The Role of Management Quality in the IPOs of Venture-Backed Entrepreneurial Firms

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Abstract

We make use of hand-collected data on the quality and reputation of the management teams of a large sample of entrepreneurial firms going public to analyze the role of management quality on the IPOs of venture capital (VC)-backed firms for the first time in the literature. We hypothesize that management quality may affect a VC-backed firm's IPO characteristics and post-IPO operating performance through two channels: a "certification" channel, where firms with higher management quality face reduced information asymmetry in the IPO market, and therefore find it easier and cheaper to go public; and an "ability" channel, where firms with higher quality managements select better projects and implement them more ably, thus leading to better post-IPO operating performance. However, VC-backing may itself affect a firm's IPO, indirectly by affecting a firm's management quality, and directly through the above certification and ability channels. We therefore first study the effect of VC-backing on management quality, before analyzing the effect of both management quality and VC-backing (as well as the interaction between the two) on the IPO characteristics and post-IPO operating performance of VC-backed firms. Our empirical findings can be summarized as follows. First, in both our ordinary least squares regressions and our propensity score matching analyses, VC-backed firms are associated with higher management quality compared to non-VC-backed firms. Second, both management quality and VC-backing have a positive effect on a firm's IPO underwriter reputation, offer size, post-IPO analyst coverage, and post-IPO institutional equity holdings; and a negative effect on its age at IPO and its costs of going public. Third, management quality and VC-backing also have a positive effect on firm valuation, both in the IPO and in the immediate secondary market. Finally, both VC-backing and management quality are positively related to the changes in a firm's post-IPO operating performance. While VC-backing and management quality act as substitutes in their effect on a firm's IPO characteristics, they act as complements in their effect on a firm's IPO and secondary market valuation and its post-IPO operating performance.

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1. Introduction

The quality of a firm's management is widely used by venture capitalists (VC) and other practitioners in assessing that firm's viability in its early life. As the firm matures, it may attempt to add additional members to its management team, with varying degrees of success. One would expect to find considerable variation across firms in the strength of the management team they have built up by the time of going public. The quality and reputation of a firm's management team can affect its interactions with the IPO market in two important ways. First, management quality can have a certifying effect on firm value (the "certification channel" from now on): higher quality managers may be able to convey the intrinsic value of their firm more credibly to outsiders, thus reducing the information asymmetry facing their firm in the equity market. This reduction in information asymmetry, in turn, will affect various aspects of its IPO: e.g., its costs of going public.[1] Second, higher quality managers may be able to select better projects (characterized by a larger NPV for any given scale) for their firm and implement them more ably. Thus firms with higher quality managers can be expected to have better post-IPO operating performance, which may affect their IPO market valuations and other IPO characteristics (the "ability channel" from now on). However, the relationship between the quality and reputation of a VC-backed firm's management and various aspects of its IPO and its post-IPO performance has received relatively little attention in the literature. The objective of this paper is to remedy this gap by analyzing, for the first time, the role of management quality in the IPOs of VC-backed entrepreneurial firms.

[1] This certification effect can arise as follows. Senior members of a firm's management team build up reputational capital over their career. These senior managers are involved in repeated dealings with the financial market as part of their job (e.g., raising bank financing or arranging private placements of equity). Further, these managers know that there is a significant chance that they will leave their firm to join another (in other words, they have to interact with the labor market repeatedly) and that their future employer will be influenced by their reputation in dealing with the financial market in deciding whether or not to hire them, as well as in deciding their compensation package. Overpricing or ''hyping'' their firm's stock (or deceiving the financial market in other ways) may tarnish their personal reputation in the equity market, thereby diminishing their future value in the labor market. Thus, the greater the personal reputation managers have at stake, the greater is the future loss from mispricing their firm's equity. Therefore, managers of higher quality and reputation are more likely to price their firm's equity more fairly. For a theoretical model of how long-lived players associated with a firm's IPO can help to reduce the information asymmetry facing it in the equity market (and increase its IPO offer price), see Chemmanur and Fulghieri (1994).

The only paper in the existing literature to study the role of management quality in IPOs is Chemmanur and Paeglis (2005). That paper, however, studies only the IPOs of non-VC-backed firms. Analyzing the role of management quality in VC-backed firms is fundamentally different from studying its role in non-VC-backed firms for several reasons. First, VC-backing may itself affect management quality: one of the many ways in which VCs have been conjectured by both academics and practitioners to add value to entrepreneurial firms is by building up their management teams, as has been argued by the theoretical and practitioner literature. If this conjecture is correct, we would expect VC-backed firms to have higher quality management teams compared to non-VC-backed firms. Second, VC-backing may itself affect a firm's IPO characteristics and its post-IPO performance through effects similar to the certification and ability channels we discussed above in the context of the effect of a firm's management quality on its IPO.[2] Thus, a study of the role of management quality in VC-backed entrepreneurial firms has to disentangle the effects of management quality on a firm's IPO from those of VC-backing. Third, management quality and VC-backing may interact in affecting a firm's IPO characteristics and post-IPO operating performance. Thus, the effects of management quality and VC-backing on IPOs may be complements or substitutes in acting through the certification channel. If each agency (management quality or VC-backing) is individually enough to perform certification fully, then they will be substitutes; otherwise they will be complements. Similarly, the effects of management quality and VC-backing on IPOs may also be complements or substitutes in acting through the ability channel.

The empirical strategy we adopt to disentangle the effects of management quality and VC-backing on a firm's IPO characteristics and post-IPO operating performance is to compare the effect of management quality on VC-backed IPOs to its effect on non-VC-backed IPOs (using various univariate and multivariate tests). Further, to analyze the effect of VC-backing on management quality, we use univariate tests, ordinary least squares regressions, and propensity score matching analyses to compare the management quality of VC-backed and non-VC-backed firms. Finally, we also empirically estimate

[2] Similar to the role of management quality we discussed above, the existing literature has argued that VC-backing can also play a certifying role in conveying firm value to the financial market (Megginson and Weiss (1991)).

the interaction effects between management quality and VC-backing on firms' IPO characteristics and post-IPO operating performance, and thus determine whether management quality and VC-backing are substitutes or complements in their effects on the above variables.

We therefore have three objectives in this paper. First, as a prelude to our analysis of the role of management quality in the IPOs of VC-backed firms, we analyze the effect of VC-backing on the management quality of a firm at the time of its IPO.[3]

Second, we study how management quality of VC-backed firms affects their IPO characteristics. As discussed earlier, a firm's management quality may affect its IPO characteristics through either the certification channel or the ability channel (or both). Higher quality and more reputable managers may be able to convey their firm's intrinsic value more credibly to outsiders, reducing the information asymmetry facing their firm in the equity market. This, in turn, implies that a firm's management quality will affect various aspects of its interaction with the IPO market. For example, given the importance of management quality in certifying firm value, it is possible that underwriters and other financial intermediaries use this variable, in addition to other measures of firm quality, when choosing firms to take public. Management quality may be a particularly important variable when analyzing younger, smaller, and more obscure firms, which are likely to suffer from a great degree of information asymmetry in the equity market. Thus, firms with higher management quality may be associated with more reputable underwriters. Next, given the reduction in information asymmetry resulting from managerial certification, underwriters and other intermediaries may incur lower costs in acquiring and transmitting information about firms with higher management quality. This, in turn, implies that such firms need to provide underwriters and other intermediaries only a smaller amount of compensation for taking them public, reducing their costs of going public. The reduction in outsiders' information acquisition costs for firms with higher quality managers could also lead to greater analyst coverage and institutional interest in the IPOs of such firms.

[3] Little empirical evidence exists regarding the relationship between VC backing and the quality and reputation of firm management at IPO. An important exception is Hellmann and Puri (2002), who study a sample of 170 VC-backed high-tech firms, but long before their IPO. They show that VCs help to professionalize the management of start-up firms. We will discuss the relation of our paper to the above paper in more detail in the next section.

Further, if management quality and reputation can certify a firm's intrinsic value to the financial market, firms with higher quality managers may also be able to access the IPO market at a younger age and obtain higher market valuations in the IPO market and in the immediate after-market. Management quality may also affect firm age at IPO and firm valuations in the IPO and immediate after-market through the ability channel discussed earlier: higher quality managers may be able to select better projects (characterized by a larger NPV for any given scale) for their firm and implement them more ably, resulting in better post-IPO operating performance. If the IPO market anticipates this, it may result in higher management quality firms being able to go public at a younger age and being awarded higher valuations in the IPO and immediate after-market. This also implies that firms with higher quality managers are likely to have a larger equilibrium scale of investment, and therefore larger IPO offer sizes (we discuss the underlying theory in more detail and develop testable hypotheses in section 3).

Third, we empirically analyze how management quality and VC-backing affect a firm's post-IPO operating performance. The effect of a firm's management quality on the *level* of its post-IPO operating performance may depend on two opposing effects. On the one hand, higher quality managers may select better projects and implementing them more ably, generating greater profits on average: i.e., firms with higher quality managers can be expected to have a higher level of operating performance, through the ability channel. On the other hand, as discussed earlier, higher management quality firms may be able to go public at a younger age, at which point in time their profitability is likely to be lower than that of firms going public at a more mature stage. If the former effect dominates, we would expect a firm's managerial quality to positively affect the level of its post-IPO operating performance; if, however, the latter effect dominates, we would expect a firm's managerial quality to negatively affect the level of its post-IPO operating performance. One can separate out how managerial quality alone affects operating performance by studying the *changes* in a firm's post-IPO operating performance: we expect firms with higher quality managers to realize larger improvements in operating performance in the years immediately after IPO.

We empirically analyze the relationships hypothesized above using a large hand-collected dataset on the management quality of 3,240 firms that went public during 1993-2004. Making use of this dataset,

we create ten individual proxies of management quality and reputation (we discus these in detail in section 5.1). Since true management quality itself is unobservable, each of the above ten proxies may have their own unique limitations in capturing this unobservable construct. We therefore conduct a common factor analysis using these individual proxies to produce a single measure of management quality that captures the variation common to these observable individual proxies of management quality. We use this management quality factor in most of our subsequent empirical tests (we report some results with our individual proxies of management quality as well).

Our empirical findings can be summarized as follows. In the first part of our analysis, we find that VC-backed firms have a greater percentage of management team members with MBA degrees, a greater percentage of managers with prior managerial experience, a greater percentage of managers in core functional areas (operations and production, sales and marketing, R&D, and finance), and larger management teams compared to non-VC-backed firms. At the same time, VC-backed firms have a lower percentage of managers who are CPAs and who have prior managerial experience at law and accounting firms; further, their managers have shorter average tenures and smaller heterogeneity in these tenures. Overall, we find that VC-backed firms have a higher management quality than non-VC-backed firms as measured by our management quality factor.

We recognize that the decision of entrepreneurial firms to be backed by VCs is not completely exogenous and may depend on their size, performance, industry, state where they are located, and other factors, which, in its turn, may affect their management quality. Therefore, we also study the relationship between management quality and VC-backing by using a sub-sample of propensity score matched VC- and non-VC-backed firms, matched on the variables mentioned above. The results of our propensity score matched sub-sample analysis are similar to the results using our full sample and provide further support to our finding that VC-backed firms have higher management quality compared to non-VC-backed firms.

In the second part of our analysis we find the following. First, both management quality and VC-backing have a significantly positive effect on the underwriter reputation and IPO offer size, and a significantly negative effect on the costs of going public. Further, management quality and VC-backing

act as substitutes in their effect on the above IPO characteristics: i.e., the effect of management quality on the above variables is weaker in VC-backed than in non-VC-backed firms. Second, both management quality and VC-backing have a significantly positive effect on the analyst coverage and institutional holdings of firms immediately after their IPO, and act as substitutes in their effect on these variables. Third, firms with higher quality managers and those backed by VCs are able to access the financial market at a younger age. Management quality and VC-backing act as complements in reducing firm age at IPO: i.e., the effect of management quality on firm age at IPO is stronger for VC-backed compared to that for non-VC-backed firms. This younger age at IPO may be due to the greater participation by various financial market players in the IPOs of higher management quality and VC-backed firms that we documented earlier (which may enable these firms to go public earlier by reducing the information asymmetry facing them in the financial market). Fourth, both management quality and VC-backing have a significantly positive effect on firm valuations both in the IPO and in the immediate secondary market; further, management quality and VC-backing act as complements in their effect on IPO firm valuations.

Our findings in the third and final part of our analysis are the following. First, both management quality and VC-backing have a significantly negative effect on the *level* of post-IPO operating performance of firms going public. This may be partly due to the fact that firms with higher management quality and those backed by VCs go public and access the financial market at a younger age and thus initially lag behind (in profitability) firms going public at a later stage in their life cycle.[4] Second, both management quality and VC-backing have a significantly positive effect on the *changes* in operating performance of firms relative to the year prior to their IPO. Thus, we find that VC-backed firms experience significant improvements in their post-IPO operating performance (relative to the year prior to their IPO), while non-VC-backed firms experience a deterioration in their post-IPO operating

[4] We find that firms with higher management quality and those backed by VCs invest significantly more (have significantly larger levels of capital expenditures and R&D expenses) in the years after their IPO (these results are not reported in the paper but are available to interested readers upon request). This may also contribute to their lower levels of post-IPO operating performance since higher investment levels result in smaller accounting earnings and, consequently, in lower accounting performance ratios, such as ROA. For example, higher capital expenditures reduce firm's accounting earnings through higher depreciation expenses charged in subsequent years; higher R&D expenses reduce earnings as well, since they are subtracted against revenues in the year they are incurred.

performance (relative to the year prior to their IPO). Similarly, within VC-backed firms, firms with higher quality managers experience significantly larger improvements in operating performance in the years after their IPO compared to firms with lower management quality. Finally, we find that the sample of non-VC-backed firms experience a deterioration in their post-IPO operating performance; within this sample of non-VC-backed firms, firms with higher quality managers experience a smaller extent of deterioration in post-IPO operating performance compared to lower management quality firms. The above results indicate that firms with higher management quality are indeed able to select better projects and implement them more ably, and that VC-backing plays an important role in improving firm performance as well.

The rest of this paper is organized as follows. Section 2 discusses how our paper is related to the existing literature and the contribution made by our paper relative to this literature. Section 3 summarizes the relevant theory and develops our testable hypotheses. Section 4 describes our data. Section 5 develops our measures of management quality and reputation as well as other measures of firm quality and internal governance. Section 6 presents our empirical tests and results. Section 7 concludes.

2. Relation to the Existing Literature and Contribution

Our paper is related to several strands in the literature. The first is the literature on venture capital. Hellmann and Puri (2002) study 170 young high-technology firms in Silicon Valley and show that VC-backing is positively related to the professionalization of start-up firms, as measured by human resource policies, the adoption of stock option plans, and the hiring of a marketing VP. Unlike Hellmann and Puri (2002), who use a small sample of young high-technology Silicon Valley firms long before IPO, we study the relationship between VC-backing and management quality in a large sample of firms going public. Further, unlike our paper, where the focus is on the relationship between VC-backing and management quality, Hellmann and Puri (2002) focus only on the professionalization of start-up firms.[5]

[5] See also Kaplan, Sensoy, and Stromberg (2009), who use a sample of 50 VC-backed firms to study the evolution in firm characteristics from business plan to public firm, and show that business lines remain remarkably stable while management turnover is substantial.

The second is the emerging literature on management quality and its effect on a firm's interaction with the financial market and performance. As discussed earlier, the paper in this literature closest to ours is Chemmanur and Paeglis (2005), who study the relationship between management quality and IPO characteristics. They, however, explicitly exclude VC-backed IPOs in their analysis. Thus, there has been no study in the existing literature on the relationship between management quality and IPO characteristics in VC-backed IPOs, and no study on how management quality and VC-backing interact to affect IPO characteristics (i.e., whether management quality and VC-backing are complements or substitutes).

There has also been no prior literature on how management quality affects post-IPO operating performance of VC-backed firms. The literature on the relationship between VC-backing and post-IPO operating performance is also sparse: the only paper we are aware of is Jain and Kini (1995), who analyze a sample of IPOs in 1976-1988 and show that VC-backed firms experience relatively smaller declines in post-IPO operating performance (relative to the pre-IPO year) compared to non-VC-backed firms.[6]

This paper contributes to the literature in several ways. First, this is the first study of how VC-backing affects a firm's management quality at IPO. We show that the positive effect of VC-backing on management quality applies to the entire population of firms going public and persists at the time of IPO. Second, this is the first study of how management quality affects IPO characteristics in VC-backed firms (as discussed above, the only existing study of this relationship, Chemmanur and Paeglis (2005), focuses solely on non-VC-backed firms). By focusing on both VC- and non-VC-backed firms, we are able to analyze not only the effect of VC-backing and management quality on IPO characteristics such as underwriter reputation, offer size, cost of going public, firm age at IPO, post-IPO institutional investor holdings and analyst coverage, but are also able to study the interaction between management quality and

[6] Our paper is broadly related to the literature documenting that VCs help to improve the efficiency of the private firms they invest in (see, e.g., Chemmanur, Krishnan, and Nandy (2011)). It is also indirectly related to the papers that examine the relationship between VC-backing and IPO underpricing (Megginson and Weiss (1991), Chemmanur, Krishnan, and Loutskina (2004), Lee and Wahal (2008)). None of the latter papers, however, touch upon the relationship between VC-backing and management quality or the effect of management quality on a firm's IPO characteristics. Our paper is also related to the broader theoretical IPO literature and the theoretical literature on the role of financial intermediaries such as investment banks and VCs on a firm's interaction with the financial market (see, e.g., Allen and Faulhaber (1989), Chemmanur (1993), Chemmanur and Fulghieri (1994), Welch (1989), or Welch (1992)).

VC-backing in affecting these variables. Third, this is the first paper to analyze the effect of management quality on the valuation of IPO firms (both at IPO and in the immediate secondary market) and the interaction between management quality and VC-backing in affecting this relationship. Finally, this is the first paper to study the effect of management quality on the post-IPO operating performance of VC-backed firms; it is also the first paper to study how management quality and VC-backing interact to affect this performance. In summary, this paper contributes to the literature by presenting a comprehensive picture of the effect of VC-backing on a firm's management quality and demonstrates how VC-backing and management quality interact to affect a firm's IPO process and its post-IPO operating performance.

3. Theory and Hypotheses Development

3.1. VC-Backing and Management Quality

A number of papers have argued that VCs may be able to create "extra-financial" value for the entrepreneurial firms they back (Chemmanur and Chen (2006), Repullo and Suarez (2004)). One way in which VCs can create such value is by helping the firm acquire a higher quality management team either by attracting more qualified managers to join the firm or by fostering the development of a higher quality management team in other ways. Thus, our first hypothesis is regarding the relationship between VC-backing and the management quality of a firm at the time of its IPO. We expect VC-backed firms to have higher quality management teams compared to non-VC-backed firms (**H1**).

3.2. Management Quality, VC-Backing, and the IPO Market

In this section, we develop hypotheses regarding the relationship between management quality, VC-backing, and various variables characterizing a firm's interaction with the IPO market. As discussed in the introduction, management quality may affect a firm's IPO characteristics through two channels: the certification channel and the ability channel. In a similar vein, VC-backing may also affect a firm's IPO characteristics through the above two channels. The VC literature has long argued that, since VCs (like other financial intermediaries) are long-term players in the financial market, VC-backing may certify an

IPO firm's intrinsic value to the financial market (thus reducing the extent of asymmetric information faced by the firm): see, e.g., Megginson and Weiss (1991) for informal arguments and evidence, and Chemmanur and Fulghieri (1994) for a theoretical model of certification by financial intermediaries. The above two effects have important implications for the relationship between VC-backing, management quality, and various variables characterizing firm's interaction with the IPO market, which we discuss below. An additional interesting question that arises here is how the effect of management quality on IPO characteristics differs across VC-backed and non-VC-backed firms. In other words, are management quality and VC-backing substitutes or complements in affecting a firm's interaction with the IPO market?

3.2.1. Management Quality, VC-Backing, and Underwriter Reputation

Given the importance of management quality in certifying firm value, it is likely that underwriters and other financial intermediaries use this variable, in addition to other measures of firm quality, when evaluating firms to take public.[7] Chemmanur and Fulghieri (1994) and Carter and Manaster (1990) argue that more reputable underwriters will be associated with higher quality and less risky firms (see also Booth and Smith (1986)). This implies that firms with higher management quality will be associated with more reputable underwriters (**H2**). Similarly, if VCs are able to certify intrinsic firm value, VC-backed firms will be associated with higher reputation underwriters. Further, if management quality and VC-backing are complements in their certification ability, we expect the effect of managerial quality on underwriter reputation to be stronger in VC-backed firms than in non-VC-backed firms (**H3A**); the reverse will be true if management quality and VC-backing are substitutes in terms of certification (**H3B**).

3.2.2. Management Quality, VC-Backing, and the Costs of Going Public

Given the reduction in information asymmetry due to managerial certification, underwriters and other intermediaries may need to incur only lower costs in acquiring and transmitting information about

[7] This may be a particularly important variable for younger, smaller, and more obscure firms, which are likely to suffer from a considerable degree of information asymmetry in the equity market.

firms with higher management quality. This, in turn, implies that such firms need to provide underwriters and other intermediaries only a lower amount of compensation (underwriting spread and other expenses) for taking them public (**H4**). In a similar vein, if VCs are able to certify intrinsic firm value, VC-backed firms will be associated with lower costs (underwriting spread and other expenses) of going public. Similar to their effect on underwriter reputation, if management quality and VC-backing are complements in their certification ability, we expect the effect of management quality on the costs of going public to be stronger in VC-backed firms relative to non-VC-backed firms; the reverse will be true if management quality and VC-backing are substitutes in terms of certification.

3.2.3. Management Quality, VC-Backing, and IPO Offer Size

The quality of a firm's management will also have a significant impact on the amount raised by the firm in the IPO. First, since they are likely to be better at both selecting and implementing projects, higher quality managers will have better quality projects (i.e., larger NPV for any given scale), and assuming decreasing returns to scale, the equilibrium scale (level of investment) of their projects will be larger (see Figure 1). Second, higher quality managers will be able to convey their private information about project quality to the equity market more credibly (as discussed above), so that the adjusted NPV (net of financing costs) of firms with higher management quality will be larger for any given scale. These two effects (acting through the ability and certification channels, respectively) together will lead to a larger amount raised in the IPOs of firms with higher management quality (**H5**). In a similar vein, if VC-backed firms have higher quality (scalable) projects compared to non-VC-backed firms, and given that VCs have some certification ability, we would expect VC-backed firms to raise larger amounts in their IPOs compared to non-VC-backed firms. Similar to their effect on the other two IPO characteristics discussed above, if management quality and VC-backing are complements in affecting IPO offer size, we expect the relationship between management quality and IPO offer size to be stronger in VC-backed firms compared to non-VC-backed firms; the above relationship between management quality and IPO offer size will be weaker in VC-backed firms if management quality and VC-backing are substitutes.

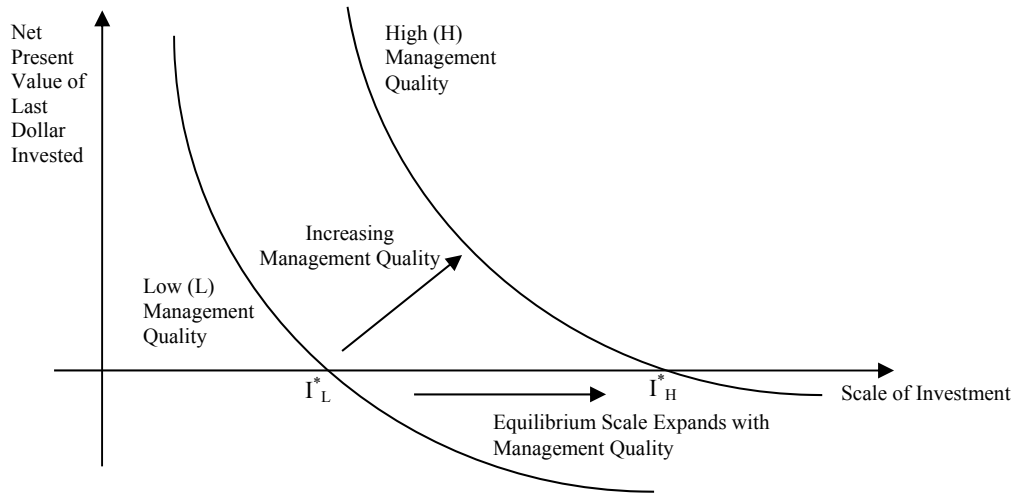

Figure 1: Relationship between Management Quality and Investment.
As management quality increases from low (L) to high (H), the scale of the firm increases from I^*_L to I^*_H.

3.2.4. Management Quality, VC-Backing, and Other Financial Market Players

Similar to the case of IPO underwriters, management quality may also play an important role in certifying the firm's intrinsic value to other important financial market participants such as financial analysts and institutional investors. If this is the case, the cost of information production of these financial market players will be reduced, so that higher management quality firms will be associated with greater analyst coverage and institutional investor participation immediately post-IPO (**H6**). In a similar vein, if VCs are able to certify intrinsic firm value, VC-backed firms will be associated with greater analyst coverage and institutional investor participation immediately after the IPO. Finally, if management quality and VC-backing are complements in their certification ability, we expect the effect of management quality on analyst coverage and institutional investor participation to be stronger in VC-backed firms relative to non-VC-backed firms; the above relationship between management quality and analyst coverage and institutional investor participation will be weaker in VC-backed firms if management quality and VC-backing are substitutes in terms of certification.

3.2.5. Management Quality, VC-Backing, and Firm Age at IPO

If management quality is able to certify firm value to the financial market, then firms with higher management quality will be able to access the financial market more easily (at a younger age). Further, management quality may also affect firm age at IPO through the ability channel discussed earlier: higher quality managers may be able to select better projects for their firm and implement them more ably, resulting in better post-IPO operating performance. If the IPO market anticipates this, it may result in higher management quality firms being able to go public at a younger age. Thus, management quality may act through both the certification and ability channels in affecting firm age at IPO: in other words, higher management quality firms will be able to access the IPO market at a younger age (**H7**). In a similar vein, if VCs are able to certify intrinsic firm value, VC-backed firms will have younger ages at IPO, which has been documented in the existing literature (see, e.g., Megginson and Weiss (1991) or Lee and Wahal (2004)). We will therefore also study whether management quality and VC-backing are complements or substitutes in terms of making it easier for a firm to access the financial market.

3.2.6. Management Quality, VC-Backing, and Financial Market Valuation

If management quality is able to certify a firm's intrinsic value to the financial market, firms with higher management quality will be associated with higher valuations in the IPO and secondary markets. Management quality may also affect firm valuations in the IPO and immediate after-market through the ability channel, similar to its effect on firm age at IPO (by affecting the market's expectations of the firm's post-IPO operating performance). Thus, management quality may act through both the certification and ability channels in affecting firm valuations at IPO: in other words, higher management quality firms will have higher valuations in the IPO and secondary markets (**H8**). In a similar vein, if VCs are able to certify intrinsic firm value, VC-backed firms will have higher IPO and secondary market valuations. VC-backing may also affect firm valuations at IPO through the ability channel, similar to the effect of management quality on the above variable. Finally, if management quality and VC-backing are complements in their ability to affect firm valuations, we expect the effect of management quality on IPO

and secondary market valuations to be stronger in VC-backed firms relative to non-VC-backed firms; the above relationship between management quality and IPO and secondary market valuations will be weaker in VC-backed firms if management quality and VC-backing are substitutes in terms of affecting firm valuations.

While we also study the relationship between management quality and IPO underpricing in this paper, we will not test any specific hypotheses regarding this relationship here. This is because underpricing reflects differences in IPO and secondary market valuations. If management quality positively affects secondary market valuations to a greater extent compared to its effect on IPO valuations, then management quality will have a positive effect on IPO underpricing. On the other hand, the relationship between management quality and IPO underpricing will be negative if management quality has a smaller positive effect on secondary market valuations compared to its effect on IPO valuations. Similar arguments apply to the relationship between VC-backing and IPO underpricing.[8]

3.3. Management Quality, VC-Backing, and Post-IPO Operating Performance

The relationship between management quality and the level of post-IPO operating performance may depend upon two opposing effects. On the one hand, higher quality managers may be better at selecting and implementing projects, thereby generating greater profits, on average, for their firms. If this effect of managerial ability dominates, the quality of a firm's management will be positively related to its post-IPO operating performance. On the other hand, as discussed earlier, higher management quality firms may be able to access the financial market at an earlier (younger) stage in their life cycle, at which point their profitability is likely to be lower than that of firms going public at a later (more mature) stage in their life cycle. If this stage (life cycle) effect dominates, the quality of a firm's management team will be negatively related to the level of its long-term operating performance subsequent to the IPO. One can

[8] Perhaps because of this, the relationship documented in the literature between VC-backing and IPO underpricing is ambiguous: papers analyzing this relationship prior to the 1990s document it as a negative one (e.g., Megginson and Weiss (1991)), while those using data from the 1990s or subsequently document this relationship as a positive one (see, e.g., Chemmanur and Loutskina (2006), Lee and Wahal (2004), Francis and Hasan (2001)).

separate out the effect of managerial ability alone on operating performance by studying the *changes* in operating performance after IPO: we expect firms with higher management quality to experience unambiguously larger improvements in operating performance in the years immediately after IPO (**H9**).

By an argument similar to the above, if VCs can help a firm perform better in the product market and also access the financial market at an earlier stage in their life cycle, then we would expect the relationship between VC-backing and post-IPO operating performance to be either positive or negative, depending on whether the product market effect dominates or the stage (life cycle) effect dominates. One can separate out the above two effects by studying the *changes* in post-IPO operating performance: we would expect VC-backed firms to experience unambiguously larger improvements in such performance compared to non-VC-backed firms (**H10**), if VCs can indeed help firm management pick better projects and implement them more ably. We will also study whether management quality and VC-backing are complements or substitutes in their effect on post-IPO operating performance.

4. Data and Sample Selection

The list of U.S. IPOs in 1993-2004 comes from the SDC/Platinum Global New Issues database. We excluded real estate investment trusts (REIT), closed-end funds, unit IPOs, spin-offs, equity carve-outs, financial firms (with SIC codes between 6000 and 6999), foreign firms, and former leveraged buy-outs (LBO). We further eliminated 9 firms which did not have management quality information available in their prospectuses. Thus our final sample consists of 3,240 IPO firms; 1,851 are VC-backed firms and 1,389 are non-VC-backed firms. Table 1 demonstrates how our final sample was constructed.

Information on various management quality proxies, such as team size, education, prior managerial experience, functional expertise, and tenure of management team members was hand-collected from the "Management" section of IPO prospectuses. The data necessary to calculate the CEO dominance variable came from the "Executive Compensation" section of the prospectuses. Information on internal governance mechanisms (such as CEO/Chairman-of-the-board duality, proportion of outside directors, and insider stock ownership) came from the prospectuses as well. IPO prospectuses were

obtained from the Thomson Financial database. IPO characteristics were taken from the SDC/Platinum Global New Issues database. Information on the institutional shareholdings was obtained by searching 13F and 13F-E filings. The financial analyst coverage data was obtained from IBES. Finally, accounting data came from Compustat and stock price data came from CRSP.

5. Measures of Management Quality and Reputation, and Firm Quality

5.1. Measures of Management Quality and Reputation

We follow Chemmanur and Paeglis (2005) in constructing many of our management quality measures. Management quality is affected by the amount of human and knowledge resources (including education and experience) available to the management team. Thus, our first proxy of management quality, the management team size, measures the amount of human resources available. It is defined as the number of executive officers with a title of a vice president or higher on the management team (TSIZE). The next two proxies measure the education level of managers. Our second proxy of management quality is the percentage of management team members with an MBA degree (PMBA) and the third proxy is the percentage of management team members who are Certified Public Accountants (PCPA). The greater the percentages of MBAs and CPAs on the management team, the greater its quality.

We measure prior managerial experience of management team members by using the following two proxies. Our fourth proxy is the percentage of managers who have served as executive officers at other firms prior to joining the IPO firm (PFTEAM) and our fifth proxy is the percentage of managers who were partners at law or accounting firms prior to joining the IPO firm (PLAWACC). Clearly, the greater the percentage of management team members with prior managerial experience (including experience in the areas of law and accounting) the greater the management team quality.

Our sixth proxy of management quality is the percentage of team members with core functional expertise, namely, the percentage of team members holding positions in the areas of operations and production, R&D, sales and marketing, and finance (PCORE). The greater the percentage of team members with core functional expertise the greater the management quality.

Our seventh proxy of management quality is CEO dominance (FCEO). On the one hand, a strong CEO may improve the cohesion of the management team. On the other hand, a strong-willed and dominating CEO may severely diminish possible contributions from other team members. Thus, while we believe that CEO dominance is an important measure of team quality, we are agnostic about the direction of the expected impact (positive or negative) of this measure of management quality. Our measure of CEO dominance is the ratio of CEO salary and bonus to the average salary and bonus of other team members listed in the executive compensation section of the prospectus in the fiscal year prior to the IPO. Assuming that CEOs have a substantial influence over their own pay and nearly total influence over their subordinates' pay, this measure reflects the gap between the CEO's assessment of his own worth to the firm and his assessment of other team members' worth, and is thus a good measure of CEO dominance.[9]

Our eighth proxy of management quality measures the reputation of management team members in the business community. It is the number of other firms' corporate boards that team members sit on (BOARDS). While the measures discussed above also partially capture management team reputation, this proxy is a better representation of the reputation and visibility of managers in the business community. The greater the value of BOARDS, the greater the quality and reputation of a firm's management team.

Our last two proxies of management quality measure the degree of uniformity or heterogeneity in the tenures of management team members. Our ninth proxy of management quality is the average tenure of team members (TENURE), defined as the average number of years that team members have been with the firm. Greater average tenure may indicate shared experiences and cohesion and thus lower transaction costs of interaction between team members. However, longer tenures may also result in complacency and rigidity in team interactions. An ideal management team would have members from different cohorts, which would ensure an inflow of new ideas and perspectives. Thus, a higher management quality would be associated not only with longer average tenures but also with greater dispersion in such tenures.

[9] Similar measures have also been used in the strategy and organizational behavior literature to study the effect of management team quality on firm performance: see, e.g., D'Aveni (1990) and Hambrick and D'Aveni (1992), who use such measures to study the deterioration of management team quality around bankruptcies.

Therefore, we use the heterogeneity in management team tenures (TENHET) as our tenth management quality proxy. It is defined as the coefficient of variation of management team members' tenures.

5.2. Other Measures of Firm Quality and Internal Governance

In order to separate the effect of management quality from that of other aspects of firm quality and internal governance, we control for these other aspects by including the following variables as controls in our multivariate tests. The first proxy of firm quality we use is firm size, defined as the natural logarithm of the book of value of firm's assets immediately prior to IPO (LNBVA). The second proxy of firm quality is firm age, defined as the natural logarithm of one plus the firm's age (LFAGE). The larger and older the firm, the greater its quality.[10] Further, we control for the proportion of outside directors (directors who are not executive officers, founders, former employees, or anyone who is engaged in business dealings with the firm) in the firm's board of directors (ODIR). Outside directors can enhance firm quality by, first, providing linkages to external parties such as underwriters, financial institutions, and auditors, and, second, by providing additional knowledge/expertise (inputs and perspectives) to the firm's management. The greater the proportion of outside directors, the greater the firm's quality.[11]

We also control for insider stock ownership defined as the proportion of voting power held by firm insiders such as executive officers and directors both before and after the IPO (INSIDERB and INSIDERA, respectively). We use either INSIDERB or INSIDERA depending on the particular test that we conduct. Finally, we control for CEO/Chairman-of-the-board duality by creating a dummy variable equal to one if a firm's CEO is also its Chairman of the board of directors, and zero otherwise (BOSS). Separation of the roles of CEO and the Chairman of the board of directors creates greater management accountability and enhances internal governance and management quality.[12]

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[10] These measures of firm quality have been widely used in the literature (Ritter (1984), Michaely and Shaw (1994)).
[11] Several studies in the corporate control literature demonstrated that outside directors enhance firm value (see, e.g., Cotter, Shivdasani, and Zenner (1997) and Borokhovich, Parrino, and Trapani (1996)).
[12] Yermack (1997) shows that firms which separate the roles of a CEO and a Chairman of the board receive higher valuations. Rechner and Dalton (1991) show that such firms outperform those that combine these roles.

5.3. Common Factor Analysis of Management Quality Variables

Although the individual management quality proxies discussed above are expected to measure management quality and reputation, they may each have unique limitations in capturing the underlying unobservable construct. Therefore, we use common factor analysis to construct a single factor for management quality that will capture the variation common to the observable measures of management quality and reputation discussed above.[13] In order to ensure that this single factor captures only the effect of management quality and not that of other variables such as firm size, firm age, industry characteristics, or VC-backing, we use firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted individual management quality proxies to extract the common factor.[14] Thus, our management quality factor score (MQF) is constructed using firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, CORE, LAWACC, CPA, FCEO, and BOARDS. These variables refer, respectively, to the management team size, the number of management team members with MBA degrees, the number of management team members with prior managerial experience, the number of management team members with core functional expertise, the number of management team members with prior experience as law and accounting partners, the number of management team members who are CPAs, CEO dominance, and the number of other firms' corporate boards that management team members sit on.

We exclude TENURE and TENHET from the construction of the above common factor since these two proxies have negative factor loadings and negative scoring coefficients if included in the common factor analysis. The interpretation of our common management quality factor becomes problematic when some individual management quality proxies have positive scoring coefficients and others have negative scoring coefficients. Therefore, we restrict our common factor analysis to the first

[13] Several papers in the empirical finance and accounting literature make use of factor analysis to isolate the unobservable construct underlying several proxy variables. See, e.g., Gaver and Gaver (1993) and Guay (1999), who make use of factor analysis to study the size of a firm's investment opportunity set.

[14] We adjust individual management quality proxies for firm size, firm age, industry characteristics, and VC-backing by regressing those management quality proxies on firm size, firm age, 2-digit SIC code industry dummies, and VC dummy, and take the residuals of such regressions (in other words, the variation in individual management quality proxies not explained by firm size, firm age, industry characteristics, or VC-backing) to be our firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted individual management quality proxies.

eight management quality proxies, since they have positive factor loadings and positive scoring coefficients when included in the common factor analysis. We then use TENURE and TENHET as control variables in our multivariate regressions.[15]

Adjusting individual management quality variables for VC-backing orthogonlizes the management quality factor score (MQF) described above relative to the VC dummy (the correlation coefficient between MQF and VC dummy is zero) which precludes us from using MQF in our analysis of the relationship between VC-backing and management quality. Similarly, adjusting individual management quality variables for firm age orthogonlizes MQF relative to firm age (the correlation coefficient between MQF and firm age is zero) which precludes us from using MQF in our analysis of the relationship between management quality and firm age at IPO.

Thus, in addition to MQF (management quality factor score adjusted for firm size, firm age, industry characteristics, and VC-backing), we construct two additional management quality factor scores. For our analysis of the relationship between VC-backing and management quality we construct a new management quality factor score MQFVC using firm-size-, firm-age-, and industry-dummies-adjusted individual management quality proxies as explained above. In other words, when constructing MQFVC we adjust individual management quality proxies only for firm size, firm age, and industry characteristics, without adjusting for VC-backing. Further, for our analysis of the relationship between management quality and firm age we construct another management quality factor score MQFAGE using firm-size-, industry-dummies-, and VC-dummy-adjusted individual management quality proxies as explained above. In other words, when constructing MQFAGE we adjust individual management quality proxies for firm size, industry characteristics, and VC-backing only, without adjusting for firm age.

[15] Negative factor loadings and negative scoring coefficients of TENURE and TENHET are due to negative correlations that these two proxies have with other management quality variables. For example, the correlation between TENURE (TENHET) and the percentage of management team members with prior managerial experience at other firms (PFTEAM) is -0.50 (-0.19) and the correlation between TENURE (TENHET) and the percentage of management team members with MBA degrees (PMBA) is -0.19 (-0.06). Indeed, firms that have management teams with longer average tenures are more likely to develop their managers internally, rather than to hire them from outside, and consequently such managers are less likely to have prior managerial experience at other firms. Similarly, managers who have longer average tenures with their firms are more likely to acquire their managerial skills internally, rather than externally at an educational institution.

Table 2 presents the results of our common factor analysis. Panel A of Table 2 presents the starting communalities of eight management quality proxies (for each of the three management quality factors described above), estimated as the squared multiple correlations obtained from regressing each management quality proxy on the remaining management quality proxies used in common factor analysis. Panel B of Table 2 presents the eigenvalues of the reduced correlation matrices. As suggested by Harman (1976), the number of factors necessary to approximate the original correlations among individual measures is equal to the number of summed eigenvalues necessary to exceed the sum of communalities. The eigenvalue of the first factor in our common factor analysis of MQF is 1.62 and it is larger than the sum of communalities of 1.45. The eigenvalue of the first factor in our common factor analysis of MQFVC is 1.66 and it is larger than the sum of communalities of 1.49. The eigenvalue of the first factor in our common factor analysis of MQFAGE is 1.60 and it is larger than the sum of communalities of 1.43. This suggests that one factor (MQF, MQFVC, or MQFAGE) parsimoniously explains the intercorrelations between individual management quality proxies. Panel C of Table 2 presents the correlations between the common factors and the eight management quality proxies, respectively, while Panel D provides the summary statistics of these common factors.

6. Empirical Tests and Results

6.1. The Effect of VC-Backing on the Management Quality of Firms Going Public

In this section we test hypothesis **H1**, which predicts that VC-backed firms will have higher quality and reputation management teams compared to non-VC-backed firms. We first present the results of our univariate tests and then we test this hypothesis using a multivariate analysis.

6.1.1. Univariate Tests of the Relationship between VC-Backing and Management Quality

Table 3 presents the summary statistics of management quality proxies split into two groups of VC-backed and non-VC-backed firms, and univariate tests of differences in the means and medians of such proxies between the two groups. Table 3 shows that VC-backed firms have significantly larger

management team sizes (TSIZE) compared to non-VC-backed firms. The mean (median) team size of VC-backed firms is 6.78 (6) members compared to 5.63 (5) members of non-VC-backed firms. These differences are statistically significant at the 1% level. VC-backed firms have also significantly larger percentages of team members with MBA degrees (PMBA) and with prior managerial experience (PFTEAM). The mean (median) percentage of MBAs in the management teams of VC-backed firms is 15.6% (11.1%) compared to 7.8% (0%) in non-VC-backed firms, and the mean (median) percentage of team members with prior managerial experience in VC-backed firms is 55.4% (57.1%) compared to 45.4% (42.9%) in non-VC-backed firms. All these differences are statistically significant at the 1% level. VC-backed firms have also significantly larger percentages of team members in core functional areas (PCORE) with the mean (median) proportion of 59.2% (60.0%) compared to 51.6% (50.0%) in non-VC-backed firms; these differences are statistically significant at the 1% level. Table 3 also demonstrates that VC-backed firms have more dominant CEOs (FCEO). According to the median values of FCEO, CEOs of VC-backed firms earn 26.3% more than the average member of their team, whereas CEOs of non-VC-backed firms earn 19.3% more than the average member of their team; this difference is significant at the 1% level. Thus, according to the above five proxies of management quality, VC-backed firms have higher quality managements compared to non-VC-backed firms.

Table 3 further shows that management teams of VC-backed firms have lower percentages of CPAs (PCPA) and managers who previously served as law and accounting partners (PLAWACC). The mean percentage of PCPA in VC-backed firms is 6.6% compared to 10.3% in non-VC-backed firms, and the mean percentage of PLAWACC in VC-backed firms is 2.4% compared to 2.9% in non-VC-backed firms; the former difference is significant at the 1% level and the latter difference is significant at the 10% level. Further, the management teams of VC-backed firms have significantly shorter average tenures (TENURE) and smaller tenure heterogeneity (TENHET). The mean (median) TENURE in VC-backed firms is 4.43 (3.29) years compared to 5.61 (4.2) years in non-VC-backed firms. These differences are statistically significant at the 1% level. The mean (median) TENHET in VC-backed firms is 0.69 (0.57) compared to 1.22 (0.62) for non-VC-backed firms; these differences are statistically significant at the 1%

level.[16] Thus, the management quality of VC-backed firms is relatively lower compared to non-VC-backed firms according to the above four management quality proxies. Table 3 also shows that there are no significant differences in the number of other firms' corporate boards that management team members sit on across VC-backed and non-VC-backed firms.

The overall effect of VC-backing on management quality is positive, as demonstrated in Table 3 by the significantly larger (significant at the 1% level) mean and median management quality factor scores (MQFVC) of VC-backed firms compared to non-VC-backed firms. Thus our univariate tests show that although some individual management quality variables are smaller for VC-backed firms, the overall effect of VC-backing on management quality is positive, providing support for hypothesis **H1**.[17]

6.1.2. Ordinary Least Squares Analysis of the Effect of VC-Backing on Management Quality

Next we analyze the relationship between VC-backing and management quality by using ordinary least squares (OLS) regressions of the management quality factor score (MQFVC) as well as individual management quality variables on a dummy equal to one for VC-backed firms and zero for non-VC-backed firms (VCDUM), and a set of controls such as firm size (LNBVA) and age (LFAGE), proportion of outside directors (ODIR), insider ownership before IPO (INSIDERB), and a dummy equal to one if a firm's CEO is also its Chairman of the board and zero otherwise (BOSS). The results are in Table 4.

In regressions 1 and 2, where we use management quality factor score (MQFVC) as the dependent variable, VCDUM is positive and highly significant, indicating that the effect of VC-backing on management quality is positive even after controlling for firm size, age, and internal governance

[16] The smaller tenure heterogeneity of VC-backed firms' management teams is not surprising given the shorter average tenures of VC-backed firm managers; in general, the shorter the average tenure the smaller the expected dispersion in such tenures. The shorter average tenures of VC-backed firms can be explained by the fact that VC-backed firms are on average younger firms; the mean (median) age of VC-backed firms is 10.32 (6) years compared to 13.80 (8) years of non-VC-backed firms.

[17] In addition, Table 3 shows that although VC-backed firms are significantly younger compared to non-VC-backed firms, their book value of assets is significantly larger. VC-backed firms also have significantly greater proportions of outside directors in their boards of directors and significantly lower insider ownership both before and after their IPO. Finally, VC-backed firms have significantly less incidences of CEOs also serving as Chairmen of the board, compared to non-VC-backed firms. These results provide some evidence that VC-backed firms have somewhat better internal corporate governance mechanisms compared to non-VC-backed firms.

mechanisms. Further, the results of regressions 3 to 6 in Table 4 show that the effect of VC-backing (VCDUM) on management team size (TSIZE), the percentage of MBAs in the management team (PMBA), the percentage of managers with prior managerial experience (PFTEAM), and the percentage of managers with core functional expertise (PCORE) is positive and highly significant as well. Regressions 7, 8, 11, and 12 in Table 4 indicate that VC-backing is associated with a smaller percentage of managers who previously served as law and accounting partners (PLAWACC), a smaller percentage of CPAs (PCPA), shorter average tenures (TENURE), and lower tenure heterogeneity (TENHET).

Thus, consistent with our univariate tests, our multivariate regressions demonstrate that even after controlling for firm size, age, and internal governance mechanisms the overall effect of VC-backing on the management quality of IPO firms is positive, which is consistent with our hypothesis **H1**.

6.1.3. Propensity Score Matching Analysis of the Effect of VC-backing on Management Quality

We recognize that the decision of entrepreneurial firms to be backed by VCs is not entirely exogenous and may depend on the characteristics of these firms such as the industry they are in, their size, performance, the proximity to VC firms, etc. Thus, not all firms will seek and receive VC financing. Ideally, to study the effect of VC-backing on management quality, we need to measure the management quality of the same firm with and without VC-backing. However, we observe each firm only once, after it has received VC-backing, and we do not observe the same firm without VC-backing. Therefore, we compare the management quality of VC-backed firms to that of non-VC-backed firms, and since the decision to receive VC-backing is endogenous it introduces bias in our analysis.

Rubin (1974, 1977) and Rosenbaum and Rubin (1983) show that in such situations comparing firms matched on their propensity of being treated (in our case, the propensity of receiving VC-backing) tends to eliminate the bias. Therefore, following the methodology described in Lee and Wahal (2004) we match VC-backed firms in our sample with non-VC-backed firms using one-to-one "nearest neighbors" propensity score matching technique. According to this methodology, in the first stage we run probit regressions with the dependent variable equal to one for VC-backed firms and zero for non-VC-backed

firms on a set of independent (matching) variables. We use two models for such regressions. In the first model, the set of independent (matching) variables includes the natural logarithm of IPO offer size, two-digit SIC code dummies, IPO offer year dummies, IPO firm headquarter dummies, and the natural logarithm of one plus the lead underwriter's reputation as measured by Loughran and Ritter (2004). In the second model, in addition to the five independent variables in the first model, the set of independent (matching) variables also includes the pre-IPO book value per share normalized by the offer price, the pre-IPO sales per share normalized by the offer price, the pre-IPO total assets normalized by the offer price, and a dummy variable equal to one if pre-IPO earnings are positive.[18] Then each VC-backed firm is matched with one non-VC-backed firm with the closest propensity score estimated from the probit regressions.[19] All matching is conducted with replacement.[20]

Our first probit model uses 3,179 IPO firms (1,830 VC-backed firms and 1,349 non-VC-backed firms) and estimates their propensity scores (propensity of receiving VC-backing). For each 1,830 VC-backed firms the model finds one non-VC-backed matching firm (some non-VC-backed firms are used as a match for several VC-backed firms based on the closeness of their propensity scores). Our second probit model uses 2,772 IPO firms (1,646 VC-backed firms and 1,126 non-VC-backed firms) and estimates their propensity scores; for each 1,646 VC-backed firms the model finds one non-VC-backed matching firm. We then calculate the mean differences between management quality variables of VC-backed and propensity score matched non-VC-backed firms (so called average treatment effect on the treated (ATT)) and compute bootstrapped standard errors (with 50 replications) of these mean differences to conduct our statistical tests. These mean differences along with their test statistics are reported in Table 5; Panel A reports the results of our matching analysis using the first model with five independent (matching)

[18] Lee and Wahal (2004) use these independent (matching) variables by observing significant industry, time, and geographical clustering between the IPOs of VC-backed and non-VC-backed firms, as well as significant differences in such firms' pre-IPO sales, size, and performance.

[19] We run probit regressions with the option of "common support," which drops treatment observations (VC-backed firms) whose propensity score is higher than the maximum or less than the minimum propensity score of the controls (non-VC-backed firms).

[20] We have also employed the kernel (with Gaussian kernel type) and local linear regression propensity score matching techniques to conduct our analysis. The results of these alternative propensity score matching techniques were similar to the one-to-one nearest neighbors technique reported here. For the sake of preserving space, the results of these alternative propensity score matching techniques are not reported in this paper.

variables and Panel B reports the results of our matching analysis using the second model with nine independent (matching) variables as described above.

As shown in both Panels A and B of Table 5, the average differences between the management quality factor scores (MQFVC) of VC-backed firms and propensity score matched non-VC-backed firms are positive and highly significant, indicating that VC-backing significantly increases management quality. Further, Table 5 (both Panels A and B) shows that VC-backing significantly increases the percentage of MBAs in management teams, the percentage of managers with prior managerial experience, and the percentage of managers in core functional areas. Table 5 (both Panels A and B) also shows that VC-backing significantly decreases the percentage of CPAs in management teams, the average tenure of team members, and the heterogeneity in their tenures. The mean differences between FCEO and BOARDS variables are also significantly negative in Panel A only and Panel B only, respectively.

Further, we use our propensity score matched sub-sample to run regressions of the management quality factor score (MQFVC) as well as individual management quality variables on a dummy equal to one for VC-backed firms and zero for propensity score matched non-VC-backed firms, and a set of controls as described in the previous section. We use the second matching model with nine independent (matching) variables as described earlier. Since in this sub-sample some non-VC-backed firms are used as a match for several VC-backed firms, we make use of weighted least squares (WLS) regressions where the weight for each VC-backed firm is equal to one, whereas the weight for each non-VC-backed firm is equal to the number of times it is used as a match for VC-backed firms in this sub-sample.

The results of these regressions are reported in Table 6. In regressions 1 and 2, MQFVC is the dependent variable and VCDUM is positive and highly significant, implying that VC-backing increases management quality after controlling for firm size, age, internal governance mechanisms, and the endogeneity of VC-backing. Further, the results in Table 6 show that VC-backing (VCDUM) also increases management team size (TSIZE), the percentage of MBAs in the management team (PMBA), the percentage of managers with prior managerial experience (PFTEAM), the percentage of managers with core functional expertise (PCORE), and CEO dominance (FCEO). Next, Table 6 indicates that VC-

backing is associated with a significantly smaller percentage of managers who previously served as law and accounting partners (PLAWACC), a smaller percentage of CPAs (PCPA), a smaller number of team members sitting on the boards of other firms (BOARDS), and shorter average tenures (TENURE).

Overall, our findings in this section indicate that after controlling for the endogeneity of VC-backing, the overall effect of VC-backing on management quality of IPO firms is positive (although it has a negative effect on some individual management quality variables), which supports our hypothesis **H1**.

6.2. The Effect of Management Quality and VC-Backing on the IPO

6.2.1. Management Quality, VC-Backing, and IPO Characteristics

In this section we study the relationship between management quality, VC-backing, and four IPO characteristics: underwriter reputation (REP), defined as the natural logarithm of one plus the lead underwriter's reputation as measured by Loughran and Ritter (2004);[21] underwriting spread (SPREAD), measured as a percent of the offer price; other offering-related expenses (EXP), measured as a percent of the offer size; and IPO offer size (LNOFF), defined as the natural logarithm of the IPO proceeds (in $).

We study the relationship between management quality, VC-backing, and IPO characteristics by running multivariate regressions with various IPO characteristics as dependent variables on VC dummy (VCDUM), management quality factor score (MQF), interaction of management quality factor score with VC dummy (MQF×VCDUM), and a set of controls: the average tenure of management team (TENURE), tenure heterogeneity (TENHET), firm size (LNBVA) and age (LFAGE), proportion of outside directors (ODIR), insider ownership before IPO (INSIDERB), and a dummy equal to one if the CEO is also the Chairman of the board (BOSS). In other words, we estimate regressions of the following type:

$$\begin{aligned} Dependent\ \ variable_i = {} & \beta_0 + \beta_1 VCDUM_i + \beta_2 MQF_i + \beta_3 MQF_i \times VCDUM_i + \beta_4 TENURE_i \\ & + \beta_5 TENHET_i + \beta_6 LNBVA_i + \beta_7 LFAGE_i + \beta_8 ODIR_i + \beta_9 INSIDERB_i + \beta_{10} BOSS_i + \varepsilon_i . \end{aligned} \quad (1)$$

The results of our regressions are presented in Table 7. Regressions 1 and 2 use underwriter reputation as the dependent variable and test our hypotheses **H2**, **H3A**, and **H3B**. First of all, these

[21] This measure takes on values from 0 (least reputable underwriters) to 9 (most reputable underwriters).

regressions show that VC-backed IPOs are associated with significantly higher reputation underwriters; the coefficient estimates of VCDUM are positive and highly significant. Next, these regressions show that management quality has a significantly positive effect on underwriter reputation in non-VC-backed IPOs; the coefficient estimates of management quality factor score (MQF) are positive and highly significant. Finally, the coefficient estimates of MQF×VCDUM are negative and significant but smaller in absolute terms than the coefficient estimates of MQF. This indicates that although the effect of management quality on underwriter reputation in VC-backed IPOs is still positive (the differences between the coefficient estimates of MQF and MQF×VCDUM are positive), the magnitude of this effect for VC-backed IPOs is significantly smaller compared to that for non-VC-backed IPOs. These findings indicate that both management quality and VC-backing have a positive effect on underwriter reputation and that they act as substitutes in this effect, providing support for our hypotheses **H2** and **H3B**.

Regressions 3 and 4 in Table 7 use underwriting spread as the dependent variable and regressions 5 and 6 use other offering-related expenses as the dependent variable. These four regressions test our hypothesis **H4** regarding the relationship between management quality, VC-backing, and the costs of going public. The coefficient estimates of VCDUM are negative and highly significant in all four regressions, suggesting that VC-backed firms are associated with significantly lower costs of going public. Further, the coefficient estimates of MQF are all negative as well; however, they are statistically significant only in the underwriting spread regressions, indicating that management quality has a significantly negative effect on underwriting spread in non-VC-backed IPO firms, but its effect on other offering-related expenses is not significant (though still negative). The coefficient estimates of the interaction term of MQF with VCDUM are all positive; they are smaller in absolute terms (and significant at the 1% level) than the coefficient estimates of MQF in the underwriting spread regressions, but larger in absolute terms (and statistically insignificant) in the other offering-related expenses regressions. This implies that management quality tends to reduce underwriting spread in VC-backed firms as well, but to a smaller extent compared to non-VC-backed firms. These findings indicate that both management quality and VC-backing significantly reduce underwriting spread (providing support for our hypothesis **H4**) and

act as substitutes in this effect. However, only VC-backing significantly reduces other offering-related expenses, whereas management quality does not have a significant effect on such expenses.

Regressions 7 and 8 in Table 7 use IPO offer size as the dependent variable and test our hypothesis **H5**. The coefficient estimates of VCDUM are positive and highly significant indicating that VC-backing significantly increases IPO offer size. The coefficient estimates of MQF are positive and highly significant as well, indicating that management quality significantly increases IPO offer size in non-VC-backed firms. The coefficient estimates of the interaction term of MQF with VCDUM are negative and smaller in absolute terms than the coefficient estimates of MQF; this suggests that management quality significantly increases IPO offer size in VC-backed firms as well, though the magnitude of this effect is smaller compared to that for non-VC-backed firms. These findings indicate that both management quality and VC-backing have a significantly positive effect on IPO offer size (providing support for our hypothesis **H5)** and that they act as substitutes in determining this effect.

Our analysis in this section indicates that both management quality and VC-backing help to certify firm value to the IPO market, and, thereby, have a significant effect on various IPO characteristics. Further, management quality and VC-backing act as substitutes in affecting these IPO characteristics.

6.2.2. Management Quality, VC-Backing, and Other Financial Market Players

In this section we study the relationship between management quality, VC-backing, and financial market players such as financial analysts and institutional investors. We use two variables to proxy for the financial analyst coverage of IPO firms: NUMEST, which is the number of analysts following the IPO firm at the end of the fiscal year of the issue as reported by IBES, and NUMESTALL, which is the number of analysts following the IPO firm at the end of the fiscal year of the issue, where the observations missing in IBES are set equal to zero (in other words, we assume that if the data on analyst coverage of IPO firms are missing in IBES, it means such firms are not covered by financial analysts). [22]

[22] First, the analyst coverage data are not available for the fiscal year prior to the IPO, so that we use the data for the fiscal year of the IPO. Second, IBES reports analyst coverage data for 2,034 firms in our sample at the end of the

We use two additional variables to proxy for the institutional investor participation in IPOs: INSTP and INSTN. The first variable INSTP is the proportion of IPO firm shares held by institutional investors at the end of the first quarter after the IPO, and the second variable INSTN is the number of institutional investors holding IPO firms' shares at the end of the first quarter after the IPO.[23]

We study the relationship between management quality, VC-backing, and the participation of financial market players by running multivariate regressions with various proxies of financial market player participation (as described above) as dependent variables. The independent variables in these regressions are the same as in the regression equation (1) in the previous section (we replace the insider ownership before IPO variable INSIDERB with the insider ownership after IPO variable INSIDERA).

Table 8 shows the results of our regressions. Regressions 1 to 4 are Poisson maximum-likelihood estimations with NUMEST and NUMESTALL as dependent variables.[24] The coefficient estimates of VC dummy are positive and highly significant indicating that VC-backed firms are covered by a significantly greater number of financial analysts immediately after their IPOs. The coefficient estimates of MQF are also all positive and highly significant indicating that management quality has a significantly positive effect on the analyst coverage of non-VC-backed firms. The coefficient estimates of MQF×VCDUM are all negative (and significant in NUMESTALL regressions) and smaller in absolute terms than those of MQF. This suggests that management quality has a significantly positive effect on the analyst coverage of VC-backed firms as well; however the magnitude of this effect is smaller for VC-backed firms compared to that for non-VC-backed firms. These findings indicate that both management quality and VC-backing have a significantly positive effect on analyst coverage (providing support for our hypothesis **H6**) and that management quality and VC-backing act as substitutes in their effect on analyst coverage.

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fiscal year of their IPOs. The remaining 1,206 firms in our sample do not have analyst coverage data in IBES at the end of the fiscal year of their IPOs. The NUMEST variable uses only the data on the 2,034 firms which are covered in IBES. NUMESTALL uses the entire sample of IPO firms, assuming that if a firm is missing analyst coverage data in IBES for the end of the fiscal year of its IPO, such firm is not covered by financial analysts for that period (and we set the number of analysts following such firm equal to zero). This allows us to make use of our full sample of IPO firms; however our empirical results using NUMESTALL are very similar to those using NUMEST.

[23] Similar to the analyst coverage data, the data on institutional holdings are not available for the quarter prior to the IPO, so that we use the data for the quarter after the IPO.

[24] We have also estimated these relationships using OLS regressions with the natural logarithm of one plus the number of analysts as the dependent variable. The results of these regressions were similar to the ones reported here.

Regressions 5 and 6 in Table 8 are logistic regressions using the proportion of IPO firm shares held by institutional investors at the end of the first quarter after the IPO as the dependent variable.[25] Regressions 7 and 8 in Table 8 are Poisson maximum-likelihood estimations using the number of institutional investors holding IPO firm shares at the end of the first quarter after the IPO as the dependent variable.[26] The coefficient estimates of VCDUM in all four regressions are positive and highly significant indicating that VC-backing significantly increases the institutional investor interest in IPO firm shares both in terms of the number of institutional investors and the proportion of IPO firm shares held by institutional investors. The coefficient estimates of MQF are all positive and highly significant indicating that management quality has a positive effect on institutional interest in non-VC-backed IPO firm shares. Finally, the coefficient estimates of MQF×VCDUM are all negative and significant (except for regression 5 in Table 8) and smaller in absolute terms compared to the coefficient estimates of MQF. This suggests that management quality has a positive effect on institutional interest in VC-backed IPO shares as well, though the magnitude of this effect is significantly smaller for VC-backed IPOs compared to that for non-VC-backed IPOs. These findings indicate that management quality and VC-backing have a significantly positive effect on institutional investor interest (providing support for our hypothesis **H6**) and that management quality and VC-backing act as substitutes in their effect on institutional investor interest.

6.2.3. Management Quality, VC-Backing, and Firm Age at IPO

In this section we study the relationship between management quality, VC-backing, and firm age at IPO. We test our hypothesis **H7** that management quality is associated with younger firm age at IPO in the framework of a survival-time model. We consider firm age at IPO as the length of time a firm survives as a private company. In particular, we use accelerated failure time (AFT) maximum likelihood

[25] We make use of logistic regressions here since the dependent variable is a proportion bounded between 0 and 1. See, e.g., Hox (2002), who shows that logistic regressions are the appropriate estimation method when a dependent variable is a proportion bounded between 0 and 1.

[26] We have also estimated regressions 7 and 8 in Table 8 using OLS regressions with the natural logarithm of one plus the number of institutional investors holding IPO firm shares at the end of the first quarter after the IPO as the dependent variable. The results of these regressions were similar to the ones reported here.

estimation model with lognormal and exponential distributions.[27] The dependent variable in this estimation is the firm age (number of years from founding year to IPO year). The independent variables are the VC dummy (VCDUM), management quality factor score (MQFAGE), interaction of management quality factor score with VC dummy (MQFAGE×VCDUM), and a set of control variables such as the firm size (LNBVA), proportion of outside directors (ODIR), insider ownership before IPO (INSIDERB), and a dummy variable equal to one if the CEO is also the Chairman of the board of directors (BOSS).

The results of our estimations are reported in Table 9. Regressions 1 to 3 are estimated using the maximum-likelihood technique assuming a lognormal distribution, while regressions 4 to 6 are estimated using the maximum-likelihood technique assuming an exponential distribution. The coefficient estimates of VCDUM are negative and highly significant in all six regressions suggesting that VC-backing significantly reduces the time a firm survives as a private company; in other words, it significantly reduces firm age at IPO. The coefficient estimates of MQFAGE are negative in all six regressions as well (and significant in regressions 2, 3, and 6) indicating that management quality tends to reduce non-VC-backed firm age at IPO. Finally, the coefficient estimates of MQFAGE×VCDUM are negative in all six regressions (and significant in regressions 1, 4, and 5) implying that management quality tends to reduce VC-backed firm age at IPO as well, and the effect of management quality on firm age at IPO is greater in VC-backed firms compared to non-VC-backed firms. These findings show that both management quality and VC-backing have a negative effect on firm age at IPO, and they act as complements in this effect. Thus VC-backed firms with higher quality managements tend to be the youngest firms at the time of IPO.

6.2.4. Management Quality, VC-Backing, and Financial Market Valuation

In this section we study the relationship between management quality, VC-backing, and IPO firm valuation both in the IPO market as well as in the secondary market immediately after the IPO. We measure IPO firm valuation using Tobin's Q, which is the ratio of the market value of assets over the

[27] We have also estimated this model with a Weibull distribution. The results were similar to the ones reported here.

book value of assets, where the market value of assets is equal to the book value of assets minus the book value of equity plus the product of the number of shares outstanding and share price. We measure firm valuation in the IPO market by using the IPO offer price as the share price in the above definition (QOP). We measure IPO firm valuation in the secondary market by using either the first trading day closing price as the share price in the above definition (QFTD) or the share price at the end of the IPO issue month (QIM). We also construct industry-adjusted Q ratios (QOPADJ, QFTDADJ, and QIMADJ) by subtracting contemporaneous 2-digit SIC code industry median Q ratios from the above proxies. The book value of assets and the book value of equity both for IPO firms and industry peers are taken from the first available post-IPO quarter on Compustat. The number of shares outstanding for industry peers is taken from the first available post-IPO quarter on Compustat as well and the share price of industry peers is the IPO month closing price from Compustat. To construct QIM and QIMADJ, we use the number of IPO firm outstanding shares from the first available post-IPO quarter on Compustat and the issue month IPO firm closing price from Compustat. To construct QOP, QOPADJ, QFTD, and QFTDADJ we use the number of IPO firm outstanding shares and the first trading day IPO firm closing price from CRSP (IPO offer price is taken from the SDC/Global New Issues Database).

Regressions 1 to 6 in Table 10 present the results of our valuation analysis with various definitions of Q ratios (as described above) used as dependent variables. The independent variables are the same as in the regression equation (1). The coefficient estimates of VCDUM are positive and highly significant in all six regressions indicating that VC-backing significantly increases IPO firm valuation both in the IPO market and in the secondary market. The coefficient estimates of MQF are positive and significant in all six regressions as well suggesting that management quality significantly increases non-VC-backed firm valuation in both the IPO and the secondary market. Finally, the coefficient estimates of MQF×VCDUM are all positive and significant in regressions 3 to 6, which use secondary market valuation proxies as dependent variables; however such coefficient estimates are not significant in regressions 1 and 2 which use IPO market valuation proxies as dependent variables. These suggests that management quality significantly increases IPO firm valuations both in the IPO and in the secondary

market for both non-VC-backed and VC-backed IPO firms providing support for our hypothesis **H8**. These findings also suggest that the effect of management quality on IPO firm secondary market valuations is significantly larger in VC-backed firms compared to that in non-VC backed firms, so that management quality and VC-backing act as complements in their effect on secondary market valuations. However, the effect of management quality on IPO market valuations is roughly the same both for non-VC-backed and VC-backed IPO firms.

In this section we also study the relationship between management quality, VC-backing, and IPO underpricing. We measure IPO underpricing as the percentage difference between the first trading day's closing price and the IPO offer price (UNDERPR). Regressions 7 and 8 in Table 10 are OLS regressions using UNDERPR as the dependent variable. The independent variables are the same as in the valuation regressions above. The coefficient estimates of VCDUM in both regressions are positive and highly significant, indicating (consistent with previous literature) that VC-backed IPOs are associated with significantly larger underpricing. The coefficient estimates of MQF are not statistically significant indicating that management quality does not significantly influence the IPO underpricing of non-VC-backed firms. The coefficient estimates of MQF×VCDUM are positive and highly significant suggesting that management quality has a significantly positive effect on the IPO underpricing of VC-backed firms.

These findings are consistent with our valuation analysis: since the effect of management quality on IPO market valuations is roughly the same in both non-VC-backed and VC-backed firms, while the effect of management quality on secondary market valuations is significantly greater in VC-backed firms compared to non-VC-backed firms, the effect of management quality on IPO underpricing can be expected to be significantly greater in VC-backed firms (given that underpricing reflects the difference between secondary and IPO market valuations).

6.3. The Effect of Management Quality and VC-Backing on Post-IPO Operating Performance

In this section we study the relationship between management quality, VC-backing, and the post-IPO operating performance of firms going public. We use two measures of operating performance: ROA

and OIBD/Assets, where ROA is the ratio of net income (Compustat item 172) over the book value of total assets (item 6), and OIBD is the operating income before depreciation plus interest income (Compustat items 13 and 62, respectively). We construct industry-adjusted ROA and OIBD/Assets by subtracting the respective 2-digit SIC code industry medians.

We test our hypotheses regarding the relationship between management quality, VC-backing, and post-IPO operating performance by splitting our sample into four groups (A, B, C, and D): first into two groups of VC-backed and non-VC-backed firms, and then within each of these two groups by the median management quality factor score (MQF). Firms with above median values of MQF are high management quality firms and firms with below median values of MQF are low management quality firms. Thus, in group A, we place VC-backed firms with high quality managers (firms with above median MQF within VC-backed firms); in group B, we place VC-backed firms with low quality managers (firms with below median MQF within VC-backed firms); in group C we place non-VC-backed firms with high quality managers (firms with above median MQF within non-VC-backed firms); and in group D we place non-VC-backed firms with low quality managers (firms with below median MQF within non-VC-backed firms). We then compare the operating performance across these groups. Panel A of Table 11 presents the industry-adjusted median levels of ROA and OIBD/Assets of the four groups and the results of Wilcoxon rank-sum tests of differences in medians between these four groups.

Panel A of Table 11 shows that VC-backed firms have lower median ROA ratios than non-VC-backed firms in all years. These differences are even larger within the group of high management quality firms where VC-backed firms significantly underperform non-VC-backed firms in all years except year 4. Within the group of low management quality firms, VC-backed firms significantly underperform non-VC-backed firms in years -1, 0, and 4. Further, within the group of VC-backed firms, high management quality firms significantly underperform low management quality firms in all years except year 4. Finally, within the group of non-VC-backed firms, high management quality firms significantly underperform low management quality firms in years -1 and 4. The results are very similar using OIBD/Assets ratios.

These findings indicate that both management quality and VC-backing have a negative effect on the level of operating performance of IPO firms. Clearly the effect of going public at a younger age (VC-backed firms and firms with higher management quality go public earlier in their life cycle as demonstrated in section 6.2.3) dominates the effect of higher quality managers and VCs selecting better projects and implementing them more ably. Indeed VC-backed firms with high quality managements significantly underperform their industry peers in the year prior to the IPO; the median industry-adjusted level of ROA of such firms is -24.38%. Although the performance of both VC-backed firms and high management quality firms improves in the years after the IPO (i.e., the severity of underperformance diminishes over time) compared to non-VC-backed firms and firms with low management quality, they still lag behind their industry peers even after five years since their IPO.[28]

We now turn to our analysis of the effects of management quality and VC-backing on the *changes* in operating performance of a firm in the years following its IPO. The underperformance of higher management quality and VC-backed firms that we documented above may be due to their accessing the IPO market earlier in their life cycle (as we discussed in section 3.3) so that analyzing the changes in operating performance may be a more appropriate way to assess the effects of management quality and VC-backing on post-IPO performance. To perform this analysis, we construct the changes in our operating performance measures by subtracting the industry-adjusted performance measures in the year prior to the issue (year -1) from the industry-adjusted performance measures in subsequent years (years 0 through 5). Panel B of Table 11 presents the changes in industry-adjusted levels of ROA and OIBD/Assets of the four groups of firms in the five years after the IPO and the results of Wilcoxon rank-sum tests of differences in medians across these four groups.

Our results show that within both high and low management quality firms, VC-backed firms experience significantly greater improvements in their operating performance in the years after the IPO compared to non-VC-backed firms (non-VC-backed firms in fact experience a deterioration in their post-

[28] Such underperformance can also be explained by our findings (which are not documented in this paper but are available from the authors upon request) that VC-backed firms and firms with higher quality managements invest significantly more than their industry peers and implement larger acquisitions in the five-year span after their IPO.

IPO operating performance). Indeed, the changes in performance measures of VC-backed firms are all positive, whereas the changes in performance measures of non-VC-backed firms are negative. Further, within VC-backed firms, firms with higher management quality experience a significantly larger improvement in performance compared to firms with lower management quality, and within non-VC-backed firms, firms with higher management quality experience a significantly smaller deterioration in performance in the years 0, 1, and 2 after the issue compared to firms with lower management quality.

These findings indicate that both management quality and VC-backing significantly improve the post-IPO operating performance of IPO firms (measured by changes in post-IPO operating performance), which supports our hypotheses **H9** and **H10**. The effect of management quality on such performance is stronger in VC-backed firms compared to non-VC-backed firms, which suggests that management quality and VC-backing act as complements in their ability to improve post-issue operating performance.

7. Conclusion

In this paper we have used hand-collected data on the management quality of a large sample of 3,240 entrepreneurial firms going public during 1993-2004 to conduct the first large-sample study of the relationship between VC-backing and management quality and the effect of these two variables on a firm's IPO characteristics and valuation, and post-IPO operating performance.

Our empirical findings are as follows. First, we find that overall VC-backed firms have higher quality management teams compared to non-VC-backed firms. In particular, VC-backed firms have a greater percentage of management team members with MBA degrees, a greater percentage of managers with prior managerial experience, a greater percentage of managers in core functional areas (operations and production, sales and marketing, R&D, and finance), and larger management teams compared to non-VC-backed firms. At the same time, VC-backed firms have lower percentages of management team members who are CPAs and who have prior managerial experience at law and accounting firms; further, their managers have shorter average tenures and smaller heterogeneity in these tenures.

Second, we find that both management quality and VC-backing have a positive effect on underwriter reputation and IPO offer size, and a negative effect on underwriting spread and other offering-related expenses. Further, management quality and VC-backing act as substitutes in their effect on the above IPO characteristics. Third, we find that both management quality and VC-backing have a positive effect on the analyst coverage of firms immediately after their IPO and on institutional investor interest in IPO firm shares. We also find that management quality and VC-backing act as substitutes in their effect on the extent of participation of the above-mentioned financial market players in IPOs. Fourth, we find that firms with higher management quality and firms backed by VCs are able to access the financial market earlier in their life cycle (at a younger age). Fifth, we find that both management quality and VC-backing have a positive effect on firm valuations both in the IPO market and in the secondary market immediately after the issue and they act as complements in affecting firm valuations.

Our study of the relationship between management quality, VC-backing, and firms' post-IPO operating performance reveals that although both high management quality and VC-backed firms are associated with lower levels of post-IPO operating performance (perhaps due to going public at a younger age and due to higher levels of post-IPO investment compared to firms with lower management quality or non-VC backed firms), we find that management quality and VC-backing positively affect the changes in a firm's post-issue operating performance. We also find that management quality and VC-backing act as complements in their effect on these changes in post-IPO operating performance.

The above findings add to our knowledge of the role played by VCs on the management quality of firms going public, and the joint effect of management quality and VC-backing on various aspects of a firm's IPO, its interactions with the financial market, its firm valuation, and its post-IPO operating performance. We find that management quality is an important determinant of firm quality even in VC-backed firms. Further, while in some cases management quality acts as a substitute for VC-backing, in other cases it acts as a complement to VC-backing.

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Table 1. Number of IPOs by year

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Total	827	646	579	875	638	392	542	389	137	173	131	307	5,636
REITs	48	40	7	6	26	15	2	0	1	5	9	31	190
Closed-end funds	110	39	2	3	7	23	29	3	37	76	45	50	424
Unit IPOs	87	103	67	84	46	14	10	5	8	8	2	14	448
Spin-offs/Equity carve-outs	117	76	47	64	45	28	49	41	23	16	6	16	528
Financials	41	27	34	57	50	55	40	10	11	13	17	36	391
Foreign	28	36	30	71	61	33	24	26	7	7	3	26	352
Former LBOs	12	8	5	6	17	6	0	0	0	0	0	0	54
Information on management not available	4	2	0	0	3	0	0	0	0	0	0	0	9
Final sample	380	315	387	584	383	218	388	304	50	48	49	134	3,240

Table 2. Selected statistics related to a common factor analysis of eight measures of management quality and reputation

The sample consists of 3,240 initial public offerings conducted between 1993 and 2004. MQF is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. MQFVC is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, and industry-dummies-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. MQFAGE is the management quality factor score obtained using common factor analysis on the firm-size-, industry-dummies, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TSIZE is the size of a firm's management team, defined as the number of executive officers with a rank of vice president or higher. MBA is the number of management team members with MBA degrees. FTEAM is the number of management team members who have served as executive officers and/or vice presidents prior to joining the IPO firm. CORE is the number of management team members who have core functional expertise, namely, holding positions in operations and production, sales and marketing, research and development, and finance. LAWACC is the number of management team members who have previously been partners in a law or accounting firm. CPA is the number of management team members who are Certified Public Accountants. FCEO is the ratio of CEO salary and bonus to the average salary and bonus of other management team members in the fiscal year preceding the IPO. BOARDS is the number of other companies' boards that management team members sit on.

Panel A. Estimated communalities of eight management quality measures.

Common factor	TSIZE	MBA	FTEAM	CORE	LAWACC	CPA	FCEO	BOARDS	Total
MQF	0.5402	0.0854	0.3209	0.4117	0.0369	0.0355	0.0054	0.0136	1.4496
MQFVC	0.5416	0.0984	0.3339	0.4220	0.0374	0.0336	0.0057	0.0133	1.4859
MQFAGE	0.5280	0.0910	0.3025	0.4119	0.0356	0.0355	0.0112	0.0156	1.4313

Panel B. Eigenvalues of the reduced correlation matrices.

Common factor	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
MQF	1.62246	0.19447	0.07085	0.03398	-0.02341	-0.09160	-0.12785	-0.22920
MQFVC	1.66349	0.20055	0.07002	0.03098	-0.03190	-0.09454	-0.12850	-0.22423
MQFAGE	1.59968	0.18997	0.10357	0.04299	-0.04292	-0.09964	-0.13039	-0.23200

Panel C. Correlations between the common factors and eight management quality measures.

Common factor	TSIZE	MBA	FTEAM	CORE	LAWACC	CPA	FCEO	BOARDS
MQF	0.9403	0.3710	0.7011	0.7932	0.0674	0.1227	0.0196	0.0679
MQFVC	0.9351	0.4000	0.7161	0.8020	0.0609	0.0975	0.0126	0.0636
MQFAGE	0.9363	0.3791	0.6771	0.8034	0.0731	0.1286	0.0053	0.0695

Panel D. Descriptive statistics of the common factors extracted from eight management quality measures.

Common factor	Maximum	Third quartile	Median	First quartile	Minimum	Mean
MQF	4.511	0.480	-0.071	-0.579	-2.463	0.000
MQFVC	4.560	0.479	-0.079	-0.596	-2.420	0.000
MQFAGE	4.461	0.472	-0.075	-0.582	-2.359	0.000

Table 3. Summary statistics and univariate tests

The sample consists of 3,240 IPOs conducted between 1993 and 2004. TSIZE is the size of a firm's management team, defined as the number of executive officers with a rank of vice president or higher. PMBA is the percentage of a firm's management team with MBA degrees. PFTEAM is the percentage of a firm's management team who have served as executive officers and/or vice presidents prior to joining the firm. PCORE is the percentage of a firm's management team who have core functional expertise, namely, holding positions in operations and production, sales and marketing, R&D, and finance. PLAWACC is the percentage of a firm's management team who have previously been partners in a law or accounting firm. PCPA is the percentage of a firm's management team who are Certified Public Accountants. FCEO is the ratio of CEO salary and bonus to the average salary and bonus of other management team members in the fiscal year preceding the IPO. BOARDS is the number of other companies' boards that management team members sit on. TENURE is the average number of years a firm's management team members have been with the firm. TENHET is the coefficient of variation of the team members' tenures. MQFVC is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, and industry-dummies-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. LNBVA is the natural logarithm of the book value of the firm's assets immediately before the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the percentage of outside directors in the board of directors. INSIDERB and INSIDERA are the proportions of voting power owned by firm officers and directors immediately prior to and after the IPO, respectively. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. The results of *t*-tests for the difference in means and non-parametric Wilcoxon rank-sum tests for the difference in medians are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	VC-backed IPOs						Non-VC-backed IPOs						Difference in	Difference in
	N	Min	Mean	Median	Max	SD	N	Min	Mean	Median	Max	SD	means (*t*-statistic)	medians (*z*-statistic)
TSIZE	1,851	1	6.782	6	19	2.515	1,389	1	5.628	5	20	2.547	1.154	1
													(12.86)***	(14.02)***
PMBA	1,851	0	0.156	0.111	1	0.187	1,389	0	0.078	0	0.800	0.149	0.079	0.111
													(12.89)***	(14.02)***
PFTEAM	1,851	0	0.554	0.571	1	0.263	1,389	0	0.454	0.429	1	0.300	0.100	0.143
													(10.12)***	(10.01)***
PCORE	1,851	0	0.592	0.600	1	0.202	1,389	0	0.516	0.500	1	0.216	0.076	0.100
													(10.25)***	(10.35)***
PLAWACC	1,851	0	0.024	0	1	0.075	1,389	0	0.029	0	0.750	0.084	-0.005	0
													(-1.95)*	(-1.07)
PCPA	1,851	0	0.066	0	1	0.106	1,389	0	0.103	0	0.833	0.138	-0.037	0
													(-8.72)***	(-7.49)***
FCEO	1,851	0	1.293	1.263	4.521	0.461	1,389	0	1.289	1.193	4.436	0.551	0.004	0.070
													(0.25)	(2.85)***
BOARDS	1,851	0	0.527	0	10	1.069	1,389	0	0.543	0	9	1.165	-0.016	0
													(-0.41)	(0.96)
TENURE	1,851	1	4.431	3.286	30	3.512	1,389	1	5.608	4.200	30.125	4.591	-1.177	-0.914
													(-8.27)***	(-5.83)***
TENHET	1,851	0	0.689	0.573	16.408	0.868	1,389	0	1.224	0.622	22.854	2.128	-0.535	-0.049
													(-9.79)***	(-3.27)***
MQFVC	1,851	-2.416	0.131	0.068	4.560	0.895	1,389	-2.420	-0.174	-0.242	3.920	0.796	0.305	0.310
													(10.07)***	(10.44)***
LNBVA	1,851	12.683	17.242	17.024	22.969	1.447	1,389	8.553	16.760	16.817	23.653	1.808	0.482	0.207
													(8.42)***	(7.06)***
LFAGE	1,851	0	2.044	1.946	5.063	0.779	1,389	0	2.158	2.197	5.124	1.034	-0.114	-0.251
													(-3.60)***	(-4.51)***
ODIR	1,851	0	0.697	0.714	1	0.179	1,389	0	0.477	0.500	1	0.268	0.221	0.214
													(28.07)***	(24.86)***
INSIDERB	1,851	0	0.572	0.59	1	0.262	1,389	0	0.678	0.756	1	0.304	-0.106	-0.166
													(-10.62)***	(-12.40)***
INSIDERA	1,851	0	0.427	0.438	1	0.206	1,389	0	0.462	0.491	1	0.231	-0.034	-0.053
													(-4.48)***	(-4.93)***
BOSS	1,851	0	0.558	1	1	0.497	1,389	0	0.694	1	1	0.461	-0.136	0
													(-7.98)***	(-7.90)***

Table 4. Relationship between VC-backing and management quality

The sample consists of 3,240 IPOs conducted between 1993 and 2004 (1,851 VC-backed and 1,389 non-VC-backed). This table presents multivariate ordinary least squares (OLS) regressions of management quality variables on VC dummy (VCDUM) and other control variables. MQFVC is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, and industry-dummies-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TSIZE is the size of a firm's management team, defined as the number of executive officers with a rank of vice president or higher. PMBA is the percentage of a firm's management team with MBA degrees. PFTEAM is the percentage of a firm's management team who have served as executive officers and/or vice presidents prior to joining the firm. PCORE is the percentage of a firm's management team who have core functional expertise, namely, holding positions in operations and production, sales and marketing, R&D, and finance. PLAWACC is the percentage of a firm's management team who have previously been partners in a law or accounting firm. PCPA is the percentage of a firm's management team who are Certified Public Accountants. FCEO is the ratio of CEO salary and bonus to the average salary and bonus of other management team members in the fiscal year preceding the IPO. BOARDS is the number of other companies' boards that management team members sit on. TENURE is the average number of years a firm's management team members have been with the firm. TENHET is the coefficient of variation of the team members' tenures. VCDUM is a dummy variable equal to one for VC-backed IPOs and zero for non-VC-backed IPOs. LNBVA is the natural logarithm of the book value of assets immediately prior to the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the proportion of outside directors in the board of directors. INSIDERB is the proportion of voting power owned by firm officers and directors immediately prior to the IPO. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	MQFVC	MQFVC	TSIZE	PMBA	PFTEAM	PCORE	PLAWACC	PCPA	FCEO	BOARDS	TENURE	TENHET
Intercept	0.129	0.514	-5.001	0.247	0.282	1.146	0.138	0.258	0.234	-0.974	0.312	-1.136
	(0.76)	(0.58)	(-2.10)**	(1.43)	(1.08)	(5.68)***	(1.72)*	(2.12)**	(0.48)	(-0.87)	(0.10)	(-0.80)
VCDUM	0.291	0.347	0.596	0.049	0.053	0.062	-0.007	-0.026	-0.005	-0.029	-0.578	-0.125
	(8.54)***	(9.51)***	(6.01)***	(6.78)***	(4.85)***	(7.41)***	(-2.08)**	(-5.09)***	(-0.23)	(-0.62)	(-4.49)***	(-2.12)**
LNBVA	-0.019	-0.032	0.607	-0.000	0.005	-0.032	0.004	-0.002	0.079	0.073	0.369	-0.022
	(-1.98)**	(-3.01)***	(21.14)***	(-0.16)	(1.48)	(-12.97)***	(4.50)***	(-1.30)	(13.56)***	(5.43)***	(9.90)***	(-1.31)
LFAGE	0.021	0.021	-0.058	-0.012	-0.113	0.002	-0.002	-0.004	0.074	-0.066	2.523	0.574
	(1.19)	(1.17)	(-1.16)	(-3.45)***	(-20.62)***	(0.45)	(-1.00)	(-1.59)	(7.30)***	(-2.81)***	(38.95)***	(19.22)***
ODIR	0.077	0.117	-0.116	0.031	0.110	0.062	-0.003	-0.028	-0.022	0.033	-1.465	-0.936
	(1.08)	(1.61)	(-0.59)	(2.15)**	(5.11)***	(3.71)***	(-0.48)	(-2.79)***	(-0.56)	(0.35)	(-5.71)***	(-7.92)***
INSIDERB	-0.134	-0.148	-0.296	-0.007	-0.040	-0.045	0.002	0.008	0.070	-0.289	0.672	0.613
	(-2.42)**	(-2.60)***	(-1.92)*	(-0.60)	(-2.36)**	(-3.49)***	(0.29)	(0.99)	(2.25)**	(-3.99)***	(3.36)***	(6.65)***
BOSS	0.041	0.039	0.141	-0.007	-0.005	-0.001	-0.007	-0.008	0.055	0.172	0.188	0.124
	(1.29)	(1.23)	(1.63)	(-1.15)	(-0.49)	(-0.11)	(-2.27)**	(-1.79)*	(3.15)***	(4.22)***	(1.67)*	(2.39)**
Industry dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240	3,240
R^2	0.0343	0.0414	0.2099	0.1070	0.2091	0.1458	0.0408	0.0721	0.1321	0.0469	0.4552	0.2218

Table 5. Propensity score matching analysis of the relationship between VC-backing and management quality: univariate tests

This table reports the mean differences in management quality variables between VC-backed and propensity score matched non-VC-backed IPO firms. Propensity score matching is implemented using the one-to-one "nearest neighbors" methodology with common support. All matching is conducted with replacement. Standard errors are bootstrapped standard errors using 50 replications. Confidence intervals are 95% percent selection bias adjusted confidence intervals. MQFVC is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, and industry-dummies-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TSIZE is the size of a firm's management team, defined as the number of executive officers with a rank of vice president or higher. PMBA is the percentage of a firm's management team with MBA degrees. PFTEAM is the percentage of a firm's management team who have served as executive officers and/or vice presidents prior to joining the firm. PCORE is the percentage of a firm's management team who have core functional expertise, namely, holding positions in operations and production, sales and marketing, R&D, and finance. PLAWACC is the percentage of a firm's management team who have previously been partners in a law or accounting firm. PCPA is the percentage of a firm's management team who are Certified Public Accountants. FCEO is the ratio of CEO salary and bonus to the average salary and bonus of other management team members in the fiscal year preceding the IPO. BOARDS is the number of other companies' boards that management team members sit on. TENURE is the average number of years a firm's management team members have been with the firm. TENHET is the coefficient of variation of the team members' tenures. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	MQFVC	TSIZE	PMBA	PFTEAM	PCORE	PLAWACC	PCPA	FCEO	BOARDS	TENURE	TENHET
Panel A. Propensity score matching is implemented using the following variables: ln(offer size), 2-digit SIC code dummies, IPO offer year dummies, IPO firm headquarter state dummies, ln(underwriter rank). The sample consists of 1,830 VC-backed firms each of which is matched with one non-VC-backed firm with the closest propensity score.											
Difference in means	0.248	0.208	0.046	0.090	0.064	-0.004	-0.018	-0.081	-0.003	-1.460	-0.397
Standard error	0.068	0.156	0.012	0.018	0.020	0.004	0.009	0.039	0.082	0.315	0.097
z-statistic	3.67***	1.33	3.91***	5.13***	3.16***	-1.02	-1.95*	-2.04**	-0.03	-4.64***	-4.10***
Confidence interval	[0.116,0.381]	[-0.098,0.514]	[0.023,0.070]	[0.056,0.124]	[0.024,0.103]	[-0.012,0.004]	[-0.035,0.000]	[-0.158,-0.003]	[-0.164,0.158]	[-2.077,-0.843]	[-0.586,-0.207]
Panel B. Propensity score matching is implemented using the following variables: ln(offer size), 2-digit SIC code dummies, IPO offer year dummies, IPO firm headquarter state dummies, ln(underwriter rank), book value of equity per share over offer price, sales per share over offer price, total book value of assets per share over offer price, dummy for positive earning. The sample consists of 1,646 VC-backed firms each of which is matched with one non-VC-backed firm with the closest propensity score.											
Difference in means	0.172	0.179	0.031	0.057	0.044	-0.006	-0.039	0.056	-0.255	-1.053	-0.186
Standard error	0.087	0.226	0.016	0.025	0.017	0.007	0.009	0.047	0.115	0.333	0.079
z-statistic	1.98**	0.79	1.88*	2.25**	2.62***	-0.87	-4.20***	1.19	-2.22**	-3.16***	-2.36**
Confidence interval	[0.002,0.343]	[-0.263,0.622]	[-0.001,0.063]	[0.007,0.106]	[0.011,0.076]	[-0.020,0.008]	[-0.057,-0.021]	[-0.036,0.148]	[-0.481,0.029]	[-1.707,-0.400]	[-0.341,-0.031]

Table 6. Propensity score matching analysis of the relationship between VC-backing and management quality: multivariate analysis

The sample consists of 1,646 VC-backed IPOs and 1,126 matching non-VC-backed IPOs conducted between 1993 and 2004. This table presents multivariate weighted least squares (WLS) regressions of management quality variables on VC dummy (VCDUM) and other control variables. The weight for each VC-backed firm is equal to one, whereas the weight for each non-VC-backed firm is equal to the number of times it is used as a match for VC-backed firms in this sub-sample. Propensity score matching is implemented using the one-to-one "nearest neighbors" methodology with common support. Propensity score matching variables are ln(offer size), 2-digit SIC code dummies, IPO offer year dummies, IPO firm headquarter state dummies, ln(underwriter rank), book value of equity per share over offer price, sales per share over offer price, total book value of assets per share over offer price, dummy for positive earning. All matching is conducted with replacement. MQFVC is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, and industry-dummies-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TSIZE is the size of a firm's management team, defined as the number of executive officers with a rank of vice president or higher. PMBA is the percentage of a firm's management team with MBA degrees. PFTEAM is the percentage of a firm's management team who have served as executive officers and/or vice presidents prior to joining the firm. PCORE is the percentage of a firm's management team who have core functional expertise, namely, holding positions in operations and production, sales and marketing, R&D, and finance. PLAWACC is the percentage of a firm's management team who have previously been partners in a law or accounting firm. PCPA is the percentage of a firm's management team who are Certified Public Accountants. FCEO is the ratio of CEO salary and bonus to the average salary and bonus of other management team members in the fiscal year preceding the IPO. BOARDS is the number of other companies' boards that management team members sit on. TENURE is the average number of years a firm's management team members have been with the firm. TENHET is the coefficient of variation of the team members' tenures. VCDUM is a dummy variable equal to one for VC-backed IPOs and zero for non-VC-backed IPOs. LNBVA is the natural logarithm of the book value of assets immediately prior to the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the proportion of outside directors in the board of directors. INSIDERB is the proportion of voting power owned by firm officers and directors immediately prior to the IPO. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	MQFVC	MQFVC	TSIZE	PMBA	PFTEAM	PCORE	PLAWACC	PCPA	FCEO	BOARDS	TENURE	TENHET
Intercept	0.900	1.048	-1.751	0.278	1.086	1.237	-0.066	0.249	-1.147	-0.377	-13.825	1.298
	(4.55)***	(1.11)	(-0.70)	(1.54)	(4.24)***	(6.55)***	(-1.02)	(2.00)**	(-2.35)**	(-0.29)	(-4.70)***	(1.35)
VCDUM	0.174	0.151	0.176	0.030	0.023	0.027	-0.008	-0.033	0.088	-0.149	-0.487	0.012
	(5.01)***	(4.35)***	(1.91)*	(4.54)***	(2.42)**	(3.93)***	(-3.32)***	(-7.04)***	(4.90)***	(-3.11)***	(-4.48)***	(0.34)
LNASS	-0.058	-0.088	0.512	-0.014	-0.004	-0.053	0.004	-0.009	0.102	0.157	0.541	-0.030
	(-5.34)***	(-7.49)***	(16.51)***	(-6.05)***	(-1.30)	(-22.74)***	(4.87)***	(-5.48)***	(16.78)***	(9.76)***	(14.77)***	(-2.46)**
LNFAGE	-0.020	-0.008	-0.094	-0.019	-0.108	-0.009	-0.007	-0.016	0.136	-0.145	2.599	0.392
	(-0.99)	(-0.35)	(-1.63)	(-4.48)***	(-18.08)***	(-2.02)**	(-4.63)***	(-5.60)***	(12.03)***	(-4.82)***	(38.10)***	(17.54)***
ODIR	0.041	0.162	-0.252	0.025	0.187	0.110	0.019	-0.023	0.018	-0.459	-1.148	-0.657
	(0.51)	(2.01)**	(-1.18)	(1.59)	(8.47)***	(6.80)***	(3.35)***	(-2.10)**	(0.44)	(-4.12)***	(-4.55)***	(-7.94)***
INSIDERB	0.073	0.039	0.044	-0.023	0.014	-0.037	0.009	0.003	0.077	0.188	0.545	0.483
	(1.26)	(0.67)	(0.29)	(-2.07)**	(0.91)	(-3.11)***	(2.19)**	(0.44)	(2.55)**	(2.34)**	(2.98)***	(8.07)***
BOSS	0.062	0.059	0.121	0.005	0.023	0.032	0.005	0.017	0.037	0.245	0.092	0.082
	(1.81)*	(1.70)*	(1.33)	(0.71)	(2.49)**	(4.63)***	(1.96)*	(3.64)***	(2.09)**	(5.16)***	(0.86)	(2.33)**
Industry dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292
R^2	0.0207	0.0630	0.1639	0.1203	0.1983	0.2374	0.0651	0.1182	0.2215	0.1128	0.4634	0.1861

Table 7. Relationship between VC-backing, management quality, and IPO characteristics

The sample consists of 3,240 IPOs conducted between 1993 and 2004. REP is the natural logarithm of one plus the lead underwriter's reputation as measured by Loughran and Ritter (2004). SPREAD is the underwriting spread as a percentage of the offer price. EXP is the other offering-related expenses as a percentage of the offer size. LNOFF is the natural logarithm of the IPO issue offer size. VCDUM is a dummy variable equal to one for VC-backed IPOs and zero for non-VC-backed IPOs. MQF is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TENURE is the average number of years management team members have been with a firm. TENHET is the coefficient of variation of the team members' tenures. LNBVA is the natural logarithm of the book value of assets immediately prior to the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the proportion of outside directors in the board of directors. INSIDERB is the proportion of voting power owned by firm officers and directors immediately prior to the IPO. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	REP	REP	SPREAD	SPREAD	EXP	EXP	LNOFF	LNOFF
Intercept	-0.275	-0.902	13.184	13.482	11.545	13.234	9.963	9.603
	(-4.60)***	(-3.07)***	(80.64)***	(16.58)***	(20.91)***	(4.77)***	(69.65)***	(13.61)***
VCDUM	0.217	0.175	-0.372	-0.279	-0.454	-0.441	0.284	0.221
	(18.19)***	(14.26)***	(-11.44)***	(-8.20)***	(-4.13)***	(-3.80)***	(9.96)***	(7.50)***
MQF	0.085	0.092	-0.222	-0.230	-0.101	-0.118	0.191	0.201
	(8.46)***	(9.30)***	(-8.09)***	(-8.46)***	(-1.09)	(-1.27)	(7.93)***	(8.51)***
MQF×VCDUM	-0.036	-0.044	0.136	0.146	0.170	0.186	-0.117	-0.127
	(-2.86)***	(-3.60)***	(3.96)***	(4.28)***	(1.46)	(1.59)	(-3.88)***	(-4.29)***
TENURE	-0.003	-0.001	0.002	0.000	-0.022	-0.032	0.001	0.008
	(-1.61)	(-0.75)	(0.37)	(0.03)	(-1.40)	(-1.97)**	(0.30)	(1.82)*
TENHET	0.008	0.008	-0.026	-0.028	-0.033	-0.043	-0.010	-0.008
	(2.28)**	(2.15)**	(-2.56)**	(-2.77)***	(-0.96)	(-1.23)	(-1.13)	(-0.93)
LNBVA	0.122	0.131	-0.317	-0.335	-0.399	-0.383	0.418	0.421
	(35.68)***	(36.40)***	(-33.84)***	(-33.69)***	(-12.63)***	(-11.27)***	(51.03)***	(48.79)***
LFAGE	-0.000	-0.002	-0.032	-0.024	-0.167	-0.148	-0.075	-0.071
	(-0.05)	(-0.28)	(-1.53)	(-1.11)	(-2.35)**	(-2.03)**	(-4.04)***	(-3.85)***
ODIR	0.114	0.097	-0.286	-0.244	-0.787	-0.674	0.257	0.237
	(4.56)***	(3.94)***	(-4.20)***	(-3.58)***	(-3.42)***	(-2.89)***	(4.30)***	(4.00)***
INSIDERB	0.069	0.067	-0.069	-0.078	-0.437	-0.432	0.089	0.059
	(3.58)***	(3.49)***	(-1.30)	(-1.47)	(-2.44)**	(-2.38)**	(1.93)*	(1.28)
BOSS	-0.017	-0.020	-0.006	-0.004	-0.091	-0.068	0.024	0.004
	(-1.56)	(-1.87)*	(-0.20)	(-0.14)	(-0.91)	(-0.67)	(0.91)	(0.14)
Industry dummies	No	Yes	No	Yes	No	Yes	No	Yes
N	3,240	3,240	3,239	3,239	3,229	3,229	3,240	3,240
R^2	0.4219	0.4670	0.3660	0.3998	0.0887	0.1162	0.5151	0.5491

Table 8. Relationship between VC-backing, management quality, and the participation of financial market players in IPO firms

The sample consists of 3,240 IPOs conducted between 1993 and 2004. NUMEST is the number of analysts following IPO firm at the end of the fiscal year of the IPO as reported by IBES. NUMESTALL is the number of analysts following IPO firm at the end of the fiscal year of the IPO where observations missing in IBES are set equal to zero. INSTP is the proportion of IPO firm's shares held by institutional investors at the end of the first quarter after the IPO. INSTN is the number of institutional investors holding shares of IPO firm at the end of the first quarter after the IPO. VCDUM is a dummy variable equal to one for VC-backed IPOs and zero for non-VC-backed IPOs. MQF is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TENURE is the average number of years management team members have been with a firm. TENHET is the coefficient of variation of the team members' tenures. LNBVA is the natural logarithm of the book value of assets immediately prior to the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the proportion of outside directors in the board of directors. INSIDERA is the proportion of voting power owned by firm officers and directors immediately after the IPO. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. Specifications (1), (2), (3), (4), (7), and (8) are Poisson maximum-likelihood estimations. Specifications (5) and (6) are estimated using logistic regressions. z-statistics for Poisson maximum-likelihood and logistic regressions are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	NUMEST	NUMEST	NUMESTALL	NUMESTALL	INSTP	INSTP	INSTN	INSTN
Intercept	-1.401	-1.991	-3.220	-3.466	-10.064	5.068	-1.963	-2.490
	(-8.63)***	(-2.73)***	(-22.09)***	(-4.78)***	(-12.69)***	(3.13)***	(-45.97)***	(-9.18)***
VCDUM	0.196	0.155	0.392	0.284	1.192	0.966	0.371	0.292
	(6.28)***	(4.75)***	(12.61)***	(8.72)***	(7.00)***	(5.30)***	(40.72)***	(30.65)***
MQF	0.077	0.100	0.171	0.195	0.632	0.725	0.124	0.153
	(3.05)***	(3.95)***	(6.76)***	(7.70)***	(4.96)***	(5.36)***	(16.59)***	(20.36)***
MQF×VCDUM	-0.017	-0.043	-0.086	-0.114	-0.269	-0.407	-0.019	-0.048
	(-0.56)	(-1.41)	(-2.88)***	(-3.80)***	(-1.27)	(-1.84)*	(-2.15)**	(-5.42)***
TENURE	-0.003	0.002	-0.003	0.001	0.011	0.015	0.000	0.006
	(-0.73)	(0.44)	(-0.64)	(0.23)	(0.39)	(0.55)	(0.16)	(4.95)***
TENHET	-0.016	-0.014	-0.005	-0.002	0.111	0.137	-0.005	-0.002
	(-1.43)	(-1.28)	(-0.47)	(-0.23)	(1.92)*	(2.25)**	(-1.53)	(-0.55)
LNBVA	0.125	0.151	0.198	0.236	0.692	0.756	0.268	0.297
	(14.34)***	(15.11)***	(24.60)***	(26.15)***	(13.35)***	(13.46)***	(115.66)***	(113.30)***
LFAGE	-0.035	-0.051	-0.083	-0.085	-0.067	-0.120	-0.054	-0.060
	(-1.91)*	(-2.65)***	(-4.64)***	(-4.55)***	(-0.58)	(-0.99)	(-10.67)***	(-11.24)***
ODIR	0.258	0.229	0.243	0.209	0.841	0.829	0.280	0.231
	(3.98)***	(3.43)***	(3.79)***	(3.18)***	(2.89)***	(2.71)***	(14.72)***	(11.85)***
INSIDERA	0.226	0.167	0.412	0.355	0.214	0.170	0.227	0.136
	(3.81)***	(2.72)***	(7.11)***	(5.91)***	(0.61)	(0.46)	(13.59)***	(7.87)***
BOSS	0.058	0.041	0.058	0.041	0.018	0.014	-0.013	-0.033
	(2.20)**	(1.52)	(2.19)**	(1.54)	(0.12)	(0.09)	(-1.72)*	(-4.17)***
Industry dummies	No	Yes	No	Yes	No	Yes	No	Yes
N	2,034	2,034	3,240	3,240	3,240	3,134	3,240	3,240
R^2	0.0442	0.0597	0.0828	0.1077	0.2518	0.2916	0.2824	0.3239

Table 9. Relationship between VC-backing, management quality, and firm age at IPO

The sample consists of 3,240 IPOs conducted between 1993 and 2004. Dependent variable AGE is the number of years from firm founding year to IPO year. MQFAGE is the management quality factor score obtained using common factor analysis on the firm-size-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. LNBVA is the natural logarithm of the book value of assets immediately prior to the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the proportion of outside directors in the board of directors. INSIDERB is the proportion of voting power owned by firm officers and directors immediately prior to the IPO. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. Specifications (1) through (3) use a maximum-likelihood survival-time estimation model with lognormal distribution. Specifications (4) through (6) use a maximum-likelihood survival-time estimation model with exponential distribution. *z*-statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	AGE	AGE	AGE	AGE	AGE	AGE
Intercept	2.158	-0.176	0.794	2.695	-1.169	-0.115
	(90.17)***	(-1.03)	(0.95)	(100.44)***	(-5.83)***	(-0.11)
VCDUM	-0.114	-0.091	-0.071	-0.282	-0.246	-0.179
	(-3.61)***	(-2.67)***	(-2.03)**	(-7.95)***	(-6.19)***	(-4.24)***
MGFAGE	-0.043	-0.059	-0.063	-0.002	-0.037	-0.070
	(-1.43)	(-2.04)**	(-2.25)**	(-0.06)	(-1.05)	(-1.99)**
MQFAGE×VCDUM	-0.084	-0.053	-0.046	-0.177	-0.116	-0.068
	(-2.23)**	(-1.46)	(-1.32)	(-4.29)***	(-2.66)***	(-1.55)
LNBVA		0.152	0.151		0.241	0.210
		(16.25)***	(15.56)***		(22.19)***	(17.81)***
ODIR		-0.436	-0.414		-0.481	-0.419
		(-6.19)***	(-6.02)***		(-5.67)***	(-4.87)***
INSIDERB		-0.058	0.002		-0.133	-0.080
		(-1.05)	(0.04)		(-2.08)**	(-1.21)
BOSS		0.049	0.053		0.029	0.025
		(1.57)	(1.76)*		(0.80)	(0.67)
Industry dummies	No	No	Yes	No	No	Yes
Observations	3,240	3,240	3,240	3,240	3,240	3,240

Table 10. Relationship between VC-backing, management quality, and IPO firm valuation and IPO underpricing

The sample consists of 3,240 IPOs conducted between 1993 and 2004. Dependent variables are three definitions of Tobin's Q (QOP, QFTD, and QIM) and three definitions of industry-adjusted Tobin's Q (QOPADJ, QFTDADJ, and QIMADJ). Tobin's Q the ratio of the market value of assets to the book value of assets, where the market value of assets is equal to the book value of assets minus the book value of common equity plus the number of shares outstanding times the market price (either IPO offer price (for QOP and QOPADJ), first trading day closing price (for QFTD and QFTDADJ), or the closing price at the end of the issue month (for QIM and QIM ADJ)) or times the share price at the end of the issue month (for industry peers). Industry-adjusted Tobin's Q (QOPADJ, QFTDADJ, and QIMADJ) is the difference between the IPO firm's Tobin's Q and the median of its 2-digit SIC code industry peers. UNDERPR is the IPO underpricing, measured as the percentage difference between the first trading day closing price and the IPO offer price. VCDUM is a dummy variable equal to one for VC-backed IPOs and zero for non-VC-backed IPOs. MQF is the management quality factor score obtained using common factor analysis on the firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. TENURE is the average number of years management team members have been with a firm. TENHET is the coefficient of variation of the team members' tenures. LNBVA is the natural logarithm of the book value of assets immediately prior to the IPO. LFAGE is the firm age defined as the natural logarithm of one plus the firm age. ODIR is the proportion of outside directors in the board of directors. INSIDERB is the proportion of voting power owned by firm officers and directors immediately prior to the IPO. BOSS is an indicator variable equal to one if a CEO is also a Chairman of the board of directors, and zero otherwise. Dependent variables in specifications (1) through (6) are winsorized at the 99th percentile. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	QOPADJ	QOP	QFTDADJ	QFTD	QIMADJ	QIM	UNDERPR	UNDERPR
Intercept	4.640	5.165	6.815	6.861	6.386	7.030	16.022	12.679
	(15.23)***	(3.56)***	(11.02)***	(2.27)**	(10.20)***	(2.31)**	(1.53)	(0.25)
VCDUM	0.361	0.455	1.096	0.968	0.989	0.815	15.960	11.602
	(6.01)***	(7.37)***	(8.98)***	(7.52)***	(8.02)***	(6.24)***	(7.74)***	(5.41)***
MQF	0.183	0.231	0.204	0.299	0.206	0.314	-0.876	0.530
	(3.60)***	(4.65)***	(1.98)**	(2.88)***	(1.96)*	(2.96)***	(-0.50)	(0.31)
MQF×VCDUM	-0.008	0.022	0.446	0.412	0.305	0.250	12.817	10.943
	(-0.13)	(0.35)	(3.47)***	(3.18)***	(2.33)**	(1.89)*	(5.90)***	(5.07)***
TENURE	-0.029	-0.024	-0.082	-0.061	-0.082	-0.059	-1.291	-0.890
	(-3.40)***	(-2.81)***	(-4.66)***	(-3.38)***	(-4.61)***	(-3.20)***	(-4.33)***	(-2.96)***
TENHET	0.011	0.019	0.020	0.026	0.012	0.015	0.221	0.098
	(0.61)	(1.03)	(0.54)	(0.67)	(0.30)	(0.38)	(0.34)	(0.15)
LNBVA	-0.222	-0.218	-0.302	-0.259	-0.269	-0.218	0.655	1.768
	(-12.80)***	(-11.93)***	(-8.55)***	(-6.82)***	(-7.51)***	(-5.64)***	(1.10)	(2.79)***
LFAGE	-0.057	-0.131	-0.155	-0.282	-0.133	-0.242	-4.375	-5.434
	(-1.45)	(-3.36)***	(-1.96)**	(-3.46)***	(-1.66)*	(-2.92)***	(-3.27)***	(-4.02)***
ODIR	-0.093	-0.007	0.049	0.201	0.107	0.219	3.766	3.799
	(-0.74)	(-0.05)	(0.19)	(0.77)	(0.42)	(0.83)	(0.87)	(0.88)
INSIDERB	0.286	0.282	0.520	0.434	0.469	0.335	7.313	4.580
	(2.93)***	(2.93)***	(2.62)***	(2.16)**	(2.33)**	(1.63)	(2.17)**	(1.36)
BOSS	0.001	-0.048	-0.099	-0.153	-0.076	-0.153	0.145	-1.047
	(0.03)	(-0.89)	(-0.89)	(-1.36)	(-0.68)	(-1.34)	(0.08)	(-0.56)
Industry dummies	No	Yes	No	Yes	No	Yes	No	Yes
N	3,115	3,115	3,115	3,115	3,046	3,046	3,219	3,219
R^2	0.0995	0.2541	0.1102	0.2213	0.0906	0.2053	0.0805	0.1331

Table 11. Relationship between management quality, VC-backing, and post-issue operating performance of IPO firms

The sample consists of 3,240 IPOs conducted between 1993 and 2004. This table presents the median levels and the median changes of industry-adjusted post-issue operating performance of IPO firms split into four groups: first into two groups of VC-backed and non-VC-backed firms, then within each of these two groups by the median management quality factor score (MQF). MQF is obtained using common factor analysis on the firm-size-, firm-age-, industry-dummies-, and VC-dummy-adjusted TSIZE, MBA, FTEAM, LAWACC, CPA, CORE, FCEO, and BOARDS. The median changes of industry-adjusted post-IPO operating performance are calculated as the difference in the industry-adjusted performances measure in a given year after the IPO (up to five years including the year of IPO) and the industry-adjusted performance measure in the fiscal year prior to the IPO (year -1). ROA is the return on assets measured as the ratio of net income (Compustat item 172) to the book value of total assets (item 6). OIBD/Assets is the ratio of operating income before depreciation plus interest income (items 13 and 62, respectively) to the book value of total assets. All performance measures are adjusted for industry performance by subtracting contemporaneous industry (2-digit SIC code) medians. Year 0 is the year of IPO. Significance levels are based on the Wilcoxon rank-sum test for the difference in medians. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

	VC-backed & High Management Quality		VC-backed & Low Management Quality		Non-VC-backed & High Management Quality		Non-VC-backed & Low Management Quality		Median Test *z*-statistic	Median Test *z*-statistic	Median Test *z*-statistic	Median Test *z*-statistic
	Group A		Group B		Group C		Group D					
Performance measures	N	Value	N	Value	N	Value	N	Value	A – B	A – C	B – D	C – D
Panel A. Median levels of industry-adjusted post-issue operating performance of IPO firms												
ROA 5	528	-2.91%	520	-0.09%	384	-0.22%	390	0.21%	-1.70*	-1.68*	-0.48	-0.57
ROA 4	603	-3.34%	592	-1.68%	438	-0.63%	441	0.56%	-1.25	-1.41	-2.45**	-2.00**
ROA 3	681	-4.49%	665	-1.55%	498	-0.92%	494	0.19%	-3.21***	-3.20***	-1.20	-1.11
ROA 2	759	-5.35%	753	-1.92%	568	-0.97%	558	-0.85%	-3.52***	-4.15***	-0.70	0.04
ROA 1	840	-6.00%	850	-0.76%	635	0.37%	632	0.03%	-3.94***	-4.95***	-0.39	0.78
ROA 0	909	-4.01%	916	-0.87%	674	1.27%	672	0.66%	-5.05***	-7.72***	-2.10**	1.16
ROA -1	907	-24.38%	907	-4.64%	650	1.47%	628	2.90%	-7.12***	-12.01***	-8.09***	-1.92*
OIBD/Assets 5	526	-3.06%	519	-0.01%	383	0.00%	389	0.03%	-2.55**	-2.80***	-0.89	-0.46
OIBD/Assets 4	599	-2.16%	590	-0.22%	436	-0.37%	439	0.82%	-2.49**	-2.01**	-1.50	-1.86*
OIBD/Assets 3	673	-3.85%	661	-0.21%	497	-0.43%	490	0.57%	-3.58***	-4.14***	-1.29	-0.73
OIBD/Assets 2	757	-5.48%	746	-0.77%	568	-1.13%	556	-0.13%	-4.70***	-4.69***	-0.73	-0.73
OIBD/Assets 1	832	-4.64%	845	-0.24%	634	0.00%	629	-0.04%	-4.65***	-5.28***	-0.28	0.50
OIBD/Assets 0	904	-6.12%	912	-1.21%	674	1.06%	668	0.74%	-6.95***	-9.44***	-2.44**	0.78
OIBD/Assets -1	904	-23.39%	903	-1.69%	649	2.87%	624	4.82%	-8.08***	-12.35***	-7.08***	-1.35
Panel B. Median changes of industry-adjusted post-issue operating performance of IPO firms												
ΔROA -1 to 5	515	11.56%	510	1.38%	363	-2.91%	357	-4.09%	4.66***	7.41***	4.42***	0.93
ΔROA -1 to 4	589	8.12%	580	1.00%	415	-3.16%	402	-4.17%	4.16***	7.51***	4.05***	-0.03
ΔROA -1 to 3	667	5.44%	651	1.82%	474	-4.29%	452	-4.18%	2.86***	7.69***	5.52***	-0.41
ΔROA -1 to 2	743	4.38%	735	1.90%	537	-2.78%	508	-4.45%	2.75***	6.36***	6.15***	1.69*
ΔROA -1 to 1	824	5.94%	831	2.67%	601	-0.80%	575	-3.10%	3.44***	7.73***	7.20***	2.04**
ΔROA -1 to 0	893	11.85%	897	2.98%	642	0.57%	617	-1.25%	5.56***	9.93***	8.43***	3.20***
ΔOIBD/Assets -1 to 5	511	10.74%	505	1.19%	362	-3.27%	354	-5.58%	5.30***	7.79***	4.64***	1.31
ΔOIBD/Assets -1 to 4	583	8.37%	574	1.71%	413	-3.93%	398	-4.85%	4.64***	8.38***	5.43***	0.62
ΔOIBD/Assets -1 to 3	659	7.17%	644	1.79%	472	-3.48%	446	-4.06%	4.79***	8.46***	5.66***	0.88
ΔOIBD/Assets -1 to 2	739	6.56%	724	1.26%	536	-3.53%	505	-4.97%	4.70***	8.26***	6.61***	1.74*
ΔOIBD/Assets -1 to 1	815	6.15%	822	1.69%	599	-2.56%	569	-3.79%	4.69***	9.50***	7.56***	1.46
ΔOIBD/Assets -1 to 0	888	9.83%	890	2.52%	641	-0.34%	611	-1.95%	5.92***	10.18***	7.71***	2.14**