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How Could Venture Capitalists Improve Their Performance at Fund Management Level via Better Allocating Their Financial and Human Capitals - A Cross-Fund Approach

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ABSTRACT

Venture capitalists' performance has been studied at the levels of portfolio company and fund. But no similar study at the fund management entity level has been documented. This study fills in the gap to examine the drivers of the venture capitalists' performance at the fund management entity level. This study uses the capital allocation theory to develop five hypotheses on its performance. Each of them embodies an aspect of the feature of capital allocation in the venture capital investment process. With an expanded concept of capital for capital allocation, this study examines the allocation of both the financial capital and the human capital of venture capitalists. The capital allocation in venture capital investment is a process of capital leveraging and channeling by venture capitalists at the fund management level to the portfolio companies. Our results show that the amount of leveraging financial capital channeled to the individual portfolio company on average is negatively associated with venture capitalists' performance at the fund management level, while the reserve ratio of leveraging the financial capital, the degree of human capital clustering, and the quality of human capital are positively related to venture capitalists' performance at the fund management level.

Keywords: Venture Capital, Performance, Financial Capital, Human Capital, Leveraging, Channeling, Capital Allocation, Fund Management

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Chapter 1 Introduction

Venture capitalists participate in all the three stages of the venture capital investment process. At the first stage, they are managers/owners of the venture capital fund management entity (FME)[1]. FME creates the venture capital funds (VCF) to carry out the venture capital investment. After the VCF has been established, venture capitalists also manage the VCF in the second stage. When VCF is in operation, it will look for potential investment opportunities in the market and will begin investing in startups which are called the portfolio companies (PCs). Representing VCF, the venture capitalists serve as board members on PCs (the startups) in the third stage. At each stage, the activities of venture capitalists have their influences on the business entities that they engage in.

The relationship among the business entities that participate in the process of venture capital investment can be described as a hierarchically structured relationship. This is a structure of venture capital investment management. There is a three-level pyramid-like structure of venture capital investment management, namely the management at the PC level, the VCF level, and the FME level. Correspondingly, venture capitalists' performance can be evaluated at all the three stages of the venture capital investment. Each stage corresponds to a level of management of venture capital investment. Thus, venture capitalists' performance can be evaluated at three levels: the PC level, the VCF level, and the FME level.

[1] FME may exist in two types of organizational structure when creating VCF. That can be shown more clearly in Appendix A.

Studies of venture capitalists' performance are based on the studies of the performance of the business entities in the venture capital investment structure because the performance of the venture capitalists is embodied in the performance of those business entities. In other words, the studies of the performance of the venture capitalists are the studies of the performance of the business entities in which the venture capitalists play a role. Therefore, the studies of the performance of venture capitalists at the levels of PC, VCF, and FME correspond to the studies of the performance of PC (from the perspective of the role of the venture capitalists), the performance of the VCF, and the performance of the FME.

Figure 1 shows the entire structure of the venture capital investment and the roles of venture capitalists at the three levels: FME, VCF and PC.

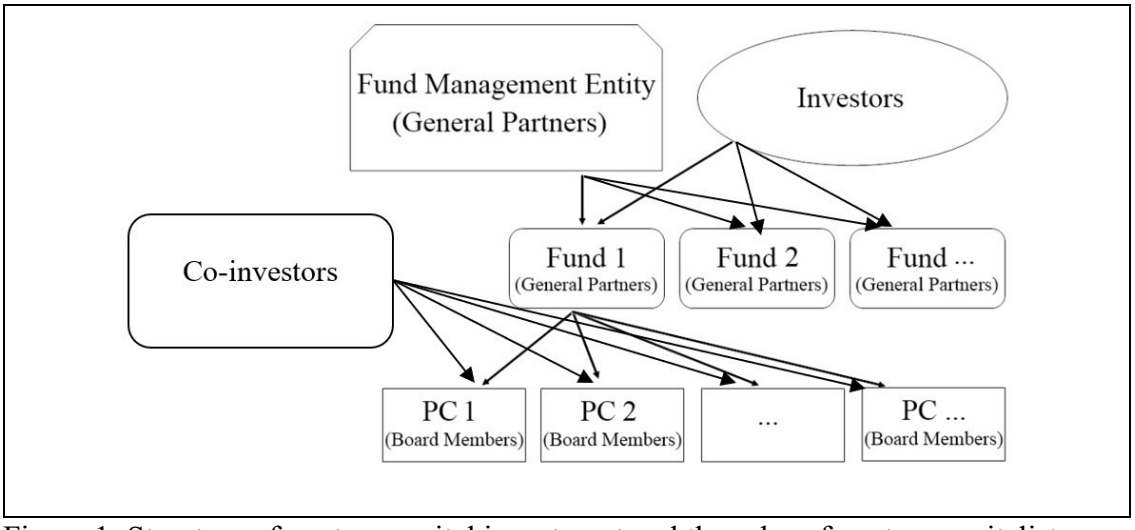

Figure 1: Structure of venture capital investment and the roles of venture capitalist

However, the result of literature review shows that the studies of the performance of venture capital investment (VC performance) either focus on the performance of

VCFs or on the venture capitalists' role in the performance of PCs. No prior study is available on the performance of the FME. This is a research gap in the venture capital literature on the VC performance, and it is an important gap. This study tries to fill this research gap.

It is important to study specifically the performance of FME. The fundamental idea is to understand the driving forces behind the FME performance. A better understanding of these drivers helps PCs, fund investors, co-investors (i.e., investors in PCs) and venture capitalists make better decisions and improve their performance. Previous studies of the performance of VCF and the role of venture capitalist in PC's performance have enhanced the understanding of those drivers and provided forceful instruments for the stakeholders of the venture capital investment to improve their quality of decision-making and performance. Prior studies of the VC performance[2] do not specifically examine the performance of FME. Examination on the performance of VCF and/or PC is incomplete on overall performance of the venture capitalists because venture capitalists manage multiple VCFs, and each of those VCFs, in turn, manage multiple PCs. Performance of VCFs and of the PCs is not the final performance of venture capitalists. In any given process of venture capital investment, the performance of the venture capitalists is conclusive only at the FME level. It is a common mistake to think that the VCF's performance is the same as the FME's performance and the literature overlooked the significance of identifying factors that impact the FME's performance.

[2] VC performance stands for the performance of venture capital investment. This is a concept referring to the performance of venture capitalists at different levels.

A complete cycle of venture capital investment consists of at least six steps. They are idea generating, planning, fundraising, project scouting and selecting, value adding, and exit. The first three take place before the establishment of VCF and the remaining three take place after the establishment of VCF. Previous studies of the VCF-PC performance[3] focus only on the effects of project scouting (Granz et al., 2020), project screening (Kaplan & Strömberg, 2001; Guerini & Quas, 2016; Casamatt & Haritchabalet, 2007; Croce et al., 2013), project evaluating (Seppä & Laamanen, 2001; Cumming & Dai, 2011; Carlos et al., 2014; Miloud et al., 2012; Köhn, 2017), project selection (Zhang, 2012; Bertoni et al., 2015) and exit (Cumming & Johan, 2008; Cumming & MacIntosh, 2003; Guo et al., 2005), one paper discussed the effects of type fundraising team on the success of the venture capital investment with the ability to raise subsequent funds post its first fund as a proxy of fund performance (Walske & Zacharakis, 2009). However, the effects of idea generating, fund planning, and fundraising which are closely related to the performance of FME which means the final returns to venture capitalists after the completion of the full cycle of the investment has been ignored. Idea generating and planning are the result of market research and accumulation of experience. They decide the result of fundraising and the ensuing management of the funds (VCFs). Venture capitalists need to produce a fundraising prospectus which is based on the fund ideas and planning and present it to the potential investors to raise funds. The fundraising plan is a guideline and roadmap of the

[3] Performance of VCF is the cross-PC performance and performance of FME is the cross VCF (cross-fund) performance. This study emphasizes the difference between the performance of the FME and the Performance of the VCF and of PC due to venture capitalists' activities. To be concise, we will use the term VCF-PC performance for the later when we do not intend to distinguish the difference between the performance of the VCF and the performance of PC due to venture capitalists' activities.

investment of the planned fund. Based on the prospectus, investors (i.e., investors in the VCF) will negotiate in detail with the venture capitalists. The success of fundraising depends on how good the ideas/plan about the fund are.

The success of fundraising has two dimensions. One is how much total money the FME can raise for the ensuing investment; the other is what leveraging ratio (how much money the FME can raise with each dollar it contributes into the fund as initial money[4]) it can get. Furthermore, the ideas, strategy, and plans embedded in the prospectus of fundraising will direct the implementation of the fund plan though there are flexibility of change at the discretion of the venture capitalists to acclimate the change of the market. Obviously, the three steps before the establishment of the VCF are very important for the success of the entire cycle of the venture capital investment. The result of studies of the VC performance may be unreliable without integrating the activities of the venture capitalists before the establishment of the VCF. So, it is necessary to study the performance of FME.

Another reason that supports the study of the performance of FME is that the performance of FME cannot be understood simply as the sum of the performance of the VCF. Venture capitalists from the same FME can manage multiple VCFs. Some of the VCFs may perform well; some may perform modestly, while some may perform poorly. The performance of individual VCF under the same FME is not necessarily an indicator of the overall performance of the FME. Evaluation of the performance at FME level is an overall and better evaluation of performance for the venture capitalists.

[4] Generally, we mean money to money ratio when we talk about leveraging ratio. This is different from the leverage rate which is defined as the rate of number of PCs in which the FME invest with given amount of capital raised. The later measures how well the FME can allocate its capital while the former measure the ability of FME to raise funds.

Therefore, this study focuses on the survey of the performance of the FME. We measure performance of FME by the ratio of the total number of exits from its PCs to the total number of investments that the FME made in its PCs.

In light of the research gap discussed above, this study examines the performance of the FME. Basically, this study sheds light on the following two questions:

1) *What are the factors that affect the FME's performance?*
2) *How do the factors on VCF performance differ from that of FME?*

This study contributes to literature by filling in the gap in literature of VC performance for absence of studies on the performance of FME and to the practice of venture capital investment. The results of this study provide a starting point for future research on venture capitalists in managing the venture capital investment. It helps the venture capitalists to treat the process of the venture capital investment as a whole rather than separates the process of planning and fundraising from the process of VCF investment.

Second, this study provides a framework to analyze the process of venture capital investment by employing the concept of capital leveraging and channeling. It will facilitate the venture capitalists to manage dynamically the process of investment rather than making decisions case by case. This study extends the capital allocation theory by including the notion of both financial cand human capital. As this study identifies important factors affecting the performance of FME, venture capitalists can make use of those drivers in their investment decision.

Chapter 2 Literature Review and Hypotheses

2.1. Literature review

The objective of this study is to examine the performance of the FME. The literature review covers the VC performance at all the three levels of PC, VCF, and FME. We focus on the measure of VC performance and the factors that have impacts in the VC performance because a large part of the literature is related to the VC performance. The factors that have impacts on the VC performance serve as important references for variables of this study and the various hypotheses in the literature help current study in the development of hypotheses.

There are three patterns of studies of VC performance. The first one is to focus the performance of the VCF (Cumming et al., 2017; Buchner et al., 2017; Bellavitis et al., 2016; Fonseca et al., 2014; Wang & Wang, 2011; Wasserman, 2008; Hochberg et al., 2007; Jääskeläinen et al., 2006; Abell & Nisar, 2007). The other is to focus on the studies of the performance of the PCs (e.g. Kang et al., 2022; Calder-Wang & Gompers, 2021; Xing et al., 2016; Li et al., 2014; Wang et al. 2013; Wang & Wang, 2012; Dai et al., 2012; Wang & Wang, 2011; Gompers et al., 2009; Nahata, 2008; Brown, 2005; Schefczyk & Gerpott, 2001; Fredriksen et al., 1997). The third one is to use an ambiguous term to refer to the performance of either FME or VCF (e.g. Hüther et al., 2019; Li et al., 2014; Walske & Zacharakis, 2009; Abell & Nisar, 2007; Dimov & De Clercq, 2006; De Clercq & Sapienza, 2006; De Clercq & Sapienza, 2005; De Clercq & Fried, 2005; Hege et al., 2003; Schefczyk & Gerpott, 2001). These studies emphasize the presence of venture capital and using the success of the PC. For example, Li et al. (2014) studied the performance of venture capital investment in foreign countries. They

distinguish the venture capital by domestic venture capital or international venture capital and do not distinguish the investment is by VCF or FME.

Walske & Zacharakis (2009) studied the performance at the FME level, emphasizing the ability of fundraising of FME.[5] They measured the performance by the success in raising subsequent funds. The definition of performance of FME relates to exit from the PC, which differs from the returns to investment in Walske and Zacharakis.

VC performance is also studied at other levels. One is the VC performance at the deal level (Achleitner et al., 2013; Gompers et al., 2021). A deal is usually defined as a transaction with PC, including both transactions of the PC with the FME and transaction of the PC with a third party with FME getting involved. The purpose of these studies is to examine how successful the activities of venture capitalists are on the deal-by-deal basis. The other strand of studies relates to VC performance at the round level (Dai et al., 2012). A round is defined as the discrete fund-raising event for a startup. They examine how successful the activities of venture capitalists are in different rounds of investment (Dushnitsky & Shapira, 2010; Cochrane, 2001). Both the deal performance and the round performance are interim performance of performance of VCF. We do not distinguish them from the performance of performance of VCF.

[5] The term used in this study is venture capital firm. This is not a proper term for FME since in both academics and practice this term can refer to FME, VCF and the mixture of them. For example, Wang and Wang (2012) also used the term venture capital firm. But they referred to both FME and VCF.

Appendix A indicates two important features of VC performance. First, the FME's performance is directly linked to the performance of VCFs under its management, while the VCFs performance, in turn, are directly decided by the performance of the PCs. In other words, the performance of the FME is the result of the interaction between the cross-fund performance and the cross-PC performance. From the perspective of venture capital investment management, to improve the performance of the FME is to improve the performance of both VCF and PC as a holistic treatment. Previous studies of the VC performance viewed the influence of the FME or VCF as a static and direct impact on the PC. However, capital allocation theory believes that the performance of the entire business organization is the result of the dynamic allocation of the capital of the business organization to the operation units (Busenbark et al., 2022; Cai & Wang, 2021; Busenbarket al., 2017; Dhaene et al., 2011). In this venture capital investment management structure, from the perspective of FME, the management of the venture capital investment is a process of investment allocation. The gap in literature about performance of FME is then identified as the study of the drivers of the performance of FME within the framework of capital allocation theory.

Clearly, the FME's performance is determined by the performance of its PCs. Success of both FME and VCF is to exit the PCs through IPO or trade sales (Hochberg et al., 2007; Bellavitis et al., 2016; Jääskeläinen et al., 2006; Gompers et al., 2021; Nahata, 2008; Wang & Wang, 2011; Dai et al., 2012). Thus, the performance of the FME can be the number of exits from its PCs. To compare the performance of FMEs of different size, measuring the performance of FME by the rate of total number of exits from its PCs to the total number of investments into its PCs by a FME is

reasonable. The process of venture capital investment is a process that FME allocates its capitals to the PCs via VCFs. Successful exits depend on how well FME allocates its capitals. There are two dimensions of capital allocation for FME. One is what the factors that will affect the performance of FME are; the other is how those factors are allocated. The two dimensions together constitute the driver of the performance of FME. This study highlights the drivers for the FME performance as shown in the following.

2.2. Drivers of performance

2.2.1 Average financial capital allocation

This study uses the capital allocation theory to develop our hypotheses. The theory argues that allocation of capital to divisions within multiple divisions in a firm to increase efficiency and maximize performance (Busenbark et al., 2022; Busenbark et al., 2017; Collis et al., 2007; Bower et al., 2005; Glaser et al., 2013; Cai & Wang, 2021; Zaks & Tsanakas, 2014). Venture capital investment is a process of capital allocation (Piacentino 2019; Norton 1996). Appendix A indicates that this venture capital investment process is indeed a typical multi-layer hierarchical structure of capital allocation.

The capital allocation theory focuses primarily on the financial capital allocation. FME's financial capital contribution in the VC investment process takes only a small portion of the total financial capital pool, ranging 1% to 20%. An 1% contribution is most common. The capital by FME signals its dedication and interest to investors who entrust their money to the FME. In reality, venture capitalists allocate both financial capital and human capital to PCs (Wang & Wang, 2011; Zarutskie, 2010; Batjargal,

2007; Dimov & Shepherd, 2005). Both kinds of capital can facilitate the growth of PCs to help improve the FME's performance.

There are two leveraging processes of capital flow from FME to PCs. The first is in the process of fundraising to set up VCF. FME leverages its own money to attract investors to engage in the FME's funds in setting up the VCF. The greater the leverage effect in this process, the more capital will be pulled into the capital pool of FME. The second leverage effect is in the process of VCF investment into PCs. VCFs will coinvest with co-investors (those investing in the portfolio companies) to reduce risk of their investment. The average amount of capital invested into the PCs decides the number of PCs in which the VCF can invest when the initial capital of FME is given. The greater the leverage effect in this process, the more PCs will be included in the investment process. When there are the more PCs, the better the chance of success by FME.

When the FME allocates its capital into different PCs, the rate of the asset of FME to the number of PCs under its management (i.e., asset/total number of PC) can be viewed as the average amount of FME's financial capital allocated to individual PC (financial capital allocation when used as a variable, denoted by **$Asset/#PC_ALOC**). That is, for a given capital, if FME is able to invest in more PCs under its management, the capital utilization is more efficient. This means that this rate (the FME's asset to the number of PC) is negatively associated with FME performance. For example, for a given capital ($100 million) of FME, 20 the FME is able to attract PC, the asset/PC ratio is 5. If FME invests in only 10 PCs, the asset/PC will be 10. It is clearly that the

higher the rate is, the less efficient the FME is using of the capital allocation in the investment process.

The direct effect of the leveraging effect is to increase diversity of the investment. The more PCs under the management of the same FME indicates a higher diversification of the investment. We argue for a positive relationship between the diversification and the performance of the FME (Buchner et al., 2017; Chang et al. 2013).

In light of our arguments above, we propose that the leveraging effect of capital yields the following hypothesis.

Hypothesis 1: A higher average asset allocated to the individual PC, representing less effective capital allocation, will lower the performance of the FME.

2.2.2 Reserve ratio of leveraging financial capital

We define the *reserve ratio of leveraging financial capital, which is the ratio of dry powder to total fund raised* (i.e., dry-powder/total asset, denoted by **$DryPowser/$Asset_Resv**). We use this ratio to examine its effect on performance of FME. "Dry powder" is the amount of capital committed by the investors to the FME but not used yet by the FME. It is the difference between the financial capital (the marketable securities of high liquidity which are considered cash-like) hold by the FME and the total committed capital in the capital pool (Chakraborty & Ewens, 2018). It is an unspent cash reserve that is ready to be invested.

Practitioners recognize at least three ways of using the dry powder for FME. First, FME can use the dry powder to make new investment when a good investment opportunity becomes available. Relatively more dry power available means that the

FME is more cautiously in making investment. So, the reserve ratio represents a proxy of prudence at FME. It indicates that FME wants to retain more capital under control for future investments. Thus, the dry power will enhance performance.

Second, FME may use the dry powder to support and fuel the growth of the PC when they feel necessary. After the initial investment in startups, FME will typically provide additional investment, which is called the follow-on investment, to an existing PC to protect or enhance its value of previous investment (Knockaert et. Al., 2010; Nanda et al., 2020). As venture capital support for the PCs takes time, follow-on investment in the PCs will increase the likelihood of success of those PCs. More dry power in hand means better ability of FME to make follow-on investment. In practice, VCFs typically reserve between 40% and 60% of their funds for follow-on. This is a strategy to re-invest into VCF's winners. This also represent the prudence of FME. The FME may have no follow-on capital to support the better performed PCs if there is not enough reserve of financial capital.

Finally, FME can use dry power to solve the near-term liquidity issues.[6] Dry powder represents financial flexibility to the FME and implies a better chance of grasping the available opportunities of investment in adjusting capital allocation, and a better chance of leveraging more capital.

The dry powder is useful in the second-stage process of leveraging the capital. We use this ratio of estimated dry powder currently available in the hand of a FME to the total money raised by the FME in the last past 10 years for two reasons. First, the life circle of venture capital investment by VCF is usually between seven and ten year

[6] PitchBook. (2021, July 8). What is dry powder in private equity? Pitchbook.com. https://pitchbook.com/blog/what-is-dry-powder

(Zider, 1998). Most VCFs have a 10-year time horizon to complete the circle of investment and return the profits to the investors. In any given year, a FME may have multiple VCFs under management. The fundraising and investment occur concurrently during any 10-year time window. The 10-year benchmark reflects the realistic reserve cycle of the FME. The second one is about data availability. The data compiled the data vendor use 10-year benchmark.

The benefit of the dry powder is to enable the leveraging investment by bringing in larger amount of financial capital from co-investors to PCs. Higher dry powder ratio means that FME has a greater flexibility to fund a new potential PC. In addition, the VCF can offer support to the PCs under management with good progress more easily, such as follow-on investment. Follow-on investment improves the possibility of better performance (Crain, 2018; Peters, 2017) as well as the performance persistence of venture capitalists (Hochberg et al., 2013). Following-on is crucial for successful venture capital investment. Partitioners argue that around 66% of the money in a VCF should be reserved for following-on.

We propose that more dry powder here indicates better performance in the following hypothesis.

Hypothesis 2: A higher reserve ratio of leveraging financial capital is positively associated with the performance of the FME.

2.2.3 Deal Clustering – allocation of Deals

Previous literature supports the arguments that such intrinsic human capitals as experience, reputation, knowledge, information, and personalities of venture capitalists play a role in the success of the venture capital investments. Allocation of intrinsic

human capital generally is not easily observable. De Clercq & Fried (2005) and De Clercq & Sapienza (2006) developed the construct of commitment by the time and energy that the venture capitalists devote into the portfolio companies to proxy the allocation of intrinsic human capital and show that commitment positively impacts the perception of the VCF performance. Gerasymenko (2014) developed a similar construct labelled *involvement* and showed a positive relationship between the scope of involvement and the performance of the PC. There appears to be a positive relationship between attention (measured by portfolio size) and the performance of PC (Jääskeläinen et al., 2006) and between the amount of fund managed by the VCF and the performance of PC (Cumming & Dai 2011).

Better human capital of the FME will trigger a bigger leverage effect of its financial capital (Metrick & Yasuda, 2021; Gompers & Lerner, 2001; Zider, 1998; Sahlman, 1990). The capital appreciation of venture capital comes almost totally from the value-addition activities of the human capital of the venture capitalists (Croce et al., 2012), such as scouting and coaching (Xue et al., 2019; Colombo & Grilli, 2009; Baum & Silverman, 2004), certification effect (Li et al., 2020; Dai, 2007; Hamao et al., 2000), and monitoring (Nahata, 2008).

The number of areas in which the VCF provided advice or established network contacts, portfolio size, and the amount of fund managed are different dimensions of the activities of extrinsic human capital allocation. The more venture capital investment activities the VCF gets involved into a PC, FME will deploy the more human capital into the PCs.

Making deals with a PC is another dimension of venture capital investment activity. The deal marks down the amount invested and what the investor gets in return. In other words, a deal is more than an investment. It is an investment arrangement such as a package of ownership trade and a liquidation preference. Number of deals made with a PC is an indicator of attention of the venture capitalist paid to the PC. When there are a greater number of deals made, it implies greater concerns of the venture capitalist about the PC, and therefore more human capital is allocated into the individual PCs. Number of deals made with a PC can be used as a proxy of the allocation of human capital to PC.

We argue that the average number of deals that the FME made with individual PC (i.e., Deal clustering measured by Deal/PC, denoted as **#Deal/#PC_Clust**) can be used as a proxy for extrinsic human capital allocated to per PC. We expect this variable is positively related to FME's performance since such a relationship had been repeatedly reported in literature that examines different constructs of intrinsic human capital (Sun et al., 2018; Hochberg, 2007; Abell & Nissar, 2007; Jia & Wang, 2017; Gerasymenko, 2014; Cumming & Dai, 2011; De Clercq & Sapienza, 2006; Jääskeläinen et al., 2006; De Clercq & Fried, 2005). Therefore, we propose the following hypothesis.

Hypothesis 3: The deal clustering (Deal/PC) is positively associated with the performance of the FME.

2.2.4 Co-investor clustering

Valuable human capital indicates the ability that a FME can bring outside resources that is not under its control or is not built in itself. FME uses its extrinsic human capital mainly in the activity of syndication that results in the formation of

effective network. There are two measures of network. One is the size, or the quantity side of the network; the other is the strength of the network, or the quality side of network (Hochberg et al., 2007; Abell & Nisar, 2007; Dubini and Aldrich,1991). From the perspective of capital allocation, it is related to the impact of the clustering of network on the performance. The size of network is measured by the number of co-investors that syndicate with the FME in venture capital co-investment. Co-investment gets co-investors involved in the management of the PC as well as enhances the ability to invest in more deals per dollar of invested capital. Co-investors bring into the PCs not only financial capital but also human capital. Clustering of co-investors thus means clustering of network while network is a tested driver of VCF's performance. Co-investor clustering is the result of how the FME brings co-investors into its network in terms of capital allocation.

Network theory in venture capital performance was borrowed from the network studies in sociology (Hochberg et al., 2007). The quantitative aspect of the network is measured by the construct *centrality* which is defined as the number of relationships an actor in the network has. In studies of venture capital performance, centrality of network just means the size of the network which is defined as the number of relationships that the VCF has (Xue et al., 2019; Yang et al., 2018; Bellavitiset al., 2016; Huggins, et al., 2012; Acevedo, 2007; Abell & Nisar, 2007).

We use the number of co-investors in the network (i.e., Co-investor/PC, denoted as **#CoInvestor/#PC_Clust**) to proxy the network capital of FME. It is the number of co-investors for each PC under its management. It measures the degree of centrality of extrinsic human capital of the FME. The degree of centrality of the network, or in other

words, the number of co-investors brought to the PC by the FME, is the result of how the FME channels the network capital under its management to the PCs. Centrality of network at the VCF level has been documented to have a positive relationship with the performance of the VCF. We propose the following hypothesis.

Hypothesis 4: The degree of Co-investor clustering of the FME (co-investor/PC) is positively associated with the performance of the FME.

2.2.5 Co-investor's commitment

Co-investor's commitment is the measure of the quality of the network. Originally, quality of network refers to the closeness of the members in the network. Granovetter (1973) argues that ties with close friends and associates is critical to understand the network relations in that whether people in the network know each other matters. This particular measure of the quality of network was then expanded to refer to an actor's ties to others by the importance of the actors he is tied to in the network (Bonacich, 1972, 1987). Hochberg et al., (2007) adopted this concept and applied it in their research about the impact of network on the performance of venture capital investment. They use the term closeness which is defined as the extent to which a VC is connected to other well-connected VCs to measure the quality of the network. Abell & Nisar (2007) also examined the impacts of the qualitative aspect of the network on VCF's performance. He used the term network strength to refer to the quality of the network. He pointed out that "strength" or "quality" or "closeness" of network are the same thing. The dimension of strength of network has independent significance for performance of venture capitalists. The strength of network is related to such constructs as *trust* and *moral obligation* (Abell & Nisar, 2007). It is important to examine this

dimension of network capital in our study related to the allocation of extrinsic human capital in venture capital investment.

People usually pay more attention to a thing if they commit more money into that thing. This is the common sense that people will care about their money. A closely related theory regarding money commitment and result of investment is the skin in the game theory. The term skin in the game simply means that the financial managers should put at least a small proportion of their own money into the fund they manage to guarantee their commitment into the operation of the fund (Demiroglu & James, 2012). The rationale of the skin on the game theory may vary. But the empirical studies show that there is positive relationship between the ownership stakes and the performance of investment fund (Cremers et al., 2009; Jia and Wang, 2017). This means that the amount of money committed by a co-investor will positively related to their attention to the PC in which they invest. Therefore, the amount of money that gets involved in the PC of a co-investor is a good proxy of the commitment of the co-investor into the PC. The more money a co-investor spent on a PC, the more attention it will give to that PC, the more human capital it may bring to the PC, and the closer relationship it may have with the PC. This study uses how much the average financial commitment that a co-investor allocates to the network cooperation as the proxy of the strength of the network (denoted as **$Deal/#CoInvestor_COMT**). It is defined as the state that co-investors of a FME dedicate to their co-investments. The variable is measured by the total amount of deals in dollar amount made by the FME with its PCs divided by the total number of Co-investors of the FME. This variable is the proxy of closeness of network. The extant literature documents a positive relationship between the strength

of network and the performance of venture capital investment (Abell & Nisar, 2007; Hochberg et al., 2007). We then propose the following hypothesis.

Hypothesis 5: Co-investors' commitment is positively associated with the performance of the FME.

Chapter 3 Research Methodology

3.1 Methodology

This study uses a regression analysis to test the five hypotheses discussed in Chapter 2 as follows:

$$\#\text{exits}/\#\text{ investments}_i = \alpha + \beta_1 \$\text{Asset}/\#\text{PC\_ALOC}_i + \beta_2 \$\text{DryPowser}/\$\text{Asset\_Resv}_i + \#\text{Deal}/\#\text{PC\_Clust}_i + \#\text{CoInvestor}/\#\text{PC\_Clust}_i + \beta_5 \$\text{Deal}/\#\text{CoInvestor\_COMT}_i + \beta_6 \text{Control variables} + \varepsilon_i \quad (1)$$

3.2 Variables

3.2.1 Dependent variable

The dependent variable is the performance of the FME. We adopt the proxy of exit-investment rate for the performance of FME, which is the percentage of exit out of the total number of investments of FME in PCs under its management, i.e., *the number of exits from PCs by the FME/the total number of investments that the FME made into the PCs* (**#exits/#investments**). This definition of VC performance reflects the likelihood of exit, or success (Hochberg et al., 2007; Gompers et al., 2021; Nahata, 2008; Wang & Wang, 2011; Li et al., 2014; Calder-Wang & Gompers, 2021; Wang et al. 2013). Alternatively, we may also construct the performance of the FME with *the number of exits from PCs by the FME/the total number of PCs under the management of the same FME* (**#exits/#PCs**). The difference lies in that FME may make several investments into one PC. The two constructs should produce similar results because we assume that on average the effect of each investment is the same. More investment in the same PC will not significantly change the effects of investment. Exit is a good measurement of VC performance because it provides an easy and practical measure for

evaluating the performance of venture capitalists (Sparks & Al, 2021; Laine & Torstila, 2005).

Another reason for using the exit rate as the measure for performance of the FME lies in that FME are of different size and make different number of investments. From the perspective of efficiency and survival, this research is more interested in the unit return (return per unit) than in the overall return (absolute income). The exit rate is a concept of ratio. A ratio expressed as percentage can also be viewed as the return on unit measurement. It fully satisfies the need of this research. Comparing with other measures, exit rate is based on exit, implying the completion of an investment. It wraps up both costs and return. As a conclusion, exit rate of the PC under the management of FME is the appropriate measure of performance of FME for this research.

3.2.2 Explanatory variables of interest

The first independent variable is the allocation of the financial capital of the FME (**$Asset/#PC_ALOC**), which is the inverse proxy of the leveraging rate of the financial capital of FME. It is obtained by *log (the total asset under the FME's management/the total number of PCs under the FME's management)*. The logarithm form of the allocation of the financial capital embodies the expected non-linear relationship between the allocation of the financial capital and the performance of the FME. The rationale is that investing in more PCs with given financial capital increases the diversity and the chance to succeed. At the same time, more PCs under management increases the management difficulties for the venture capitalist. Thus, the effect of positive impact of the rate of financial capital allocation will marginally decrease with

the increase of the rate of financial capital allocation. Hypothesis 1 suggests that $\beta_1 < 0$ in Equation (1).

The second independent variable is the reserve ratio of the leveraging financial capital (**$DryPowser/$Asset_Resv**), which the ratio of the leveraging financial capital reserved in the hand of the FME to the total leveraging financial capital available for venture capital investment. It is *the current dry powder of FME available for investment/the total money raised by the FME in the past 10 years*. We expect $\beta_2 > 0$ *in Equation (1) if Hypothesis 2 is true.*

Third, the intrinsic human capital relates to the concentration of the deals to individual PC, namely the degree of clustering of the deals (**#Deal/#PC_Clust**) (Zarutskie, 2008; Pereira et al., 2019; Ekholm & Maury, 2014). It is *the total number of deals made by an FME/the total number of PCs under the management of the FME*. Alternatively, we can construct this variable with number of investments, namely, *the total number of investments made by an FME/the total number of PCs under the management of the FME* (**#investment/#PC_Clust**). This is because investment, like deal, increase the contacts and concerns of the FME with the PC, and therefore brining more human capital to the PC. Hypothesis 3 implies $\beta_3 > 0$ in Equation (1).

Fourth, the quantitative aspect of the extrinsic human capital deals with the size of the network of the FME available for individual PC, or the ability of syndication of the FME and relates to the degree of clustering of the co-investors (denoted as **#CoInvestor/#PC_Clust**). The variable is *the total number of the co-investors of the FME/the total number of PCs under the FME's management*. If Hypothesis 4 holds, we expect $\beta_4 > 0$ *in Equation (1).*

Finally, the qualitative aspect of the extrinsic human capital deals with the quality, closeness, or strength of the network of the FME. This variable reflects the strength of the network of the FME and the degree of dedication of the co-investors into the co-investments with the FME. This variable is *the total amount of deals in dollar/total number of coinventors* (denoted as **$Deal/#CoInvestor_COMT**). The variable is expected to have a positive effect on the FME performance, implying that $\beta_5 > 0$ *in Equation (1).*

3.2.3 Control variables

We use several control variables in this study, which are listed as follows.

First, we control for operational environment where the FME operates in. Guo and Jiang (2013) compared the performance of PCs backed by Chinese VCFs with those backed by VCFs from other countries and found significant difference. The classification of the Chinese VCF and other VCFs is based on the location of the headquarter of the VCFs. Guler & Guillén (2010) reported that home country network will help venture capital's foreign expansion. We control for the business location of the FME as it affects performance (Hege et al., 2003; Lerner et al., 2011; Cumming & Dai 2010; Guler & Guillén, 2010; Guo & Jiang, 2013). If the FME's business center is located in a country with a mature market (**Bus_Center_mature**), it is denoted as 1 and 0 otherwise.

Second, we control for the *Market focus* (**MKT_Mature**). Hege et al. (2003) compared the performance of venture capital in the US and Europe. Their hypothesis that more mature VC market is related to the higher average level of return is supported. It is likely that better developed stock markets significantly enhance VC performance

because developed stock market is associate with mature market (Nahata et al. 2014).. reported that cross-border VC performance is related to the economic freedom. We believe that maturity of the market is typically associated with greater economic freedom that helps VC performance (Wang & Wang 2012). Thus, we control for the mature market effect. If the FMT focuses on mature market, it is 1 and 0 otherwise.

Third, we control for the operational strategy, which is an important element that has proved impacts on the VC performance. Some PEs focus their business on venture capital investment and become FME; others stick to traditional PE business but also make venture capital investment. The latter is recorded as FME when the statistics is collected. The difference between them is whether they focus on the venture capital business. A strong positive relationship between the degree of specialization by venture capitalists seems to relate to the success of PC (Gompers et al., 2009). Generalist venture capitalists have poorer performance because they lack the ability to efficiently allocation of the capital across industries and poor ability to screen and select good PC within industries. Specialization directly influences professional performance and indirectly impact financial performance (Wilson et al.,2019). If FME adopts the strategy of specialization (**PEStrategy_VC_Only**), it is denoted as 1 and 0 otherwise.

Fourth, we control for the *Staging strategy*. Staging is a concept related to the venture capitalists' investment strategy for the different stages of the financing process of a PC to invest. This is a strategy about considerations of risk evaluation, exit timing expectation, and commitment needed. According to the risk management literature, venture capitalists seldom invest alone to avoid putting all their eggs in one basket (Jiang & Feng, 2021; knill, 2009; Goldwhite, 2009). Venture capitalists usually stage

their investment throughout the life circle of a venture capital investment (Tian, 2011; Hill et al., 2009; Li, 2008; Hege et al., 2003; Gompers, 1995). They adopt continuously adjustable strategies to decide how to allocate their VCFs in different rounds of venture capital investment. Literature has proved that invest in late state usually gain a better return. If a FME focuses on investing in the late stage (**Focus_Late_Stage**), it is denoted as 1, otherwise, 0.

Fifth, follow-on is another investment strategy for venture capitalists. It is documented that VCFs that make follow-on investment perform better than VCFs those do not make follow-on investment (Knockaert et al., 2010), while higher returns on the current VCF spurs a higher probability for the venture capitalists to make follow-on investments. (Hochberg et al., 2013). If the FME engages a follow-on investment, it is denoted as 1 (**Follow-on_Investment**) and 0 elsewhere.

Sixth, we control for different industry strategy in high-tech, and other industries. This classification is supported by the practitioners' report. Cambridge Associates (an FME) reported that, from 1997 to 2015, returns from venture capital investment in high-tech industries have higher average IRRs than that in other industries. If the FME is in high-tech (**Focus_Industry_HiTech**), it is 1 and 0 elsewhere.

Finally, we control for the age of the firm *Age* (**FME_Age**), which is an important aspect of characteristics of venture capitalists on performance (Lee et al., 2011; Clarysse, 2011; Lerner, 1994; Barry, 1994). Age is calculated by subtracting the year of establishment of FME from 2021 - the benchmark year.

3.3 Data

This research uses secondary data from the commercial data vendor, Preqin, which is one of the largest and best venture capital data vendors and on the collection of supplementary data prepared by PitchBook which is the largest provider of the venture capital data. Data related to venture capital were widely explored with the reference to the guidelines created by forerunners of this field (e.g., Kaplan et al., 2016; Kaplanet al., 2002). The data from Preqin is the primary data for this research. Using the search engine of Preqin, we filtered the relevant data with the criteria of venture capital. We supplement the data with the data from PitchBook for missing variables and missing values. The final sample for our study ends up with 386 firms for analysis. We also followed the Cross-Industry Standard Process for Data Mining (CRISP-DM) (Olson & Delen, 2008) to cross check the data for the empirical test.

Chapter 4 Empirical Analysis and Results

4.1 Descriptive Statistics

4.1.1 Data distribution

This research looks at the whole picture of the entire industry of venture capital investment all over the world. This study has been targeting on the data that can cover as larger geographical region as possible. The final original dataset for the analysis has the following distributions.

Figure 2 shows the data distribution by FME locations which is classified by geographic region. The data sample covers all continents of the world. North America has the most observations - 198 observations that takes 51.30% of the total observations. Europe follows and has 93 observations that takes 24.09% of the total observations. Asia has 59 observations that take 15.28% of the total observations. Altogether, there are 350 observations in those three regions, which take 90.67% of the total observations. Africa has the least observation. Only 1 observation is shown.

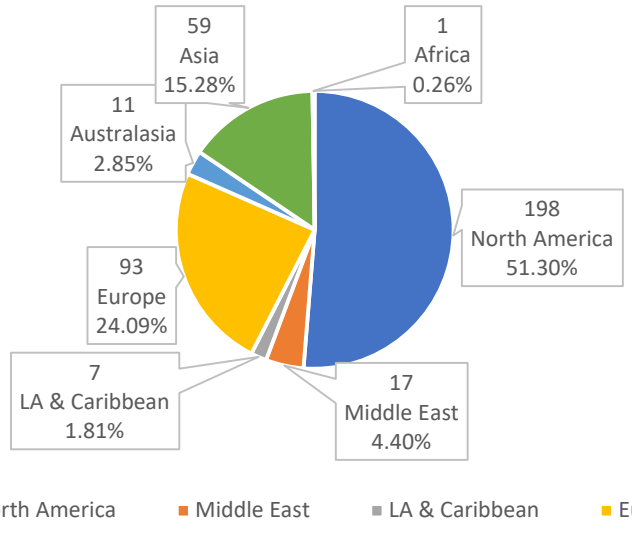

Figure 2: Data Distribution of FME Location by Region (FME Number & Percentage)

Figure 3 shows the same data distribution by FME locations which are classified by countries. The data covers 37 countries all over the world. There are 186 observations from United States which takes 48% of the total observations. UK follows up with 22 observations. These two countries altogether have 208 observations, taking 54% of the total observations. Both Figure 2 and Figure 3 indicate that the venture capital activities are concentrated on several most developed countries.

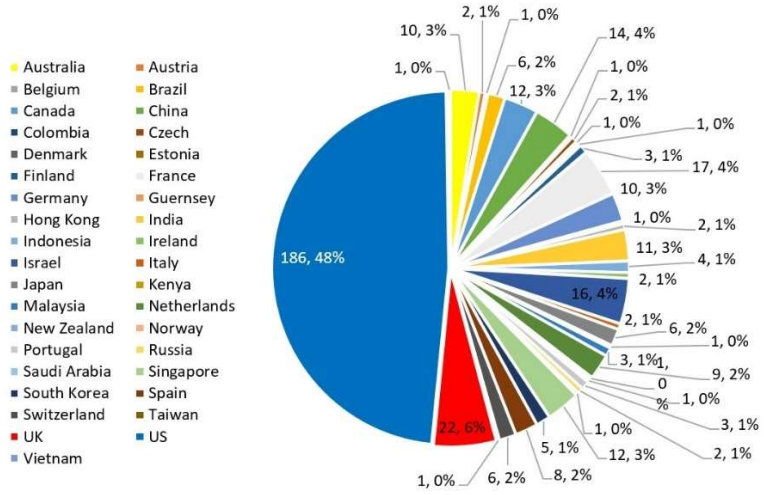

Figure 3: Data Distribution of FME Location by Country (FME Number & Percentage)

The data show that the geographical distribution of venture capital industry is uneven. Majority of the venture capital investment take place in the developed market and emerging market. US leads the trend of venture capital investment. This distribution of sample data is in consistency with the expectation based on literature and industry discussions.

Table 1 shows the countries with more than 10 observations (the bolded countries). They are Australia, Canada, China, France, Germany, Israel, Singapore, UK, and India. Altogether, the observations from those countries take 78.3% of the total observations.

Table 1: Sample distribution by region and country

Region	**North America**	**Middle East**	**LA & Caribbean**	**Europe**	**Australasia**	**Asia**	**Africa**	**Total**
(Obs. (%))	198 (51.3%)	17 (4.4%)	7 (1.8%)	93 (24.1%)	11 (2.8)	59 (15.3%)	1 (0.3%)	386 100%)
Countries in Region	2 (5%)	2 (5%)	2 (5%)	18 (49%)	2 (5%)	10 (27%)	1 (3%)	37 (100%)
Country	**Australia**	Austria	Belgium	Brazil	**Canada**	**China**	Colombia	
(Obs. (%))	**10 (2.6%)**	2 (0.5%)	1 (0.3%)	6 (1.6%)	**12 (3.1%)**	**16 (4.2%)**	1 (0.3%)	
	Denmark	Estonia	Finland	**France**	**Germany**	Guernsey	Taiwan	
	1 (0.3%)	1 (5%)	3 (0.8%)	**17 (4.4%)**	**10 (2.6%)**	1 (0.3%)	1 (0.3%)	
	Indonesia	Ireland	**Israel**	Italy	Japan	Kenya	Malaysia	
	4 (1%)	2 (0.5%)	**16 (4.2%)**	2 (0.5%)	6 (1.6%)	1 (0.3%)	3 (0.8%)	
	Norway	Portugal	Russia	Sandi Arabia	**Singapore**	S. Korea	Spain	
	1 (0.3%)	3 (0.8%)	2 (0.5%)	1 (0.3%)	**11 (2.9%)**	5 (1.3%)	8 (2%)	
	Switzerland	**UK**	**US**	Vietnam	Czech	**India**	New Zealand	
	6 (1.6%)	**22(6%)**	**186 (48%)**	1 (0.3%)	2 (0.5%)	**11 (2.9%)**	9 (2.3%)	

4.1.2 Descriptive statistics of the variables

The dependent variable and the independent variable are constructs from the raw data. Table 2 reports the summary of the descriptive statistics of the variables.

The mean exit rate measured by number of investments is very close to the mean exit rate measured by number of PCs, 26.8% and 24.5% respectively. Some of the FMEs in this sample are newly established and have no exit yet. The minimum 0 stands for this scenario. The means of exit rate just embodies the industry estimation that ¾ of the venture capital backed startups fails. The mean of the average amount of financial capital being allocated to single PC is 1.163 million dollars with a standard deviation value of 0.612 while the median is 1.124 million dollars. This indicates that on average each PC can get a little more than 1 million dollars from FME and half of the start-ups can get less 1.124 million dollars from FME. The mean of the reserve ratio of asset is 0.678. It is consistent with the common practice of reserving about 66% of the financial capital for follow-on investment. On average, each PC can get about 3 investments and about 2 deals. The variable of investment clustering has a minimum of 1 and the variable of deal clustering has a minimum of 0.046 indicate that each PC will get at least one investment from FME, but some of the PCs get no deals with FME. The maximum of 63 investments per PC and 71 deals per PC indicate that the interaction between the FME and the PC could become very intensive. Both the mean and median of the co-investor clustering is around 4. This is an embodiment of the practice of syndication in venture capital industry. The minimum of the co-investor clustering is less than 1 (0.064) indicates that not all FMEs will co-invest with co-investors.

Table 2: Descriptive Statistics

VARIABLES	(1) N	(2) mean	(3) median	(4) s.d.	(5) min	(6) max
Dependent Variables						
#exits/# investments	386	0.268	0.236	0.173	0	0.925
#exits/# PCs	386	0.245	0.185	0.208	0	0.952
Main explanatory Variables						
$Asset/#PC_ALOC	386	10.665	10.625	0.782	7.146	13.651
$DryPowser/$Asset_Resv	386	0.687	0.710	0.210	0.158	1
# Deal/#PC_Clust	386	3.042	2.173	3.781	1	63
# Investment /#PC_Clust	386	2.514	1.667	4.047	0.046	71
#CoInvestor/#PC_Clust	386	4.259	3.834	3.326	0.064	43.419
$Deal/#CoInvestor_COMT	386	0.944	0.896	0.508	0.015	3.210
Control Variables						
MKT_Mature	386	0.469	0	0.500	0	1
Bus_Center_Mature	386	0.863	1	0.345	0	1
PEStrategy_VC_Only	386	0.736	1	0.442	0	1
Focus_Late_Stage	386	0.062	0	0.242	0	1
Follow-on_Investment	386	0.251	0	0.434	0	1
Focus_Industry_HiTech	386	0.246	0	0.431	0	1
FME_Age	386	13.98	11	11.066	1	76
Female_Owner	386	0.088	0	0.284	0	1
Minority_Owner	386	0.047	0	0.211	0	1

Table 3 shows that performance of FME is positively associated with the allocation of leveraging financial capital, $p<0.01$, the financial capital reserve, $p<0.01$, the deal clustering, $p<0.01$, the investment clustering, $p<0.01$, and the deal amount devoted by co-investors, $p<0.01$, but not associated with the co-investor clustering.

The direction of the correlation between the performance of FME is reverse to the expected negative direction. This indicates that the relationship between the

performance of FME and the allocation of leveraging financial capital is conditional on some factor else (Schey, 1993). This is not a reason to exclude it from the model since we will see that the result of regression analysis for this driver is in consistency with the hypothesis. Also, the insignificant correlation coefficient for co-investor clustering indicates that it alone may not a predictor of the performance of FME. Co-investor clustering do not seem to directly influence the performance of FME. Some other predictors may exist and work together with it and make the story different. A tentative explanation is that the co-investors do not play the role of managing the PC. Their impacts on the performance of FME are through the venture capitalists.

Table 3: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) #exits/# investments	1.000																
(2) #exits/# PCs	0.840***	1.000															
(3) $Asset/#PC_ALOC	0.216***	0.278***	1.000														
(4) $DryPowser/$Asset_Resv	0.302***	0.278***	-0.009	1.000													
(5) #Deal/#PC_Clust	0.314***	0.387***	0.307***	0.068	1.000												
(6) #Investment/#PC_Clust	0.340***	0.687***	0.192***	0.125**	0.258**	1.000											
(7) #CoInvestor/#PC_Clust	0.078	0.101**	0.178***	-0.088**	0.071	0.064	1.000										
(8) $Deal/#CoInvestor_COMT	0.430***	0.534***	0.593***	0.115**	0.495***	0.327***	-0.026	1.000									
(9) MKT_Mature	0.117**	0.094*	-0.052	-0.086*	-0.056	0.036	0.065	-0.132**	1.000								
(10) Bus_Center_Mature	0.228***	0.232***	-0.004	-0.065	0.081	0.082	0.145**	0.040	0.375***	1.000							
(11) PEStrategy_VC_Only	0.318***	0.260***	0.288***	0.145***	0.132***	0.127*	0.005	0.362***	-0.120*	-0.034	1.000						
(12) Focus_Late_Stage	0.125**	0.049	0.097*	0.002	-0.039	-0.018	0.034	0.062	-0.005	-0.022	0.106**	1.000					
(13) Follow-on_Investment	-0.023	-0.133***	-0.096**	0.005	-0.145***	-0.125**	-0.069	-0.188***	0.090**	0.040	-0.195***	0.148**	1.000				
(14) Focus_Industry_HiTech	0.162***	0.151***	0.099**	0.000	0.013	0.042	-0.029	0.057	0.114**	0.106**	-0.026	0.052	-0.040	1.000			
(15) FME_Age	0.558***	0.626***	0.273***	0.190***	0.297***	0.307***	-0.045	0.486***	0.003	0.114***	0.237***	-0.058	-0.162***	0.024	1.000		
(16) Female_Owner	-0.080	-0.080	-0.060	-0.006	-0.050	0.001	0.067	-0.117**	0.019	0.044	-0.021	-0.042	-0.033	0.077	-0.127**	1.000	
(17) Minority_Owner	-0.027	-0.052	-0.061	-0.027	-0.045	-0.046	0.012	-0.029	-0.060	0.053	-0.007	-0.057	0.042	-0.041	-0.069	0.105**	1.000

*** p<0.01, ** p<0.05, * p<0.1

4.2 Multivariate analysis

We conducted the OLS regression of the performance of FME (#exits/# investments) on independent variables. Financial capital allocation that embodies the leveraging and channeling effects includes the allocation of leveraging financial capital ($Asset/#PC_ALOC) and the financial capital leveraging reserve ratio ($DryPowser/$Asset_Resv). Human capital allocation that embodies the leveraging and channeling effects includes allocation of the intrinsic human capital proxied by deal clustering (#Deal/#PC_Clust), the quantitative aspect of the extrinsic human capital proxied by co-investor clustering (#CoInvestor/#PC_Clust), and the qualitative aspect of the extrinsic human capital proxied by the co-investor's dedication ($Deal/#CoInvestor_COMT). Controlled variables include the variables of business environment, including whether the investment is in the mature market (MKT_Mature) and whether the business center of the FME is located in a country with mature market (Bus_Center_Mature), the main investment strategy variables, including the PE strategy of specialization vs generalization (PEStrategy_VC_Only), the stage focusing strategy – late stage vs other stages (Focus_Late_Stage), the follow-on strategy – follow-on vs no follow-on (Follow-on_Investment), and industry focusing strategy – hi-tech industry vs traditional industries (Focus_Industry_HiTech), and the variables related to the characteristics of the FME – the age of the FME (FME_Age). Table 4 shows the results of the regression of multivariate analysis of the data.

Table 4: Determinants of FME Performance: Baseline Model

VARIABLES	#exits/# investments	
	Coef.	t-statistic
Main explanatory variables		
Financial Capital Allocation		
$Asset/#PC_ALOC	-0.031**	-2.41
$DryPowser/$Asset_Resv	0.152***	4.65
Human Capital Allocation		
#Deal/#PC_Clust	0.004**	2.26
#CoInvestor/#PC_Clust	0.006**	2.19
$Deal/#CoInvestor_COMT	0.066***	2.97
Control variables		
Business Environment		
MKT_Mature	0.031**	2.25
Bus_Center_Mature	0.062***	3.41
Main investment strategy		
PEStrategy_VC_Only	0.069***	4.42
Focus_Late_Stage	0.076**	2.39
Follow-on_Investment	0.037**	2.28
Focus_Industry_HiTech	0.050***	3.04
FME's Characteristics		
FME_Age	0.007***	6.97
Constant	0.160	1.25
Observations	386	
R-squared	0.509	
VIF	1.35	

*** p<0.01, ** p<0.05, * p<0.1

To avoid the issue that default standard errors of OLS may overstate estimator precision (Cameron & Miller, 2015), we directly conduct the robust OLS regression (the same as regress with cluster-robust standard errors) and reported this result. The benefit of doing so is that we do not need to worry about possible problem of clustering effect with inaccurate t statistics, p value, and confidence intervals.

To ensure there is not an issue of multicollinearity, We conducted a variance inflation factor test. All VIFs are smaller than 10 which is the acceptable limit of VIF (Shrestha, 2020; Neter et al., 1996). The average variance inflation factor is 1.35.

The regression results show that all my hypotheses are supported by the sample data. We classified my explanatory variables into two categories – the financial capital allocation and the human capital allocation. There are two drivers of the performance of FME with regard to financial capital allocation – the allocation of leveraging financial capital and the reserve ratio of financial capital leveraging. There are three drivers of the performance of FME with regards to the human capital allocation – the deal clustering – allocation of deals, the co-investor clustering, and the co-investor's commitment – deal amount committed by the co-investor. They are all supported by the regression results.

The allocation of leveraging financial capital is negatively associated the performance of FME. Literally, this indicates that the more leveraging capital the FME allocates to individual PC, the worse the FME will perform. Looking at the construct of the leveraging financial capital we see that it is measured by the logarithm of the ratio of the total assets under management to the total number of PCs. The interpretation of this result is that, on average, the percentage of the PCs under the given FME's management that exit through IPO or trade sales will decrease 0.031 ($p< 0.05$) when the average financial capital invested by the FME into a single PC in its portfolio increases one percentage point.

The financial capital leveraging reserve rate has positive impact on the performance of FME. The exit rate of a FME will increase 15.2% ($P<0.01$) when the

reserve ratio of leveraging of financial capital increase 1%. This is reward to prudence and learning. FME does not need to put all the dry powder in the financial capital pool into the investments or deals. Within the investment window of a VCF under its management, FME can hold and watch, sensing the change of the market, observing the performance of the invested PC, and learning from the operation. Higher financial capital reserve rate gives the FME more flexible and make the investment decision wiser. Slowing down the pace of investment will also give potential co-investors time to observe, learn, and prepare. In the contrary case that the FME is a co-lead or a co-investor, the holding and watching also allow time and learning for the FME to make investment decisions. Keep enough dry powder will help the FME to improve performance.

The deal clustering is positively related to the performance of FME. The exit rate of the FME will increase 0.4% ($p<0.05$) with each additional deal made into individual PC. Investment clustering is a comprehensive measure of resource concentration. Both financial capital and human capital gets involved in the allocation of investments. With regard to human capital, investment usually bring both intrinsic and extrinsic human capital into the PC. More investments are indicators of more financial capital flow into the PC. At the same time, investment is a manifestation of the attention of the FME to the PC. Human capital of the FME will flow into the PC together with the investment. It is sure that the intrinsic human capital will go together with investment. Extrinsic human capital will not flow in until participation of co-investors is confirmed.

In consistency with the study of previous studies at the VCF level, the extrinsic human capital of FME which is represented by the network in the corresponding

previous studies (Bellavitis et al., 2016; Abell & Nisar, 2007; and Hochberg et al., 2007) has positive impacts on the performance of FME. There are two dimensions of extrinsic human capital – the co-investor clustering which stands for the magnitude of the extrinsic human capital of FME and the co-investor's commitment which stands for the quality of the extrinsic human capital of FME. They are the human capital from co-investors brought in by the FME. Each additional co-investor will contribute 0.6% ($P<0.05$) exit rate to the FME.

Co-investor clustering reveals on average how many co-investors a PC managed by the FME has. More co-investors in a PC means more potential extrinsic human capital available for the PC to take advantage of. But how forceful support a Co-investor will give to the PC is related to the amount of money it put into the PC. Larger amount of money put into the PC will cause more concern for the co-investor. The amount of money a co-investor places into the co-operative project – deal – indicates how closely the co-investor will cooperate with the FME. The more money a co-investor put into the deals of the FME, the stronger engagement of the co-investor into the cooperative deals, the larger extrinsic human capital it will bring into the cooperative deals, the stronger commitment the co-investor makes to the cooperative deals. Each one million dollars committed by a single co-investor in the deals co-invested with the FME are corresponding to 6.6% ($P<0.01$) of the exit rate of the FME. Both the dimensions of the extrinsic human capital have significant impacts on the performance of the FME.

In addition to the drivers of the performance of FME, the significant coefficients of the control variables show that the findings regarding those control variables in the previous studies are possibly be generalized to the FME level.

Target market also matters. Those FMEs focusing on the mature market enjoys an average of 3.1 % ($P<0.05$) higher exit rate than those targeting on the other market.

Location of business center refers the location of the domicile, the headquarter, or the main operation center of the FME. FMEs located in the countries with mature market enjoy on average 6.2% ($P<0.01$) higher exit rate than those FMEs located in the other countries.

The PE strategy, namely whether specialized in venture capital, make difference. FME's specialized in venture capital on average have 6.9% ($p<0.01$) more exit rate than those just make venture capital investments as a part of its portfolio. This result cannot be used to conclude that the specialization strategy is better than the diversification strategy without the overall performance of those FMEs with the diversification strategy. This is because the data in this sample regarding those FME contains only the information of their investment activities in venture capital industry. Their investment activities in other financial market are not in this sample.

The result of the test of the impact of stage strategy on FME's performance is also in consistent with the results of the previous studies at the VCF level (Dai et al., 2021). Specially, FMEs that adopt the strategy investing in the late stage of the PC have higher exit rate than those adopt the strategy investing in early stage of the PC or the strategy investing in all stages of PC. On average, FMEs who adopt the strategy of investing in the late stage of the PC enjoys a 7.6% ($P<0.05$) higher exit rate. The rationale is that

PCs at the early stages have higher information asymmetry and uncertainty while PCs at the later stage have shown its profitability and provide venture capitalists better information to make decision.

Making follow-on investment also helps improve performance (Crain, 2018; Peters, 2017; Hochberg et al., 2013). Follow-on investment is based on the previous performance of the PC. Better performance of a PC induces more follow-on investments. In turn, follow-on investment further facilitates the performance of the PC and increases the probability that the PC will result in a successful exit. On average, FMEs that make follow-on investments have a higher exit rate (3.7%, $P<0.05$) than those FMEs that do not make follow-on investments.

The strategy of industry focus also makes difference. FMEs focusing on the high-tech industries enjoy 5% ($P<0.01$) higher exit rate than those focusing on traditional industries.

Age of the FME is positively associated with the performance of the FME. This finding is consistent with the findings of the relationship between venture capitalists' performance and the proxied factors, such as reputation and experience, at VCF level. In a word, the intrinsic human capital of FME has positive impact on the performance of the FME. Each year's accumulation of the intrinsic human capital (age) contributes 0.7% ($P<0.01$) to the exit rate of the FME.

Our results are supported by the robustness check, see the Appendix B for details.

Chapter 5 Conclusion and Discussion

5.1 Summary

Venture capitalists manage resources in various levels, including the FME, the VCF, the PC, the investor, and the co-investor. This research explores the drivers and mechanisms of venture capitalists' performance at the FME level as an independent entity.

Venture capital investment is a process of allocating the financial capital and human capital available for venture capitalists to operate. Venture capitalists utilize and leverage their own and other people's financial capital and human capital to gain better return.

The activities of the venture capitalists engage in leveraging and channeling of financial capital in the investment process. This study creates constructs that can embody these activities and enable us to examine their effects related to the distribution of the financial or human capital of the FME and drivers of the performance of FME.

We develop and test empirically several hypotheses related to the drivers of the FME's performance. To improve performance at the FME level, there are two possible strategies regarding financial capital. The first is to boost the leveraging effects of the financial capital. In other words, venture capitalists can improve their performance by ameliorating the leveraging effects of their initial money to leverage in more PCs. This strategy can bring in more PCs with less financial capital of the venture capitalists. The other strategy is to keep enough dry powder in hand and not to invest a large proportion of the available financial capital too quickly. This is a strategy of how to channel the financial capital available to the better performed PC(s). Keeping enough dry powder

in hand allows venture capitalists to observe the performance of the PCs in hand to decide which one(s) to allocate more capital for scouting better PCs. There is a limitation for this strategy. Venture capitalists need to carefully make a balance between the dry powder and the capital invested.

The results of empirical tests indicate three possible human capital strategies for venture capitalists at the level of FME. Making a larger number of investments or deals with the individual PC will help FME to improve performance. A larger number of investments or deals involve more financial capital investment. There is the trend that a larger number of investments or deals brings in more financial capital to the PC. The number of investments or deals with an individual PC reflects the extent of attention that the venture capitalists from FME pay to the PC along with the financial capital flow. The implication in the empirical results is that venture capitalists should make more intensive transactions with the promising PCs to facilitate their success.

Similarly, we show that more co-investors in an individual PC will help the PC to be successful. More money from individual co-investor devoted into the FME indicates more committed that co-investor into the cooperation with the FME, and that helps improve the FME's performance.

The results of the controlled variables indicate that they all have impacts on the performance of the FME, include the age of the FME, the PE strategy of the FME, the location of the business center, the geographic distribution of the target market, the strategy of staging and follow-on, and the industry decision for investment. Those factors are proved to have impacts on venture capitalists' performance at the VCF level.

5.2 Contribution

This study provides several contributions to the literature. First, this study is the first to clearly distinguish the performance of the venture capitalists from the performance of the business entities over which the venture capitalists manage. The performance of FME differs from the studies on the performance of VCF. The notion of FME provides a new method of viewing the performance of the venture capitalists at a new level, taking the whole picture of the process of venture capital investment into account. We study the drivers of the venture capitalists' performance at FME level with a new angle of capital allocation.

Different from previous studies of capital allocation in risk management that focus on the financial capital allocation, we introduce the concept of allocation of human capital into the study of capital allocation. We reveal that the capital allocation in the process of venture capital investment is characterized by the capital leveraging and channeling. We also create the concepts of intrinsic human capital which is the human capital of the venture capitalists and extrinsic human capital which is the human capital available from the investor and co-investor.

Second, our study integrates many factors that are examined in previous studies, such as experience, reputation, and network. In addition, we also include PE strategies and others examined earlier.

Third, this study offers venture capitalists new tools to improve their performance in practice. More importantly, the whole-picture view provides venture capitalists with a new perspective of consideration for decision-making. The current practice is that the venture capitalists raise funds based on VCF. The results of our study indicate that venture capitalists can start the leveraging and channeling process when they start to

plan an investment, integrating the planned VCFs together and utilize the leveraging and channeling strategy to realize better performance.

5.3 Limitations

Some limitations of this study are noted. First, the leveraging effect is not endless, there must be a cutting line. It is impossible to use a small money to leverage infinitely a large number of PCs. There should be a limit for the effect of leveraging capital.

Second, the effectiveness of financial leveraging capital reserve rate also merits further studies because there are pros and cons for holding dry powder. Future studies may examine more closely the costs and benefits of dry powder.

Third, this study finds that both gender and minority are not significant determinant for the performance of FME shown in Appendix B. Further studies are still needed to resolve the issue as why other studies showing that gender and minority have a significant effect on firm's performance.

Fourth, the specialization strategy needs to be examined with data that include the performance of the PE with portfolio in venture capital, the PE without portfolio in venture capital, and PE with only venture capital investment.

Lastly, this study did not survey the behavioral aspects of the capital allocation of FME. Future studies can make efforts to explore these issues. The proxies of the variables have both financial capital and human capital involved. Future research may come up with a better measure of the human capital that affects performance of FME.

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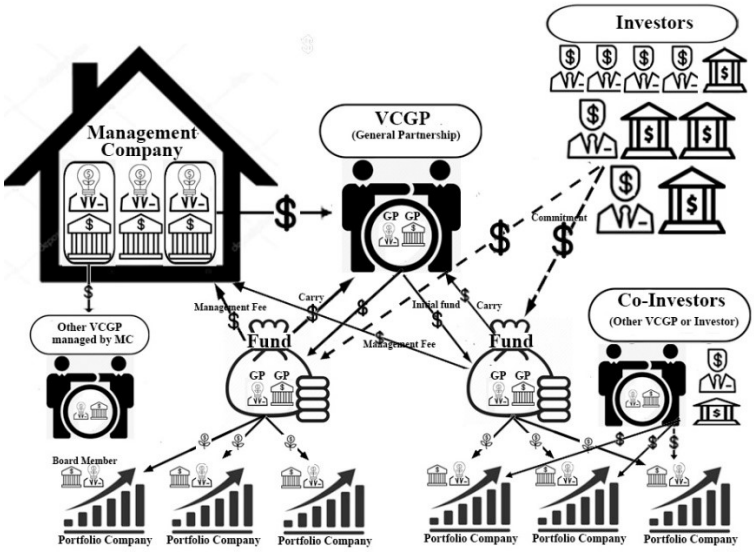
Appendices

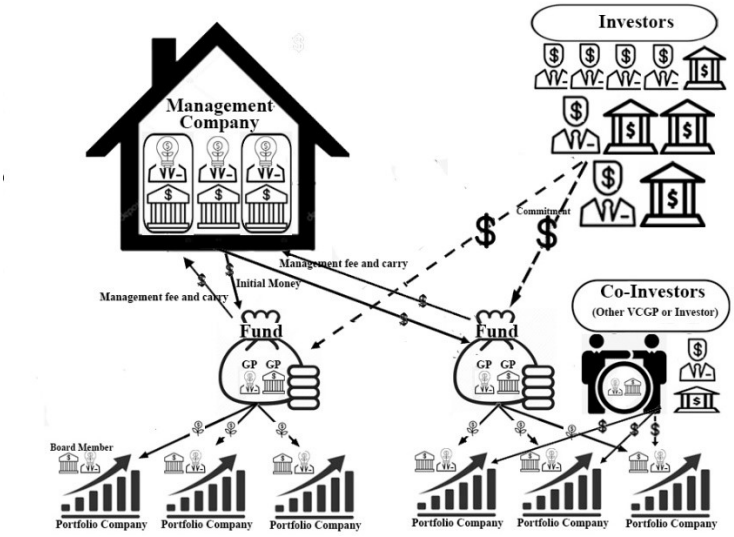
Appendix A: Managerial arrangements of venture capital investment

Managerial arrangements of venture capital investment

Arrangement One



Arrangement Two



Appendix A illustrates two managerial arrangements of FME. The managerial arrangements of venture capital investment are pyramid-like hierarchical structure.

Arrangement One shows seven players: venture capitalist, MC (management company), GP (general partner), the third-party investor (Investor), VCF, PC, and the co-investor in PC (Co-investor). Venture capitalist will organize an MC as a single shareholder or together with other venture capitalists once he gets an idea of initiating a business of venture capital investment. Venture capitalists are general partners of the GP. They make investment plans and present the plans to the potential investors who are rich individual persons or institutional investors such as pension VCFs and university VCFs to raise money, i.e., selling the idea to potential investors. A Limited Partnership Agreement (LPA) will be entered to establish VCFs to carry out the investment if the Investor buy the investment plan. Venture capitalists now become the general partners of the VCFs. In the LPA, the Investors agree to invest certain amount of capital to the VCFs. Venture capitalists generally will join in the PC to act as board members of the PC to monitor and facilitate the growth of the PC.

The second arrangement (Arrangement Two) differs from Arrangement One in that the MC carries out the investment directly without establishing the GP. The functions and interests of the MC and the GP merge together in Arrangement Two. In terms of return distribution, MC in Arrangement One collects only the management fee (commonly 2% of the capital of the VCF managed by venture capitalists from MC) and GP collects the carry (the venture capitalists' share in the return from successful VCFs).

The two arrangements can be conceptualized as one thing. Arrangement One separates the role of administration of the venture capitalist from the role of financial advisor (for Investors), capital manager (for VCFs), and management consultant (for PCs). From the perspective of investment management, there is no essential difference

between the two arrangements in that the administrative role of the venture capitalist is not directly connected with the role of investment management. From the perspective of performance evaluation, there are also no essential difference between the two arrangements. The effects of tax take place only after the returns (namely, the carry) has been distributed to the venture capitalists. It does not influence the returns of the venture capitalists in MC when the returns are used to evaluate the performance of the venture capitalists at the FM level. In addition, the different managerial arrangements for the investment do not have associations with the evaluation of the performance of the venture capitalists when the performance is measured by the exit rate as adopted in this study.

Exit rate will not change whichever arrangement the venture capitalists adopt in their practice. Both arrangements have nothing on the role of venture capitalist as investment manager and the evaluation of their performance.

Appendix B: Robustness Check

There are several concerns in this research. The first is the common shortcomings of the secondary data. The data come from Preqin which presets the standard of the information collection. To avoid possible correlations among the residuals across FME and biased OLS standard errors (Petersen, 2008), This study conducted the robust OLS regression for estimating the standard errors using the Huber-White sandwich estimators to deal with a collection of minor concern such as normality, heteroscedasticity, or some observations that exhibit large residuals. Only the robust estimation is reported.

We assume that the data and the model satisfy all the assumptions of OLS regression that make it BLUE. However, the assumptions may not be correct. We adopt different methods to release the assumptions to repeat the test in order to make sure our assumptions are good, and our model is useful (Box, 1976).

To test the robustness of the coefficients estimated, we conducted different regression analyses with alternative estimation methods (Zhang & Churchill, 2020). First, this study conducted the analysis with the Generalized Linear Model (GLM), relaxing the assumption of normal distribution of the OLS error terms to allow for other error distributions, and alternative relationships between the dependent variable and the independent variables. The idea is that no significant differences should be shown between the results of the estimates obtained by the OLS method and by the GLM method. Stata reported z statistics rather than t statistics in the GLM regression result. This indicates that the Stata recognized an asymptotic normal distribution. With our sample size, there is no practical difference between using the z statistics and the t

statistics. We just report the z statistics as given. The coefficients of the GLM regression and the OLS robust regression are exactly the same. But the variances are different (not reported). This indicates that the assumptions for the OLS regression hold, and the OLS estimation is robust.

Second, to double check the method robustness, this study further conducted the weighted least-squares (WLS). The idea is that the WLS method requires less restrictive assumptions than OLS methods. The results of the OLS regression will not hold under WLS if the homoscedasticity assumption is violated or there are outliers that lead to biased estimation with the OLS regression. The scatter plot and visual screening did not find outliers (not reported). The estimated variance for weighing is generated with auxiliary regressions (the log squared residuals method) and the estimate of the variance is used as the weight (Woodridge, 2018). The results of the WLS method show that the statistical estimates with the OLS method do not change when they are estimated with the WLS method instead. The coefficients of the variables with the WLS method are very close to those with the OLS method. This indicates that the OLS estimates are robust.

The results of estimation with alternative methods are shown in Table 5. The results are robust with the alternative estimation methods.

Table 5: Robust test – alternative estimation with GLM and WLS

Dependent variable: #exits/# investments				
	(1)		(2)	
VARIABLES	GLM	z-value	WLS	t-value
Main explanatory variables				
Financial Capital Allocation				
$Asset/#PC_ALOC	-0.031**	-2.44	-0.027**	-2.14
$DryPowser/$Asset_Resv	0.152***	4.72	0.150***	4.03

Human Capital Allocation				
#Deal/#PC_Clust	0.004**	2.30	0.007***	2.75
#CoInvestor/#PC_Clust	0.006**	2.23	0.005***	3.15
$Deal/#CoInvestor_COMT	0.066***	3.02	0.050**	2.28
Control variables				
Business Environment				
MKT_Mature	0.031**	2.29	0.021	1.31
Bus_Center_Mature	0.062***	3.47	0.076***	3.39
Main investment strategy				
PEStrategy_VC_Only	-0.069***	4.49	0.091***	4.36
Focus_Late_Stage	-0.076**	2.43	0.071***	3.55
Follow-on_Investment	0.037**	2.31	0.047***	2.85
Focus_Industry_HiTech	0.050***	3.08	0.049***	3.16
FME's Characteristics				
FME_Age	0.007***	7.08	0.005***	8.25
Constant	0.160	1.27	0.122	0.95
Observations	386		386	
R^2			0.435	
VIF			1.32	

*** p<0.01, ** p<0.05, * p<0.1

The data were collected mainly based on self-reported data from the venture capital entities. Other sources of the data are the data collected by the employees of Preqin from open sources such as online publications and media. How well those preset variables can be good proxies of the constructs that this study wants to measure need to be further examined. To ensure the validity of the constructs, we constructed alternative dependent and independent variables to test the validity of my constructs. In the original OLS model, the dependent variable is measure by the exit rate regarding number of investments. It manifests the performance of FMEs with regards to their investment. Alternatively, an exit rate based on the number of PCs under the management of the FMEs is meaningful in that PC is the unit of exit. FMEs may have

several investments in one PC, but there is one exit of that PC. The alternative dependent variable is constructed as the exit rate with regards to the number of PCs under the management of the FMEs (denoted as #exits/# PCs). It is calculated by dividing the total number of exits of a FME with the total number of PCs under the management of the same FME. There are several candidates of independent variables to construct alternative independent variable. This study creates a new construct for the variable that examines the allocation of extrinsic human capital. Both the number of investments and the number of deals represent the intensity of contact between the FME, therefore investors and co-investors related to the specific activities, and the PC. They are similar activities that attract the interest of the venture capitalists and characterized as flow of human capital together with financial capital. This study creates the alternative construct investment clustering to replace the construct deal clustering (denoted as #Investment/#PC_Clust). It is calculated by dividing the total number of investments a FME made with the total number of PCs under the management of that FME. We replaced the corresponding variables in OLS model respectively. The result is shown in Table 6 through Table 8. The results show that all the coefficients of the explanatory variables keep robust with the changes of the independent and dependent variables.

Table 6: Robust test – alternative dependent variable

VARIABLES	#exits/# PCs	
	Coef.	t-statistic
Main explanatory variables		
Financial Capital Allocation		
$Asset/#PC_ALOC	-0.045***	-3.72
$DryPowser/$Asset_Resv	0.155***	4.41

Human Capital Allocation		
#Deal/#PC_Clust	0.005**	2.50
#CoInvestor/#PC_Clust	0.008***	3.80
$Deal/#CoInvestor_COMT	0.137***	6.38
Control variables		
Business Environment		
MKT_Mature	0.030*	1.95
Bus_Center_Mature	0.074***	3.27
Main investment strategy		
PEStrategy_VC_Only	0.027	1.55
Focus_Late_Stage	0.044	1.48
Follow-on_Investment	-0.002	-0.09
Focus_Industry_HiTech	0.050***	3.03
FME's Characteristics		
FME_Age	0.008***	11.10
Constant	0.214	1.70
Observations	386	
R-squared	0.578	
VIF	1.35	

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Robust test – alternative independent variable

VARIABLES	#exits/# investments	
	Coef.	t-statistic
Main explanatory variables		
Financial Capital Allocation		
$Asset/#PC_ALOC	-0.029**	-2.69
$DryPowser/$Asset_Resv	0.148***	4.69
Human Capital Allocation		
#Investment/#PC_Clust	0.005***	2.67
#CoInvestor/#PC_Clust	0.006***	2.85
$Deal/#CoInvestor_COMT	0.072***	3.97
Control variables		
Business Environment		
MKT_Mature	0.028**	2.00
Bus_Center_Mature	0.064***	3.18

Main investment strategy		
PEStrategy_VC_Only	0.067***	4.23
Focus_Late_Stage	0.073***	2.76
Follow-on_Investment	0.037**	2.45
Focus_Industry_HiTech	0.049***	3.29
FME's Characteristics		
FME_Age	0.006***	9.28
Constant	0.142	1.26
Observations	386	
R-squared	0.512	
VIF	1.32	

*** p<0.01, ** p<0.05, * p<0.1

Table 8:Robust test – alternative dependent variable and alternative independent variable

VARIABLES	#exits/# PCs	
	Coef.	t-statistic
Main explanatory variables		
Financial Capital Allocation		
$Asset/#PC_ALOC	-0.027***	-2.84
$DryPowser/$Asset_Resv	0.130***	4.84
Human Capital Allocation		
#Investment/#PC_Clust	0.026***	16.72
#CoInvestor/#PC_Clust	0.006***	3.66
$Deal/#CoInvestor_COMT	0.095***	6.13
Control variables		
Business Environment		
MKT_Mature	0.020*	1.69
Bus_Center_Mature	0.070***	4.06
Main investment strategy		
PEStrategy_VC_Only	0.024*	1.79
Focus_Late_Stage	0.047**	2.07
Follow-on_Investment	0.008	0.62
Focus_Industry_HiTech	0.046***	3.64
FME's Characteristics		
FME_Age	0.007***	11.72
Constant	0.045	0.46
Observations	386	

R-squared	0.755
VIF	1.32

*** p<0.01, ** p<0.05, * p<0.1

Another concern for my regression analysis is about the validity of the specification. We examine how the baseline regression coefficient estimates behave when the regression specification is modified. If the coefficients are plausible and robust, this is commonly interpreted as evidence of structural validity. To address the issue of model uncertainty, following the method of adding or removing regressors (Lu & White, 2014), we include two other variables that may affect the performance of FME into the OLS model to compare the plausible alternative model with the baseline model of OLS (Young, 2018; Young & Holsteen, 2016). One is gender (Gompers et al., 2021; Calder-Wang & Gompers, 2021), the other is ethnic group (Iqbal et al., 1999; Elyasiani & Mehdian, 1992). The results shown in Table 9 below show that the new model does not change the conclusion of the key estimates of the OLS model.

Table 9: Robust test – alternative model specification (additional independent variables)

Dependent variable: #exits/# investments				
	Original model		Alternative model	
	Coef.	t-value	Coef.	t-vale
Additional independent variables				
Female_Owner			-0.016	-0.58
Minority_Owner			0.024	0.76
Main explanatory variables				
Financial Capital Allocation				
$Asset/#PC_ALOC	-0.031**	-2.41	-0.031**	-2.43
$DryPowser/$Asset_Resv	0.152***	4.65	0.153***	4.68
Human Capital Allocation				

#Investment/#PC_Clust	0.004**	2.26	0.004**	2.27
#CoInvestor/#PC_Clust	0.006**	2.19	0.006**	2.18
$Deal/#CoInvestor_COMT	0.066***	2.97	0.065***	2.92
Control variables				
Business Environment				
MKT_Mature	0.031**	2.25	0.031**	2.33
Bus_Center_Mature	0.062***	3.41	0.062***	3.38
Main investment strategy				
PEStrategy_VC_Only	0.069***	4.42	0.069***	4.43
Focus_Late_Stage	0.076**	2.39	0.076**	2.41
Follow-on_Investment	0.037**	2.28	0.036**	2.16
Focus_Industry_HiTech	0.050***	3.04	0.051***	3.08
FME's Characteristics				
FME_Age	0.007***	6.97	0.007***	6.89
Constant	0.160	1.25	0.164	1.29
Observations	386		386	
R-squared	0.509		0.510	
VIF	1.35		1.31	

*** p<0.01, ** p<0.05, * p<0.1

In summary, capital allocation is important for improving the performance of FME. Capital allocation in venture capital investment include the financial capital allocation and human capital allocation. They are allocated to the PCs – the products of the venture capital industry- to facilitate the development of the PCs. The process of capital allocation is a process of capital leveraging and channeling. The flowing of both the financial capital and human capital in this process amplifies the financial capital and optimizes the capital allocation to generate better performance. The capital allocation is embodied in the activities of the venture capitalists, including their investment pattern, attention, and devotion. Their activities eventually shape into five drivers of performance of venture capitalists at the FME level. The empirical test show that those drivers have statistically significant relationship with the performance of FME. The

amount of financial capital allocated to individual PC is negatively related to FME's performance, indicating the requirement of larger capital leveraging. The dry powder reserve rate is positively related to the FME's performance, indicating the reward to prudence and flexibility of investment. The deal or investment clustering reflects the intrinsic human capital allocation, including experience, reputation, attention, commitment, etc. They are positively associated with the FME's performance. The clustering of Co-investor and the amount of money committed by the individual Co-invest manifest the quantity and quality of the extrinsic human capital of the FME. Both of them are positively related to the performance of FME. The results of the empirical analysis were supported by robust checks with alternative estimation methods, alternative variables, and alternative model specifications.