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HOW MUCH DO THEY MAKE BY JUST STANDING THERE? DEAL FLOW ALLOCATION AS A STRUCTURAL DETERMINANT OF VC PERFORMANCE



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ABSTRACT

This study suggests a theoretical complement to thus far proposed explanations of disproportionate returns in the venture capital industry. Departing from a focus on firm-specific resources, we develop a model and simulate a process of hierarchical market allocation, in which the most promising ventures are allocated to venture capital firms (VCFs) in the order of a generally shared criterion, such as reputation, status, or expected value of VCF's contribution to venture. The second part of the study tests proposed relationships from the simulation on a sample of 227 US early stage VC funds. The findings suggest that the mechanism of hierarchical market allocation is a significant driver of systemic differences in VCFs' performance. Importantly, this effect is not specific to characteristics of any individual VCF, but to the VCF's position in the hierarchy. Both simulation and empirical findings show that performance of the VCF is curvilinearly related to the position in hierarchy: the higher up the VCF moves in the hierarchy, the higher the marginal effect on performance.

INTRODUCTION

Venture capital markets are often described as opaque and fraught with uncertainty (Hochberg, Ljungqvist & Lu, 2007). Not only do venture capital firms (VCFs) conduct deep due diligence on entrepreneurial ventures to reduce the information asymmetry in their deals, but equally, the quality of the VCFs themselves is not an easy task to assess (Dimov & Milanov, 2010; Podolny, 2001). In that sense, multiple studies have shown that audiences evaluate VCFs' quality by observing different signals, most commonly represented by VCFs' reputation and status. Indeed, good reputation and high status are known to appeal to a range of audiences: prospective syndicate partners (Dimov & Milanov, 2010), limited partners who provide the funds (Bothner et al. 2010.; Gompers, 1996), as well as entrepreneurial ventures seeking investments (Fund et al., 2008; Hsu, 2004).

Consistent with many other fields, the literature on VCF performance has long recognized the self-reinforcing relationship between quality signals and performance (Seppa & Jääskeläinen, 2002). However, the phenomenon of how and why well-performing VCFs might continue on this trajectory (or the 'rich getting richer' phenomenon) has insofar been explained by looking at the isolated effects of quality signals, while only implicitly assuming the resulting behaviors of signal receivers – the perception-holders - that are expected to contribute to the returns of focal actors. Motivated by this observation, in this research we explicitly account for one such mechanism that operates in signal-imbued markets and in doing so answer the call for better understanding of the mechanisms that operate behind potential cumulative advantages of preferential signals of quality (Di Prete & Eirich, 2006)

The general mechanism we propose is motivated by the premise that the investigation of assumed positive effects of audiences' perceptions for the focal actors' returns should not be divorced from audiences' resulting *behaviors* as informed by such perceptions. Translated to the VC context, the reasoning that new ventures are more attracted to obtain the backing of highly regarded VC firms - which in turn gain privileged access to the most promising deals - is occasionally encountered in literature (Fund et al., 2008; Hsu, 2004, Sorensen, 2007), yet the full richness of this mechanism for the systematic consequences on VC returns – especially as observed on an industry level - has not been exploited.

In this paper, in agreement with above mentioned evidence (Fund et al., 2008; Hsu, 2004; Sorensen, 2007), we argue that VC markets are characterized by a hierarchical market allocation process, where ventures, based on shared criteria and perceptions of VCF quality, tend to prefer higher ranked VCFs over others. We use a simulation of the theoretical model to examine the emergent consequences of the proposed hierarchical allocation process. We envision a VC market characterized by 1) a supply of ventures seeking VCFs to provide services that enhance their value and 2) syndicate formation between VCFs as they provide services to the ventures. We assume that ventures choose VCFs based on their perceived contribution to the value of the venture and other VCFs choose their partners based on the same perceived contribution. The results of the simulation allow us to propose a systemic effect of hierarchical allocation that leads to *disproportionate* rewards for highly positioned actors, which we confirm with an empirical test using the realized returns of 227 US venture capital funds.

The results of this study contribute to literatures in venture capital and economic sociology of markets. For VC literature, we propose that a significant source of performance is tied to the *positions* in the emergent hierarchy rather than to VCFs themselves or their isolated characteristics. Accordingly, we introduce an instance of structural determinants of performance, which future literature may advance by addressing other criteria that may result in systemic processes found in VC markets. Second, we contribute to the literature on the economic sociology of market dynamics by reconciling some of the standing problems regarding the relationships between status, reputation and quality. By conceptualizing quality perceptions in terms of a firm's relative position in *any* hierarchy relevant to opportunity allocation, we are able to isolate one important mechanism in their influence on returns – one that transcends the definition of an 'absolute construct' such as status or reputation, and directly accounts for the otherwise assumed underlying hierarchy and relativity of the position. Finally, we show that even under conditions of perfect information, the mere existence of any kind of shared selection preferences creates conditions for disproportional rewards for the relative positioning of organizations within a hierarchy. Thus, we demonstrate that the positional rents are partly a property of the hierarchical ordering within the industry, regardless of whether the hierarchy is based on true quality, or its signals as represented by perceptions of performance and social standing.

HIERARCHY IN THE VC INDUSTRY

Entrepreneurial ventures seeking capital are often advised that “it is far more important *whose* money you get than how much you get” (Bygrave and Timmons, 1992:208). Indeed as financial capital *per se* is not a differentiated good, entrepreneurship scholars devoted substantial efforts to identify the attributes that help differentiate VCFs and accordingly explain differences in their performance. While these efforts distinguished a range of important attributes, ranging from human capital (e.g. Dimov & Shepherd, 2005) to investment strategies (Dimov & DeClerq, 2006;

Jääskeläinen, Maula & Seppa, 2006), two dominant streams of literature have formed around the signals that may reduce some of the uncertainties in evaluating the VCF's quality, as represented by status and reputation.

Literature on VC reputation is rooted in economics and argues that a firm's prior actions and performance act as strong signals from which the VCF's future performance may be gauged (Lee, Jin & Pollock, 2011; Dimov & Milanov, 2010). Formally defined, reputation is a "perceptual representation of a company's past actions and future prospects that describe the firm's overall appeal to all its key constituents when compared to other leading rivals" (Fombrun, 1996: 72). Hence, the value of VCF's reputation cannot be divorced from audiences' perceptions and their recognition of a firm's quality of past outputs. Arguing from the sociology perspective, another stream established social status as a central signal to mitigate uncertainty. While mostly agreeing on the definition that status is a positional element of the social structure which gives an "effective claim to social esteem in terms of positive or negative privileges" (Weber, 1978: 305), literature is somewhat divided on the origin of status signals. One set, including advocates of signaling theory (Spence, 1974) starts with the mindset of rational choice and assumes that status is tightly coupled with actor's underlying quality, where its value increases with inaccessibility of relevant information about the actors' true quality (Podolny, 2001; Spence, 1974). The second set follows a more constructivist approach in assuming that there is no implied relation between status and underlying quality, and that status hierarchy is instead based on the logic of deference from other high status actors. While the sources of this deference are rarely discussed, this stream implies that status and its benefits are potentially unearned (Washington & Zajac, 2004), stemming from historical legacy of once acquired status positions. In the VC context, it was observed that initial status positions were formed in the times when venture capital was provided by wealthy families to the VC industry and that this historical sense of status hierarchy prevailed among the modern VCFs (Gompers, 1995).

Despite apparent differences in above noteworthy efforts to understand the sources of signals in resolving quality-related uncertainties, there are some commonalities in their approaches which may in turn help reconcile some of the inherent tensions in the literature. First, despite their differing views regarding the relationship of actual quality and its signals, both status and reputation literatures emphasize the importance of information opacity in determining the returns to these signals of quality. Hence, if we are able to vary the level of information available on actors' true quality, we can begin to understand whether and to what extent status and reputation considerations become obsolete – or in contrast - still have some role in determining a VCF's returns. Second, studies of reputation and status either implicitly assume (e.g. Dimov & Milanov, 2010) or explicitly state (Podolny, 2001; Lee et al., 2011) that the desirability of the focal actor will be determined by its *relative* standing or rank in the industry, thus implying the existence of a status- (Podolny, 2001) or reputation-based (Fombrun, 1996) hierarchy. Indeed, by broadly conceptualizing the hierarchy as an implicit rank-order of organizations with respect to a valued social dimension (c.f. Magee & Galinsky, 2008) (be it reputation or status), we can begin to appreciate some of the commonalities in the apparently different traditions discussing quality signals.

In this paper, we seek to make a theoretical step towards better understanding the nature of the relationship between hierarchical positions based on varied signals of quality and the rewards derived from holding these positions. Rather than building on the differences of dominant approaches, we leverage on their commonality: both streams agree on the importance of a hierarchy as a result of differing preferences towards actors occupying positions in it. This focus

in turn enables us to focus on one important function of a hierarchy: the role it plays in the opportunity allocation (Magee & Galinsky, 2008). In the venture capital context, an important aspect of opportunities is reflected in the deal-flow that VCFs have access to (Sorensen, 2007). Our focus on the role of hierarchy in opportunity allocation in the VC context is supported by anecdotal evidence and empirical findings. For example, scholars suggested that ventures are expected to prefer high status VCFs (Fund et al., 2008) and that entrepreneurs may be more likely to present their business plans to highly networked incumbents (Hochberg, Ljungqvist & Lu 2010). Similarly, we have empirical evidence demonstrating ventures' preference for reputable (Hsu, 2004) and experienced (Sorensen, 2007) VCFs. While these studies point to the advantages of experience, reputation and status for individual VCFs, their suggestions also allow us to speculate that what broadly matters in understanding VCFs' returns above and beyond their individual attributes are the *positions* they occupy in the industry hierarchy. Hence, explicitly modeling audiences' preferences towards hierarchically higher positioned actors (rather than assuming their perceptions) might help us to reveal systemic effects that shape the returns of VC industry members and allow us to better understand the nature of this effect. In what follows, we develop an argument that the significance of organizational reputation and status at least in part stems from the emergent process of hierarchical opportunity allocation.

MODEL OF HIERARCHICAL ALLOCATION OF OPPORTUNITIES

The central argument advanced in this paper is that a hierarchical opportunity allocation emerges whenever audiences have some shared criterion of judgment in evaluating actors. The existence of a shared criterion leads to a situation where audiences will prefer same actors, which then rank high when opportunities are allocated. The evaluation criterion may be based on social, economic, or psychological motivations of relevant audience, but the important condition is that we assume that audiences agree on a criterion as a key concern that affects their selection of available partners, resource provisions, or opportunity allocation. In the context of venture capital, the relevant audiences are the ventures that choose VCFs as prospective investors, and the venture capital firms themselves, as they choose among prospective syndicate partners¹.

In order to link our argument to the existing studies looking at the effects of perceptions of organizations on allocation of rewards, we consider a situation where the key criterion is based on the perceived value of the choice outcome. Accordingly, we consider a context with a supply of ventures seeking VCFs to provide services that enhance ventures' own value. Ventures will hierarchically choose VCFs based on the highest perceived quality of the VCF. Similarly to ventures, VCFs choose their syndicate partners based on the same logic: prospective partner's perceived contribution to add value to jointly financed ventures. In short, each venture and VCF aims to choose what they perceive as the highest value added VCF.

The selection of highest value-adding VCF is based on the audience's perceptions regarding the VCF's ability to add value, denoted with Q_i . In essence, Q_i can be thought to measure the extent of correspondence of the actor to a contextually relevant criterion that is consequential to the performance of the project, such as capability of a venture capitalist to add value to a venture. Accordingly, if we denote a venture's value before engaging with a VCF as $V_{p,t=0}$, the quality of a VCF i , Q_i , is defined as its effect on the growth of the venture's value. For a given venture p , its terminal value $V_{p,T}$ as a stand-alone venture is defined by its intrinsic quality, Q_p , determining its internal growth rate². Depending on the quality of a VCF, venture's internal growth rate is increased by VCF i 's ability to add value to the venture, represented by Q_i . Formally,

$$V_{p,T} = (1 + Q_i) (1 + Q_p) V_{p,t=0} \tag{1}$$

To maximize its value, a venture aims to secure contribution from the VCF that adds the highest value, i.e., the VCF with highest Q_i . Accordingly, projects follow a selection rule of

$$\max(Q_i), \text{ where } i \in \{\text{available actors}\} \tag{2}$$

While the actual quality of a VCF is the key variable of interest for establishing the ranking that guides the ventures' and other VCFs' preferences, the assessment of the quality of a VCF i is affected by the level of observability of this quality, i.e. how transparent the contributions of the VCFs are to their ventures. If observability is less than perfect, the assessment of quality is only partially based on the actual quality Q_i . Rather, the assessment is augmented using an assessment of quality deduced from other observables, q^* . Using o to denote the observability of actual quality, the perceived quality is

$$q_i = o Q_i + (1 - o) q_i^* \tag{2}$$

Perceived quality is thus the function of actual quality and the deduced quality, weighted by the level of observability, as defined on the system (population of VCFs) level³. With perfect observability in the system ($o=1$) the perceived quality of a VCF is equal to its actual quality. If actual quality cannot be observed ($o=0$), the perceived quality is determined by the deduced quality q^* that is based on two proxies identified as important in the VC literature: 1) the perceived quality of a focal VCF's co-operation partners (as established in status literature) and 2) the VCF's past performance, as determined by the success of its past ventures (as established in reputation literature). We denote the relative influence of the two proxies, past performance and quality of partners, with variable s , and therefore the deduced quality

$$q_i^* = s q_{s,i} + (1 - s) q_{p,i} \tag{3}$$

Where $q_{s,i}$ is the structural component of quality signals deduced from the quality of partners and $q_{p,i}$ is the quality deduced from the VCF's past observable outputs. Combining the components of deduced quality (2) and (3), we have the formal description of relationships between the key concepts

$$q_i = oQ_i + (1 - o) (s q_{s,i} + (1 - s) q_{p,i}) \tag{4}$$

where $o,s \in [0,1]$, and Q_i , $q_{s,i}$ and $q_{p,i}$ are the median-scaled measures for actual quality, perceived quality deduced from structural partnerships, and perceived quality deduced from outputs.

Hierarchical allocation

The described search behavior effectively introduces the hierarchical allocation of ventures. Since the interest of the ventures is to maximize Q_i , we can hierarchically organize VCFs according to their intrinsic qualities. Thus, rather than observing the absolute level of quality, more consequential for the allocation process is the relative level, or the ranking within the preference hierarchy that corresponds to a certain quality level. To achieve a parsimonious model, we assume that rather than making comparisons on the level of intrinsic and deduced qualities, the audiences base their judgments specifically on the relative positioning of a VCF within each of the scales. The assumption of search behavior that seeks to maximize quality of VCF implies that as long as ventures are able to rank VCFs, the differences between the actual levels of quality are consequential only in so far as they help in creating the hierarchy. Accordingly, we model the allocation process as

$$R(q_i) = R(oQ_i) + (1 - o) (s R(q_{s,i}) + (1 - s) R(q_{p,i})) \quad (5)$$

where R is a ranking function that produces a vector of integers indicating the ordered position of values of the argument. The position of a VCF in the allocation hierarchy is determined as a linear combination of its position in the hierarchies of intrinsic quality, structural positioning and relative performance.

To formalize the structural proxy for quality, let a_{ij} denote the association between VCFs i and j . Then the perceived quality deduced from the associations of a VCF i , $q_{s,i}$ is defined as the weighted average of the perceived qualities of the VCFs it has associations with. The VCF's perceived quality at time t , $q_{s,i,t}$ is based on the perceived quality of its partners in time $t-1$:

$$q_{s,i,t} = \sum_{j=1}^n a_{ij} q_{j,t-1} \quad (6)$$

where n is the number of actors that the focal actor partners with, and a_{ij} equals zero when $i=j$. The perceived quality of VCF i is therefore higher, the higher the perceived quality of the VCFs it has relationships with (Gould, 2002; Lynn et al., 2009).

The second proxy for actual quality, the quality deduced from the outputs of the VCF i , $q_{p,i}$ is defined as relative performance of the projects undertaken by VCF i with respect to all realized projects by all VCFs. The relative performance is measured as the degree to which the ventures of VCF i have exceeded or failed to match the outcomes of the average realized venture in the system. As we assume ventures to start as equal sized, we express VCF i 's deduced quality from outputs, $q_{p,i}$ in terms of average growth of the VCF's ventures. If M_t is the set of all realized ventures at time t , and $M_{i,t}$ is the set of VCF i 's realized ventures, then:

$$q_{p,i,t} = \frac{\sum_{k \in M_{i,t-1}} V_{T,k} / N}{\mu_{1/2}(V_{T,k \in M_t})} \quad (7)$$

where N is the number of the realized ventures of VCF i at time $t-1$ and $V_{T,k}$ is the terminal value of each venture k belonging to sets $M_{i,t}$ or M_t .

Model dynamics

The estimation of perceived quality forms the basis of allocation process. We simulate this allocation process using a number of simulation trials modeling the selection and allocation process of a group of actors. On each round of a trial consists of three separate steps. First, a set of ventures is generated. We assume a venture-rich context where the supply of ventures does not restrict allocation, and accordingly set the ratio of new ventures to VCFs to be 10:1. Effectively, as the quality of ventures is normally distributed with a mean of one, the ventures undertaken represent the right tail of the quality distribution.

In the second step, the ventures approach VCFs in the order of the perceived quality of the VCFs, that is, each venture follows a selection rule (2)⁴. In each round each of the VCFs is able to engage in only one venture. If the venture meets the required level of quality, the VCF undertakes the venture and seeks other VCFs to co-manage it⁵. Ventures that have not found a VCF willing to take it, move lower in the hierarchy, until a VCF with a low enough criterion is found. If no VCF is willing to take the venture, the venture leaves the simulation. After an investment decision,

VCFs seek co-managers in a similar manner: approaching the other VCFs in the order of perceived qualities, and correspondingly, these VCFs compare the expected payoffs of offered ventures to those that approach them directly⁶. If reservation quality is met, VCFs engage in the project as co-managers or syndicate partners. We assume that each VCF seeks two other syndicate partners to co-manage investments.

In the final step, we record the outcomes of past ventures. We assume that investment length equals one round of simulation, that is, ventures undertaken in round $t-1$ are completed in round t . This final step is then completed by updating the existing co-operation relationships and recent investment performance of VCFs. We assume that information for both the co-operation relationships, output performance, and qualities of observed ventures remains recorded in a memory equaling five rounds of simulation. After this, information is discarded. As a consequence, if a VCF due to high reservation quality does not invest in a given round, the assessments of its performance and relationships remain reasonably stable until the next round. We run a trial for 100 rounds, after which we stop the simulation and calculate the output measures. The appropriate length of trial was determined by observing the allocation processes in preliminary trials. If hierarchies stabilized, this happened systematically before the 50th round. The key parameters of the model are summarized in Table 1.

SIMULATION RESULTS

Effects of hierarchical allocation on reward distribution

The core interest of this paper is to examine how the hierarchical allocation process affects the distribution of rewards and to examine whether high hierarchical positions lead to disproportional rewards. The distribution of rewards under hierarchical allocation is measured by the cumulative returns on VCFs' projects. To examine the effect of hierarchical allocation, we start with a situation where all actors and projects have perfect information ($\sigma=1$). We contrast its observed effects on distribution of rewards with the same effect obtained under the conditions of purely random allocation. With random allocation, all VCFs have on average equally distributed venture portfolio with respect to the quality of ventures, meaning that differences in rewards stem solely from the differences in VCF qualities. That is, under random allocation process, given (1), the magnitude of rewards, R , is a linear function of the quality q , $R=aq$, where a is a constant. Should the hierarchical allocation affect the distribution of rewards, we should observe that the simulated reward distribution deviates from the proportional rewards of random allocation.

Figure 1 presents the results from two simulations with identical VCFs, where one simulation is based on random allocation and the other on hierarchical allocation of projects. When compared to random allocation, the introduction of hierarchical allocation of projects produces significant disproportionality in the distribution of rewards. A marginal increase in hierarchical position leads to larger increase in rewards, the higher the position. Given that the simulated VCFs and thereby their positions in the hierarchy are identical in both simulations, the increased performance of VCFs positioned high in the hierarchy can be attributed solely to the allocation of projects. Furthermore, it appears that at the higher end of the hierarchy, the distribution effect of hierarchy has a substantial effect on actor performance when compared to the effects of quality alone. Within simulation, the cumulative performance of highest ranking actors is nearly 2.5 times greater within hierarchical than in random allocation.

Prevalence of hierarchy effects with varying conditions

A significant aspect of the above results is that the hierarchy and its effects emerge even if all actors make perfectly informed decisions. These decisions do not rely on proxy information, and thus there is no perception-amplifying feedback effect that would introduce conditions for cumulative advantage⁷. The decisions are based on the perfectly observed intrinsic VCFs' qualities, and consequently the effects on reward distribution are solely driven by the emergent hierarchical allocation resulting from shared preferences. The next question then is to understand the extent to which these effects prevail when we depart from the assumption of perfect information, and how do the underlying assumptions regarding the attention given to respective quality signals affect the results.

To test whether the hierarchy emerges without perfect information, we vary the level of observability ($o < 1$), and also examine how the distribution of rewards is influenced by the roles of shifting weights between structural and output proxies (s) on a plane demarcated by o - s dimensions. We compare the effects by using an index to depict the magnitude of return dispersion, i.e., how disproportional the return distribution is. We define this dispersion index as the magnitude of deviance from proportional distribution. If $f(q)$ is a hypothetical linear rewards function for which the $f(q_{\min}) = R_{\min}$ and $f(q_{\max}) = R_{\max}$, and $f^*(q)$ is the actual observed rewards function, the dispersion measure, D , for the magnitude of departure of f^* from hypothetical f is defined as

$$D = 1 - \frac{\int_{q_{\min}}^{q_{\max}} f^* dq}{\int_{q_{\min}}^{q_{\max}} f dq} \quad (8)$$

For proportional rewards $D=0$ and for a case where all rewards are taken by a single actor, $D=1$. In figure 1, the dashed line above the results of hierarchical allocation process depicts the linear comparison against which the dispersion of hierarchical allocation, $D=0.32$, is measured.

The results of these analyses are presented in Figure 2. In the figure, observability is represented on the left horizontal axis and the proxy weight (structure vs. output) on the right horizontal axis. The vertical axis graphs the value of dispersion index D . The figure illustrates, that the relative weights of quality proxies have no effect on the results as long as we assume perfect observability of actual quality. However, when we relax this assumption, and move towards the low observability, the proxies gain increasing influence on the perceived quality. If we assume that the lack of observability is compensated by relying on the observed outputs as a proxy for value that actor adds to a project ($s=0$), it appears that dispersion index remains nearly constant until observability is reduced to minimal levels. However, should the lack of information be based on the assessment of structural proxy, the dispersion index decreases with lack of observability and is ultimately reduced to zero, ($o=0, s=1$). Given that dispersion index for distribution of rewards is highest when the priority in opportunity allocation is awarded consistently to same actors, near to zero dispersion suggests that relying only on structural proxy makes allocation more random. This does not exclude the possibility that stable hierarchies could not emerge when observability is zero, it merely points that if social judgment is based on quality, and there is no information regarding quality, the decisions become more random.

EMPIRICAL STUDY

The purpose of the empirical part is to examine whether the curvilinear relationship between position and rewards observed in the simulation results is also observable in an empirical context. We use a sample of US VC funds and examine the fund performance with respect to the hierarchical positioning in the markets. The key assumption of the model is that the ventures share the criteria that they use to assess the actors. Therefore, we include only funds that are 1) managed by private and independent venture capital firms 2) and have made at least 50% of their investment in venture capital stage, and 3) have more than three investments. In total, the sample includes 227 US VC funds from 1986-2004 that were either established prior to 1997 or have been liquidated prior to June 2008 when data is collected. We use Thomson VentureXpert database to observe the investment activity of funds (e.g. Hochberg et al., 2007) and Private Equity Intelligence database (the world's most extensive and transparent database of VC fund returns) to acquire the IRR data for the funds (e.g. Lerner, Schoar & Wongsunwai, 2007).

Variables

Rewards / Performance. To measure the VCFs' aggregated rewards we used realized net internal rate of return (IRR) of VC funds. As a measure of fund performance, it captures the aggregated profits of multiple investments, and readily corresponds to the outcome variable used in the simulations.

Position. To operationalize the hierarchical position of VCF within the markets, we draw from the existing measures for VCFs' reputation and status. The measures reflect the two main components of social evaluation, reputation capturing the relative performance of firms and status capturing the relative inter-organizational positioning based on affiliation (syndication) with other VCFs. For reputation, we follow Dimov et al. (2007) and use a composite measure consisting of firms' age, cumulative number of investment targets, and the cumulative number of IPOs, each measured at the time of starting year of the fund. We operationalize VCF status consistent with prior literature using Bonacich's (1987) centrality measure that captures the focal VCF's centrality in the overall industry syndicate network (Hochberg et al. 2007, Podolny 2001). We construct the network using the investments the VCF has done within a window of three years, the last year being the focal year. To relate the firm-level measures of reputation and status to fund-level performance, we calculate the measures for the starting year of the fund, thereby capturing the positioning of the firm as it starts to invest the funds. The reported results are based on this approach. We also checked the robustness of the results with respect to potential changes in the firms' positions during their investment windows and the results did not change.

Control variables

To control for unobserved heterogeneity and alternative explanations, we included an array of control variables standard in the literature. First, we controlled for funds' investment specialization in three dimensions: stage, industry, and geography (Dimov & DeClercq, 2006). Following prior literature, each specialization was calculated as a Herfindahl index based on the classification of funds' investments as recorded in the VentureXpert database. In addition we controlled for the percentages of investments in different investment stages, industries and areas (1) *share of early stage* investments (seed + start up + other early stage investments divided by total investments). (2) percentages of portfolio companies in different industry classes according to the VentureXpert database (*biotechnology, communications, computer-related, medical, semiconductors* and *non high technology*) where non-high technology was left out as the reference group, (3) shares of investments

made in the two largest markets in US, *California* and *Massachusetts*. We also controlled for the *fund size*. Finally, we control for time dependency with fund vintage *year dummies* for 1987-1996 with the year 1986 as the base category.

Analytical methods

We observed 735 US VC funds corresponding to our sample criteria, 227 of which we are able to associate with reliable IRR information. In our regression analyses we used Heckman selection model (Heckman 1979) to control for potential biases in the availability of IRR measures in our data. In the selection equation predicting the availability of IRR information, we controlled for the number of preceding funds by the VC management firm and the vintage decade.

Results

We test the predicted pattern of progressively increasing returns for high hierarchical position by regressing IRR on squared terms of status and reputation, respectively. Table 2 presents the results of the regressions, with Models 1-7 corresponding to polynomial models. Model 1 presents the base model including only the control variables.

Models 2-4 and 5-6 present the results of second-order models with status- and reputation-based proxies for the VCF positioning in the preference hierarchy. Both sets of models present similar results. Linear effects (Models 2 and 5) are positive and statistically significant, and the squared terms are likewise positive, significant, and present a better fit. However, when both first- and second order terms are included (Models 4 and 7) neither of the terms are statistically significant, though the estimated pattern coincides with the results of the simulation. To further probe the nature of the effect, we probed the exponential functional relationship, with a logarithmic transformation of IRR as the dependent variable. Results are shown in Models 8-10 that present alternative formulation of the expected, non-linear pattern, and regress the logarithmically transformed IRR on the covariates. Both the status-based and the reputation-based proxies are statistically significant and positive, indicating that the returns are increasingly higher, the higher the measures for reputation and status. This alternative specification better approximates the theoretical model, as the empirical findings conform to the predicted relationship between hierarchical position and the rewards.

DISCUSSION

This research was motivated by the observed lack of explicitness regarding the mechanisms that underlie the observed relationships between recognized and important signals of quality – such as status and reputation – with the returns of VCFs. Using a simulation, we were first able to explicitly model the behaviors of perception-holders – new ventures seeking investments – and assuming that there exists one common and relevant criterion in evaluating VCFs, illustrate the mechanism of hierarchical opportunity allocation where VCFs are sorted in a hierarchy of positions and accordingly afforded investment opportunities. Together, our simulation and empirical results carry a number of implications for research in venture capital and economic sociology.

First, by proposing a model of hierarchical market allocation, we provide a theoretical explanation for the *systemic* performance effect in VC industry. While echoing findings that more experienced VCFs get higher quality deal-flows and their IPO likelihood benefit from such a sorting mechanism (Sorenson, 2007), importantly, our model more broadly shows that this effect is not specific to characteristics of any individual VC, but to the *position* itself. Furthermore, this

component appears to be disproportionately larger, the higher up the VC moves in the ladder. Specifically, our simulation results suggest that the magnitude of structural effect can be more than half of the returns for the upper end of hierarchy. Empirical results support this mechanism: after controlling for a series of individual VC attributes, we find disproportionate returns on VCFs' hierarchical positions, corresponding to those found in the simulation. For scholars interested in studying return consequences of quality signals, our research informs that focusing on isolated effects of status or reputation and attributing all return increases to absolute values of either of the respective constructs may be misleading. Indeed, our research emphasizes not only the importance of acknowledging the 'relative' rather than 'absolute' view of quality signals, but also the importance of accounting for the systemic effects lurking from the processes in the underlying hierarchy that such relative ranking produces on returns in the industry. Hence, we encourage scholars to account for the hierarchy and resulting opportunity allocation that might operate as a latent but important mechanism in all of the studies dealing with positional constructs in any kind of hierarchy, whether shaped by status, reputation, or other socially valued attributes.

Second, our results speaks directly to literatures in economic sociology and market dynamics. By manipulating level of quality observability, we were able to show that even if we assume all uncertainty away and imagine perfect transparency of actual quality, the differences between VCFs introduce the dispersion effect of hierarchical allocation. Hence, a key insight of the paper is the proposition that even with rational choice and perfect information, the overlapping of selection preferences creates conditions for *disproportional* rewards for the relative positioning of an organization within a hierarchy. Even in absence of deference or intrinsic value of status, the fact that organizations are ordered in terms of some widely shared relevant criteria such as the quality of their services, creates conditions that foster returns or rents on their position within this hierarchy. Thus, we demonstrate that the positional rents derived from hierarchical ordering of industries prevail even under fully rational choice and perfect information.

The results propose interesting avenues for further research. While in our model the reliance on only structural proxy resulted in random allocation due to lack of information on partners' performance, in many settings the quality-based assessment is likely to be replaced with some other criteria that produce a stable hierarchy. Thus, while rewards on position are always disproportional, under certain conditions when hierarchy is not based on contribution, they may become also unearned, as the VCFs' merits may become detached from the positions they hold. Furthermore, our results speak to the potential hidden value of different signals in markets characterized by different levels of uncertainty. Although a consistent finding in the literature is that signals of quality increase in their value under conditions of uncertainty, our results show that we might have been short-sighted in discounting the value of signals in conditions of higher information transparency, as they are still relevant to the extent that they produce a hierarchy and resulting systemic effects to organizational positions. Future research is invited to study a range of attributes and signals that might be considered relevant in shaping audiences' preferences and accordingly serve as 'hierarchy-setting' attributes.

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NOTES

1. It could be argued that the criterion for determining preferences differs between two types of audience: the ventures and the VCFs as they choose syndicate partners. However, literature in venture capital shows that ventures and syndicate.
2. We assume that actors can evaluate the intrinsic quality of project Q_p without error, and this quality is unknown to other actors. We initially define Q_p to follow normal distribution with a mean of one and a standard deviation of one, that is, on average projects do not grow.
3. While we acknowledge that observability may also vary within the system (among actors), e.g. depending on their newness in the system, in the case of imperfect information and no track record the simulation makes an initial guess of the quality to match the median of observed qualities, thus partly mitigating the issue of liability of newness among actors.
4. In case of two or more actors with equal perceived quality, the order is randomized.
5. Depending on the position of the actor in the preference hierarchy of the projects, that is, the actor's relative perceived quality with respect to other actors, each actor observes a different set of prospective projects. Accordingly, the criterion for investment varies according to quality of project expected by each actor. The reservation quality, $Q_{R,i}$, of actor i is the lowest acceptable quality of project, and is a function of remaining investment period, remaining investment capacity, and the history of projects observed by the actor. The reservation quality is set to the level that is expected to match the remaining investment capacity to the number of future project proposals that exceed the set level of quality. Formally,

$$C = \frac{R(Q_p \geq Q_R)}{N_{obs}} VT$$

where C denotes the remaining investment capacity (in number of projects), Q_R is the reservation quality, R is function whose value matches the number of past projects with quality higher than Q_R , V is the observed number of proposals per round, and finally, T is the time until the end of budget window.

6. The decision rule is $Q_i Q_p > Q_k Q_p$, where Q_p is the quality of offered project p , Q_i is the quality of inviter, and Q_j is the quality of invitee. That is, if the expected value of the offered deal given the contribution of the lead investors exceeds what invitee is able to reach with a project matching the reservation quality, invitation is accepted.
7. Feedback loops represent one of the key explanatory mechanisms for observing cumulative advantage in much of the sociology literature (e.g. Merton, 1968).

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Table 1 Parameterization and key assumption of the simulation

Parameter	Parameter value / distribution
Number of VCF, n	30
Distribution of VCF quality	Equally distributed: range=[1,3], $\text{Exp}(Q_i)=2$
# projects VCF can undertake in 1 round	1 full project, syndicated projects count as 1/3 project
Projects generated / round	300
Distribution of project quality	$N(\text{Exp}(Q_p)=1, \sigma=1)$
Syndicate size	2

Figure 1 The effect of hierarchical allocation process ($\sigma=1, n=30$)

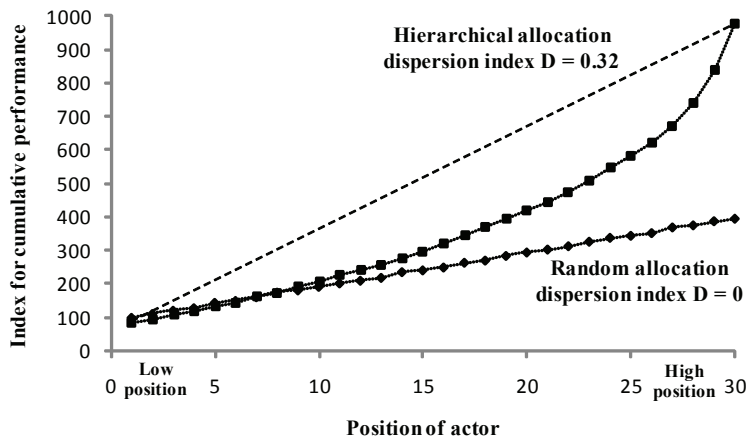
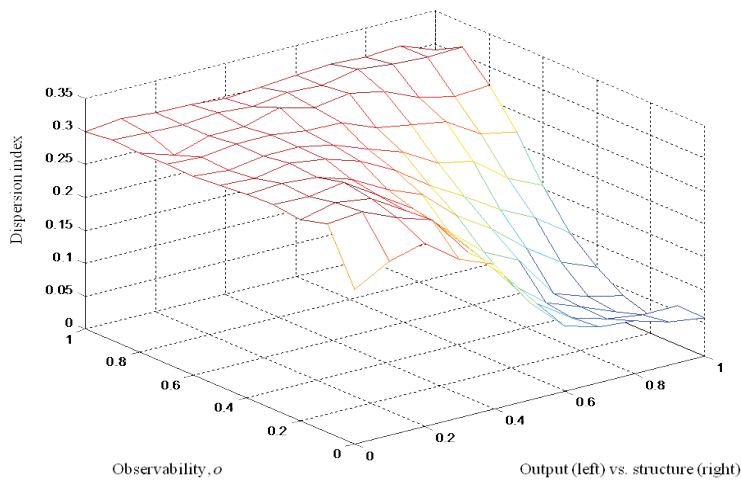


Figure 2 Dispersion index under different values of observability σ and structural proxy s



VENTURE CAPITAL

Table 2 Results of Heckman Regression

	Model 1	Model 2	Model 3	Net IRR (%)			Model 7	Model 8	Model 9	Model 10
Status		8.259 * (3.579)		-0.894 (8.417)					0.240 ** (.095)	
Status squared			1.453 ** (.558)	1.579 (1.316)						
Reputation					3.146 + (2.386)		1.087 (3.026)			0.147 ** (.061)
Reputation squared						0.422 * (.251)	0.351 (.320)			
Stage focus (Herfindahl)	-13.686 (30.430)	-3.319 (30.433)	-7.743 (30.092)	-8.347 (30.624)	-8.569 (33.080)	-12.468 (32.910)	-11.242 (33.070)	0.456 (.844)	0.772 (.841)	0.977 (.863)
Industry focus (Herfindahl)	-56.258 * (25.750)	-49.878 + (25.631)	-51.512 * (25.467)	-51.789 * (25.599)	-55.172 * (27.834)	-57.138 * (27.661)	-56.203 * (27.763)	-1.247 (.852)	-1.101 (.843)	-1.280 (.892)
Number of targets	0.162 (.221)	-0.171 (.262)	-0.219 (.262)	-0.216 (.263)	0.054 (.249)	0.084 (.242)	0.063 (.249)	0.008 (.006)	-0.002 (.007)	0.003 (.006)
Fund size (\$ millions)	-0.019 (.022)	-0.012 (.022)	-0.018 (.021)	-0.018 (.022)	-0.026 (.025)	-0.030 (.025)	-0.030 (.025)	0.000 (.001)	0.000 (.001)	-0.001 (.001)
Early stage investments (% of investments)	-2.963 (23.018)	-9.021 (22.923)	-12.836 (23.015)	-13.040 (23.094)	-4.381 (24.856)	-2.938 (24.732)	-3.625 (24.790)	0.261 (.641)	0.036 (.637)	-0.137 (.666)
California (% of investments)	23.085 ** (7.929)	23.030 ** (7.833)	24.642 ** (7.831)	24.784 ** (7.944)	20.929 * (8.838)	23.001 ** (8.605)	22.201 * (8.885)	0.422 * (.215)	0.436 * (.211)	0.382 + (.226)
Massachusetts (% of investments)	5.865 (8.391)	7.179 (8.319)	9.819 (8.411)	10.021 (8.624)	5.199 (9.121)	4.363 (9.106)	4.529 (9.112)	0.167 (.232)	0.211 (.229)	0.126 (.242)
Industry dummies					(Included in analyses, not shown)					
Year dummies					(Included in analyses, not shown)					
Constant	24.967 (34.969)	3.440 (35.558)	11.611 (34.587)	12.777 (36.291)	-8.630 (45.526)	-4.168 (40.988)	-11.193 (45.483)	1.863 * (.909)	1.327 (.912)	0.720 (1.139)
Observation	835.000	835.000	835.000	835.000	814.000	814.000	814.000	835.000	835.000	818.000
Wald	48.370	55.030	56.810	56.800	45.640	47.100	47.020	59.500	68.18	65.27
Prob	0.003	0.001	0.001	0.000	0.007	0.007	0.005	0.000	0.000	0.000