Venture debt financing as a relative new opinion for startups: An analysis of benefits and influences of venture debt

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Abstract: Debt can be considered one of the crucial ways startups can acquire capital. Unlike traditional debt, which requires startups to have positive cash flow and enough tangible assets to secure the loan, venture debt is one alternative that provides startups additional capital to reach important milestones. This paper investigates the benefits of venture debt financing for the growth of startups through analyzing three theoretical models and conducting an empirical regression analysis. With these three analytical models, it is admitted that venture debt is preferable from three main perspectives, cost-saving, minimization of dilution, and optimized capital structure. Additionally, this research uses a hierarchical regression model to analyze the relationship between VD-backed transactions and success rate [Initial public offering (IPO), trade sale, and follow-up funding]. Results conclude that venture debt can explain the specific variance of the growth of startups, and startups with VD-backed have more promising futures. These results reveal that venture debt should be one robust motivator for startups' developments. While the results provide insights into the advantages of venture debt financing, more future research is recommended.

1. Introduction

Early-stage enterprises can usually lead the country towards future development, technology, and innovation. Also, startups can improve the nation's gross domestic product (GDP) by creating job positions. However, startups always are liquidity constrained, and startups must keep acquiring capital. Startups often cannot sustain their operational activity and usually own negative cash flows. Therefore, they typically set up relationships with venture capitalists to secure their funding. Though venture capital financing is the most common choice for startups, it carries disadvantages like dilution of founders' shareholdings and high costs.

Under this circumstance, it is preferable to consider one alternative option, venture debt financing. Instead of focusing only on venture capital financing, startups can choose venture debt as one complementary option. Venture debt is an apparent contradiction with traditional debt, and this relatively new form of startup financing lies in the interaction of venture capital financing and conventional debt. Unlike traditional debt, which is unsuitable for startup cases since startups have negative cash flows and do not have enough tangible assets to secure the loan, venture debt is appropriate for early companies. Venture debt is a type of loan provided for early-stage, high-growth companies. Startups receive venture debt after initial financing and before access to public markets. Unlike venture capitalists, who exchange capital with percentage ownerships, venture lenders require startups to pay back the principal and the interests. Additionally, venture lenders are often guaranteed warrants that give the venture lenders the right to exchange them into equity shares later.

According to Pitchbook, substantial growth in the venture debt market has occurred over the past ten years, with the venture debt market increasing by a factor of five from 2010 to 25 billion dollars in 2019. Also, the result of COVID-19 left many companies without the equity support they expected, leading to intensified usage of venture debt among entrepreneurs. For these entrepreneurs, venture debt financing brings up some new advantages. The essential one is that venture debt will never dilute employees' equity as much as venture capital usually does. By the end of the date, the startup needs to

pay back the principal and the interest payment to the venture lenders. Also, sometimes, to increase the up-side of the lender enough to be willing to issue the debt, venture lenders are encouraged to issue the warrant and are allowed to convert their debt into equity at some point in time. Warrants play an essential role in attracting venture lenders. The issued warrants compensate the venture debt providers for the higher default risk of startup companies and can be converted into equity in any upside situations, including achieving a trade sale or IPO. This conversion will indeed dilute the share of the original investors' and employees' equity but much less compared to raising additional capital through venture equity. Also, since venture debt enables founders to receive money without giving up voting shares and board shares, founders can maintain their stronger voice when they run their company. Moreover, venture debt can bridge equity rounds to expand startups' growth. It can positively signal the startup's prospects, with tremendous promising effects in later financing rounds.

Based on this, this paper aims to investigate the benefits of venture debt as one new financing opinion for startups, from aspects like cost, dilution, capital structure, and effects on startups' success rate. The paper uses theoretical models and empirical regression to compare cost, return, and marginal benefit between venture capital and venture debt financing and how venture debt financing contributes to the startups' success rate (IPO, trade sale, following events). To identify these research problems, this study comes with three theoretical models to compare the cost, return, and marginal return of venture debt and venture capital financing and one empirical regression model to analyze the impact of venture debt on the growth of startups. Empirical data is based on the database Crunchbase and comprises 4,496 funding rounds. This paper compares VD-backed funding rounds with solely VC-backed funding rounds. Then, this study uses follow-up event, IPO, trade sale, and no event follow as dependent variables and applies the hierarchical regression model.

The results of this study reveal that venture debt financing costs startups less than venture capital financing. Venture debt financing minimizes dilution for existing equity holders, and increases return to equity investors. Also, venture debt holds a higher marginal benefit than venture capital financing, so startups that have acquired capital through venture debt increase the probability of their startups' success. Apart from focusing only on the main benefits of venture debt, it is also important to admit the limitation and some potential drawbacks of using venture debt financing. First and foremost, venture debt is unsuitable for startups on the downward path. Venture debt is a loan, and lenders require principal paid back and interest payments. Venture loans will become another cost for startups that do not work very well. These companies cannot undertake extra costs besides necessary expenditures for running the company. Also, it is admitted that sometimes outside equity investors may get recoiled from agreeing to invest in startups when they realize that their capital will be used to repay the venture loan rather than funding the startups' future development [1].

The paper is structured as follows. Section 2 is the literature review of this paper. In section 3, it is presented with the theoretical framework. In section 4, it is offered data and variables. Section 5 presents the methodology and results. Finally, section 6 is the conclusion.

2. Literature Review

Early-stage companies cannot sustain relying on their operating income. Most startups fail at the first stage, so entrepreneurs who want their startups to keep growing need to look into extra funding, like venture capital financing and venture debt financing. Many recent studies have focused on venture capital financing, examining the association between the presence of venture capital (VC) and the development of startups. Davila's signaling theory shows a headcount growth for startups that evolve around VC funding. The result proves that the growth of startups accelerates in the month after the VC event [2].

Compared to venture capital financing, venture debt financing is usually considered relative indifference. Under this circumstance, it is noticed that while there have been many kinds of research on the relationship between venture capital financing and startups' growth. Few researchers have taken venture debt financing and the combination of venture debt and venture capital into serious consideration. However, venture debt can play as a great tool and contain several valuable functions,

like complimenting existing funding round, acting between equity funding rounds, supporting a bridge to an exit, financing an acquisition, and simply funding working capital needs.

2.1 Venture debt

As a relatively new form of financing, venture debt is increasingly being relied upon by startups [3, 4]. Venture debt can help more capital become efficient and lead a sustainable business. Also, it is a less dilutive form of capital acquisition. Even warrants typically do not dilute ownership in the industry by more than 2%, which makes the company more attractive to both founders and investors.

Existing research has conducted several discrete choice experiments to understand what matters when venture lenders need to decide whether or not they will provide debt. They show how venture debt lenders overcome barriers that hamper startups' access to debt. Previous research has shown that factors including patents, collateral, tangible assets, warrants, and positive cash flows influence the chance of obtaining venture debt for startups [5]. Venture capital financing is another essential factor, as venture debt investors often have faith that startups that involve venture capitalists will not default in the future [6, 7, 8, 9, 10]. According to the theory provided by Hagen and Sommer, the startup will likely get the following financings from venture capital firms when a company receives funding from some known venture capital firms. This fact gives venture debt lenders colossal confidence that the company will continue to succeed and return the money [1].

Apart from researching the factors that influence the chance for startups to obtain venture debt financing, some papers have already investigated the operating mode of venture debt financing in startups. According to Krause's research, there is certainly no need for venture debt lenders to monitor startups similarly as venture capitalists do actively. Venture lender typically does not demand any ownership stake or any board seats and thus has no say in the company's business decisions. In this way, venture lenders cannot monitor the startup's actions [1]. However, in some exceptional cases, venture debt lenders can monitor the startup's day-to-day activities [11]. Hardymon et al. said in the study that it is an easy way for the largest venture debt lenders like Silicon Valley Bank to monitor their portfolio companies and offer help and advice for entrepreneurs [12].

Though venture debt financing has been researched from several aspects, few researchers have begun to study the relationship between venture debt and the development of startups. Also, limited research explored when venture debt financing is suitable for startups. This paper aims to find out how the debt financing round impacts the exit outcomes of startups with other factors. Moreover, this study shows that venture debt financing is preferable when the startup grows very well. Since venture debt financing may not be the right decision for an early company when it cannot make a reasonable budget plan or its product cannot even fit the market. In this way, the company will not have money to cover the interest payments of venture debt financing.

2.2 Comparison between VC (Venture Capital) and VD (Venture Debt)

Venture capital is a well-known funding source for startups. Even though venture capital funding is a relatively new industry that only startups developed a few years earlier, it has already attached unprecedented levels, with almost $70 million invested in the United States in 2018[13, 14]. Also, venture debt can be an equity-efficient and fascinating way to raise capital, helping the company reach the following milestone (like IPO, follow event, and trade sale) and improve the company's valuation for the subsequent financing round [1]. On average, debt financing and VC banking are substitutes. However, venture capital and venture debt can interact more nuancedly [15].

Previous researches have compared venture capital and venture debt financing and deduced some similarities and differences. Janney&Folta found out that venture capital can be used as a tool for startups to signal their value to outside investors [16]. Krause's study also shows that debt can signal the startups' value to outsiders. However, existing research concludes that venture debt provides more value than venture capital financing because venture debt can signal investors' quality and safety, while venture capital mainly signals positive prospects of startups [5, 9].

However, in Barry and Mihov's study, though they admitted that startups with VD-backed are consistent with less uncertainty about firm value than startups with solely VC-backed, they insisted

underperforming firms are frequently startups with a high level of debt financing. Startups with VC backing usually outperform [15]. Moreover, according to Axel's study, it can be concluded from the survival analysis that venture capital financing can contribute to startups' growth. Since when at least two venture capitalists are present, the chance for investments to exit will increase up to 26% faster. When more and more venture capitalists join startups, the opportunity for liquidation to occur will also significantly decrease.

Existing researches have different arguments for venture capital financing and venture debt financing, as some gaps are lacking for further study. Fewer researches have explored the effect of venture debt on the exit outcomes of startups or the combining effects of venture debt and venture capital on exit outcomes of startups. So, whether startups with venture debt backed are better than startups with only venture capital-backed or the opposite is not easy to determine. Within these limitations to judge between venture debt and venture capital, this paper investigates the difference of existing outcomes between VD-backed funding rounds and solely VC-backed funding rounds to testify whether venture debt contributes more to the growth of startups. Rather than using venture capital alone, startups that use the combination of venture debt and venture capital provide a scale-up opportunity to find investment ways that are more suitable for the market.

Additionally, few kinds of research before have found out the cost and return brought by these two financing ways, so this study plans to use three theatrical models to compare the cost, return, marginal benefit between venture capital and venture debt. When comparing the marginal benefit of venture capital financing and venture debt financing, this paper plans to prove that VD and VC need not only be substituted. Venture debt can act as a complementary role with venture capital financing. From an economic perspective, venture debt and venture capital can be better compared.

3. Theoretical Framework

3.1 Model A

Considering the cost perspective, venture debt can be a better choice.

Startups usually acquire capital from investors in two ways, venture capital and venture debt (venture lending). Startups are given these two ways to reach the next milestone, determining if the firm can be successful or just break even [1]. This model is used to prove that venture debt can cost much less than venture capital if the startup is gradually growing.

Assume the startup's value is X and the startup needs to finance t% X from investors, which means that the percentage of the ownership will be diluted t%. Regarding the typical regulation, this study assumes that the interest rate and warrant of venture debt will be around 20% and 10%, respectively. Venture lenders who provide money to startups will receive principal and interest payments by the end of the date. Also, sometimes venture lenders will ask about the security of warrant in the contract, which means that venture lenders can choose whether or not they want to convert debt (warrant percentage) to the shares in the later stage.

Under this circumstance, it is assumed that the startup's value will become (1+r) in the next year. So,

$$\text{Cost of VC: } t\%X(1+r) - t\%X = t\%Xr \tag{1}$$

$$\begin{aligned}\text{Cost of VL: } & 20\%t\%X + 10\%t\%X(1+r) - 10\%t\%X \\ & = 20\%t\%X + 10\%t\%Xr\end{aligned} \tag{2}$$

If the cost of VC and the cost of VL are equaled,

$$t\%Xr = 20\%t\%X + 10\%t\%Xr\ (20\% = 90\%r) \tag{3}$$

From this equation, it can be concluded that venture debt cost less than venture capital when r > 22.2%

For example, when the startup's value turns to 2X in the next year, then the cost of VC will be 10%X, and the cost of VL will be 3%X. Under this circumstance, if the X is one hundred million, then the cost of VC is 10 million, and the cost of VD is 3 million.

When the startup's value turns to 1.5X in the next year, then the cost of VC is 5 million, and the cost of the venture lending is 2.5 million.

Above all, from the equation$(20\% = 90\%\mathrm{r})$, firstly, it is easily concluded that the cost difference between venture debt and venture capital will be more considerable if the r becomes higher. So, venture debt will be preferable when the startup's valuation stays in a developing position. The cost of venture debt will remain stable, while venture capital will keep growing with the increase of r (r>0). It also makes sense that venture debt can motivate fast-growing startups but can be stuck for low-growing startups.

Hypothesis1:

Venture debt is preferable for fast-growing startups as the cost for venture debt will gradually be much lower than the cost for venture capital.

3.2 Model B

Under this model, it is assumed that startups have three choices to sustain their living, venture capital financing, venture debt financing, and do nothing. Venture capital financings are usually provided by wealthy individual investors, professionally managed investment funds, subsidiaries of investment banking firms, or corporations. They typically invest in startups with high-profit wishes. So, in exchange for funding, they require an ownership stake of startups, around 25 percent to 55 percent. For venture debt, though venture lenders require principal and interest payment by the end of the date, the warrant sometimes asked by venture lenders will never account for a large ownership percentage of startups. This model aims to testify the minimization dilution characteristic of venture debt financing.

As founders and existing investors have already provided a certain amount of equity, this model assigns $V_{original}$ to this particular amount of equity. Also, this model gives V_{equity} to the new injection of capital and V_{debt} to Venture Debt. This theoretical model assumes that the startup's value will be scaled by a profit factor (1+r) and the required interest rate for interest payment is R. Moreover, it is worth mentioning that if venture debt is used and the firm achieves success, venture lenders have a significant probability of exercising warrant and receiving equity shares in the firm equal to $\mu V_{debt.}$

$$\mathrm{V} = (\mathrm{Voriginal} + \mathrm{Vdebt})(1 + \mathrm{r}) - \mathrm{Vdebt}(1 + \mathrm{R}) \tag{4}$$

$(\mathrm{Voriginal} + \mathrm{Vdebt})(1 + \mathrm{r})$means the value of the firm is scaled by a profit factor (1+r)
$\mathrm{Vdebt}\ (1 + \mathrm{R})$means the principal and the interest payment that needs to be paid back.

$$Evd = \frac{\mu Vdebt}{(Voriginal + \mu \mathrm{Vdebt})} \tag{5}$$

$$Eoriginal = 1 - Evd = \frac{Voriginal}{(Voriginal + \mu Vdebt)} \tag{6}$$

In this model, it is assumed that the firm will be doubled in two years. $V_{original}$=x, V_{equity} =x, V_{debt}=x. The interest rate is 15%, and the warrant is 10% of the debt.

$$\begin{aligned} \mathrm{V} &= (\mathrm{Voriginal} + \mathrm{Vdebt}) \times (1 + \mathrm{r}) - \mathrm{Vdebt} \times (1 + 2\mathrm{R}) \\ &= (\mathrm{x} + \mathrm{x}) \times (1 + 1) - \mathrm{x}(1 + 0.15 \times 2) \\ &= 2.7\mathrm{x} \\ \mathrm{Evd} &= 10\% \times \frac{1}{(1 + 10\% \times 1)} = 9\% \\ \mathrm{Eoriginal} &= 1 - 9\% = 91\% \end{aligned} \tag{7}$$

For founders and existing investors:

$\mathrm{Eoriginal} * \mathrm{V} = 2.7\mathrm{x} * 0.91 = 2.457\mathrm{x}$

Comparing Table 1 ad Table 2 (50% & 91%, 2x & 2,457x), it can be concluded that startups with VD-backed funding rounds can have less percentage diluted and hold relative more value.

Hypothesis2:

Venture debt can minimize dilution for existing equity holders. Adding leverage through venture debt will increase returns to equity investors.

Table 1 Value and percentage under different funding ways

Funding Way	People	Total Investment	Startup's value	Percentage	Per Value
Venture Capital	Founders& Existing Investors Equity Investors	$V_{original}$ V_{equity}	$(V_{original}+V_{equity})(1+r)$	$V_{original}$ /($V_{original}$ + V_{equity}) V_{equity} /($V_{original}$ + V_{equity})	$V_{original}(1+r)$ $V_{equity}(1+r)$
Venture debt	Founders&Existing Investors Venture lenders	$V_{original}$ V_{debt}	$(V_{original}+V_{debt})$ $(1+r)–V_{debt}$ $(1+R)$	$E_{original}$ E_{vd}	$E_{original}$*V E_{vd*}V
Nothing	Founders&Existing Investors	$V_{original}$	$V_{original}$ $(1+r)$	100%	$V_{original}$ $(1+r)$

R (interest rate) r (profit factor)

V_{equity} (value of capital offered by venture capitalists) V_{debt} (value of loan provided by venture lenders)

V (total value of the firm when the venture debt is used)

$V_{original}$(value of equity that originally invested by founders and existing investors)

$E_{original}$(Percentage shares held by founders when the venture debt is used)

Evd (Percentage shares held by existing investors when the venture debt is used)

Table 2 Value and percentage under different funding ways

Funding Way	People People	Total Inv Total InInvestment	Startup's value	Percentage	P Per Value
Venture Capital	Founders& Existing Investors Equity Investors	$V_{original}(x)$ $V_{equity}(x)$	4x	50% 50%	2x 2x
Venture debt	Founders& Existing Investors Venture lenders	$V_{original}(x)$ $V_{debt}(x)$	2.7x	91% 9%	2.457x 0.243x
Nothing	Founders& Existing Investors	$V_{original}(x)$	2x	100%	2x

Table 3 Debt with Warrants (From the investors' perspective)

	Year0	Year1	Year2	Year3	Year4	Year5	(Year5)
Principal	-2000	300	300	400	500	500	500
Interests		240	204	168	120	60	60
Warrant							995
Total Cash Flows	-2000	540	504	568	620	560	1555

IRR=12% IRR=21%

Thinking from a startups' perspective, it is shown that venture lenders sometimes choose to exercise warrants, as lenders believe in the future development of startups and are willing to purchase the shares at the specified price within a specific period. It can be seen from Table 3 that lenders can earn higher IRR with the warrant, but it is noticeable that founders' & existing investors' ownership percentages will still be diluted by only 9% in this way. Also, there is a chance that venture lenders do not want to convert their debt into shares, which will not influence any ownership percentages of founders &existing investors.

3.3 Model C

In the previous Model A and B, this study considers the cost of venture capital and debt separately and feels the benefit of venture capital and debt individually. However, in reality, most firms will use venture capital and venture debt together, and these two will be combined to contribute to the growth of startups.

Therefore, this study aims to use this model to research how venture debt can complement new equity. There are two main reasons. Firstly, venture debt often accounts for a minor part of the total potential financing. The venture debt often acquired is not very close to the amount of venture capital usually does. Secondly, most of the time, startups will require venture capital and angel investors at the very early stage. They are more likely to take venture debt after a round of equity financing [1]. So, it makes more sense to consider venture debt as complementary financing instead of the direct substitute. Venture lenders use venture capital support as the validation source and one yardstick for underwriting a loan. Raising venture debt can be more efficient and feasible within the associated performance in the last round of equity. Also, usually, the size of venture debt varies between 25% and 50% of the capital amount raised in the most recent equity round. More importantly, startups without VC investors face significant difficulties attracting venture lenders.

Assume startups receive a fortune from both venture capital and venture debt, and then founders and existing investors can get $E_{original}$ percentage shares:

$$\text{Eoriginal} = \frac{Voriginal}{Voriginal+Vequity+\mu Vdebt} \tag{8}$$

Also, $R_{original}$ calculates the total investment value for founders and existing investors:

$$\text{Roriginal} = Original(1+r) + \frac{Voriginal}{Voriginal+Vequity+\mu Vdebt} \times [Vdebt(1+r-(1+R))] \tag{9}$$

Under this circumstance, this study can reach conclusions from three perspectives.

First, assuming that startups take the equity financing (Venture capital) firstly and then choose from two opinions, venture debt or nothing, two formulas below compare how the percentage of equity shares for founders and existing investors changes with equity financing and venture debt.

$$\frac{\partial \text{Eoriginal}}{\partial \text{Vequity}} = \frac{-Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2} \tag{10}$$

$$\frac{\partial \text{Eoriginal}}{\partial \text{Vdebt}} = \frac{-\mu Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2} \tag{11}$$

Since μ will be positive and set up between zero and one, it can be deduced that it is preferable to have venture debt financing rather than equity financing.

With an increase from debt financing, existing investors' ownership stake will be decreased by $\frac{\mu Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2}$. However, with the rise from equity financing, existing investors' ownership stakes will be reduced by $\frac{Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2}$, which is much higher than $\frac{\mu Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2}$.

Second, under a similar condition, the two formulas below compare how the value of equity shares for founders and existing investors change with a change in equity financing and venture debt.

$$\frac{\partial \text{Roriginal}}{\partial \text{Vequity}} = \frac{-Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2}[Vebt(1+r-(1+R))] \tag{12}$$

$$\frac{\partial \text{original}}{\partial \text{Vdebt}} = \frac{-\mu Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2}[Vebt(1+r-(1+R))] + \frac{Voriginal}{Voriginal+Vequity+\mu Vdebt}(1+r-(1+R)) \tag{13}$$

From the two equations above, it can be seen that those founders and existing investors will earn more value within the increase of venture debt financing rather than venture capital financing. These two equations show that venture debt financing should be considered a better choice when viewing from the marginal benefit perspective since the marginal benefit of venture debt can be higher than using equity.

Thirdly, concluding from the data collected through Crunchbase, this research shows that startups can roughly divide into two groups: only VC-baked and VC and VD-backed. So, the formulas below compare how the percentage and investment value of founders and existing investors change in this way.

Only VC-backed:

$$\text{Eoriginal} = \frac{Voriginal}{Voriginal+Vequity+Vequity} \tag{14}$$

$$\frac{\partial \text{Eoriginal}}{\partial \text{Vequity}} = \frac{-2Voriginal}{(Voriginal+Vequity+Vequity)^2} \tag{15}$$

VC-backed and VD-backed combined:

$$\begin{aligned}\text{Eoriginal} &= \frac{Voriginal}{Voriginal+Vequity+\mu Vdebt} \\ &= \frac{Voriginal}{Voriginal+(1+\mu)Vequty} \\ &= \frac{Voriginal}{Voriginal+(1+\mu)Vdebt}\end{aligned} \tag{16}$$

$$\frac{\partial \text{Eoriginal}}{\partial \text{Vdebt}} = \frac{\partial \text{Eoriginal}}{\partial \text{Vdebt}} = \frac{-(1+\mu)Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2} \tag{17}$$

$$\begin{aligned}\frac{-2Voriginal}{(Voriginal+2Vequity)^2} &< \frac{-(1+\mu)Voriginal}{(Voriginal+(1+\mu)Vequity)^2} \\ &= \frac{-(1+\mu)Voriginal}{(Voriginal+(1+\mu)Vdebt)^2}\end{aligned} \tag{18}$$

Through equaling (13) and (15), it can be deduced that startups can dilute less ownership with both VC and VD backed when $\text{Vequity} \leq \frac{1}{2}Vorigin$and $\text{Vdebt} \leq \frac{1}{2}Voriginal$.

Only VC-backed:

$$\text{Roriginal} = \text{Voriginal}(1+\text{r}) \tag{19}$$

So, the amount of venture capital financing will not affect the total value of founders and existing investors' investments.

VC-backed and VD-backed combined:

$$\text{Roriginal} = Voriginal(1+r) + \frac{Voriginal}{Voriginal+Vequity+\mu Vdebt} \times [Vdebt(1+r-(1+R))] \tag{20}$$

$$\frac{\partial \text{original}}{\partial(\text{Vdebt}+\text{Vequity})} = \frac{-(1+\mu)Voriginal}{(Voriginal+Vequity+\mu Vdebt)^2}[Vebt(1+r-(1+R))] + \frac{Voriginal}{Voriginal+Vequity+\mu Vdebt}(1+r-(1+R)) \tag{21}$$

From the equations (16), (17), and (18) above, it can be inferred that the total investment value of founders and original investors will not rise within the increased outside investment if the startup is

only backed with venture capital. However, within the increased investment from combined venture debt and venture capital funding, the original total investment value will gradually increase within the positive marginal benefit.

Above all, it can be seen that founders and existing investors in startups with both VD and VC-backed can have both less ownership diluted and also get their investment value appreciated at the same time.

Hypothesis3:

Venture lenders have higher marginal benefits when compared with venture capitalists.

Hypothesis4:

Startups with VD-backed instead of only VC-backed can rear the growth of their investment value.

4. DATA AND VARIABLES

4.1 Data

The primary source of data used in this study is the database Crunchbase. Crunchbase is a platform for finding information about different kinds of companies. Crunchbase provides information about startups' exit outcomes (IPO, trade sale, following event), investors, investments, and funding rounds.

Although Crunchbase contains millions of different financing rounds, this research has to apply some selection criteria to filter out the most valuable data. Despite the global pandemic, the United States still has the most active venture capital market, and venture capital funding to US-based companies has thrived, with new highs in 2020 and again in 2021. Also, traditionally, startups based in California, New York, and Massachusetts own large amounts of venture capital investment in the United States. Venture capital funding has gradually spurred across the whole country. So, this study sets the headquarters location to be the only United States, as the United States has the most complete and huge venture capital market. Also, this research chooses the funding rounds after 2010, after the financial crisis. During the first quarter in 2008 to the first quarter in 2009, venture funding was affected and fell by 50%, totaling $3.9 billion. Moreover, to be more consistent with the startup standards, this study also sets the criteria about the number of employees and total funding, with less than 1000 employees and below 1 billion, respectively.

After filtering the data, this study obtains a dataset of 4,496 funding rounds and 4,113 startups. There are 516 VD-backed financing rounds in these financing rounds and 3,980 solely VC-backed financing rounds.

4.2 Variables

4.2.1 Dependent Variables

The dependent variable in this research is the success (startup development outcomes), including IPO, trade sale, follow funding rounds, and no event, which is used to evaluate whether or not the startup has a favorable development outcome. According to much of the previous literature, IPO is undoubtedly regarded as the most successful and the most helpful exit strategy [17]. Das, Jagannathan, and Sarin (2003) showed in their research that there is a 20%-25% cumulative probability of exit by IPO [18].

As opposed to IPOs, trade sales can be seen as a universal exit route open to many companies, particularly the less successful ones. IPO is an exit that may be limited to the most promising ventures, whereas acquisitions (trade sale) is a more available exit route for both more and less profitable ventures. Apart from IPO and trade sale, there are two other exit outcomes: follow funding rounds and no event.

The exit outcome variable gives the status of the investment round, the startup's growth and can take several values.

- 4 if the exit outcome is IPO
- 3 if the exit outcome is trade sale
- 2 if the exit outcome is following event

-1 if the exit outcome is no event

4.2.2 Independent variable

The independent variable in this research is whether the funding round has venture-debt backed or not. If funding rounds have involved venture debt backed (Debt financing), then the variable is coded as 2. If funding rounds have never involved venture debt backed and funding rounds are fulfilled with series funding (Seed, SeriesA, SeriesB……SeriesJ), then the variable is coded as 1.

4.2.3 Control Variables

This study lists some control variables that can affect the development of startups. The number of patents granted is one of the control variables as patents granted positively signals the investors outside [19]. Also, according to Haussler's study, signaling and certification explain the role of patents in startup financing in a complementary way and prove that patents per se significantly affect funding [20].

Also, this study includes other control variables like the number of investors, number of funding rounds, startups' ages, total funding amount, and money raised.

4.3 Descriptive Statistics

Table 4. Descriptive Statistics for Control Variables

	N	Minimum	Maximum	Mean	Std.Deviation	Variance
Total Amount Funding	4496	1000	1400000000	121493424.33	156077203.9	24360093568394200
Number of Funding	4496	1	30	5.11	2.834	8.033
Number of Investors	4207	1	100	10.95	8.425	70.978
Patents Granted	4496	1	21	9.46	4.516	20.391
Startups Ages	3136	0	1695	11.77	50.040	2503.992
Money Raised	4496	1000	1400000000	48577834.38	72352155.282	5234834373948390
Funding Type	4496	1	2	1.08	.0.273	0.075
Exit Outcomes	4496	1	4	1.60	0.661	0.436
Valid N(listwise)	3046					

5. Methodology And Results

5.1 Methodology

It is believed that venture debt can help extend the cash runway to the following valuation milestones and allow startups to reach the vital milestone (IPO, trade sale, or subsequent events). However, it is known that that other factors can have huge impacts on the startup's exit outcomes, like startups' total funding amount, number of funding rounds, number of investors, startups' age, patents granted, and money raised during funding rounds. So, to test the impact of VD participation on the startup development outcomes, this study applies the hierarchical multiple regression model, which is a particular form of a multiple linear regression analysis. A hierarchical regression model is a specific form of multiple linear regressions in which independent variables and control variables are added to

the model in separate steps called blocks. When dealing with the hierarchical regression model, this research first puts control variables and then the independent variable to see whether the additional variable has the extra/unique impact on the relationship between several original variables.

Hierarchical Regression Model

Hierarchical regression is a method to testify whether variables explain a statistically significant amount of variance in dependent variables after accounting for all other variables [21, 22, 23]. So, to investigate how venture debt accounts for much variance in startups' growth, this study applies the following two-stage hierarchical multiple regression.

$Y_k = ß_{k0} + ß_{k1}X_1 + ß_{k2}X_2 + ß_{k3}X_3 + ß_{k4}X_4 + ß_{k5}X_5 + ß_{k6}X_6 + ß_{kn}X_n + r_k$

Y_k represents the growth of startups under the influence of different variables in different stages

$ß_{k0}$ represents the y-intercept of the regression line for different stages

$ß_{kn}$ represents regression coefficients for control variables and the independent variable in different stages

Table 5 Correlations between variables

Correlations									
		Total Funding Amount	Number of Funding Rounds	Number of Investors	Startup Age	Patents Granted	Money Raised	Exit Outcomes	Funding Type
Total Funding Amount	Pearson Correlation	1	.413**	.370**	-0.019	.072**	.651**	.044**	-.036*
	Sig. (2-tailed)		0.000	0.000	0.192	0.000	0.000	0.003	0.015
	N	4496	4496	4207	4496	3136	4496	4496	4496
Number of Funding Rounds	Pearson Correlation	.413**	1	.976**	.080**	0.035	.250**	.037*	-.082**
	Sig. (2-tailed)	0.000		0.000	0.000	0.051	0.000	0.012	0.000
	N	4496	4496	4207	4496	3136	4496	4496	4496
Number of Investors	Pearson Correlation	.370**	.976**	1	.194**	.039*	.175**	.040**	-.108**
	Sig. (2-tailed)	0.000	0.000		0.000	0.033	0.000	0.009	0.000
	N	4207	4207	4207	4207	3046	4207	4207	4207
Startup Age	Pearson Correlation	-0.019	.080**	.194**	1	.110**	-.150**	.317**	.047**
	Sig. (2-tailed)	0.192	0.000	0.000		0.000	0.000	0.000	0.001

	N	4496	4496	4207	4496	3136	4496	4496	4496
Patents Granted	Pearson Correlation	.072**	0.035	.039*	.110**	1	0.006	.078**	-0.002
	Sig. (2-tailed)	0.000	0.051	0.033	0.000		0.718	0.000	0.892
	N	3136	3136	3046	3136	3136	3136	3136	3136
Money Raised	Pearson Correlation	.651**	.250**	.175**	-.150**	0.006	1	-.033*	-0.016
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.718		0.025	0.275
	N	4496	4496	4207	4496	3136	4496	4496	4496
Exit Outcomes	Pearson Correlation	.044**	.037*	.040**	.317**	.078**	-.033*	1	.506**
	Sig. (2-tailed)	0.003	0.012	0.009	0.000	0.000	0.025		0.000
	N	4496	4496	4207	4496	3136	4496	4496	4496
Funding Type	Pearson Correlation	-.036*	-.082**	-.108**	.047**	-0.002	-0.016	.506**	1
	Sig. (2-tailed)	0.015	0.000	0.000	0.001	0.892	0.275	0.000	
	N	4496	4496	4207	4496	3136	4496	4496	4496

***. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).*

X_n represents control variables, and the independent variable

r_k represents random error for different stages

Stage one model (k = 0)

$Y_0 = ß_{00} + ß_{01}$ Total funding amount $+ß_{02}$ Number of funding rounds + $ß_{03}$ Number of investors + $ß_{04}$ Startups' age + $ß_{05}$ Patents granted + $ß_{06}$ Money raised + r_0

Stage two model (k=1)

$Y_1 = ß_{10} + ß_{11}$ Total funding amount $+ß_{12}$ Number of funding rounds + $ß_{13}$ Number of investors + $ß_{14}$ Startups' age + $ß_{15}$ Patents granted + $ß_{16}$ Money raised + $ß_{17}$Funding Type + r_1

Hypothesis5:

There is a strong positive relationship between venture debt funding rounds and the growth of startups, and VD-backed funding rounds significantly explain certain variances of the growth of startups.

5.2 Results

5.2.1 Part1: Correlations between control variables and independent variables

Pearson correlations were computed for both control variables and independent variables. Table 5 demonstrates the correlation matrix. There is a strong positive correlation between funding type and exit outcomes, with a 0.506 correlation coefficient and 0.000 significance (2-tailed), meaning that the

p-value is less than 0.001 and proves that the relationship can be considered highly statistically significant.

Additionally, from the correlation matrix above, it can be seen that there are relatively strong positive correlations between exit outcomes and startups' ages and patents granted, which is consistent with the results of previous literature. By controlling them, this study can analyze the actual effects of VD-backed on the development of early startups.

5.2.2. Part2 Hierarchical regression analysis

Table 6 Hierarchical Regression Analysis Summary (1)

	Growth of Startups					
Predictors	R	R^2	$\triangle R^2$	F	$\triangle F$	df
Stage1 Control Variables						
Total funding amount						
Number of funding rounds						
Number of investors	0.404	0.163	0.163	98.952	98.952	6
Startups' age						
Patents granted						
Money raised						
Stage2 Independent Variable						
VD-backed	0.634	0.402	0.239	291.587	1211.007	7

Note. N=4496; $\triangle R^2$ = change in R^2; $\triangle F$= change in F.

5.2.2.1 Change in R Square

In order to know the exact influence of VD-backed on the growth of startups, it is needed to control several other confounding variables (control variables), so this study conducts hierarchical regression analysis in SPSS. The main characteristic of hierarchical multiple regression is the sequence. The main aim of hierarchical multiple regression is to see if the additional variable can be related to some predictive capacity at predicting a dependent variable above and beyond one or more proved variables [24]. This research put control variables in stage one and set the independent variable in stage two, and then there are two models in the model summary.

There is a 0.163 R square in model one, and the p-value is 0.001. There is 0.402 R square in model two, and the p-value is 0.001. So, it can be concluded that these control variables (Total funding amount, Number of funding rounds, Number of investors, Startups' age, Patents granted, and Money raised) explain 16% of the startups' growth variance. The independent variable (VD-backed) explains 23.8% of the variance in the startup's growth.

5.2.2.2 F Statistics

R square values 40.2% and R squared changes 23.9% from zero, which is statistically significant. The F value, 98.952, is similar to the F change value from zero in model one.

For model one, nothing new can be found in the ANOVA table in SPSS, as the ANOVA table and model summary provide similar information. However, the ANOVA table is further information for model two, which tests the hypothesis that this R Square value of 40.2% is statistically significant. There is no F value in the model summary that tests the significance of this 40.2%. The F change value in model two in the model summary, 1211.007, is associated with the R square change rather than with the overall R square of the total model. However, the F value, 291.58 in model two in the ANOVA table corresponds to the R square value of 40.2% variance accounted for. It is statistically significant, with a p-value less than 0.001.

Table7.Hierarchical Regression Analysis Summary (2)

	Stage one model				Stage two model			
	B	Beta	t	Sig.	B	Beta	t	Sig.
Total Funding Amount	6.509E-10	0.159	7.039	.000	4.564E-10	0.111	5.821	.000
Number of Funding Rounds	0.341	1.337	15.348	.000	0.093	0.365	4.627	.000
Number of Investors	-0.113	-1.408	-15.999	.000	-0.029	-0.354	-4.405	.000
Startup Age	0.061	0.379	20.728	.000	0.040	0.247	15.532	.000
Patents Granted	0.001	0.041	2.437	.015	0.001	0.047	3.298	.001
Money Raised	-1.136E-9	-0.127	-5.791	.000	-7.609E-10	-0.085	-4.576	.000
Funding Type	/	/	/	/	1.406	0.531	34.800	.000

5.2.2.3 Beta weights and t value

Beta weights and the statistical significance associated with those beta weights in the coefficients table can show the additional information, proving that venture debt is, in fact, a statistically significant predictor. VD-backed funding rounds have 0.531 standardized coefficients beta, 34.800 t value, and a p-value of less than 0.001. Standardized coefficients beta, also called beta weights, compare the impacts of each variable on the dependent variable. The higher absolute value proves strong effects. Despite different units or scales of variables often used in the regression analysis, standardized coefficients beta help compare these variables to each other in one model and contrast the relative importance of each coefficient in the regression analysis. So, through standardizing these variables, regression analysis assists in identifying that venture debt have a relatively more substantial impact on the growth of startups among all these variables.

Also, it is proved that all six variables are statistically significant predictors since their significance values are less than 0.05. In the coefficients table, nearly all six control variables are highly statistically significant. Except patents granted, all other control variables are associated with statistically considerable beta weights.

6. Conclusion and discussion

This paper investigates the concept, benefits, and effects of venture debt financing, a relatively new option compared to venture capital financing.

Since the venture debt market has become increasingly popular among startups, it is essential for entrepreneurs and outside investors to know more about venture debt financing. This paper can help them understand more about the advantages of venture debt and its influence on the development of startups' exit outcomes, both from theoretical perspectives and empirical shreds of evidence.

The results of theoretical models in this research show that venture debt can contribute to offering benefits. Specifically, it is proved that venture debt costs less than venture capital financing when startups are growing well, and the cost difference will be extended with the growth of startups. Besides, venture debt can help minimize dilution for founders and existing investors and can help increase returns to investors through adding leverage. The fact that venture debt owns the characteristic of limited dilution may be particularly appropriate for startups that have already given away large amounts of their own to some venture capitalists [13]. Though sometimes the warrant offered for venture lenders cost some ownership stakes, the ownerships that should be given out for the regulation of warrant are much less than those needed for the venture capital financing process. In addition, it is admitted that venture capitalists usually get themselves largely involved with startups’ businesses.

Venture debt investors do not actively participate in startups' daily business, providing more freedom to founders when they need to make their company decisions [19].

Also, venture debt financing can bring a high marginal benefit to the value of the investment compared to venture capital. Moreover, this paper shows that venture debt can be an excellent complementary financing opinion to equity. Startups that carry VD-backed and VC-backed funding rounds can hold more ownership stakes than startups that only involve VC-backed funding rounds.

Additionally, it is believed that venture debt financing acts as a bridge between equity financing rounds, assisting early startups in reaching different kinds of milestones and realizing the future purpose of the high valuation of funding rounds [13]. Using a two-stage hierarchical multiple regression model and after examining a large dataset, this research shows the testified result that venture debt financing explains statistically significant variance in the development of startups after accounting for all other control variables. The added variable, venture debt financing, does predict the dependent variable above and beyond other variables. Proved by the change in R square, F statistics, and t value, venture debt, one of the forms of debt financing, does play a highly statistically significant role in the growth of startups.

This study provides several contributions to the existing researches. Firstly, this study uses three theoretical models to compare venture debt financing and venture capital financing from a cost, limited dilution effect, and marginal benefit perspective. It shows that venture debt financing has its unique peculiarity and offers many benefits to startups. Second, this study contributes to the research stream by showing that venture debt financing can be a fantastic alternative financing opinion for startups instead of acting only as of the total substitute. Third, this research proves that startups with VD-funded develop better than startups with no VD-funded, owning more chances to achieve IPO, trade sale, or have subsequent funding rounds.

However, the venture debt market is still a very under-researched field with different avenues open for future research. Apart from existing research and this study, there is still plenty of room to dive into, based on this study's needed further research area and limitations. For instance, this research currently deduces that venture debt financing contributes to startups' development, booming the exit outcomes of startups. However, nobody will be sure about the future venture debt market, so continuous analysis is expected to examine further the influences of venture debt financing on startup future performance.

Additionally, this study has some limitations. Though venture debt is proved in previous models that they are much preferred for original investors, it should also be noticed that earlier models in this research are highly simplified cases with the requirement of choosing from venture capital or venture debt. However, this paper is aware that investors usually acquire capital from both sides. Also, this study assumes that the new injection of capital is of the same size as venture debt, which is generally not the case when debt and equity are combined in a single round of capital investment. Venture debt can usually be considered one minor part of total financing.

Moreover, though this research provides a thousand data about funding rounds and startups to conduct empirical regression, this study still lacks enough funding rounds backed by venture debt financing. It makes sense that the conclusion and result can be more accurate if there is more information about funding rounds and startups already involved with VD-backed. Therefore, further examination and investigation are possible and should be pursued.

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