, the reputation of existing VCs is also critical because, in the case of top-tier VCs, it is highly likely that startups will receive additional capital, either from that VC or new investors. Since the reputation of VCs conveys signals regarding the potential of the company, well-known investors with a proven track record are seen as a valuable tool for attracting new investments. Venture debt is generally deployed to accelerate the startup's growth and enhance its market value for the follow-on equity round. However, it can also be used to avoid bridge-round financing, which may negatively affect a company's attractiveness to prospective investors.

In conclusion, we recommend this portfolio financing strategy for startups in Asia, since Asia has many young people and high expectations for innovation. More specifically, we propose the establishment of financial institutions that simultaneously provide both equity and debt financing to startups. Like the SVB model, the financial institution has control over an independent investment organization that provides equity financing as an accelerator or venture capitalist. The younger the startup (the higher the default probability), the higher the equity financing and the lower the debt financing. It is expected that an optimal portfolio financing strategy can help startups raise funds with ease, and provide investors with a higher expected return on investment. This will facilitate financing for startups and drive the economic growth of Asia.

Three policy implications are provided to stimulate portfolio financing strategy for startups. First, government body and financial companies try to reduce information asymmetry by expanding research on startups and startup's intangible assets, which could help to evaluate startup valuations. Second, it is necessary to activate the OTC bond market where institutional investors trade high-risk startup's loans or mezzanine products. Third, government body try to ease the regulation on soundness so that financial companies can participate in the startup loan market.

### **Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### **Appendix. List of active venture lenders**

Aegis Capital Group LLC  
 Agility Capital LLC  
 BFI Business Finance  
 BlueCrest Capital Finance, LP  
 Comerica  
 Culver Capital Group  
 Eastward Capital Partners LLC  
 Escalate Capital Partners  
 Gold Hill Capital Management LLC  
 Harris & Harris Group Inc  
 Hercules Technology Growth Capital Inc  
 Horizon Technology Finance  
 InnoVentures Capital Partners  
 Leader Ventures  
 Leasing Technologies International Inc  
 Lighthouse Capital Partners Inc  
 Madison Development Corporation  
 MCG Capital Corp  
 MMV Financial  
 Noble Venture Finance  
 ORIX Venture Finance  
 Oxford Finance corporation  
 Pearl Street Capital Group  
 Pinnacle Ventures  
 RCC Ventures LLC  
 Sand Hill Capital  
 Square 1 Bank  
 SVB Capital (Silicon Valley Bank)  
 US Capital Partners  
 Velocity Financial Group  
 Wellington Financial LP

Source: [Fischer and de Rassenfosse \(2012\)](#)  
 See [Tables A.1–A.6](#).

**Table A.1**

First round of funding.

	Number of deals	Funding size (million USD)	Firm's age (years)
Equity financing	913	402.2	20.09
Debt financing	81	207.4	36.25
Extra (Bankruptcy)	6	–	36.5
Total	1000	385.6	36.5

**Table A.2**

Last round of funding.

	Number of deals	Funding size (million USD)	Firm's age (years)
Equity financing	913	402.2	20.09
Debt financing	81	207.4	36.25
Extra (Bankruptcy)	6	–	36.5
Total	1000	385.6	36.5

**Table A.3**

Correlation matrix of variables.

	Growth rate	Revenue	Funding size	Age	Dummy exit
Growth rate	1				
Revenue	0.0021	1			
Funding size	–0.0002	0.2617	1		
Age	–0.0048	0.0930	0.4378	1	
Dummy exit	0.0785	0.1082	0.1677	0.0128	1

**Table A.4**

H1 robustness check.

	Debt financing	Sales size	Firm age	First funding size	Constant
Coefficient	–0.6010	0.0125	0.0002	–0.0594	0.6747
T-statistics	–0.5198	0.0652	0.0044	–0.4643	0.6139
P-value	0.6037	0.9480	0.9964	0.6429	0.5399
R square			0.0028		

Note: We exclude samples with an age less than 1 year.

**Table A.5**

H2 robustness check.

	Debt financing	Sales size	Firm age	First funding size	Constant
Coefficient	–0.1553	–0.0455	0.0022	0.0307	0.4204
T-statistics	–1.0224	–1.7987	0.3985	1.8323	2.9120
P-value	0.3078	0.0735	0.6906	0.0684	0.0040
R square			0.2012		

Note: We exclude samples with an age less than 1 year.

**Table A.6**

H3 robustness check.

	Last funding size	Sales size	Firm age	Constant
Coefficient	–0.0623	0.0445	0.0041	0.1536
T-statistics	–5.5917	2.8107	2.1322	1.6813
P-value	0.0000	0.0053	0.0337	0.0938
R square		0.3377		

Note: We exclude samples with an age less than 5 year.

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