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Supply and Demand of Venture Capital in the U. S.

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Abstract

Venture capital is an investment made by specialized organizations in high-growth, high-risk and often highly technological firms that need capital to finance product development or growth. This sort of financing is, by nature, mostly in the form of equity rather than debt. The purpose of this paper is to identify and ascertain the effects of the various exogenous variables that influence the supply and demand of venture capital.

Keywords

Investment

Supply and Demand of Venture Capital in the U.S.

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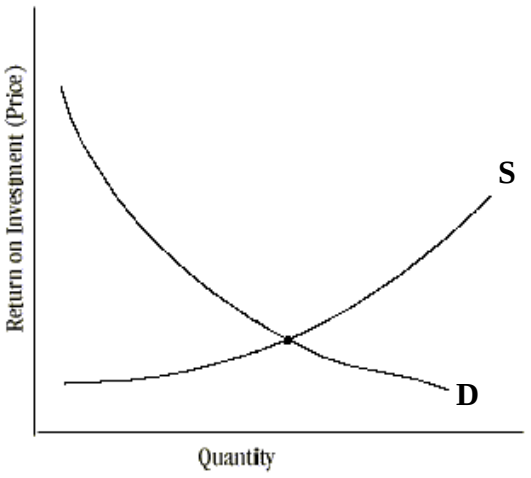
I. INTRODUCTION

Venture capital is an investment made by specialized organizations in high-growth, high-risk and often highly technological firms that need capital to finance product development or growth. This sort of financing is, by nature, mostly in the form of equity rather than debt. The capital invested in such fashion usually originates from private and public pension funds, endowment funds, foundations, corporations, wealthy individuals, and foreign investors.

Figure 1: Supply and Demand of Venture Capital



The venture capital market in the U.S. is known for its vibrancy and success in fueling the economy. Some of the biggest players in many industries received their initial impetus from these venture capital funds. In fact, countries like Japan and the UK have attempted to model their own venture capital industries after the United States (Rodney Clark, 1987). Venture capital is also an important catalyst in the development, implementation and commercialization of new technology—even creating entirely new industries, including biotechnology and overnight shipping. Some of America's most successful companies grew with the help of venture funding—Intel, DEC, Apple, Microsoft, Sun Microsystems, FedEx, Genentech, and Netscape, to name a few. (Venture One)

Venture capital institutions perform another important role. Their presence as investors in a company going public can certify that the offering price of the issue reflects all available and relevant inside information (Meggison & Weiss, 1997). It therefore becomes a matter of great significance that policies be made to encourage venture capital activity in the economy. This in turn calls for a good understanding of the various factors that affect its market. The purpose of this paper is to identify and ascertain the effects of the various exogenous variables that influence the supply and demand of venture capital. Section II will provide a theoretical background of the supply and demand of venture capital, and the various exogenous factors that may affect the market. Section III builds upon the various theories and sets up the empirical model. Section IV analyzes the results of the statistical tests that are run on the model. Finally, Section V presents some policy implications based upon the findings of the study and provides suggestions for future research.

II. THEORETICAL BACKGROUND

A. The Supply and Demand Model for Venture Capital

To understand the various mechanisms by which the different factors influence venture capital activity, it is important to discuss its quantity and price under a supply-demand framework. In Figure 1, the supply curve represents the willingness of institutions and individuals to supply venture capital as a function of the rate of return on the

investment. A higher rate of return leads to a greater desire to supply capital. Thus, as in most cases, this is an upward-sloping supply curve. The demand schedule represents the volume of venture capital demanded by firms/entrepreneurs at a given expected rate of return. Here, the rate of return demanded by the suppliers of the venture capital investments is the price of borrowing these funds for those who demand it. A higher rate of return therefore, reduces the number of firms that are willing or able to borrow capital at that rate, leading to a downward sloping demand curve.

By construction, the point of intersection of the supply and demand curves represents the equilibrium price of venture capital. However, returns from venture capital investments are generally obtained a few years after the initial investment, when the firm is taken public, or gets bought out. Such events give the venture investors a chance to exit from their investments and cash-in on the returns. Until that event occurs, the firm is valued only at cost. This measure, however, fails to account for the intrinsic value of the firm, rendering it useless as a measure of the anticipated return on venture capital investments. Gompers and Lerner also point out that the reporting and accounting practices of the various venture capital organizations differ considerably, further complicating the task of measuring the anticipated returns on venture investments (1997).

The important thing to note about the venture capital industry is that both the suppliers and the demanders of venture capital are ultimately motivated by profit. Therefore, the factors that influence venture capital activity usually do so via their influence on the expected profit (anticipated rate of return) from the venture. Given this framework, the following section discusses the major exogenous factors that influence these expectations of profit from venture investments, thus affecting the market for venture capital. For each variable, economic theory is used to predict and estimate the nature of its effect.

B. Factors Influencing the Market

1. Industry and Market Performance

Industry performance has historically proven to be extremely important in attracting more participants and capital into any industry. This can be explained by the basic principle of profit maximization, which dictates that individuals seek to participate in economic activities with a motivation of earning profit. As a result, the industry that exhibits a high probability of profit, *ceteris paribus*, generates more interest and attracts more investment. Accordingly, the performance of the venture capital industry also has an impact on the supply and demand of venture capital. Better returns in the venture industry tend to generate more demand and attract more supply of venture capital. On the other hand, poor performance (in terms of returns) depresses venture capital activity.[1]

Another related factor that works in conjunction with industry performance is the overall performance of capital markets. This is a direct result of the fact that most of the aforesaid gains made on a venture investment come from an initial public offering (IPO) and that the success of an IPO, in turn, is inextricably connected with the health of the capital markets (Venture Economics, 1988). A healthy stock market also facilitates the creation of liquidity in the venture sector, thus encouraging contributions. Black and Gilson also find in their research that growing and robust capital markets positively effect the venture capital industry.

2. Capital Gains Tax (CGT)

There has been considerable empirical evidence regarding the effects of capital gains taxes on venture capital activity. Venture capital activity and funding rose dramatically after the capital gains tax cuts of 1978 and 1981. Also, since the capital gains rate hike in 1986, the rate of venture capital investing has been rather stable in the U.S. Meanwhile, it has increased rapidly in other parts of the world. This capital gains rate hike, therefore, has in effect caused negative growth in venture capital funding in the U.S. Poterba considers these correlations to be sufficient to hypothesize a negative relationship between the capital gains tax rates and the level of venture capital funding.

According to this hypothesis, the capital gains tax has a two-sided effect. Changes in capital gains tax rates alter the expected profits from such

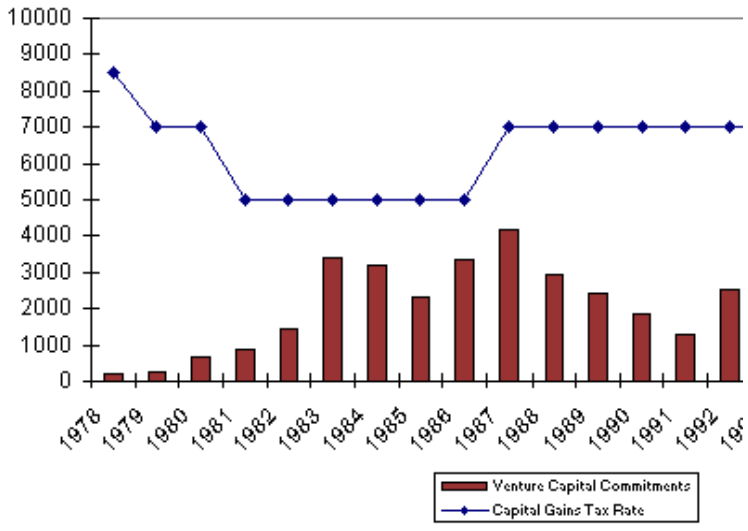
ventures for both the suppliers and the demanders. On the one hand, a reduction in the capital gains tax raises the supply of venture capital by increasing the after tax returns in assets that yield capital gains, reducing the required rate of pre-tax return. This causes a right-shift in the supply curve (Figure 1). On the other hand, a reduction in the tax rate increases the demand for venture capital funds by increasing the number of individuals that initiate start-ups, and making it easier for them to attract employees. In addition, capital gains income can be made more attractive to those entrepreneurs that are considering forgoing wage income to engage in private ventures. Consequently, there is a right-shift in the demand schedule for venture capital (Figure 1).

It is important to note that differential tax-treatment of venture investors and entrepreneurs is possible, since the two classes of people can easily be distinguished. Therefore, to formulate tax policies that are efficient, it is important to analyze the magnitude of influence that capital gains taxation has on the suppliers (venture investors) and demanders (entrepreneurs). Only after studying its effects on the two sub-groups can we formulate policies that effectively encourage venture capital. This differential will also be further analyzed using the empirical model.

3. Research and Development

As pointed out in the introduction, venture capital investments are often made in high-growth, high-risk ventures that are often highly technological in nature. Landscroner and Paroush (1995) explain that venture capital firms play a crucial role in commercializing new technologies (technologies that are still in the nascent stages of development). New technologies tend to open up new markets and new opportunities for profit, seducing individual and institutional venture capitalists as well as entrepreneurs. In turn, the flow of funds from the suppliers of venture capital helps fund further research in these new technologies. This theory, therefore, suggests a strong positive link between R&D expenditures and venture capital activity. It is important to also mention that this does not necessarily imply causation in one way or the other. The relationship between R&D and venture capital funding appears to be more symbiotic in nature, where they both mutually benefit from each other. Moreover, Lerner and Gompers found that spending on Research and Development had a significant positive impact on venture capital activity at the state-level (1998). According to them, high R&D expenditures indicate a high number of "potential entrepreneurs with promising ideas." The R&D variable could also potentially capture the

Figure 2: Venture Capital Investments and the Mximum Statutory Long Term Capital Gains Tax Rate for High-Income Tax Payers



demand effects of high-technology firms. It would therefore be reasonable to hypothesize that increased R&D spending creates a similar effect at the aggregate level.

4. Interest Rates

Basic macroeconomic theory suggests that debt instruments are an alternative to equity investments, which includes venture capital investments. Thus, if interest rates (returns on credit given) rise, the relative attractiveness of investing in venture capital funds would likely deteriorate, *ceteris paribus*. This would decrease the willingness of investors to supply venture capital at all prices, i.e., all expected return levels. Since the decision to invest is generally based upon past performance of the various alternatives, the previous year's performance of interest rate will be used as a comparative standard. In other words, the interest rates variable will be lagged. These are the major factors that are predicted to affect the supply and demand for venture capital in the US. In the following section, we will discuss the various proxies that are used in the model to account for these factors.

III. EMPIRICAL MODEL

The data set for the empirical model consists of a time series. The model is set up as an OLS model in which the dependent variable measures venture capital activity. The explanatory variables include proxies to capture the effects of the various factors discussed in the previous section. Following is a list of variables used in the model.

A.Venture Capital Commitments (VC_COMMIT)

This is the dependent variable in the model and is used as a proxy for the venture capital activity in the U.S. in a given year. It measures the total amount of commitments made by the venture capital industry in a given year. The commitments made in a given year usually span across many years. For instance, a venture capitalist might commit to providing a venture with $10 million over the next four years, although the actual funds defrayed may only be $2.5 million in the first year, $3 million in the second year, and so on. Tracking actual venture capital payments made in a given year would therefore reflect past commitments. Instead, the commitments made in a given year more accurately reflect the sentiments of the investors and the market for venture capital. Therefore, it is a reasonable measure of venture capital activity in a given year. The data was obtained from the Venture Economics database and various issues of the *Venture Capital Journal.*

B. Industry and Market Performance (IND_PERF)

To measure the effect of industry performance, some type of a handle on returns on venture capital investments is needed. Unfortunately, as pointed out before, estimating the price of venture capital is difficult, given the long-term nature of its payoffs. As a proxy, the model uses the amount of money raised by the IPOs of venture capital-backed firms in a certain year. Based on the theory described in Section II.B.1, the predicted effect of this variable on VC_COMMIT should be positive. This measure is a suitable proxy for the performance of (returns on) venture capital investments because the bulk of the profits on a venture investment are made by taking the firm public (Venture Economics, 1988). Almost 96% of the IPOs and only 59% of the acquisitions provided positive returns on investments for the venture capitalists (Venture Capital Journal[2]).

A separate Venture Economics study done in 1998 found that $1.00 invested in a firm that goes public provides an average cash return of $1.95 over the initial investment with an average holding period of 4.2 years. Compare this with the next best option, which is the acquisition of the firm that the money was invested in. In this case, the return is only 40 cents over a mean holding period of 3.7 years. This proxy also captures the effects of the performance of the markets in general because the valuation and pricing of an IPO is strongly correlated with the prevalent market conditions (Gompers and Lerner, 1999). The data was obtained from *The Venture Capital Cycle* (Gompers and Lerner, 1999).

C. Capital Gains Tax Rate (CAP_GAINS)

This was measured using the Maximum Statutory Long term Capital Gains Tax Rate for high-income tax payers as determined by the Internal Revenue Service (IRS). As the theory suggests, this variable can be expected to have a negative relationship with VC_COMMIT. The data was obtained from the IRS database.

D. Research and Development Spending (R&D)

The proxy used to measure the influence of Research and Development is national expenditures for R&D as a percentage of gross domestic product (GDP), as reported by the National Science Foundation (NSF). The advantage of using this variable is that it provides a built-in control for the overall economic situation by incorporating GDP in its calculation. This variable is expected to have a positive relationship with venture capital commitments because of the reasons described in Section II.B.3. The data was computed using data obtained from the NSF homepage.

E. Interest Rates (INT_RATE)

The lagged 30 year T-bill Constant Maturity Rate is used as a proxy to measure the prevalent interest rates in the financial market. A negative relationship is suggested between this variable and VC_COMMIT by the theory discussed in Section II.B.4. The data was obtained from the Economagic database. Table 1 summarizes the information on the different variables.

The OLS model is set up as follows:

$$\mathbf{VC\_COMMIT = a + ß_1 IND\_PERF + ß_2 CAP\_GAINS + ß_3 R\&D + ß_4 INT\_RATE + ý}$$

IV. ANALYSIS OF THE RESULTS

Data from 1978 to 1995 was used in the model described in Section III. Table 2 shows the results obtained. The adjusted R^2 was 65.11% and all the variables had the predicted signs. In terms of significance, two of the four variables were significant at the 95% level of confidence. These variables were **CAP_GAINS** and **INT_RATE**.

A second regression was run with the R&D variable lagged. This was done with the reasoning that the spending done on R&D in a given year is more likely to influence venture capital demand and supply in the following year(s). The results are shown in Table 3.

Table 1: Summary Description of Variables Used in OLS Model

Variable Name	Description	Predicted Sign
VC_COMMIT	Venture Capital Activity measured by the amount of money raised in Commitments in the given year.	N/A
IND_PERF	Industry performance measured by the total amount raised by venture-backed IPOs in the market.	+
CAP_GAINS	Max. Statutory Long term Capital Gains Tax Rate for high-income tax payers	-
R&D	Total R&D expenditure as a percentage of the GDP in the given year.	+
INT_RATE	30 Yr. T-bill rate (lagged)	-

Table 2: Regression Results

Regression Statistics					
Multiple R	0.851240136				
R Square	0.724609768				
Adjusted R Square	0.651172373				
Standard Error	1614.340511				
Observations	20				
ANOVA					
	df	SS	MS	F	Significance F
Regression	4	102857793.3	25714448.3	9.86704073	0.000405633
Residual	15	39091429.27	2606095.28		
Total	19	141949222.6			
	Coefficients	Standard Error	t Stat	P-value	
Intercept	23931.00834	8471.309805	2.82494784	0.01279856	
IND_PERF	0.242951537	0.15017403	1.61779994	0.12653641	
CAP_GAINS	-602.587606	133.3227304	-4.5197665	0.00040695	
R&D	1606.275325	2077.726642	0.77309271	0.45147902	
INT_RATE	-1036.610091	300.8904369	-3.4451414	0.00360763	

Table 3: Regression Results (R&D lagged)

Regression Statistics					
Multiple R	0.850963				
R Square	0.724138				
Adjusted R Square	0.64532				
Standard Error	1594.153				
Observations	19				
ANOVA					
	df	SS	MS	F	Significance F
Regression	4	93393653	23348413	9.187498	0.000738
Residual	14	35578544	2541325		
Total	18	1.29E+08			
	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	23821.07	8289.283	2.873719	0.012262	6042.306
IND_PERF	0.277683	0.14776	1.879289	0.081182	-0.03923
CAP_GAINS	-672.13	143.1736	-4.69451	0.000345	-979.207
R&D	2215.686	1961.902	1.129356	0.277727	-1992.18
INT_RATE	-1023.86	303.1581	-3.37733	0.004512	-1674.07

Table 4: Comparison of the Beta values of CAP_GAINS on Taxable and Non-Taxable Commitments

Taxable Commitments	Non-taxable Commitments
CAP_GAINS ß = -0.16682 p-value: 0.0017707	CAP_GAINS ß = -0.13037 p-value: 0.008117

Although one observation was lost in the process, IND_PERF (industry and market performance) became significant at the 90% level of confidence. R&D also gained some significance. The signs remained as predicted for all the variables.

The next regressions slightly modify the original model to further analyze the effects of capital gains tax on venture capital in light of its differential tax-treatment mentioned in Section B.2. A log-lin model was used instead of the standard OLS test to study the taxable commitments (commitments by individuals) and non-taxable commitments (commitments by pension funds). The equations are as follows:

$$\ln(TAXABLE) = a + ß_1 IND\_PERF + ß_2 CAP\_GAINS + ß_3 R\&D + ß_4 INT\_RATE + ý$$

$$\ln(NONTAXABLE) = a + ß_1 IND\_PERF + ß_2 CAP\_GAINS + ß_3 R\&D + ß_4 INT\_RATE + ý$$

The log-lin model was used so that the results could be standardized across the two subgroups of investors. With this model, the coefficients can be interpreted as relative changes in commitments due to an absolute change the explanatory variables.

If capital gains taxation has a stronger effect on the suppliers, then CAP_GAINS would be expected to have a significantly stronger negative impact on capital commitments from taxable investors. If the opposite hypothesis is true, that is the effect is stronger for the demanders, then the effect of CAP_GAINS should be more-or-less uniform across both the sub-groups, since the reduction in supply would then be a result of falling demand. The following coefficients were obtained for CAP_GAINS.

As shown in Table 4, the effect of capital gains tax rates is more-or-less similar across the two sub-groups of investors. For every percentage point increase in the capital gains tax rate, the taxable commitments go down by approximately 16%, and the non-taxable commitments go down by roughly 13%[3]. These results suggest that the demand side theory is correct and that the entrepreneurs (demanders of venture capital) are more sensitive to changes in the capital gains tax rate.

V. CONCLUSIONS

The purpose of this research was to assist in formulating policies that encourage venture capital. It is clear from the results that capital gains taxes have a negative impact on venture capital activity. A reduction in the capital gains tax rates would therefore boost the inflow of funds into the industry. In addition, this study found that the demand-side effect of capital gains taxes is stronger than the supply-side effect. Therefore, special attention should be paid to subsidize the entrepreneurs (the demanders of venture capital). Poterba's caveat should, however, be kept in mind. Most of the capital gains taxes collected by the government are not from capital appreciation resulting from venture investment or entrepreneurship. In fact, venture capital activity generates a rather small percentage of these capital gains. An across-the-board cut would unfairly benefit the owners of the major chunk of capital gains income that exists outside the venture capital industry. Special tax subsidies that target the industry would likely resolve the issue.

Although R&D spending did not prove to be too significant, it did have the expected sign. Also, its p-value went up from 0.45 in the first regression (Table 3) to 0.27 in the second (Table 4). The variable also was significant in the state-wide analysis done by Lerner and Gompers. Thus, the variable shows a lot of promise. It would therefore be reasonable to suggest increased R&D spending as a means of increasing venture capital activity, although further research in this area is still warranted.

In terms of future research on the topic, there are a number of aspects of this study that can be refined. The biggest challenge will be the collection of enough data to derive meaningful results from the tests. Increasing the number of observations will significantly improve the reliability of the findings. Also, a better measure for industry performance can be used. One possible proxy would be a running average of the performance of the stocks of the companies that were taken public. This proxy might be

better at capturing the long-term returns on venture investments than simply the IPO market price of these stocks.

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[1] As mentioned before, both the suppliers and the demanders of venture capital react in a similar fashion to anticipated returns on investment. Therefore, industry performance affects both the supply of and the demand for venture capital in the same direction.

[2] See: 'Exiting: New Patterns in the 1980's', *Venture Capital Journal,* August 1998, pp.12-16.

[3] Note that the coefficients are provided here for comparison purposes only. A complete analysis of the funding patterns within the two sub-groups would probably require a more comprehensive study.