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The Impact of Liquidity on Stock Performance Among Venture Capital-backed Firms in India

A study of Venture Capital Fund performance in India

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Abstract

Venture capital is a financing form that has increased in popularity during the last decades. Its emergence is closely related with the development of new technology and is, as a result, often invested in innovative companies that are considered to possess high-growth potential. In return for these investments, the investors usually demand extremely high returns. Although the VC industry in developed economies has been widely researched previously, research in VC industries in emerging markets is rather limited. During a time of emergence among many developing economies, especially in terms of their VC industries, it is of increasing importance to understand how VC-backed firms in these markets develop across time, and an example of such an emerging market is India which in 2017 and 2018 generated higher GDP growths than China. An important factor as to how companies' stock perform is their stock liquidity, a relationship that has been widely researched previously. As India continues to grow economically, it is therefore becoming more relevant to study these liquidity effects among India's emerging high-growth firms. To do so, a sample of 60 Indian VC-backed firms, constituting the emerging market, and 60 U.S. VC-backed firms, constituting the developed economy, were obtained using data ranging between the 2007-2018. The study was conducted through comparing the liquidity effects on performance between these two groups, as well as testing whether this liquidity effect holds for Indian VC-backed firms as well. Based on the results, I find no significant evidence that Indian VC-backed firms experience any different liquidity effects than U.S. VC-backed firms, but instead, the results may indicate similar behavior among the two groups.

Key words: Venture Capital, IPO, High-Growth, Emerging Market, Risk, India, U.S.

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Table of Contents

1 Introduction.....	1
1.1 Purpose and Contribution.....	1
1.2 Definition of Venture Capital.....	2
1.3 Exit Stage	3
1.4 Motivation	4
2 Literature Review	6
2.1 Development of VC in Developed Economies.....	6
2.2 Development of VC in India.....	6
2.3 VC's Contribution to Financial Performance.....	9
2.4 Stock Liquidity's Impact on Stock Performance	11
2.5 Stock Liquidity among VC-backed Indian Companies.....	12
2.6 Hypotheses	12
3 Data	14
3.1 Data Collection.....	14
3.2 IPO Data	14
3.3 Indian VC Data	15
3.4 U.S. VC Data.....	17
3.5 Data Limitations.....	19
4 Methodology	21
4.3 Other Independent Variables	23
4.4 Dependent Variable	26
4.5 Regression Models	27
4.5.1 Regressions Conditional on Country.....	27
4.5.2 Regressions with Interaction	28
5 Empirical Results	30
5.1 Regression Results	30
5.2 Robustness Tests.....	34
5.2.1 Hausman Test.....	35
5.2.2 Wooldridge Test.....	35
6 Discussion.....	36
6.1 Liquidity Effects Comparison.....	36
6.2 Performance Comparison.....	36
6.3 Institutional Factors.....	37

6.4 Data Issues as Potential Reason for Insignificance.....	38
7 Conclusions.....	39
References.....	41
Appendix.....	45

1 Introduction

1.1 Purpose and Contribution

Venture capital is arguably an important contributor to the success that companies with high-growth potential possibly achieve. The phenomenon of venture capital has been widely researched historically, for instance Lerner (1994) who studied the performance of venture capital-backed biotechnology companies between 1978 and 1992, and Gompers (1995) who studied venture capital-backed companies in the early stage, without a specification on industry. A common factor between these two studies (and one that applies to most studies related to venture capital) is that it studies the financing form in developed economies. Throughout history, most of the renowned research in venture capital is focused on companies based in North America and Europe, but little attention is given towards emerging markets even though venture capital-backing does exist in those regions. As a result, a knowledge gap has arisen.

This study will attempt to analyze the impact of stock liquidity on Indian venture capital-backed companies' annual returns. By analyzing the firms' stocks, it is possible to explore if a potential impact from the stock liquidity exists. Furthermore, since the firms studied are publicly traded on a stock exchange, an increased amount of information is made public. In order to analyze if a potential relationship between stock liquidity and stock performance exists for Indian venture capital-backed companies, I will use sample data for both Indian and U.S. venture capital-backed public firms, where the U.S. venture capital-backed firms will constitute the group characterized as a developed economy. By conducting such a comparison, it is possible to study the potential differences between a developed economy, the U.S., and an emerging market, India, in terms of liquidity's impact on performance.

After having read this thesis, one will have an increased understanding of the venture capital industry in India, in particular an understanding of specific underlying liquidity factors that potentially affect stock performance. Literature on stock liquidity impact on stock performance in India is highly limited, thus motivating the topic of this study. Ultimately, the contribution will be an up-to-date study on an otherwise rather unexplored area of the venture capital industry in India. During a time when both India and venture capital is growing in many aspects, the results will hopefully be useful for future research.

1.2 Definition of Venture Capital

Venture capital (denoted by VC henceforth) is a subset of Private Equity. It constitutes capital that is provided by specialist investment firms and is typically invested in privately held companies deemed to possess large growth potential, often due to their innovativeness (Lerner, 1994). This growth potential stems from the fact that the firm sits on an idea that could entail high growth, and in order to accomplish this the firm needs access to capital. Although such innovative firms have the potential to reward the investor with high returns, there is also the risk of significant underperformance which could lead to large negative returns (Gompers, 1995).

VC is usually infused into funds, not too surprisingly referred to as *VC funds*. These funds are then invested in younger companies, often during a very early stage such as the start-up stage. This differentiates VC from private equity in the sense that private equity is typically financed in more mature firms (Kaplan & Strömberg, 2009). Since VC refers to investments in younger companies often during the start-up stage, a typical issue that arises is *information asymmetry*. This essentially means that there is an asymmetry between information available to the firm compared to what is available to the public. This information asymmetry is an issue for the VC firms, too, and as a measure to control for this the ownership is usually divided into ownership stages, where funding is provided in stages. The reasons for the existence of information asymmetry are several, but a common reason is that the firm sits on an idea that it does not want to go public since its exclusivity for the firm entails higher profitability than had the public known about it (Lerner, 1994). Furthermore, Gompers (1995) asserts that staging capital investments is a way to reduce risk and the size of the loss in case the VC-backed company performs poorly. Historically, the occurrence of staging capital investments has been highly prevalent in the VC industry (Lerner, 1994). The procedure of investing in stages is often done in order to reduce risk as the investor is enabled to periodically observe the progress of the firm that it invests in. This risk reduction is especially important for certain risky sectors where potential losses could be very large, for instance the biotechnology industry (Lerner, 1994).

An important characterizing feature of VC funds is that they are essentially *limited partnerships*, where the managing partners constitute the VC firms and the funds' investors are the limited partners (Denis, 2004). A large amount of VC investments is made with certain rights and clauses embedded, such as anti-dilution clauses and liquidation rights (Denis, 2004; Hellman & Puri, 2002).

VC itself is comprised by an ownership form in the shape of a limited partnership where one party acts as the limited partner (LP) and the other acts as the general partner (GP). Easily summarized, the LP invests in the VC fund, and the VC fund invests in the portfolio companies. The GPs often sit on the portfolio company boards of directors and provide experience and insight, as well as brings networks and an enhanced reputation (if the GP is well renowned in the VC industry) (Kaplan & Strömberg, 2009; Denis, 2004).

In addition to providing vital funding to companies deemed to be of high growth potential, VC firms contribute in other ways as well. Examples of ways they contribute are through monitoring, professionalization and certification (Denis, 2004). Monitoring is made possible due to the VC firms' position in the sense that they own several companies in their portfolios. VC firms conduct active monitoring, and if there are signs of potential future underperformance for the portfolio company, the venture capitalist would consider decreasing its holdings or even getting rid of their ownership (Gompers, 1995).

As an important capital form with evidently beneficial contributions to innovative firms, VC is an interesting investment type that remains important for current and future research.

1.3 Exit Stage

VC investments are realized through an *exit*. Essentially, the main goal is to maximize and realize returns by doing an exit. In fact, Metrick and Yasuda (2010) argue that venture capitalists invest if they assert that there is an achievable and clear path to reaching the stage of exit, resulting in realized return for the venture capitalist as well as for its investors. The exit, thus, is of high importance to the VC-backed firm and the venture capitalist since it highly impacts the return that is subject to both parties and the investors. In particular, important aspects of doing an exit concern *when* to do it and *how* to do it. According to Ball et al. (2011), VC-backed firms have a tendency to do an exit when their fundamentals have culminated. Other reasons for doing an exit include conditions of the capital market and the desire to exploit market over-optimism in order to maximize returns (Ball et al., 2011). The exit stage or process requires a great set of skills and knowledge. This stage is namely different from the previous stages concerning the time of being under VC ownership. Specifically, during the exit stage several consultations and discussions with investment banks will be conducted, implying an imperative need of expertise from the venture capitalist firm, according to Metrick & Yasuda

(2010). They further mention the fact that an IPO, historically, has constituted the most profitable exit method for VC-backed firms. On the other hand, according to Metrick & Yasuda (2010), doing an exit through the sale of the firm to a strategic buyer can, too, pose a profitable exit method, but is dependent on the competition for the transaction.

A widely discussed area concerning the exit is the valuation of the firm at the stage of exit. Various techniques and methods exist. The VC method is, according to Metrick and Yasuda (2010), the most common method among venture capitalists. The implementations of the VC method are several. The two main valuation approaches are *relative valuation* and *absolute valuation*. The former implies identifying other companies with characteristics similar to the firm of interest. Subsequently, several varying ratios are computed for these companies, often incorporating market conditions and accounting values. In contrast, absolute valuation concerns solely taking the firm of interest into consideration, instead of making comparisons with other firms. The analyst uses valuation models such as the *discounted cash flow model (DCF)* to estimate the value of the firm (Metrick & Yasuda, 2010; Kaplan & Strömberg, 2009). Apart from the mentioned valuation methods, other methods exist as well, such as the *graduation value* (Metrick & Yasuda, 2010).

1.4 Motivation

Stock liquidity is an important factor when deciding to purchase shares of a company. It is desirable to hold a stock that is easily traded in case one wants to sell quickly. If a sudden downfall in the economy occurs, it is expected that some investors will sell off shares if they assess that this will limit the losses, and the same can be expected if a sudden rise happens as some investors will want to realize profits quickly. India is growing economically, amounting to GDP growths of 7.17% and 6.9% in 2017 and 2018, respectively, making India a faster growing economy than China and thus one of the highest growing economies in the world (World Bank, 2019; IMF, 2019). The fact that India is one of the highest growing economies motivates the use of India in the study. Furthermore, India is still considered an emerging market (MSCI, 2019), and to better understand the driving factors of high-growth firms, one method of doing so is by conducting a comparison with an established and developed economy that is widely researched and well-reported. U.S. fulfills these criteria and was thus chosen as the subgroup to be compared with the Indian subgroup. By conducting a study on India, it can shed light on how liquidity effects look in a more volatile environment which has not

previously been researched but needs to be researched as these less developed markets are becoming more relevant for investors in, and outside, of these emerging markets.

Stock liquidity has been found to have a significant effect on performance (Datar et al., 1998; Stoll, 1989; Amihud, 2000) and, thus, stock liquidity constitutes an important performance factor. Since India is an innovative nation and has evidently grown significantly during the last years (World Bank, 2019), it becomes increasingly relevant to study the innovative firms of the nation. It is, furthermore, interesting to study how these firms are affected by conducting their operations in an emerging market with a less stable institutional environment. As a result, it is of high interest to study whether liquidity effects can be discovered among these upcoming Indian firms.

2 Literature Review

2.1 Development of VC in Developed Economies

Historically, VC can be traced back to the year 1946 when the American Research and Development Corporation was formed, but it was not until the late 1970s and early 1980s that the financing form truly emerged (Kortum & Lerner, 2000). An example of VC funding that occurred during this period was when Apple Computer received three VC infusions, amounting to \$518,000 in the first round, \$704,000 in the second round, and \$2,331,00 in the third round. Each of these increasing capital infusions reflected the improvement of firm performance, implying that the VC firm found it feasible to invest increasingly more capital. These increasing capital infusions, as well as the fact that the investments were staged, are in line with assertions of Lerner (1994), namely that increasing capital infusions and capital staging is done partly in reason for risk reduction for the VC firm. Finally, an additional reason for the VC industry's growth was the 1979 Department of Labor policy change, allowing pension funds to invest VC in higher volumes (Gompers, 1995).

VC grew significantly during the 1990s (Kaplan & Schoar, 2005). Having experienced a boom in the 90s, the VC industry has been a major contributor for the rise of many high technology firms such as Facebook and Amazon. After the dot-com bubble, however, the VC industry suffered tremendously, but regained its popularity some years later. Today, VC, as a financing form, remains an important way for early-stage innovative firms to grow and for society to benefit in terms of innovative ideas being realized (Hellman & Puri, 2002; Kortum & Lerner, 2000). In recent times, specifically during the 2000s, VC remains a popular form of financing for investors. According to Denis (2004), investments in VC funds increased highly between the years 1992 and 2000, from \$3.1 billion in 1992 to \$87.3 billion in 2000.

2.2 Development of VC in India

It was in 1988 that the VC industry was established in India as a result of (and in conjunction with) the World Bank's efforts of liberalizing the economy in India (Dossani & Kenney, 2002). In the same year, the first VC company was established – Technology Development and Information Company of India (TDICI) – as a subsidiary of the then state-owned Industrial Credit and Investment Corporation of India (ICICI), which was then considered the second-largest development bank in

India. TDICI would prove to have the most successful VC operations in the early years of the country's VC industry development (Dossani & Kenney, 2002).

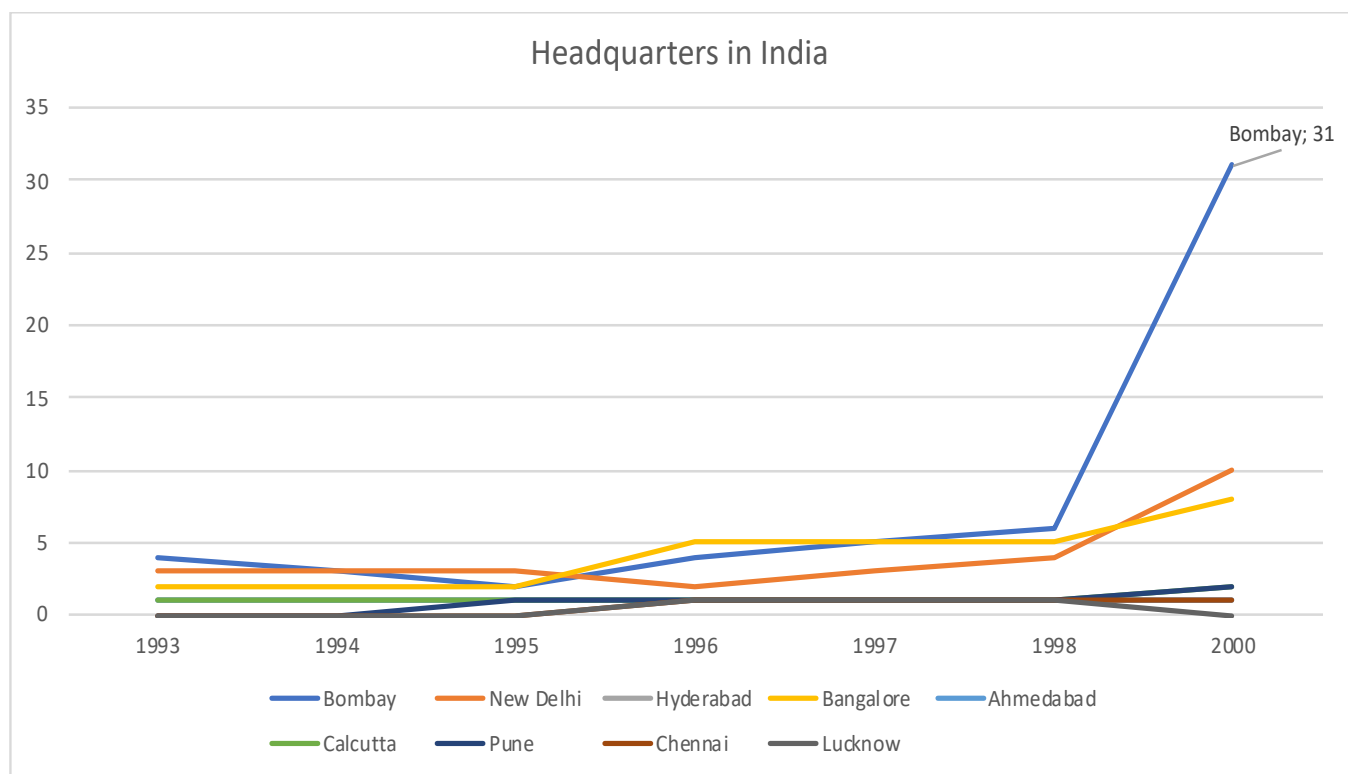
As can be seen in Table 1 below, Bombay had, between the years 1993-2000, experienced a drastic increase in the number of headquarters of members (VC firms) of the Indian Venture Capital Association, followed by New Delhi. This development is also depicted graphically in Figure 1 below. Most notably is the development of Bombay as a prominent location for venture capitalists to conduct their operations. The last two years in the data set, 1998 and 2000, show the most dramatic change, in particular for Bombay, but large increases can be seen for New Delhi and Bangalore as well. The development of the *total* number of venture capitalist firms in India between the years 1993-2000 is shown graphically in Figure 7 in the appendix.

Table 1. Allocation of headquarters in India, 1993-1998, 2000.

	1993	1994	1995	1996	1997	1998	2000
Bombay	4	3	2	4	5	6	31
New Delhi	3	3	3	2	3	4	10
Hyderabad	1	1	1	1	1	1	1
Bangalore	2	2	2	5	5	5	8
Ahmedabad	1	1	1	1	1	1	1
Calcutta	1	1	1	1	1	1	2
Pune	0	0	1	1	1	1	2
Chennai	0	0	0	1	1	1	1
Lucknow	0	0	0	1	1	1	0
Total	12	11	11	17	19	21	56

The table shows the allocation of headquarters among VC firms in India during the years 1993-1998 and 2000. Source: Indian Venture Capital Association (various years)

Figure 1. Allocation of headquarters in India among VC firms.



Graphical depiction of the development of the number of headquarters in India among VC firms, specifically firms that were part of the Indian Venture Capital Association during the time period 1993-1998 and 2000. Furthermore, the allocation of headquarters between cities in India is shown. Source: Indian Venture Capital Association (various years).

Although India possesses a relatively sophisticated financial system compared to other emerging markets, it does face several challenges in order to meet up to its fullest potential regarding its VC industry, according to Dossani and Kenney (2002). They have studied the conditions for innovative and high-growth firms with a focus on India, comparing the status of the Indian VC industry to the equivalent of other emerging markets such as Israel and Taiwan. They assert that although the Indian ecosystem for VC functions better than the ones in Taiwan and Israel, several changes in the system do need to be made in order for India to become an attractive innovative nation for entrepreneurs. The authors refer to the bureaucratic structure of the Indian government, as well as the high level of regulation of the VC industry as reasons for why the emergence of industry has not yet fully developed. Dossani and Kenney (2002) conclude that although barriers such as regulations exist, there is potential for India to grow into a prominent VC nation which motivates this thesis further to study Indian VC-backed firms.

The conclusions made by Dossani and Kenney (2002) on the institutional difficulties that India faces are in accordance with the results and conclusions of Wright et al. (2002), although the approach is slightly different in the sense that focus is put on comparing the propensities of VC firms in India versus U.S. VC firms to succeed. They find that there is a significant need for foreign firms to adapt their operations and strategies in order to fit the prevalent market conditions in India.

Venkatakrishnan and Loganathan (2017) studied the state of the VC market in India with a large emphasis on the most active VC firms and discovered that the most prevalent industry among VC-backed firms in India is (not too surprisingly) the technology sector. Furthermore, they found that the VC industry increased significantly between the years 2012 and 2015, from \$1.0 billion in invested capital to \$2.0 billion. As an interesting conclusion, Venkatakrishnan and Loganathan (2017) assert that entrepreneurs in India lack involvement with VC because of a perception that venture capitalists seek too high of returns on their investments. Furthermore, they conclude that the VC industry in India can - and should - have a larger role.

The overall theme of previous research that is focused on India as a VC industry seemingly concerns the fact that barriers currently exist preventing VC from fully emerging, although significant potential exists. With the background in the doubling of VC investments between 2012 and 2015, India should be considered a prosperous economy for emerging, innovative firms. Furthermore, the Indian economy has experienced significant growth in GDP per capita during the last years, with a GDP growth of 5.878% in 2018 (World Bank, 2019). Although obstacles exist for VC to prosper fully in India as Dossani and Kenney (2002) and Wright et al. (2002) argue, potential does exist for the nation emerge in the VC industry. With this background in mind, it becomes even more interesting to study the Indian VC industry which highly motivates this study.

2.3 VC's Contribution to Financial Performance

Several of the previous studies support the notion that the VC contribution for innovative companies leads to enhanced performance in terms of profitability and returns. In particular, it is interesting to look at how the VC firms themselves differ. Lerner (1994) studied a sample of 350 private biotech companies between the years 1978-1992 and found that VC firms with more experience are superior in timing an IPO compared to less experienced venture capitalists. The main theme of his study is analyzing the optimal timing of conducting an IPO, that is, the timing that leads to the highest possible return for the VC-backed company (and the venture capitalist). The conclusion from the study is that

an IPO should be done when overall equity values on the stock market are high, that is when widespread optimism is prevalent. Ball et al. (2011) refer to this type of timing as the *market-timing hypothesis*. The market-timing hypothesis, according to them, is the notion that VC-backed firms have the ability to time the market in the optimal period of time. The interesting aspect of the study is that it tests the findings of Lerner (1994) by using a relatively longer sample period, namely a data set spanning over three decades. While Lerner (1994) concluded that VC-backed firms are able to time the market at peaks, Ball et al. (2011) find no sufficient evidence of this conclusion. Instead, they refer to a so-called pseudo-market timing that is prevalent among VC-backed companies.

Hellmann and Puri (2002) made several interesting findings in their study. The study was based on examining the potential impact that VC can have on new technology firms using a sample data set consisting of Silicon Valley start-ups. One of the findings was the discovery that firms that had received VC-backing at some point in time tended to have a higher propensity to replace the founder with an outsider as the position of CEO. Furthermore, a more generally applicable conclusion is that firms that receive VC investments are more likely of becoming *professionalized*, meaning that they become less reliant on their investors (Hellmann & Puri, 2002).

When studying the impact of VC, one should remember that VC investments have larger implications than simply the fact that a high-growth company receives financing. As mentioned previously, VC is tightly related with technological development. Kortum and Lerner (2000) assert that VC has a positive effect on technological innovation in society. More specifically, they look at the patenting activity as well as R&D expenditures for the U.S. manufacturing sector during a time period of three decades. Ultimately, they conclude that VC investments are associated with increased patenting rates. Lerner et al. (2011) conducted a similar study, namely focusing on patenting activity's effect on innovation related to leveraged buyouts (LBOs). Although the study is not precisely related to VC (it is about private equity), it is still of great importance as a way to see the effects that patenting activity actually has. Denis (2004) supports the notion of VC's contribution, namely that VC investments contribute to innovation, subsequently leading to better performance.

Meggison and Weiss (1991) find other evidence in terms of VC's contribution to returns. By comparing samples of VC-backed and non-VC-backed companies during the mid 1980's, they assert that being backed by venture capitalists leads to an enhanced certification of quality in the IPO issue. Furthermore, those firms that are backed by VC have a greater propensity of being linked to superior underwriters. This constitutes a clear advantage. Chemmanur et al. (2011) agree that VC firms

significantly contribute to success, mentioning several ways that venture capitalists contribute such as management competency, incentive creation for employees, and the provision of professional networks. Furthermore, they argue that also the reputation of the venture capitalist has an impact on the ability to provide competence and services relative to venture capitalists with less renowned reputation. The notion that a VC firm's reputation has a positive impact on the performance of the acquired entrepreneurial firm is also supported by Stuart et al. (1999). In particular, they conclude that entrepreneurial firms with backing from renowned VC firms have a greater probability of establishing superior alliance partnerships. The entrepreneurial firm, as a result of the VC-backing, obtains widespread recognition, which could possibly lead to greater success. The importance of reputation for VC firms is also highlighted by Megginson and Weiss (1991).

2.4 Stock Liquidity's Impact on Stock Performance

Stock liquidity's impact on how publicly traded stocks perform in terms of returns is a widely researched area. Methods of measuring liquidity are several, where examples include the stock's bid-ask spread (Amihud & Mendelson, 1986; Datar et al., 1998). Amihud (2000), too, found a negative correlation between stock liquidity and stock returns. He adds that this relationship is a possible explanation for the existence of a so-called illiquidity premium, ultimately explaining the widely researched equity premium puzzle. Datar et al. (1998) argue that stocks that possess less liquidity need to offer investors higher returns to compensate for the costs of being a security that is less traded than other, more liquid stocks. This is due to the fact that the rational investor cares about returns. By controlling for firm-specific characteristics such as firm size and book-to-market ratio, they conclude that illiquid stocks *do* give higher returns, or in particular, stock returns are negatively correlated with turnover rates (Datar et al., 1998). This conclusion is fully reasonable, seeing as it is logical that an investor is compensated for the cost of illiquidity, thus giving rise to a higher compensated risk. The claim of Datar et al. (1998) that less liquidity should result in higher returns is particularly interesting to this study as I specifically study stock liquidity's impact on annual returns.

Stoll (1989) analyzes the elements of bid-ask spread, which also constitutes a liquidity measure, and makes a distinction between *quoted* bid ask spread and *realized* bid ask spread. Using a sample of data from NASDAQ during the year 1984 he finds negative serial covariances between returns and the square of quoted spreads. Quoted spreads simply represent the difference in prices quoted by a dealer during a certain point.

2.5 Stock Liquidity among VC-backed Indian Companies

VC is a widely researched capital form as a whole. Common topics among previous research in VC include patents and innovation (Lerner et al., 2011), optimal timing of capital infusions (Gompers, 1995), exit strategies (Ozmel et al., 2013), among others. Furthermore, previous research that relate to India in particular include the studies of risk assessment in the Indian VC industry (Wright et al., 2002), as well as the historical establishment of VC in India. However, previous research on the specific topic of stock liquidity's impact on stock performance among VC-backed Indian companies is yet to be found and hence lays the groundwork to the motivation behind this thesis. As mentioned, India possesses an emerging VC industry, and it has been proven in previous studies that stock liquidity is an important factor for stock performance. As a result, this knowledge gap is important to fill, and with this study I hope to shed light on this matter.

2.6 Hypotheses

This study attempts to fill a knowledge gap in the VC sphere, namely whether the stock liquidity among VC-backed firms in India has a significant impact on stock performance, as measured by annual returns. Previous studies have not touched upon this particular topic for VC-backed firms in India, hence motivating the study. Furthermore, by incorporating modern data ranging from 2007-2018, I aim on providing an up-to-date study which is in contrast to some of the previous research that relate to liquidity's impact on performance.

The first hypothesis concerns the stock's free float volume. The hypothesis concerns whether the stock's volume of free float, that is the volume of shares that is available to public investors to be traded, has a significant impact on stock returns. Specifically, it states the following:

Hypothesis 1

H1: The volume of free-floating shares that is available to public investors has a significant and negative effect on the performance for Indian VC-backed companies.

It is believed that a negative correlation between free float volume and stock performance will be found which would be in accordance with previous research, which have found a negative correlation between liquidity and performance. By collecting the necessary data and performing analyses as well

as conducting robustness tests, one will be able to determine whether this hypothesis holds. Regardless of outcome, I will conduct an analysis and discussion of the results.

The second hypothesis concerns whether the stock's *trading volume* has an impact on stock returns. The trading volume refers to the stock volume that is traded during a specific amount of time. Specifically, the hypothesis states the following:

Hypothesis 2

H2: The volume of shares that is traded has a significant and negative effect on the performance for Indian VC-backed companies.

Like Hypothesis 1, it is believed that a negative correlation between stock volume and stock performance will be found which would be in accordance with previous research, which have found a negative correlation between liquidity and performance. Regressions will be run to determine whether Hypothesis 2 holds. Regardless of the outcome, analyses and discussions of the results will be conducted. Finally, a third hypothesis states that there is a significant difference in liquidity effects between Indian and U.S. VC-backed firms. This hypothesis is tested through the use of interaction terms in the regressions. This third hypothesis states the following:

Hypothesis 3

H3: There is a significant difference between liquidity effects of Indian VC-backed firms compared to American VC-backed firms.

This hypothesis states that when taking into account both groups in one regression using interaction terms and if a significant result is obtained, it would imply that there are significant differences in liquidity effects between the two groups and that the hypothesis, thus, holds. The result of this outcome will be discussed further, regardless of statistical significance or not.

3 Data

3.1 Data Collection

The set of data that was used in this study involves financial performance and stock market performance data for Indian and U.S. VC-backed firms that had conducted an IPO. One of the main criteria was that stock market data had to be available for the period 2007-2018 which is the study period of the thesis. The data set was subsequently divided into two subsamples, American and Indian, to account for the nationalities of the stocks.

In order for the data to be qualified to be used in the regressions, several requirements had to be fulfilled for the sample companies. The main criteria for the inclusion of sample companies were:

- *Be (or have been) VC-backed*
- *Have been publicly listed during the study period (2007-2018)*
- *Have data available that is expressed continuously during the study period*
- *Have data available for the chosen variables*

All classifications of the above criteria were made by the main data source for this study, Thomson Reuters Eikon. Such classifications include, for instance, the nationalities of the companies, in this study being U.S. and Indian firms. No restrictions were made on when the firms in the data set had gone public – instead, the necessity was that their stock had been listed on a stock exchange during the study period 2007-2018.

3.2 IPO Data

The data set used in the study was downloaded using the data source Thomson Reuters Eikon. The procedure for finding companies that fulfilled the main requirements as described in section 3.1 Data Collection initially involved identifying VC firms that invested actively in India and the U.S., respectively. For the Indian dataset, 26 VC firms with portfolio holdings in India were identified, whereas six VC firms with portfolio holdings in the U.S. were identified. All of the U.S. and Indian VC firms that were used in the study can be found in Table 2 in the appendix. The VC funds of these VC firms contain the VC-backed firms that were ultimately used in the study.

The next step was identifying each VC firm's VC funds as the portfolio holdings contained the VC-backed companies that could potentially be used in the study. This applied to both the U.S. and Indian VC firms. It is important to note that several of these VC funds had portfolio holdings in numerous countries instead of the one specific country of interest (India or U.S.). For instance, the VC funds where Indian VC-backed firms were found also included VC-backed firms from other emerging markets such as China and Singapore. To overcome this, filtering was utilized, ultimately resulting in that only the countries of interest, India and U.S., remained in the data set.

When downloading portfolio data, Thomson Reuters Eikon will include information regarding company name, industry, information whether the company is still in the portfolio, company status, last investment and location. All VC portfolios were compiled into one list in order to make the list of VC-backed firms more manageable. For the Indian dataset, a total of 1001 VC-backed companies were found in the downloaded data set for the VC funds, but due to duplicates the list was reduced to 824 unique companies. For the U.S. dataset, 2300 VC-backed firms were found, but after having excluded duplicates as well as excluding firms that had not, by the time of this study, gone public the resulting number of unique U.S. VC-backed firms equaled 811.

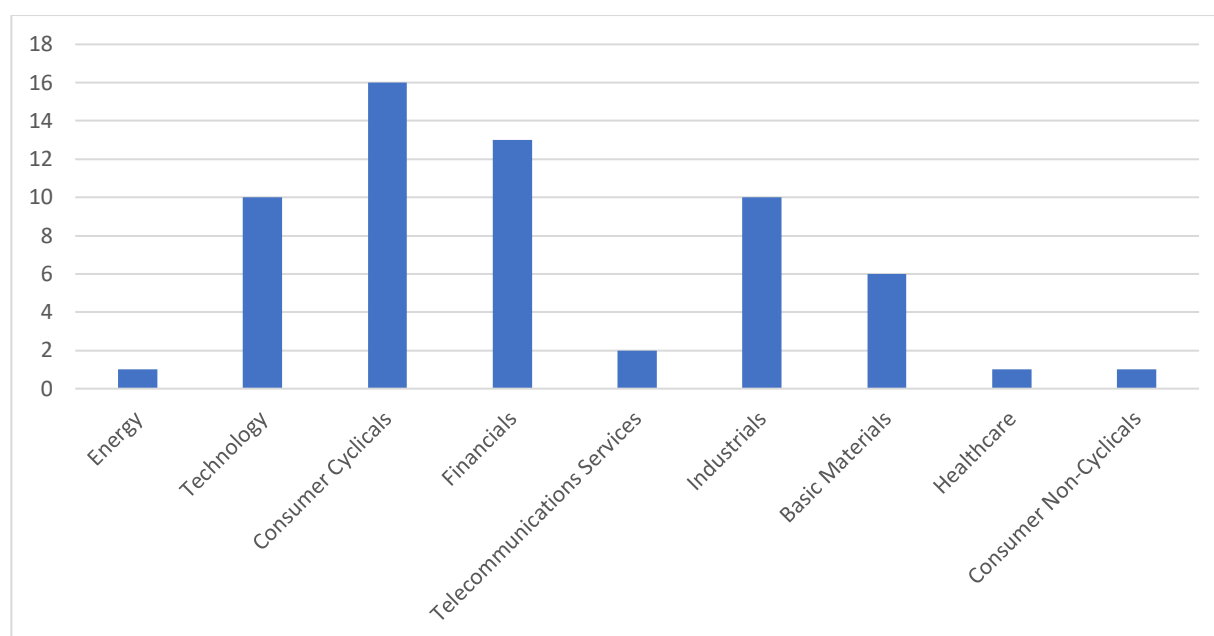
3.3 Indian VC Data

The data set constituting Indian VC-backed firms mainly consisted of firms noted on the National Stock Exchange of India Ltd (NSE). A minor part of the data set consisted of firms noted on BSE, formerly known as Bombay Stock Exchange Ltd. The distribution of industries among all Indian VC-backed companies in the data set are as follows: approximately half (48.18%) of the VC-backed companies were active in the technology industry, followed by consumer cyclicals (16.14%) and industrials (11.17%) as the top three most frequent industries.

As mentioned previously, difficulties were met in terms of obtaining data for the Indian VC-backed firms and this is where the largest setbacks were encountered. Out of 824 identified VC-backed Indian firms, only 71 companies (around 8.62%) of the companies had, by the time of this study, done an IPO *and* had their stock noted on a stock exchange during the study period 2007-2018. The rest of the firms that were dismissed from the study had company statuses characterized as either "active" (79.1%) which implies that the firm is operating but has not undergone an IPO, having been acquired (8.98%), "in registration" (1.09%), "LBO" (0.49%), "merger" (0.24%), or pending acquisition (0.97%).

Out of the 71 companies that had gone public, 60 of them were finally chosen for the study and thus constituted the firm sample of Indian VC-backed firms that was used in the study. The reason for the reduction from 71 to 60 companies was that a significant amount of data was missing relating to the variables that were to be used in this study. In particular, a significant amount of data related to the stocks such as stock prices were found to be missing, thus making it necessary to omit these companies. For the 60 companies that were ultimately used in the study, the industry distribution can be found in Figure 2.

Figure 2. Distribution of industries in the final sample among the Indian VC-backed companies used in the study.



The figure shows the industry distribution for the Indian VC-backed firms that were used in the regressions. A relatively even distribution can be observed between Consumer Cyclical, Financials, Technology and Industrials.

The stock market data set that was downloaded included daily stock prices, daily free float volumes for the stocks, daily trading (stock) volumes and daily market capitalization values for all of the firms in the Indian subsample. Stock free float represents the portion of shares that is available to public investors and is, according to Chan et al. (2002), a feasible liquidity measure. In this study, however, the *volume* of free float was used. No restrictions on the age of the VC-backed companies were made which was motivated in the sense that by not making such restrictions, I could ensure that a sufficiently large data set could be used in the study.

Apart from stock market data, annually expressed values of total assets and price-to-book ratios were obtained for all Indian VC-backed firms. Furthermore, annual stock market returns of NIFTY500 (index containing the 500 largest Indian publicly traded firms based on market capitalization) and annual risk-free rates in India were downloaded using Thomson Reuters' Eikon.

3.4 U.S. VC Data

A subset of the firm sample consists of American VC-backed firms. The reason for including American firms in the study is that it constitutes a reference group in the regression that will help determine whether significant differences between the liquidity effects of Indian and American VC-backed firms are found, that is, by comparing an emerging market with a developed economy.

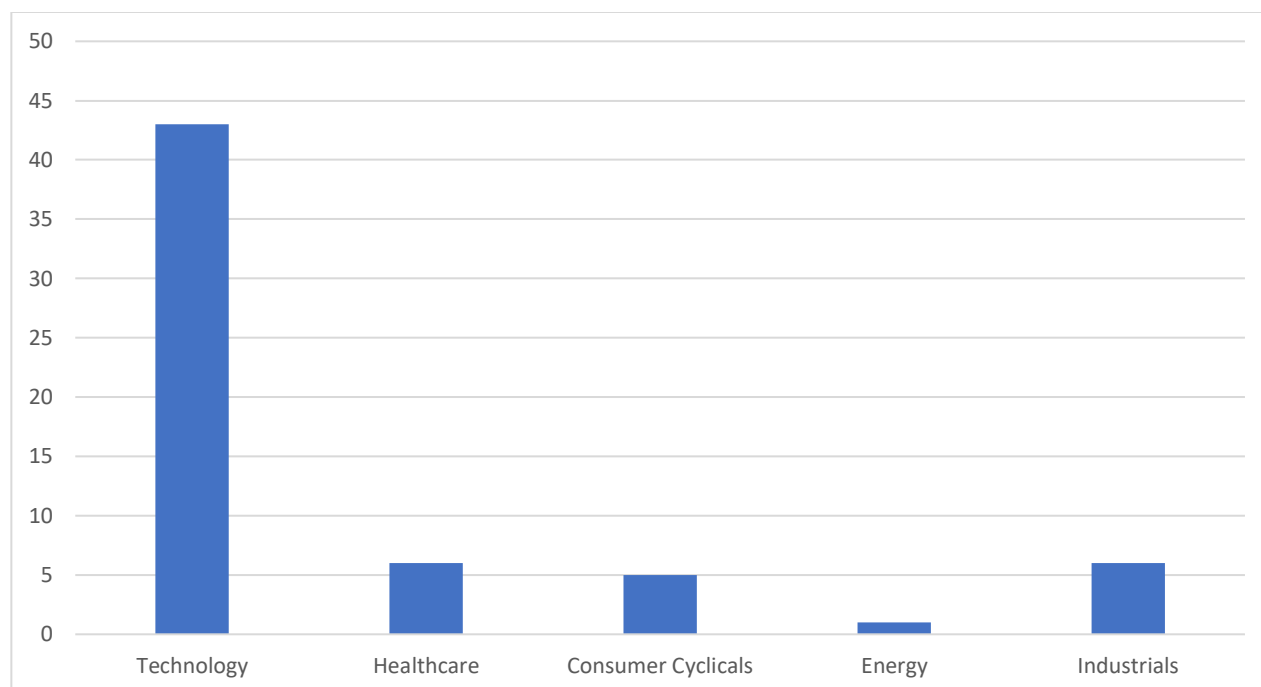
Prior to making restrictions, a total of 2300 American VC-backed companies were initially identified in the VC funds that had been downloaded, as previously described. This sample of 2300 VC-backed companies included, for instance, duplicates. Furthermore, it included companies that had current company statuses that were uninteresting to the study. These statuses included, for example, having been acquired by another company, still operating under the original ownership, having gone defunct, among others. The company status that is interesting to this study is when the company has done an IPO, implying that stock market data is available.

Furthermore, the companies had to fulfill the requirements that were previously defined, namely having stock data continuously available between the years 2007-2018, as well as having data available for the variables *total assets* and *price-to-book ratio*. The requirements are identical to those of the Indian subsample. After having taken these requirements into account and having excluded duplicates, a final sample of 60 VC-backed U.S. companies with the necessary data available for the study period was obtained and subsequently used in the regressions. The reason for the large reduction in the number of companies is that a large majority of the VC-backed companies found in the VC funds had not, by the time of this study, gone public. In fact, only a small fraction of the companies had done an IPO.

The chosen 60 U.S. VC-backed sample companies were all noted on the U.S. stock exchanges NASDAQ and New York Stock Exchange. In terms of industry distribution, the sample companies were found to be operating in the technology, healthcare, consumer cyclicals, energy, and industrials

sectors. This industry distribution can be seen in Figure 3 below, where the number of firms in each industry is depicted. The number of firms operating in the technology sector represented a significant majority in the sample, amounting to 43 firms (70.49%) out of the 60 VC-backed public companies. Followingly, in decreasing order, one can observe the healthcare and industrials sectors (equally as many firms), followed by consumer cyclicals and energy sectors. The dominance of technology firms in our sample is reasonable, considering earlier research that asserts that the technology industry is the main industry of interest among VC firms when exploring prospective investments (Gompers, 1995; Lerner et al., 2011).

Figure 3. Distribution of industries among American VC-backed firms in the sample.



Distribution of industries among American VC-backed firms in the final sample of 60 U.S. VC-backed firms that was used in the regressions. Technology is the most common industry in the sample, amounting to 43 firms.

The U.S. VC data that related to daily stock prices, total assets and market capitalization were all denominated in U.S. dollars. In order to adjust for currency differences between the Indian subsample (specified in Indian Rupees) and the U.S. subsample (specified in U.S. Dollars), the U.S. VC data for the mentioned variables were converted into rupees. This conversion was done in Excel using the currency conversion rate USD/INR observed on the date 2019-05-31. At this date, the conversion

rate was valued at 69.62, according to Thomson Reuters Eikon. Specifically, daily adjusted stock price, total assets and market capitalization were all multiplied with the factor 69.62, resulting in comparable values in the same currency which, thus, enabled the variables to be included in the regressions.

Apart from stock market data, annually expressed values of total assets and price-to-book ratios were obtained for all U.S. VC-backed firms. Additionally, annual returns of S&P500 and risk-free rates in the U.S. were downloaded using Thomson Reuters' Eikon.

3.5 Data Limitations

As an important note to the study, several difficulties in terms of data obtaining were encountered during the work of this thesis. The first issue encountered was obtaining data for a sufficiently large number of Indian VC-backed companies. The main reason why a large fraction of companies had to be omitted from the original sample was due to insufficient data regarding stock market and financial data. In particular, those firms that were omitted had a considerably large amount of missing data for the chosen variables in most of the years of the study period, 2007-2018.

Initially, a comparison between VC-backed and non-VC backed companies in India was planned to be conducted. However, due to being unable to identify non-VC backed Indian firms (that is, assessing with full certainty that the firms were not originally VC-backed) that fulfilled the criteria of having gone public and having data for the study period, it was decided to conduct a study comparing the Indian VC-backed firms with U.S. VC-backed firms instead. If I was to attempt to identify non-VC backed firms, this would require going back many years to see if VC investments were made into the firm, and for many of these Indian firms it was not possible due to insufficient data. This is in contrast to when VC-backed firms were identified, in this case the procedure was precise and simple as I could simply identify these VC-backed firms by analyzing the VC funds in which they were included. Conducting a study comparing Indian and U.S. VC-backed firms does not necessarily constitute a disadvantage – quite the contrary, one can study the potential differences in liquidity effects between a developed economy which has an established VC industry with an emerging market which has a VC industry that is still emerging. This, therefore, motivates the approach I have taken on in this study.

Issues also existed related to potential liquidity variables that were initially considered to be included in the study but had to be omitted due to insufficient data. Specifically, other liquidity variables were considered to be used in the regression models but were unfortunately dismissed due to missing data.

Regarding the sample companies that were finally used in the regressions, missing data were also prevalent for sporadically distributed observations and were, as a result, dropped, but these missing observations were deemed not to affect the regressions and the subsequent results significantly. Examples of this includes missing stock prices and data related to the financial variables. However, the regression software that was used in the study, Stata, takes this issue into account. The reason for these data insufficiencies is unknown but a possible reason could be less strict information disclosure requirements for public companies in India relative to public companies in developed economies. This hypothesis would be in accordance with the discussions made by Dossani & Kenney (2002) and Wright et al. (2002) who discuss the regulatory system in India and how it functions differently compared to the regulatory systems in developed economies.

The largest data issue encountered in the study was the necessity of having to use the last observation per year for the liquidity variables stock volume and free float. This had to be done due to a large portion of observations being missing. A possible weakness that arises by using the last observation per year is that these observations may not be representative for the whole year. Furthermore, it could be misleading. Although being aware of these weaknesses, the same procedure is used in each year, thus being consistent in each year for this data procedure.

As a last note, it was planned to conduct a difference-in-difference regression to compare the liquidity effects of Indian and U.S. VC-backed firms. However, this method turned out not to be possible due to the nature of the data. As a result, it was decided to conduct this comparison using interaction terms which was considered a feasible method, too, as used by Carlin and Mayer (2003) previously.

4 Methodology

This thesis focuses on the impact of stock liquidity on stock performance among VC-backed companies in India. In this study, an Ordinary Least Squares (OLS) regression approach is used with robust standard errors, specifically a multiple linear regression model. The reason for utilizing a multiple OLS regression model is to account for the multiple independent variables (Brooks, 2014) that are included in the regression models. In this study, a multiple OLS regression model makes it possible to control for other variables than the liquidity variable, namely *market capitalization*, *total assets*, *Risk Premium*, *price-to-book ratio (P/B)*, as well as the dummy variable *country*. In the final regression, interaction terms are, too, included. The data is sorted into panel data to account for multiple entities (firms) observed at multiple points in time for the period 2007-2018.

The analysis is conducted through six OLS regressions. The first two regressions both include the first liquidity variable, *stock volume*. The difference between these two regressions is that the first regression is run only using data for Indian firms, whereas the second regression is run only using data for U.S. firms. Subsequently, another two regressions are run with the exception that stock volume is replaced with *free float*. Again, these regressions will be run based on country, where the first regression is conditional on Indian firms and the second is run only for U.S. firms. By running these four regressions with the two liquidity variables conditional on where the companies are based (India or U.S.), I am able to explore the potential impact of liquidity on stock performance for the respective country. By conducting these regressions conditional on country, the isolated effects are captured.

Subsequently, two additional (and final) OLS regressions will be run using the same independent variables as were used in the previous regressions. However, interaction terms will also be included. The regressions models used in the analysis can be seen further in section 4.5 Regression Models. Panel data is used in the analysis. All regressions are run with robust standard errors to account for heteroscedasticity (Brooks, 2014). Using the interaction terms in the final regression model, conclusions will be made regarding the comparison of liquidity effects between the two groups.

4.1 First Liquidity Variable: Stock Volume

Stock volume is generally defined as the number of shares traded during a certain period, for instance daily or annually. According to Copeland (1979), it is a way of measuring liquidity of a stock and therefore considered feasible in this study. As a result, it is used in this study as one of two liquidity variables to explore the potential impact of stock liquidity on stock performance. Avramov et al. (2006) used daily trading volume as a measure when studying liquidity and autocorrelation among U.S. public firms. Additionally, Nimalendran et al. (2007) have used trading volume as a measure for liquidity in relation to VC-backed companies that have gone public.

In this study, the last observation of stock volume of each year will be used in the regression model involving stock volume. Specifically, the stock volume observed on the last trading day of the year is used. This procedure is done for all years running from 2007 to 2018. The method of using the last observation per year has been used by Ewert et al. (2000).

Furthermore, the decision of using the last observation of the year stems from limited available data on daily stock volume mostly for the Indian subsample. Additionally, annually expressed stock volumes were not found for these Indian firms. However, for all firms (including all Indian firms) the last observation of stock volume was found. As a result, and in order to still be able to conduct the study with the liquidity variable as key variable, the last observation per year were used. By doing this for all firms it would result in consistency, as this procedure is done for all firms without any missing values based on the choice of observation frequency. Further discussion on this can be found in section 3.5 Data Limitations.

After the OLS regressions which includes variable *stock volume* have been run, it is possible to see whether the firm's stock volume significantly has an impact on annual returns. Specifically, the null hypothesis for the liquidity variable stock volume states that stock volume is not significantly different from zero and thus does not have an impact on annual returns. The alternative hypothesis, on the other hand, states that stock volume is indeed significantly different from zero, and that it consequently has an impact on annual returns, logically implying a negative correlation between liquidity and performance, which would be in accordance with previous research.

4.2 Second Liquidity Variable: Free Float

Stock free float represents the portion of shares that is available to public investors and is, according to Chan et al. (2002), a feasible liquidity measure. In this study, however, the *volume* of free float for

the share is used. In a similar procedure to the other liquidity independent variable, *stock volume*, the volume of free float is obtained from the last trading day of each year. The value is then included in the panel data, and ultimately used in the OLS regressions.

Free float itself is a particularly interesting measure in India. Free float denotes the portion of shares that is available to public investors, as mentioned by Chan et al. (2002). In India, free float portions are significantly smaller compared to developed economies as reported by Bloomberg (2019), who reported on the potential governmental action of increasing the minimum public free float portion from 25% to 35%.

Free float has previously also been used by Rhee and Wang (2009) to study the impact of institutional ownership on market liquidity in Indonesia, another nation classified as an emerging market (MSCI, 2019). The procedure of obtaining free float volume from the last trading day is done for both American and Indian VC-backed firms. Like the other liquidity variable *stock volume*, annually expressed volumes of free float were not found for the Indian subsample, and a large portion of daily free float volumes were found missing for many Indian firms which could have resulted in misleading results. However, the last observation for each year was found for all firms, thus leading to the use of this method. Ewert et al. (2000) used a similar method in their study. Further discussion on data limitations regarding free float is found in 3.5 Data Limitations.

After the OLS regressions have been run, one can determine whether free float has a significant impact on annual returns for the respective country groups. This is identical to the other liquidity independent variable, *stock volume*, namely in the sense that the null hypothesis for free float states that free float is not significantly different from zero and thus does not have a significant impact on annual returns. In contrast, the alternative hypothesis states that free float is significantly different from zero, resulting in the rejection of the null hypothesis and concluding that free float does have an impact on annual returns. In the final regression model that also includes interaction terms, free float is used to test whether significant differences in liquidity effects between the two countries are found.

4.3 Other Independent Variables

The liquidity independent variable in each regression is the variable of interest since the study examines stock liquidity impact on stock performance. However, other factors have to be controlled for which motivates the use of additional independent variables in the regression. The data set consists

of U.S. and Indian VC-backed firms of varying size, thus making it important to control for these variations. To do so, control variables *market capitalization*, *total assets* and *price-to-book ratio (P/B)* were included in the regression models. Additionally, in the final regressions, dummy variable *Country* is included to control for whether the firm is Indian or American. Furthermore, interaction terms are used in the final regressions to explain the interactive relationships between the variables across the groups, and in particular, the difference in liquidity effects (Stock & Watson, 2003).

Market Capitalization ($\ln(\text{Market capitalization})_{ic,t-1}$)

Represents the market capitalization value for company i at year $t-1$, that is, a one-year lag. Each annual value of market capitalization is taken from the last trading day of the previous year, $t-1$, for each firm, i . By observing the value of market capitalization at the end of each previous year, one can explore the potential causal effect on the dependent variable (Brooks, 2014). C denotes the country of the firm, either being Indian or U.S. The natural logarithm is finally applied to gauge the marginal effect on the dependent variable, holding all other variables constant. A comparable use of market capitalization as an explanatory variable was used by Datar et al. (1998) when they studied whether stock liquidity is related to stock returns, also using a lagged value of market capitalization. In that study, market capitalization represented firm size, which is also my intention in this study, that is, to control for firm size. Finally, in the study of Datar et al. (1998), the natural logarithm was applied which is also similar to this study.

Total Assets ($\ln(\text{Total assets})_{ic,t}$)

Variable *Total Assets* represents the total value of assets for firm i in year t . The value of total assets, downloaded from Thomson Reuters Eikon, is disclosed on an annual basis, representing the value of total assets at the end of each year. By including the variable, one is able to control for firm size, as has been done by Degryse, de Goeij and Kappert (2012). C denotes country. The natural logarithm was applied in order to gauge the marginal effect of an increase in total assets on the dependent variable, annual returns, holding all other variables constant.

Price-to-Book ratio ($\ln(P/B)_{ic,t-1}$)

The variable *Price-to-Book ratio (P/B)* is a financial ratio obtained for firm i in year $t-1$, that is, with a lagged period of one year ($t-1$). The method of using a lagged value of this variable has previously been used by Lewellen (1999). By doing this, it possible to capture the potential causal effect on stock performance (Brooks, 2014). The ratios were downloaded from Thomson Reuters Eikon. According

to Reuters' data source, the ratio is calculated by dividing the last stock price of the year by the firm's book value per share. Gompers (1995) refers to the P/B ratio as a representative measure of future investment opportunities, making the variable particularly interesting in this study due to the use of innovative firms in the sample. C denotes country.

The natural logarithm was applied in order to gauge the marginal effect of an increase in the P/B ratio on the dependent variable, annual returns, holding all other variables constant.

Year Dummies ($Year_{tc}$)

By including year dummies in the panel regressions, it is possible to control for aggregate time trends in the data and reduce bias (Baldwin & Taglioni, 2006). Aggregated, rising trends in the respective market of the sample companies can be controlled for using year effects, as it is not desired to aggregate trends which could otherwise influence the regression results. As a result, market risk is indirectly controlled for by including year dummies. C denotes country. Year dummies were used by Kortum & Lerner (2000) when assessing the impact of VC funding on innovation in the U.S.

Risk Premium ($Risk\ Premium_{tc}$)

To account for market risk, variable Risk Premium has been added to the regressions. Risk Premium is calculated for each year by subtracting the risk-free rates (of India or U.S., depending on firm) from each annual stock market index return. For Indian firms, this index is represented by NIFTY500 which includes the largest 500 Indian firms based on market capitalization, whereas for U.S. firms the index is represented by S&P500. Both indices are considered feasible representative measures of the respective country's stock market, thus constituting appropriate measures of market risk for each market. Similar use of market risk premium has been done by Gençay et al. (2005) and Neely et al. (2014).

Country ($Country_i$)

$Country_i$ represents a dummy variable that take on a value of either 1 or 0. A value of 1 implies that the company is an Indian VC-backed firm, whereas a value of 0 means the company is an American VC-backed firm. This distinction is of importance to the study as it enables one to study whether there are significant differences between the two subgroups in terms of performance. As one may recall, Indian VC-backed firms constitute the group of interest since this study attempts to explore whether stock liquidity among Indian VC-backed firms has a significant impact on stock

performance. In order to study this, a comparison with American VC-backed firms as a reference group is considered a feasible method.

If found that the dummy variable is significantly different from zero, it is concluded that there are significant differences between American and Indian VC-backed firms in terms of performance.

Interaction Terms

In order to compare the potential differences in liquidity effects between U.S. and Indian firms, several interaction terms were included in the final two regressions. The interaction terms are all conditional on the country, that is, by multiplying the dummy variable with the particular independent variable. In particular, by including the interaction term *country*stockvolume* and *country*freefloat*, it enables to compare the differences between liquidity effects of Indian and U.S. firms, which is of interest to this study. Furthermore, the other interaction terms used are *country*totalassets*, *country*marketcap* and *country*P/B*. Interaction terms have been commonly used in previous research, for instance by Carlin and Mayer (2003), when comparing countries' financial structures.

4.4 Dependent Variable

For both of the two regression models, the dependent variable consists of the annual return for each stock during the period 2007-2018. In the two regression models, this variable is denoted by $r_{i,t}$, where i is the firm and t is the year. The annual returns are calculated by subtracting the natural logarithms of stock prices at two consecutive time indices, as can be seen in Equation 1:

$$r_{ic,t} = \ln(P_{ic,t}) - \ln(P_{ic,t-1}) = \ln\left(\frac{P_{ic,t}}{P_{ic,t-1}}\right)$$

Equation 1. r denotes return for company i in year t . P denotes stock price, and c denotes country.

By computing annual returns in the same manner as in Equation 1 for all stocks in the sample as well as for all years, I end up with 1182 annual returns. Stock returns are widely considered a legitimate performance benchmark in relation to VC-backed companies as explained by Metrick and Yasuda (2010). Furthermore, Gompers (1995), too, used stock returns when studying optimal timing of VC investments.

4.5 Regression Models

4.5.1 Regressions Conditional on Country

Initially, four regressions are run, of which two regressions are run using only Indian firms (that is, being conditioned on that the firms are Indian). Similarly, two regressions are run using only U.S. firms, identically implying that the regression is conditional on that the firms are American.

Of the two regressions for Indian firms, one regression model involves free float as liquidity independent variable, whereas the other regression model includes stock volume as the liquidity independent variable. Apart from this different liquidity variable, the regression models are identical. The same regression models apply for U.S. firms, that is, the regressions are conditional on that the firms used are American. See Equation 2 for the regression model involving free float and Equation 3 for the regression model involving stock volume.

$$r_{ic,t} = \beta_0 + \beta_1 * \ln(\text{free float})_{ic,t} + \beta_2 * \ln(\text{market capitalization})_{ic,t-1} + \beta_3 * \ln(\text{total assets})_{ic,t} + \beta_4 * \ln\left(\frac{P}{B}\right)_{ic,t-1} + \beta_5 * \text{Risk Premium}_{c,t} + \beta_6 * \sum_{t=2007}^{2018} \text{Year}_{c,t} + \varepsilon_{ic}$$

Equation 2. The first regression model that uses free float as the liquidity independent variable. The regression model is run twice: firstly, conditional on Indian firms, subsequently conditional on U.S. firms.

The intercept is denoted by β_0 . $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ are coefficients, and ε_{ic} is the error term. i denotes firm and t denotes year, and c is the country (Indian or U.S.). Year effects are included in the regression.

$$r_{ic,t} = \gamma_0 + \gamma_1 * \ln(\text{stock volume})_{ic,t} + \gamma_2 * \ln(\text{market capitalization})_{ic,t-1} + \gamma_3 * \ln(\text{total assets})_{ic,t} + \gamma_4 * \ln\left(\frac{P}{B}\right)_{ic,t-1} + \gamma_5 * \text{Risk Premium}_{c,t} + \gamma_6 * \sum_{t=2007}^{2018} \text{Year}_{c,t} + v_{ic}$$

Equation 3. The second regression model that uses stock volume as the liquidity independent variable. The regression model is run twice: firstly, conditional on Indian firms, subsequently conditional on U.S. firms.

The intercept is denoted by γ_0 . $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6$ are coefficients, and v_{ic} is the error term. i denotes firm, t denotes year, and c is the country (Indian or U.S.). Year effects are included in the regression.

As seen in Equation 2 and 3, the two regression models are designed containing the liquidity variables of interest, respectively. For each regression model, that is for both the free float model and the stock volume model, regressions using robust standard errors are run. The advantage of using robust standard errors is that the errors account for potential heteroscedasticity that may exist in the data. Heteroscedasticity implies that the variance for the standard errors has a positive correlation with independent variables, and by using robust standard errors, the result implies conservative estimates (Brooks, 2014). Stata has a built-in function that uses robust standard errors and is thus used in the regressions.

Finally, by using the natural logarithm of the obtained value of stock volume and free float, respectively, we can gauge the marginal effect of an increase in stock volume or free float on the dependent variable, *annual stock return*, holding all other variables constant. This is specifically explained by Brooks (2014), stating that as a natural logarithm is applied to both the dependent variable and the independent variables, one can gauge the marginal effect of a 1% increase in an independent variable on the dependent variable, holding everything else constant. The magnitude of this effect is measured by the coefficient obtained in the regression.

4.5.2 Regressions with Interaction

After the four regressions have been run, which were conditional on country, two additional regressions are run using also interaction terms. By using interaction terms, it is possible to compare the liquidity effects between U.S. and Indian firms, which is of interest to the study. The first regression model includes free float as the liquidity variable, the second regression model includes stock volume as the liquidity variable. These regression models can be seen in Equation 4 and Equation 5, respectively.

Equation 4 is the regression model that includes free float as the liquidity variable. Additionally, the model includes variables market capitalization, total assets, P/B, dummy variable Country, interaction terms for these independent variables, as well as year dummies to control for year-specific effects. By using interaction term *country*free float*, it is possible to control for the liquidity variable. This regression model includes both U.S. and Indian firms and, thus, allows to compare the liquidity effects between the countries.

$$\begin{aligned}
r_{ic,t} = & \varphi_0 + \varphi_1 * \ln(\text{free float})_{ic,t} + \varphi_2 * \ln(\text{market capitalization})_{ic,t-1} + \varphi_3 \\
& * \ln(\text{total assets})_{ic,t} + \varphi_4 * \ln\left(\frac{P}{B}\right)_{ic,t-1} + \varphi_5 * \text{Risk Premium}_{c,t} + \varphi_6 \\
& * \text{country}_i + \varphi_7 * (\text{country}_i * \ln(\text{free float}_{ic,t})) + \varphi_8 \\
& * (\text{country}_i * \ln(\text{total assets}_{ic,t})) + \varphi_9 * (\text{country}_i \\
& * \ln(\text{Market capitalization}_{ic,t-1})) + \varphi_{10} * (\text{country}_i * \ln\left(\frac{P}{B}\right)_{ic,t-1}) + \varphi_{11} \\
& * \sum_{t=2007}^{2018} \text{Year}_{c,t} + \omega_{ic}
\end{aligned}$$

Equation 4. Regression for both countries with free float as liquidity variable, with interaction terms included. Market capitalization and P/B are lagged values with period t-1. For the interaction terms, the natural logarithm is used for variables free float, total assets, P/B and market capitalization (lagged with period t-1). Year effects are used in the regression.

Equation 5, as seen below, is similar to Equation 4 with the exception of the liquidity variable that is now stock volume. Additionally, it should be observed that variable country*free float that was used in Equation 4 has been replaced by country*stock volume. Apart from these differences, the independent variables are identical. Again, this regression model is run using both Indian and U.S. firms, and by using interaction terms in the regression it allows for comparing liquidity effects between Indian and U.S. firms. Robust standard errors were used, and year dummies were applied to the regression to control for year-specific effects.

$$\begin{aligned}
r_{ic,t} = & \delta_0 + \delta_1 * \ln(\text{stock volume})_{ic,t} + \delta_2 * \ln(\text{market capitalization})_{ic,t-1} + \delta_3 \\
& * \ln(\text{total assets})_{ic,t} + \delta_4 * \ln\left(\frac{P}{B}\right)_{ic,t-1} + \delta_5 * \text{Risk Premium}_{c,t} + \delta_6 * \text{country}_i \\
& + \delta_7 * (\text{country}_i * \ln(\text{stock volume}_{ic,t})) + \delta_8 \\
& * (\text{country}_i * \ln(\text{total assets}_{ic,t})) + \delta_9 * (\text{country}_i \\
& * \ln(\text{Market capitalization}_{ic,t-1})) + \delta_{10} * (\text{country}_i * \ln\left(\frac{P}{B}\right)_{ic,t-1}) + \delta_{11} \\
& * \sum_{t=2007}^{2018} \text{Year}_{c,t} + \tau_{ic}
\end{aligned}$$

Equation 5. Regression for both countries with stock volume as liquidity variable, with interaction terms included. The natural logarithm is used for stock volume, market capitalization (lagged t-1), total assets and P/B (lagged t-1). Year effects are used in the regression.

5 Empirical Results

5.1 Regression Results

This thesis attempts to study the potential impact that stock liquidity has on stock performance among Indian VC-backed companies by conducting a comparison with U.S. VC-backed firms. In order to do so, Ordinary Least Square (OLS) regressions are run using the software Stata. Four initial regressions are run conditional on whether the firm is Indian or American, as well as whether stock volume or free float is used as liquidity independent variable. After having obtained these results, two additional regressions with interaction terms are run involving firms from both countries in order to study and compare the liquidity effects between the countries.

As a first step, annual return is regressed on the independent variables *free float*, *market capitalization*, *total assets*, *price-to-book ratio*, *Risk Premium* and the dummy variable *country*. The regression results for this regression are found in Table 3 where coefficients are presented, as well as robust standard errors presented in the parentheses. (1) represents the regression with free float as liquidity variable only using Indian firms, whereas (2), too, uses free float as liquidity variable but the regression is only run for U.S. firms. (3) represents the regression with stock volume as liquidity variable run only for Indian firms. (4) represents the regression with stock volume as liquidity variable, run only for American firms. Importantly, it is worth mentioning that year effects were included in all regressions, specifically regressions (1) – (6).

In (1), involving only Indian firms, it is found that the liquidity variable, free float, is insignificant. Furthermore, the lagged variable market capitalization is significant on a 5% significance level. Total Assets, P/B and Risk Premium, however, were found insignificant. In (2), with only U.S. firms, an insignificant result for the liquidity variable is also found. Furthermore, market capitalization is negative, significant at a 1% significance level, total assets is positive, significant at a 1% significance level, and P/B is positive, significant at a 5% significance level. Risk premium was found significant and positive at a 1% significance level.

Regression (3) involves only Indian firms with stock volume as liquidity variable. It shows a negative, significant result for liquidity variable stock volume at significance level 5%. This negative relationship between return and liquidity is in accordance with findings of Datar et al. (1998), that is, as liquidity increases, return decreases. Furthermore, results show significance at a 5% level for market capitalization, as well as insignificant results for variables total assets, P/B and Risk Premium.

Regression (4), using only American firms, shows negative significant results for stock volume, at significance level 1%. Additionally, market capitalization, total assets and Risk Premium were also significant a 1% significance level, with market capitalization having a negative relationship with returns and total assets having a positive relationship with returns. Finally, P/B was found significant at a 5% significance level with a positive relationship with returns. R squared equaled 0.143 for regression (1), 0.298 in regression (2), 0.152 in regression (3), and 0.308 in regression (4).

Table 3. Results for regressions involving only Indian or U.S. firms, using either free float or stock volume.

Variables	(1)	(2)	(3)	(4)
Free Float	-0.016 (0.014)	-0.242 (0.016)		
Stock Volume			-0.019** (0.007)	-0.031*** (0.108)
Market Capitalization	0.034** (0.013)	-0.087*** (0.028)	0.032** (0.013)	-0.080*** (0.027)
Total Assets	0.007 (0.014)	0.123*** (0.028)	0.009 (0.013)	0.124*** (0.027)
P/B	-0.009 (0.016)	0.045** (0.018)	-0.011 (0.016)	0.046** (0.018)
Risk Premium	0.126 (0.085)	0.628*** (0.157)	0.127 (0.087)	0.570*** (0.155)
Observations	479	547	479	547
Number of Companies	60	60	60	60
R ²	0.143	0.298	0.152	0.308

Regression results for regressions involving only Indian or U.S. firms. (1) represents the regression that is run using only Indian firms, using free float as liquidity variable. (2) represents the regression where free float is used, run using only U.S. firms. (3) is the regression using stock volume, run using only Indian firms. Finally, (4) is the regression using stock volume as liquidity variable, run using only U.S. firms. Robust standard errors are presented in the parentheses. Significance levels of 10%, 5% and 1% are represented by *, ** and ***, respectively. All regressions include year effects.

In Table 4 the two regressions involving interactions terms are presented. (5) is the regression that

includes free float as liquidity variable and (6) is the regression that includes stock volume. Important to note is that in these regressions, both U.S. and Indian firms are included. Apart from having included interaction terms, the choice of independent variables in regressions (5) and (6) is identical to the regressions in Table 3, using market capitalization (lagged one period), total assets, P/B (lagged one period), Risk Premium, and dummy variable Country as independent variables.

In regression (5), it can be seen that interaction term country*free float was found insignificant. This interaction term poses as the possible determinant to whether significant differences in liquidity effects exist between the two groups. Since the obtained result is insignificant, it can be concluded that there is not enough evidence to reject the null hypothesis. Furthermore, variable free float was also found insignificant, which would imply that it cannot be concluded that free float has a significant impact on returns when using data from both country groups, that is, American and Indian firms. Similarly, dummy variable Country was found insignificant, meaning that it cannot be concluded that significant differences in stock performance exist between the two groups. However, market capitalization (lagged with one period), total assets, Risk Premium and P/B were found significant at significance levels 1%, 1%, 1% and 5%, respectively, meaning that we can reject the null hypotheses for each variable and as a result conclude that they do have a significant impact on returns at the mentioned significance levels. As for the rest of the interaction terms, country*totalassets, country*marketcap and country*P/B, these were all found significant.

Regression (6) uses stock volume as liquidity variable. The interaction term that is intended to show the difference in liquidity effects between the groups, country*stockvolume, was found insignificant. As a result, insignificant results were obtained for the difference in liquidity effects for both country*stockvolume and country*freefloat. However, liquidity variable stock volume was found significant at a 1% significance level and with a negative relationship with returns, again in accordance with previous findings of Datar et al. (1998) and Amihud (2000). Variables market capitalization (lagged with one period), total assets, Risk Premium and P/B (lagged with one period) were found significant at significance levels 1%, 1%, 1% and 5%, respectively, concluding that they have a significant impact on returns. Market capitalization was found having a negative relationship with returns, while total assets, P/B and Risk Premium were found to a positive relationship.

Dummy variable Country, as in regression (5), was found insignificant, thus not being able to conclude that there are significant differences in stock performance between the groups. Furthermore, interaction terms country*totalassets, country*marketcap and country*P/B were found significant at significance levels 1%, 1% and 5%, respectively.

Table 4. Regressions involving both U.S. and Indian firms, using interaction terms.

Variables	(5)	(6)
Free Float	-0.024 (0.016)	
Stock Volume		-0.032*** (0.010)
Market Capitalization	-0.087*** (0.028)	-0.080*** (0.028)
Total Assets	0.123*** (0.028)	0.124*** (0.028)
P/B	0.045** (0.018)	0.046** (0.018)
Risk Premium	0.628*** (0.157)	0.568*** (0.155)
Country	-0.084 (0.291)	0.085 (0.293)
country* Stock Volume		0.013 (0.013)
country * Free Float	-0.007 (0.021)	
country * Total Assets	-0.116*** (0.031)	-0.115*** (0.031)
country* Market Cap	-0.121*** (0.031)	0.112*** (0.031)
country * P/B	-0.055** (0.025)	-0.057** (0.025)
Constant	-0.594*** (0.169)	-0.853*** (0.194)
Observations	1,026	1,026
Number of Companies	120	120
R ²	0.234	0.244

Regressions include year effects. Robust standard errors are presented in the parentheses. Significance levels of 10%, 5% and 1% are represented by *, ** and ***, respectively. All estimations include year dummies and interaction terms for the independent variables. Dummy variable equal to 1 implies an Indian firm, a value of 0 implies an American firm. (5) is the regression that uses free float, whereas (6) uses stock volume.

Finally, the coefficient of determination, R squared, equaled 0.234 in regression (5) and 0.244 in regression (6). I will discuss more specifically in the Discussion section about possible reasons why the interaction terms country*stockvolume and country*freefloat, which tested whether differences in liquidity effects between the groups exist, were found insignificant. Furthermore, other results will also be discussed.

A correlation table can be seen in Table 10 which shows the correlation between the independent variables, including the liquidity variables and the interaction terms. Not too surprisingly, several of the variables showed high correlation, for example dummy variable Country and the interaction terms. Also, for instance, total assets and market capitalization were shown having high correlation, with a correlation of 0.873. This makes sense as one could argue that the underlying components are quite similar.

As a result of the regressions, Hypothesis 2 was found to be supported, since the stock volume was found to have a significant and negative on stock performance. This rejection of the null hypothesis was done in regressions (3), (4) and (6), as seen in Table 3 and 4. However, Hypothesis 1, which states that free float has a significant and negative impact on performance, could not be supported by the results in any of the regressions. The same applies for Hypothesis 3, which states that there is a significant difference in liquidity effects between the groups. This hypothesis could not be supported, as seen in the results in Table 4.

5.2 Robustness Tests

Before the previously obtained results can be fully conclusive, robustness checks have to be made to confirm the validity of the results. Due to the use of robust standard errors in Stata, the standard error estimates are not prone to heteroscedasticity, as explained by Brooks (2014). Heteroscedasticity refers to the occurrence of the variance of the error terms not being constant. Instead, homoscedasticity is desirable. Had heteroscedasticity existed among the standard errors in the regression models, the assumptions underlying the Gauss-Markov theorem would have been violated (Brooks, 2014).

To account for large outliers in the data set, Stata's *winsorizing* function was used which replaces extreme values found in the data set, specifically the percentiles of 1% and 99%.

5.2.1 Hausman Test

Before deciding on the type of regression that was going to be run using the data downloaded for the Indian and the U.S. VC-backed firms, it was first considered whether *fixed effects* or *random effects* were going to be utilized. Theoretically, as explained by Brooks (2014), a random effects model is generally thought of as appropriate when entities within the sample are possible to have been randomly selected from a larger population. On the other hand, a fixed effects model can be appropriate when the sample, that is used in the study, is suspected to constitute the whole population. The *Hausman Test* explicitly helps determine whether a fixed effects approach or a random effects approach should be used. As a result, a Hausman test was conducted in Stata. The test results are found in Table 7 and 8 in the appendix. The null hypothesis states that a fixed effects model should be used for the regression, whereas the alternative hypothesis states that a random effects model is to be used. In accordance with the test results for both regression models, a fixed effects model would have been appropriate for the regressions. However, when a fixed effects approach is used for both regression models, it is discovered that the dummy variable *country* gets omitted. Due to *country* being a variable of particular interest to the study, it is assessed that the significance of the study will be impacted if the variable is omitted. Instead, it was decided that an OLS approach is appropriate and thus, it was used in the regressions.

5.2.2 Wooldridge Test

To further improve the robustness of the results, an autocorrelation test is deemed as appropriate. Autocorrelation refers to the occurrence of when the covariance between error terms over time is not equal to zero. When this is violated, the assumption, too, is violated. If autocorrelation exists in the model, the results could be inefficient coefficient estimates, although the coefficients still remain unbiased (Brooks, 2014). Therefore, it is of importance to check for autocorrelation which motivates the reason for doing so in this study. In particular, the first-order autocorrelation is checked for by using the Wooldridge test, in accordance with Drukker (2003). The results of the Wooldridge test for the regressions can be found in Table 9 in the appendix.

6 Discussion

6.1 Liquidity Effects Comparison

The difference in liquidity effects between U.S. and Indian firms was found insignificant for both of the two regressions involving liquidity variables free float and stock volume, respectively, as seen in Table 4. This is based on the regressions involving interaction terms. However, when observing the isolated regressions using data from only one nation, which can be seen in Table 3, the liquidity effects on stock performance are seen to be significant for the variable stock volume in regressions (3) and (4). Regression (3) uses only Indian firms whereas regression (4) only uses American firms. Based on this, it is possible to draw the conclusion that the liquidity effect from stock volume is indeed significant and negative for both Indian and U.S. VC-backed firms. This implies a negative correlation between liquidity and performance, as was previously found by Datar et al. (1998), Stoll (1989) and Amihud (2000). However, it is important to note that these findings from previous research are based on mostly U.S. firms (and not Indian firms), and since the results of this study *also* show such a significant liquidity effect for Indian firms, this could possibly shed light on how liquidity effects look in emerging markets, in this case in the more volatile and less institutionally stable environment of India (Dossani & Kenney, 2002; Wright et al., 2002).

One possible reason for obtaining insignificant results for the difference in liquidity effects is that differences in liquidity effects may not actually exist, despite the differences in institutional factors that the firms of the two groups experience. This would imply that having used stock volume and free float as liquidity variables, it cannot be concluded that there are significant differences in liquidity effects, and thus, the liquidity effects for Indian and U.S. VC-backed firms *may* look similar to each other. As a result, a possibility is that Indian VC-backed firms' stocks behave more similarly to U.S. VC-backed firms' stocks in other ways as well, other than just in terms of liquidity effects on performance. I would suggest that this calls for further research.

6.2 Performance Comparison

By observing the dummy variable Country in the regressions, it is possible to see whether significant differences in sole stock performance can be found. Specifically, the inclusion of dummy variable Country tests if significant differences in performance is found when comparing the two countries. As was seen in the results for regressions (5) and (6) in Table 4, the result for dummy variable Country

was insignificant. In other words, it can be inferred that given the data used in this study, it cannot be concluded that there is a significant performance difference between the Indian and U.S. VC-backed firms used in the study. Reasons for this insignificance could for instance include data insufficiency, deficiencies related to the research method, among others.

By first looking at variable free float, it can be seen in Table 3 that, although free float was found insignificant, it has a negative correlation with stock performance. When also including interaction terms in Table 4, and although it was again found insignificant, the variable is found to have a negative impact on stock performance. This is in line with previous research which assert that stock liquidity has a negative impact on performance, among them Datar et al. (1998) and Stoll (1989). Like free float, stock volume was found to experience a negative correlation with performance. However, this impact was significant, with a significance level of 1% in all regressions in which the variable was included, except for regression (3) of Table 3 which showed a 5% significance level. What is especially interesting is that similar impacts are found when solely observing Indian and U.S. firms, that is, the regressions that only take into account one country. Looking at Table 3, regression (3) shows a negative relationship of -0.019 for stock volume among Indian firms, whereas U.S. firms experience a relationship of -0.031. These coefficients are arguably similar to each other which is an interesting finding considering the different institutional environments that U.S. and Indian VC-backed firms operate within (Dossani & Kenney, 2002).

Having found a negative relationship between liquidity and stock performance intuitively makes sense. An increased stock liquidity implies that an investor more easily can sell of his or her holdings in the event of a drastic fall in the stock market. This benefit of holding an asset with higher liquidity is offset with a decrease in stock returns, associated as a “cost” by Datar et al. (1998).

6.3 Institutional Factors

Institutional factors are arguably important factors for many parts of the results in this study. Institutionally, there are large differences between the VC industries of India and the U.S. An interesting question to ask oneself is *why* an increase in, for instance, free float (although having been found insignificant) leads to a decrease in annual returns, in this case by -0.016% and -0.024% for Indian and U.S. firms, respectively. As has been proven in previous research, liquidity significantly impacts returns, but free float, in contrast with stock volume, may have institutional implications. India has a relatively low requirement regarding its minimum public free float portion, currently

amounting to 25% . A low free float portion implies that only a small portion of a firm's shares is available to public investors. As explained by Bloomberg (2019), it is currently discussed whether to increase this limit from 25% to 35%. An interesting research question that I would therefore suggest and encourage is to study the impact of free float on stock performance when the minimum free float portion has been increased (that is, obviously, *if* the minimum free float portion is increased). I would argue that this topic is not sufficiently discussed, especially considering the ongoing emergence of the VC industry in India.

6.4 Data Issues as Potential Reason for Insignificance

While obtaining data for the study, it was obvious that the choices of data for the liquidity variables were not optimal. Had there been a more representative measure available for the liquidity variables, it is possible that the outcome could have been different, for instance by having obtained significant results. This poses as a potential motivation for future research. Furthermore, a larger data sample (that is, using a larger number of firms, or including more years of data) could also result in significance.

Another possible interesting finding in the results is whether free float has proved to be a less accurate representation of stock liquidity. As seen in the results for regressions (3) and (4), which capture the isolated effects from Indian and U.S. firms, respectively, stock volume was found to have a significant and negative impact on stock returns. Furthermore, stock volume was again found significant and negative in regression (6). However, it is seen that free float was found insignificant in regressions (1), (2) and (5). This conclusion could be useful for future research as a potential indicator that free float may not be as feasible as stock volume when used as a measure of liquidity. This would, however, make sense since a larger part of previous research has used stock volume than free float when measuring liquidity effects on stock performance.

7 Conclusions

This study attempts to explore whether stock liquidity has a significant impact on stock performance among Indian VC-backed firms. In order to do so, panel data for 60 Indian VC-backed firms and 60 U.S. firms during the time period 2007-2018 were obtained. By comparing these two country groups, it was possible to study whether significant differences in liquidity effects on performance exist between a developing VC industry, India, and an already developed VC industry, the U.S.

Two liquidity variables were used, free float volume and stock volume, to study the impact on performance. Consequently, several regressions were run, having initially been run using only country-isolated data. Subsequently, the two groups were used in the same regressions, having incorporated interaction terms to test for potential differences in liquidity effects. The results for differences in liquidity effects were found insignificant, however, interesting findings were still made. The results support previous research in terms of stock liquidity's impact on performance, implying a negative relationship between liquidity and performance for U.S. VC-backed firms, but also for Indian VC-backed firms, which in previous research has not been explored. Furthermore, despite obtaining insignificant results when testing the differences in liquidity effects between the groups, these results could imply that these groups experience similar liquidity effects on performance. Additionally, these groups may experience other similar behaviors that have not yet been investigated. This would call for future research.

Limitations and Further Research

Although I have made several conclusions based on my results from this study, it should be noted that this study was made using a limited amount of data. Most of the limitations are derived from data relating to the Indian VC-backed subgroup. Specifically, data collection problems have led to the dismissal of variables that were initially considered to be included in the study. Furthermore, where data has been found to be missing in the variables that were chosen, observations have had to be dropped. Although one could argue that data collection problems is not unexpected when it comes to VC-backed firms in a developing nation, I believe that it is possible to obtain more data than I have managed to do in my study which would ultimately result in more reliable and valid results.

For future research I would therefore recommend increasing the sample size as well as making further restrictions in the data set, for instance related to the age of the sample firms. Furthermore, it would be interesting to see the results of a similar study conducted after (*if* it does happen) an increase of the minimum portion of free float among Indian public firms from the current 25% has occurred. Additionally, it would be interesting to compare those results with what I have found in my study. India is continuously growing economically and thus, studies that focus on India will in the future be highly relevant.

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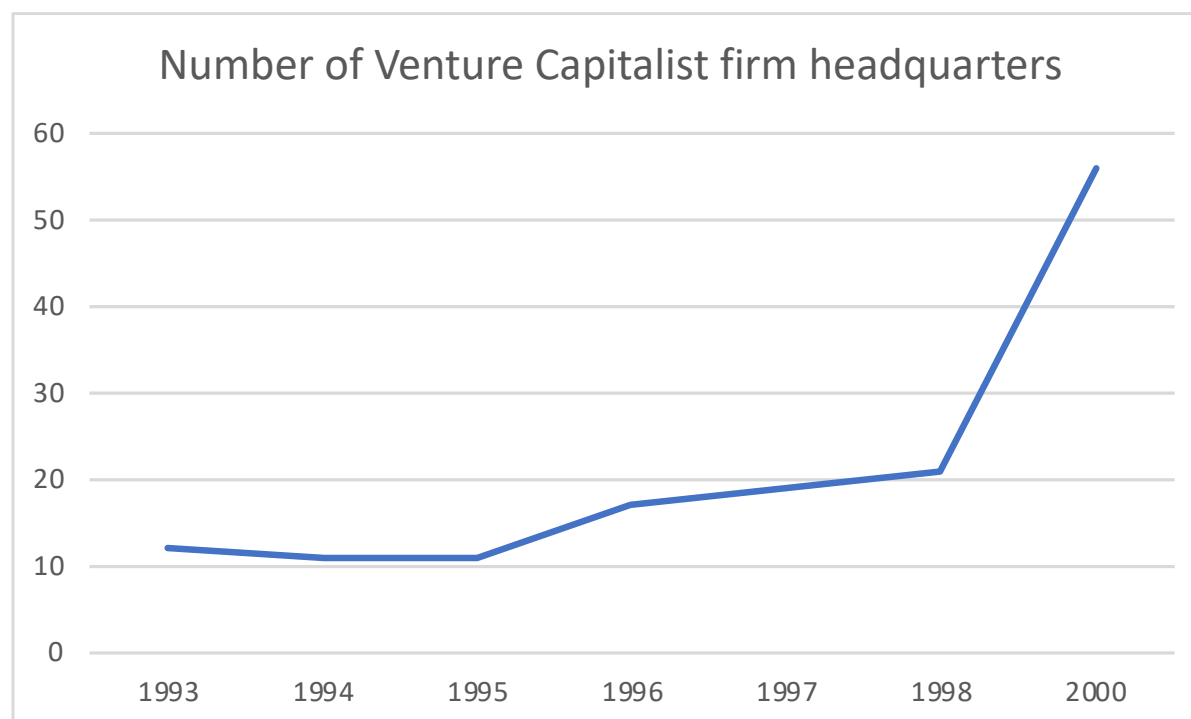
Appendix

Table 2. List of all VC firms used in the study.

India	U.S.
500 Startups LP	Accel Partners & Co Inc
Accel Partners & Co Inc	Bain Capital Venture Partners LLC
Ankur Capital Advisors	IDG Ventures USA
Blume Ventures Advisors Pvt Ltd	Matrix Partners LP
Draper Fisher Jurvetson International Inc	Oak Investment Partners
Goldman Sachs & Co LLC	Sequoia Capital Operations LLC
Helion Venture Partners LLC	
Intel Capital Corp	
Inventus Capital Partners	
Jungle Ventures Pte LTD	
Kalaari Capital Partners LLC	
Khosla Ventures LLC	
Kleiner Perkins	
Matrix Partners LP	
Nexus Venture Partners	
Norwest Venture Partners	
Omnivore Capital Management Advisors Pvt LTD	
Ridge Ventures (IDG Ventures)	
Saama Capital LLC	
SAIF Partners	
Sequoia Capital India	
SIDBI Venture Capital Ltd	
Unicorn India Ventures Advisors LLP	
Ventureast	
Y Combinator Inc	
YourNest Capital Advisors Pvt Ltd	

The table shows the VC firms that were used in the study whose funds contain the VC-backed firms that were used in the regressions.

Figure 7. Total number of venture capitalist firms (members) in India included in the Indian Venture Capital Association (various years).



The figure shows the development of VC firms in India during the years 1993-1998 and 2000. Source: Indian Venture Capital Association (various years).

Table 7. Hausman test for the regression model including free float as the liquidity independent variable.

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
Hausman Test	Fixed1	Random1	Difference	S.E
<i>Free Float</i>	-0.031	-0.017	-0.013	0.041
<i>Market Capitalization</i>	-0.123	-0.008	-0.114	0.022
<i>Total Assets</i>	0.093	0.039	0.053	0.027
P/B	-0.005	-0.005	0.001	0.016
Risk Premium	0.357	0.446	-0.089	0.015

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

Chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 51.71

Prob>chi2 = 0.000

Hausman test that was conducted for the regression which includes *free float* as liquidity independent variable. As can be seen in the table, the results favored the use of fixed effects in the regression. Market capitalization and P/B are both lagged by one period (t-1).

Table 8. Hausman test for the regression model including stock volume as the liquidity independent variable.

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
Hausman Test	Fixed2	Random2	Difference	S.E
<i>Stock Volume</i>	-0.011	-0.027	-0.016	0.008
<i>Market Capitalization</i>	-0.121	-0.001	-0.120	0.023
<i>Total Assets</i>	0.088	0.041	0.047	0.028
P/B	-0.005	-0.003	-0.002	0.016
Risk Premium	0.362	0.464	-0.102	0.017

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
Chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 42.60
Prob>chi2 = 0.000

Hausman test that was conducted for the regression which includes *stock volume* as liquidity variable. As can be seen in the table, the results favored the use of fixed effects in the regression. Market capitalization and P/B are both lagged by one period (t-1).

Table 9. Wooldridge test of autocorrelation.

	F-value	Prob > F
(1)	21.713	0.000
(2)	1.366	0.247
(3)	18.777	0.000
(4)	1.344	0.251
(5)	15.146	0.000
(6)	12.491	0.000

The table shows the obtained results for the Wooldridge test that was conducted on both regression models. Regressions (1) – (4) constitute, in the same order, the same regressions as found in Table 3. Regressions (5) and (6) are the regressions found in Table 4. The null hypothesis for each regression states that there is no first-order autocorrelation.

Table 10. Correlation between the independent variables including both liquidity variables Stock Volume and Free Float, as well as interaction terms.

	Stock Volume	Free Float	Market Cap	Total Assets	P/B	RP	Country	Country * Free Float	Country * Stock volume	Country * total assets	Country * market cap	Country * P/B
Stock Volume	1											
Free Float	0.7855	1										
Market Cap	0.614	0.701	1									
Total Assets	0.671	0.786	0.873	1								
P/B	0.121	0.1433	0.406	0.128	1							
RP	0.067	0.014	-0.042	0.045	-0.019	1						
Country	-0.282	-0.154	-0.496	-0.369	-0.210	-0.085	1					
Country * Free Float	-0.241	-0.093	-0.468	-0.329	-0.209	-0.083	0.994	1				
Country * Stock Volume	-0.130	-0.067	-0.453	-0.304	-0.222	-0.055	0.972	0.982	1			
Country * Total assets	-0.254	-0.114	-0.459	-0.132	-0.218	-0.081	0.994	0.996	0.978	1		
Country * market cap	-0.264	-0.123	-0.439	-0.328	-0.181	-0.097	0.994	0.994	0.973	0.996	1	
Country * P/B	-0.170	-0.061	-0.028	-0.206	0.586	0.586	0.390	0.387	0.357	0.376	0.422	1