# How do financial institutions affect the IPO underwriting process when they are venture investors?

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***Abstract***

Financial institutions are venture investors in a majority of U.S. venture-backed IPOs in the 1993-2000 period. Exploiting the fact that each class of financial institutions has its own investment criteria and expertise and access to customer information, we evaluate whether venture investments by commercial banks, investment banks and insurance companies have independent effects on the equity underwriting process, whether the effects are a function of investment size and whether loans and equity investments have differential effects. We find that each class of financial institutions making venture investments in a firm going public is associated with security offering outcomes indicating lower adverse selection risk such as reduced underpricing and absolute offer price revisions and stronger long-term operating performance. The impacts of debt or equity investments by separate classes of financial institutions are largely additive. Moreover, the size of financial institution ownership in an issuer is more informative than the presence of financial institution investors. This body of evidence is consistent with equity holdings and loans by each class of financial institutions providing independent certification of issuer quality.

## 1. Introduction

By the early 1990s, major U.S. financial institutions (FIs) such as commercial banks (CBs), investment banks (IBs), and insurance companies (ICs) were making large investments in the venture capital market. These FIs typically make private equity investments through venture capital (VC) affiliates, while directly extending loans to these private firms. Over the 1993-2000 sample period, we find that FIs have shareholdings in 54% of all venture backed initial public offerings (IPOs) in the U.S., whereas banks have loans in 68% of these IPO issuers. Given the importance of FIs in the private equity market, we examine how their venture investments affect the IPO underwriting process. [1] Since each class of financial institutions has its own venture investment criteria, financial expertise, regulatory constraints and sources of portfolio firm information, their investment decisions are likely to be made independently of each other. These differences suggest that venture investments by separate classes of FIs have complementary, but potentially distinct effects on the IPO underwriting process. Our study examines the effects of venture investments by CBs, IBs and ICs, and also distinguishes between FI debt and equity investments.

Analyzing the financial condition of private firms is particularly challenging given the limited public information available about their operations and financial condition, the frequent weaknesses in their internal accounting systems, weaker auditing standards and most importantly their typically high risk levels. The scarcity of public information about these risky private firms makes FI information production both quite costly and valuable, which has led to the development of specialized FIs with expertise in evaluating, monitoring, advising and investing in privately held firms.

[1] We measure FI venture investments by the post-IPO equity and loan holdings of different classes of FIs, since shares sold in a secondary offering will not have a certification effect. In addition, before the IPO, investors know approximately how many new shares are being issued, so post-IPO percentage shareholdings of FIs can be accurately estimated. Thus, our measure of venture investments reflects a FI investment decisions up to the IPO. We choose this measure because equity ownership is a consequence of an FI's continuing venture investment evaluation process, starting with its initial investment through subsequent funding rounds ending with the IPO [e.g., Lee and Wahal (2004)]. At each venture funding round, a FI venture investor must decide whether to continue investing, allow its investment position to be diluted or exit from its venture investment. Just prior to an IPO, a FI has to make additional decision about whether to sell some or all of its shares in a secondary offering that can piggyback on an IPO primary offering [Delaney (2005)].

Bank lenders to private firms generally require these borrowers to supply three years of certified or audited financial statements and often demand to be the firms' primary banker, supplying them with checking and cash management services, and giving these lenders continuous access to a borrower's bank account records.[2] Banks also impose extensive protective covenants in their loan agreements that are accounting statement based. Rajan (1992) shows that lenders are able to generate valuable information about privately held borrowers including the reliability and competence of management. Petersen and Rajan (1994) find that lending relationships reduce the asymmetric information problem between commercial banks and borrowers and result in expanded credit availability to these firms. Chemmanur and Fulghieri (1994) show that commercial banks have incentives to carefully monitor private firm borrowers to improve investment returns and build their reputations as competent lenders.

Private equity investors generally obtain board representation or observation rights, frequent financial reports and easy access to management. FI venture investors also have legal rights to exit these investments when a private firm's financial prospects seriously deteriorate. For example, detailed loan covenants allow lenders to call their loans early or to take control of liquid assets, while equity investors have the right to decline additional stock investments and often have the right to sell their preferred stock back to the firm on demand. FIs venture investors also use various accounting based milestones to determine whether further funding will be extended to their portfolio firms. To operate successfully in the venture capital market, FIs must be able to use their proprietary access to customer information to produce firm-specific financial information on a reliable and timely basis and be able to exit quickly from these investments if their private information becomes very negative. Thus, continued financial involvement in private firms by well informed FIs can act as a signal of their financial strength to uninformed investors.

Outside investors generally lack access to detailed information about private firms' operating and financial condition. However, they can observe the actions of FI investors, which can serve as credible

[2] For example, see the 2001 Silicon Valley Bank case study by Jon Biotti.

signals to outside investors given that the FIs place their own capital at risk and have access to proprietary issuer information, especially given the typical six-month lockup period faced by the private equity investors.[3] Such a signal can also be credible because FIs are unlikely to risk their reputations by continuing to back financially distressed private firms as argued by Chemmanur and Fulghieri. We term this FI venture investment effect, the VC *certification hypothesis*. These arguments are consistent with several theories of FI reputation and certification that predict that outside investors can infer information about private firms based on their relationships with commercial banks and investment banks. Puri (1994, 1996) and Schenone (2005) find evidence that prior bank loans lead to lower bond yields and lower IPO underpricing respectively, consistent with thee prior loans acting as further certification of the quality of security issues. Drucker and Puri (2005) find evidence that underwriters having prior lending or underwriting relationships with IPO issuers exhibit lower underpricing, consistent with these relationships producing stronger certification effect for the IPO issuer. There is also evidence that firms with prior public debt issues have lower asymmetric information than other IPO issuers.[4] Thus, these relationships are likely to positively affect the pricing of IPOs, as discussed in more detail below.[5]

In addition to the basic certification hypothesis, we examine several important extensions that have received little investigation in the literature. First, we examine whether the strength of an FI investment effect increases with the relative size of the venture investment, reflecting a FI's greater incentives to investigate and monitor a private firm as its capital exposure rises. We also examine whether the presence of a class of FI venture investors continues to have a certification effect, once the size of its investment is taken into account. Second, since several classes of FIs often invest in the same firms, and separate classes of FIs employ distinctly different venture investment criteria, they are likely to make independent assessments of firms. For example, it is well known that venture investors are much more risk tolerant than bank lending officers. Thus, we examine whether each class of FI investors has an

[3] Field and Hanka (2001) provide a detailed discussion of lock-up provisions and their empirical patterns.

[4] In our robustness analysis, we include an indicator for the small number of cases with a prior public bond issue since these issuers must already meet stiffer disclosure requirements.

[5] For example, James and Weir (1990) argue that receiving loans prior to selling public equity signals that the issuer is a higher quality firm since it has passed a bank's rigorous origination standards. Rajan (1992) argues that lending relationships generate valuable information about private borrowers.

independent and complementary certification effect. From this perspective, we test two extensions of the certification hypothesis, namely whether (1) VC holdings by individual FI classes have independent certification effects, which complement each other, but can differ in magnitude across classes, and (2) FI shareholdings and loans complement each other, but can exhibit distinctly different effects. An alternative hypothesis is that certification through investment by one FI class is a perfect substitute for an investment by another class.

An alternative perspective to the certification hypothesis is that a moral hazard problem is created when FI venture investors also underwrite equity offers or have close business ties to equity underwriters. Since an issuer's financial condition is significantly improved after successfully going public, a venture investor expects higher returns if this outcome occurs, and can exit from its investments more easily and profitably, once the typical 6-month lockup agreement expires. These IPO benefits create strong incentives for FI venture investors to support the efforts of its portfolio firms to go public. For CBs and IBs there is a further incentive, which is the prospect of capturing future loan and underwriting business from these growing firms after they go public. Hellmann, Lindsey and Puri (2007) present evidence of consistent with such incentives for CBs. FI support for a firm wanting to go public can include a greater willingness to underwrite weaker issues when the FI is also an equity underwriter, and efforts to sway underwriters with whom they have close business relationships to accept weaker underwriting assignments with these portfolio firms in return for other actual or potential business. This willingness to weaken the underwriting requirements can create a conflict of interest between the underwriter and equity investors, which we term the *moral hazard hypothesis*. This hypothesis also predicts an increasing conflict of interest as a FI's fractional ownership in an issuer rises. Finally, the effects of the certification and moral hazard hypotheses are expected to be larger for issuers with greater asymmetric information with outside investors.

We begin our empirical analysis by examining IPO underpricing. The certification hypothesis predicts that venture investment by FIs should reduce underpricing, or equivalently the price discount rational investors demand for purchasing shares in these firms. We also examine absolute offer price revisions from the filing range midpoint. The filing price range is nearly a mechanical function of its

midpoint, and the midpoint reflects an underwriter's initial assessment of an issuer's stock, conditioned on its preliminary due diligence investigations. The absolute price revision is a measure of the accuracy of the underwriter's initial valuation. According to certification hypothesis, if underwriters are also venture investors or have close ties to venture investors, then their access to non-public issuer information is likely to help reduce the revisions in the offer prices from the filing range mid-points, i.e., which we term IPO absolute price revisions. Thus, completed equity offers supported by better informed underwriters should exhibit lower absolute price revisions. We also examine issuer long-run operating performance, measured by its industry-adjusted five-year return on assets (ROA). The certification hypothesis predicts that issuers with continued FI holdings are in stronger financial condition when they go public, and this condition is likely to persist over time, leading to higher long-run ROA performance.[6] In contrast to the certification hypothesis, the moral hazard hypothesis predicts opposite effects for the above three issuer characteristics.

To preview our findings, the empirical evidence consistently supports the certification hypothesis, while it is inconsistent with the moral hazard hypothesis. We find that FI venture holdings in an issuer are associated with a reduction in underpricing and absolute price revisions, as well as an increase in average ROA performance. For all three major issue characteristics, the certification effect of FI investments is much stronger for issuers with relatively high information asymmetry between insiders and outside investors, further supporting the certification hypothesis. In addition, the certification effects are stronger for FIs with better VC reputations. Adjusting for potential selection bias caused by FI venture investment criteria does not affect these findings.

With regards to the extensions of the certification hypothesis, we find that the certification effect increases with the size of FI holdings in issuers. The information associated with the presence of FI investors is subsumed by the size of FI holdings, based on our analysis. Our most interesting finding is that the equity or loan holdings of separate classes of FIs have *independent* and *incremental* certification effects on each of the three major issue characteristics that we study. Disaggregating total FI

[6] FI venture investors may also demand better corporate governance practices in these private firms as a requirement for their making a venture investment.

shareholdings and loans to issuers, we find that venture investments in equity or loans of each major class of FIs has an independent certification effect, controlling for investments of other classes of FIs. The aggregate certification effect increases with each additional class of FIs investing in an issuer, and as investments expand from bank loans or equity alone to include both investment categories. Comparing different classes of FIs, we find that venture investments by IBs and CBs have stronger certification effects than venture investments by ICs.

Section 2 reviews prior research, while Section 3 discusses data sources and descriptive statistics. The next three sections report the results of prior investments by FIs on equity offer underpricing, absolute offer price revisions and long-run operating performance measures respectively. The last section summarizes our conclusions.

**2. Related Literature**

Rajan (1992) argues that lending relationships generate valuable information about private borrowers, and Peterson and Rajan (1994) go on to show that prior lending relationships reduce asymmetric information between a borrower and a lending bank. In several studies of bond underwriting, Ang and Richardson (1994), Gande, Puri, Saunders, and Walter (1997), Gande, Puri and Saunders (1999), Kroszner and Rajan (1994), Puri (1994), Puri (1996), and Yasuda (2005) report that underwriters with prior issuer lending relationships are associated with positive certification effects on these bond issues. However, the actions that lenders take that lead to certification are directly not investigated. Evidence that banks more closely monitor borrowers having greater moral hazard problems is reported by Sufi (2007). He finds that lead banks in syndicated loans to private firms retain a larger share of the loans when borrowers require more monitoring and due diligence, thus improving the bank's incentives to closely monitor the loans. When the borrower-lender information asymmetry is severe, participant lenders are closer to borrowers, both geographically and in terms of previous lending relationships, making closer and frequent monitoring less costly.

Another possible explanation for a lender certification effect is found in a recent study by Dass and Massa (2006). They categorize borrower-bank lender relationships as closer when a lender is geographically near the borrower or is the sole bank lender. They report that closer borrower-lender relationships improve bank monitoring, leading to better corporate governance in terms of increase managerial turnover, reduced private benefits of control, reduced insider trading, and lower incentives to initiate acquisitions. These borrowers also display higher Tobin's Qs, consistent with their corporate governance improving firm value.

An early study of IPOs by James and Weir (1990) finds that the presence of outstanding CB loans lowers IPO underpricing. Drucker and Puri (2005) study the effects of lending relationships by bank underwriters on the underpricing of seasoned equity offerings. They find underpricing is significantly reduced when there is a prior or concurrent lending relationship between a bank underwriter and an equity issuer. They also report that the effects of bank lending and prior underwriting relationships are roughly additive. This underpricing evidence is reinforced in a recent study of IPOs by Schenone (2005), who examines underpricing in the 1998-2000 period, when most CBs were first allowed to be IPO underwriters. Using indicators for when CB underwriters have prior lending relationships, she finds that lender-underwriter relationships are associated with less underpricing. Schenone carefully controls for the endogeneity of an issuer's prior selection of a CB for its banking needs, but finds that it only leads to a minor reduction in the effect of prior lending on IPO underpricing. One concern with this evidence is its short three-year sample period; an unusual period when the effects of the Internet "bubble" were most pronounced. Overall, this body of evidence is supports the proposition that CB lending relationships with private firms creates a positive certification effect, which reduces underpricing of their IPOs.

Hellmann, Lindsey and Puri (2007) examine the relationship between bank venture capital investment and subsequent bank lending. They find evidence that banks use their prior VC relationship to successfully build subsequent lending relationships with these VC-backed firms. More interestingly, they also report that banks with venture investments in borrowers offer them significantly lower interest rates than similar borrowers without such a VC

relationship. This suggests that banks may use their venture investments in rapidly growing firms to develop new lending relationships, and that their equity investments allow them to monitor these firms more effectively. This suggests that bank venture investments can also produce certification benefits.

Several recent studies of bank equity holdings find evidence consistent with these investments improving the quality of bank monitoring of these borrowers. Santos and Wilson (2006) investigate the effects of large shareholdings in listed firms by banks in their fiduciary capacity as portfolio managers, which they observe give the banks significant voting rights. They find that banks charge lower rates on loans to these firms and that their loan covenants are less likely to require collateral or impose dividend restrictions. They interpret this as evidence that banks with sizable voting rights are able to reduce the risk shifting incentives of these borrowers. One partial explanation for the prior result is given in Santos and Rumble (2006), who examine the voting rights of US commercial banks due to their equity investments and fiduciary powers as trustees of large personal trusts. They find that banks with large voting stakes or lending relationships are likely to be on their loan customer boards of directors. When banks have both relationships, they are more likely to be on these boards of directors. Lastly, Ljungqvist and Wilhelm (2003) find that prior equity investments by IBs are associated with reduced IPO underpricing, which is consistent with IB equity investments also having a certification effect. This set of evidence suggests that FIs with VC equity and loan relationships are often able to reduce their risk exposure to private firms. Furthermore, outside investors appear to recognize these monitoring benefits and view bank debt and equity investments in these private firms as credible forms of certification.

In summary, prior empirical studies of the corporate security underwriting process have focused on one of two questions, namely the effects of either prior loans by CBs or equity investments by IBs, but not on both effects. However, we frequently find that several different classes of FIs are venture investors

in the same issuers, taking both equity and loan positions. This pattern of multiple FI investor classes in IPO issuers makes interpreting the existing evidence based on venture investment by a single class of FIs problematic, especially given its narrow focus on FI investment in either an issuer's debt or equity, but not on both types of investments. Thus, it is unclear whether the earlier findings of reduced IPO underpricing are primarily due to prior FI equity investments, debt investments or both. It is also unclear whether the reduction in underpricing is due to venture investments by a particular class of FIs examined in prior studies or the result of venture investments by other classes of FIs. By examining both the effects of debt and equity venture investments in IPO issuers by multiple classes of FIs, we are better able to answer these pressing questions.

Our paper also extends the earlier studies that analyze the effects of VC investment on the IPO process by examining the effects of FI venture investment size. Most of the prior literature focuses on how the presence of FI investments, represented by indicators of FI investments affects IPO underpricing. However, Puri (1999) predicts that the presence and size of underwriter investments could have opposite effects. By examining investment size, we are better able to address the question of how FI venture investments affect the IPO underwriting process.

We expand on earlier IPO studies, which tend to focus on underpricing, by also examining absolute revisions in IPO offer prices from their filing range midpoints and issuer long-run operating performance over the subsequent 5 years. We control for the endogeneity of venture investments, which is not usually addressed in prior research, and find that our qualitative results are invariant to this adjustment. We examine issuer loan information and find that IPO prospectuses report a much larger portion of these loans than that reported in Dealscan, the main source of bank loan information used in prior studies. Thus, we employ loan information hand collected from IPO prospectuses, which tends to be more inclusive and also reports the size of these loans.[7] Our sample period also extends back to 1993, which substantially increase our IPO sample period relative to studies that begin in 1996.

## 3. Data Sources and Descriptive Statistics

We focus on the 1993-2000 period where a large number of IPOs involve VC investments. The National Association of Securities Dealers (NASD) rules concerning IPO underwriting procedures also exhibit relative stability in this period. The IPO sample ends in 2000 for several reasons. First, IPO issuance activity drops off dramatically in early 2001 and remained minimal for several years. Second, we are constrained by our long-run performance analysis to have stock listing and accounting data available for 5 years following the IPO year. To obtain our sample, we identify 1,500 venture-backed IPOs from Securities Data Corporation's (SDC) Corporate New Issue Database, after excluding unit offers, closed-end funds (including REITs), ADRs, limited partnerships, reverse LBOs, equity carve-outs, foreign issues, and IPOs with offer prices below $5, which are likely to have different accounting treatment and different incentives for going public. After obtaining prospectuses for all 1500 IPOs, we verify by hand their venture-backing status by reading the "Principal Shareholder" and "Underwriting" sections of each prospectus. Excluding 21 IPOs that are verified as non-venture backed from IPO prospectuses leaves us a final sample of 1479 venture-backed IPOs.

We obtain details on IPO issue characteristics from many sources. We hand collect from IPO prospectuses detailed ownership information on FI shareholdings and loans in issuers as well as pre-IPO information on shares outstanding, syndicate size, percentage of secondary shares offered, total assets, property, plant, and equipment, and underwriter warrant holdings. Equity ownership of FIs comes mainly from "Principal Shareholder" section of the prospectus. Underwriters typically disclose their equity ownership in the "Underwriting" section of the prospectus, though we also search in the "Principal Shareholder" section. FI share ownership includes shares held by their subsidiaries such as a captive venture capital funds. Information on VC fund affiliations with FIs comes from the Pratt's Guide to Venture Capital Sources, VentureXpert and individual VC websites.

Information on various types of lending including notes, term loans, bridge loans, and lines of credit comes from the "Liquidity and Capital Resources" and "Notes to Financial Statements" sections of

[7] However, Dealscan has the advantage of generally reporting lender identities, while IPO prospectuses often do not. Nevertheless, the frequency of bank loans reported in IPO prospectuses is more than double that reported by

IPO prospectuses. The IPO prospectus indicates whether the lenders are banks, but generally does not identify these institutions by name. Loan information is also extracted from Dealscan's bank loan database, though its coverage does not start until late 1994. Of the outstanding FI loans reported in the IPOs prospectuses, we find that only 30% are reported in Dealscan, which leads us to rely on prospectuses as our primary data source for loan information.[8]

We link our IPO sample to an array of other financial databases to obtain additional IPO issue characteristics. We use an index of an aggregate VC portfolio holdings obtained from Sand Hill Econometrics. This index measures the total value of VC portfolios companies each month. From the University of Chicago's Center for Research in Securities Prices (CRSP) stock price and returns database, we obtain information on stock capitalization figures, stock closing prices, bid and ask quotes, common stock outstanding, and stock returns. From the Compustat annual financial statement database, we obtain post-IPO book value of total assets, earnings before interest and taxes, and SIC codes. From Thomson Financial's New Issues database, we obtain IPO filing price ranges, initial filing dates and simultaneous global offerings. We obtain data on underwriter reputation, industry classifications for Internet and technology industries, incorporation dates, and the number of IPOs completed over the prior three months from Jay Ritter's website, http://bear.cba.ufl.edu/ritter/ipodata.htm. The VentureXpert database is the main source for information on VC firm's age and the number of completed IPOs backed by each VC.

We distinguish between IBs and CBs following Gande et al. (1999) and Chaplinsky and Erwin (2005). During our sample period, CBs made a substantial number of IB acquisitions. If a CB acquires an IB, we assume that the surviving CB acquires the entire VC investment portfolio of the IB and treat the IB as a CB subsidiary following the acquisition completion date. Information on the timing of these IB acquisitions is taken from Corwin and Schultz (2005).

Table 2 presents descriptive statistics for our dependent variables (underpricing, price revisions, and ROA means) and the issue characteristics that serve as our primary explanatory variables. IPOs are classified by whether or not FIs have post-IPO holdings of shares or loans in issuers. Comparing columns

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Dealscan.

[8] For our sample of 1269 IPOs from 1994 to 2000, we only find 266 IPOs with prior loan investments according to Dealscan. However, our hand collection from the prospectus yields 821 IPOs with prior loan investments.

2 and 3, we see that IPOs with FI equity holdings have lower underpricing and price revisions than IPOs without these equity holdings, which suggest that FI equity investments affect the underwriting process. However, these differences could also be driven by other issue characteristic differences across the two samples. Consistent with this concern, we observe that IPO issuers with FI equity holdings have significantly larger total assets, are more often NYSE listed, raise proportionately more equity, tend to use larger underwriting syndicates and are less often technology firms than IPO issuers without them. IPOs with FI equity holdings are also more apt to use underwriters with weaker reputations, which is consistent with a certification effect from FI equity holdings that partially substitutes for underwriter reputation.

Comparing the fourth and fifth columns of Table 2, we find IPO issuers with bank loans have a significantly less negative ROA, which is supportive of a bank loan certification effect. However, the two samples can also differ in other important ways which we may need to control for. To reinforce this point, we see that IPO issuers with bank loans are older and less often in Internet related technologies, have smaller stock return standard deviations, fewer global offerings and use smaller underwriting syndicates. Finally, IPOs with bank loans sell proportionately more new shares, more frequently use Big 6 auditors and list on the NYSE and have a shorter interval between filing and issuance dates. These differences in issue characteristic for firms with FI venture investments are consistent with FIs preferring venture investments in relatively less risky privately held firms.

Table 3A presents descriptive statistics on the annual number of IPOs with FI venture investments. As seen in the first row, the largest number of VC backed IPOs occurs in 1999, while years 1993, 1996, and 2000 also have a large number of IPOs. The smallest number of IPOs occurs in 1998. The frequency pattern is consistent with the evidence in prior studies of IPOs by Ljungqvist and Wilhelm (2003) and VC-backed IPOs by Lee and Wahal (2004). The data show clear evidence that the IPO market experiences hot and cold market conditions in our sample period. Examining the proportion of IPOs with FI equity or loan holdings, we find relatively stable patterns except for the 1998-2000 period when the frequency of equity holdings rises and loans fall, especially in year 2000.

Tables 3B and 3C explore the frequency of equity and loan holdings in IPO issuers by various classes of FIs. We find that 86% of our VC-backed IPO sample has FI equity and loan holdings. This

breaks down into 797 IPOs with equity holdings (54% of our sample) and 981 IPOs with bank loans (67.5% of our sample). In our sample, 530 IPOs have both FI loans and equity holdings, which means that over 40% of the FI VC-backed IPO sample has both FI equity and loans in the same issuer. Of the 797 IPOs with FI equity holdings, we find that about 25% of these IPOs involve multiple classes of FIs. Given that equity holdings by multiple classes of FIs in individual IPO issuers is commonplace and a large number of IPO issuers have both FI venture debt and equity investments, it is important to examine how both venture debt and equity holdings by individual classes of FI investors affect the IPO underwriting process.

Table 3D examines the relative size of shareholdings and loans by classes of FIs. IBs own shares in 587 IPOs, representing on average 8.2% of these issuers' shares outstanding, whereas CBs own shares in 288 IPOs with a smaller average shareholdings of 8.0%. In addition, insurers own shares in 123 IPOs and on average hold 8.3% of shares outstanding. Table 3D also shows that FIs have outstanding loans in approximately two thirds of the IPO sample and on average these loans represent 37.8% of total assets.

## 4. Empirical Results on IPO Underpricing

### *4.1. IPO Underpricing and Venture Investments by CBs, IBs and ICs*

We begin the analysis by examining IPO underpricing, measured by the percentage change in the initial trading day closing price from the offer price, when FIs continue to hold issuer debt or equity after the IPO. Under the moral hazard hypothesis, FI holdings in issuers are predicted to increase IPO underpricing; and under the certification hypothesis, FI holdings are predicted to lower underpricing. These effects are predicted to intensify with larger FI holdings in issuers and greater informational asymmetry between IPO issuers and outside investors.

Drucker and Puri (2005) and Schenone (2004) analyze bank loans in issuers with an indicator variable, while Ljungqvist and Wilhelm (2003) analyze an investment bank's percentage shareholdings. In our analysis, we initially analyze FI holdings using indicator variables to be comparable to the earlier literature, but focus on FI percentage ownership levels for our primary analysis. We also examine ownership percentages in combination with indicator variables to see if they both continue to have

explanatory power. This allows us to test the importance of FI participation, independent of their investment levels.

Based on prior research on IPO underpricing, we employ a broad set of control variables including: VC ownership, firm size, Big 6 auditors, percentage of new shares issued, prior market return over event days -60 through -1, length of the registration period (initial filing date to IPO date), underwriter reputation, a global offering indicator and an Internet indicator.[9] We include VC shareholdings of non-FIs since Megginson and Weiss (1991) find that traditional VC ownership affects underpricing. We include total assets because larger firms are likely to be more diversified and thus, less risky, resulting in lower underpricing. The percentage of new shares issued could signal an issuer's eagerness to sell equity, raising investor adverse selection concerns and consequently increasing IPO underpricing [Krasker (1986)]. Stable and robust market conditions and stronger underwriter reputation are also expected to reduce underpricing by lowering the asymmetric information in the marketplace [Edelen and Kadlec (2005), Carter and Manaster (1990), Carter, Dark and Singh (1988)]. Finally, since global offerings can be less familiar to foreign investors and more complicated legally and logistically, we expect it to increase underpricing. Most of these control variables are significant in earlier IPO underpricing studies by Cliff and Dennis (2004), Lee and Wahal (2004), Ljungqvist and Wilhelm (2003), Loughran and Ritter (2004), and Schenone (2004). Throughout our regression analysis, we include the above control variables as well as yearly fixed effects to capture secular trends in underpricing and hot and cold market conditions.[10]

Table 4A reports ordinary least square (OLS) estimates of how IPO underpricing is related to FI holdings measured by indicator variables. The t-statistics reported throughout our analysis are based on heteroscedasticity-consistent standard errors adjusted for industry clustering using the Fama-French industry classification.[11] In the first column of Panel A, we find that IPO underpricing is reduced by 10.37% in the presence of FI shareholdings. To assess its economic significance, we scale this coefficient by mean underpricing of 39.4%, as reported in Table 2, which implies that the presence of FI

[9] For a review of these control variables, see the survey paper by Eckbo, Masulis and Norli (2007).
[10] When we add a "bubble period" indicator, we obtain similar results. Year fixed effects should more thoroughly adjust for variations in IPO market conditions. The results are also qualitatively the same without year fixed effects.

shareholdings reduces average underpricing by approximately 26%. Another way to assess its economic significance is to observe that the sum of underpricing across the entire IPO sample equals $311.53 billion and 53.9% of the IPO sample has FI shareholdings, so the presence of FI shareholdings reduces aggregate IPO underpricing by $44.2 billion (=311.53*26%*53.9%). In column 2, we add several additional control variables for underwriter reputation, big 6 auditors and global offers, and find that while several of these additional control variables are significant, our primary results remain qualitatively the same.

In column 3 of Table 4A, we examine whether equity holdings by separate classes of FIs have incremental certification effects, by replacing the FI shareholding indicator with a variable that measures the number of major classes of FI shareholders, which is bounded between 0 to 3, (i.e. IB, CB and IC). The coefficient estimate on the number of major classes of FIs is negative and significant at the 1% level. The coefficient estimate indicates that underpricing falls by 7.26 percentage points with each additional FI class that invests in an issuer's equity, consistent with an incremental certification effect.

In columns 4-6 of Table 4A, we sequentially introduce three separate indicators of equity holdings in IPO issuers by IBs, CBs, and ICs. We find that only the presence of IB and CB shareholdings have a significant negative effect on underpricing. However, given the large number of IPOs with overlapping venture investments by several FI classes, it is important to examine the marginal effects of these investments by simultaneously controlling for venture investments of each major class of FIs. In column 7, we include indicators of equity holdings by each of the three major classes of FIs and for bank loans. The estimates show that the presence of IB and CB shareholders and bank lending are associated with significant reductions in IPO underpricing. Examining the relative size of the coefficient estimates, we find that CB shareholdings and bank loans have a relatively larger impact than IB shareholdings on reducing IPO underpricing. When indicators of equity investments by IBs, CBs and ICs are jointly estimated in column 7, the coefficient estimates for IBs and CBs decrease by 13.93% (= (6.55-7.61)/7.61) and 8.30% respectively compared to the coefficient estimates in columns 4 and 5, where only one indicator is included in each regression. This evidence supports the importance of simultaneously taking

[11] Throughout the study, we include yearly fixed effects, but for brevity they are not reported in the tables.

into account the venture investments of all three major classes of FIs when examining the effects of venture investments on IPO underpricing.

In column 8 of Table 4A, we further examine the impact on underpricing in the presence of multiple major classes of FI shareholdings. For this purpose, we redefine the IB, CB and IC shareholding indicators to represent issuers having only equity investment by one of these three classes of FIs and then we create three new indicators representing shareholdings by each possible pair of FI classes.[12] The results in column 8 are strongly consistent with incremental certification effects by different classes of FIs. Both the magnitude and statistical significance of the coefficient estimates are much greater for indicators of shareholdings by pairs of FI classes. For example, the exclusive presence of shareholdings by IBs and CBs reduces underpricing by 7.82 and 9.80 percentage points respectively, while the joint presence of IB and CB shareholdings reduces underpricing by 14.99 percentage points.

The adjusted R-squares of about 31% indicate that our statistical model has good explanatory power with respect to the cross-sectional variability in IPO underpricing.[13] In summary, Table 4A shows clear evidence that FI shareholdings and loans are associated with reduced underpricing, consistent with the certification hypothesis. The significance of multiple classes of FI shareholdings also provide substantial evidence of incremental certification effects, suggesting that individual classes of FIs provide independent certification of IPO issuers.

In reviewing the control variables, we find that most of the coefficient estimates are significant and have signs consistent with prior studies. Underwriter reputation, prior market return, and Internet and global offering indicators all have positive and statistically significant effects on underpricing, while shareholdings of traditional VCs, firm total assets, new shares issued and registration period duration have significantly negative effects on underpricing. The positive coefficients on the global offering and Internet indicators are consistent with both global offers and high growth firms having larger pricing uncertainty and adverse selection effects, which increase IPO underpricing. The positive effect of prior market return is consistent with earlier IPO studies by Hanley (1993) and Lowry and Schwert (2004),

[12] We omit a separate indicator for when all three major classes of FIs are issuer shareholders because there are only nine IPOs in this category.

which find only partial adjustment in IPO offer prices to positive issue information uncovered after the initial filings.[14]

In Table 4B, we report ordinary least square (OLS) estimates of the effects of FI percentage shareholdings on IPO underpricing. The primary measure of FI equity ownership is their post-IPO shareholdings as a percentage of post-IPO issuer shares outstanding. We use post-IPO shares, since shares that are being sold in a secondary offering will not have a certification effect. In addition, before the IPO, investors know approximately how many new shares are being issued, so post-IPO percentage shareholdings of FIs can be accurately estimated. The primary measure of FI debt ownership is the dollar amount of loans outstanding as a percentage of total assets. We examine the effects of percentage share holdings by CBs, IBs, and ICs individually, as well as aggregate FI percentage shareholdings.

In the first column of Table 4B, we examine how total FI percentage shareholdings are related to IPO underpricing. Each percentage point increase in aggregate FI shareholdings significantly reduces underpricing by 0.72%. To assess its economic significance, we examine the marginal effect of a one-standard deviation change in FI aggregate shareholdings on underpricing. Given a 14.4% standard deviation of aggregate FI shareholdings, the marginal effect is -10.65%. Scaling this effect by the mean level of IPO underpricing of 39.4%, as reported in Table 2, we find that a one-standard deviation increase in FI aggregate shareholdings reduces average underpricing by approximately 27%. As seen in column 2 of Table 4B, adding several additional control variables for underwriter reputation, big 6 auditors and global offers does not noticeably affect the results.

In columns 3-6 of Table 4B, we sequentially examine the individual effects of IB, CB, and IC shareholdings and bank loans. We find that all four venture investment positions are associated with significant reductions in IPO underpricing. To examine their marginal effects on underpricing, we jointly estimate the percentage shareholdings of the three major classes of FIs and bank loan size in column 7 of

[13] When the number of classes of FIs with equity investments is replaced with the number of individual FIs with equity investments, we obtain very similar results.

[14] We also included price revisions as an explanatory variable in the IPO underpricing regression. Because both underpricing and price revisions depend on offer price, we follow Ljungqvist and Wilhelm (2003) by estimating a two-stage least square model that treats both underpricing and offer price revisions as endogenous. We first estimate an OLS model for offer price revisions. We include the predicted values for price revisions in the second

Table 4B. The estimates show that shareholdings of each major class of FIs and bank loans continue to significantly reduce underpricing, even after controlling for the venture investments of other FI classes.[15] Compared to the coefficient estimates in columns 4-6, the coefficient estimates in column 7 for CB and IC shareholdings increase by 13% and 23%, respectively, (i.e., from 0.61 to 0.69 and from 0.65 to 0.80), while the coefficient estimate on bank loans drops by about 20%.[16] We find that when the effects of shareholdings by the three FI classes are analyzed individually, they are underestimated relative to when they are jointly estimated. This indicates that analyzing the effect of a single class of FIs in isolation is likely to suffer from an omitted variable bias. We conclude that controlling for the shareholdings of other major classes of FIs is important for the accurate estimation of the effect of any one class of FI shareholdings on IPO underpricing.

To assess the relative importance of various classes of FI venture investments, we multiply the individual coefficient estimates by a one standard deviation increase in investments. Given standard deviations for IB, CB, and IC shareholdings and bank loans of 11.34%, 7.76%, 4.95%, and 30.76%, respectively, we obtain marginal effects for the associated four classes of FI venture investments of -7.37 (=-0.65*11.34%), -5.35, -3.96, and -1.23 percentage points, respectively. Given underpricing averages 39.4%, as reported in Table 2, a one-standard deviation increase in the four classes of FI holdings reduces average underpricing by about 18.71% (=-7.37/39.4), 13.59%, 10.05%, and 3.12%, respectively. Obviously, shareholdings of IBs have the largest marginal impact across the classes of FI venture investments.

In column 8 of Table 4B, we further examine the relative importance of the presence and size of multiple classes of FI venture investments. For this purpose, we include indicators for IBs, CBs, and ICs shareholdings and bank loans along with their associated percentage ownership levels used in column 7 of Tables 4A and 4B. The results indicate that the size of FI holdings has a much stronger impact than the presence of FI holdings used in many earlier studies. The four coefficient estimates for the percentage

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step underpricing equation, but find the earlier results are little changed. The t-statistic of the predicted value of price revisions is -0.69. The insignificant coefficient is similar to results reported by Ljungqvist and Wilhelm.

[15] If we replace bank loans (including lines of credit) with either lines of credit or loans excluding unused lines of credit, the associated regression coefficient in either case is negative and significant. The term loan coefficient is -.02 with a t statistic of -3.43 and a line of credit coefficient of -.12 with a t statistic of -2.08.

holdings by each FI class are still negative and significant at the 1% level, whereas the corresponding estimates for the indicators of venture holdings by individual FI classes are all insignificant, except for the bank loan indicator, suggesting that the percentage shareholdings captures nearly the entire effect of having FI equity investors.[17]

These results on IPO underpricing are consistent with the findings in Ljungqvist and Wilhelm (2003) of a significant negative IB shareholding effect and in Schenone (2004) of a significant negative effect from the presence of bank loans. However, we obtain more unbiased estimates of the size of these FI certification effects by controlling for the venture holdings of other FIs. Moreover, we find that IC and CB shareholdings have certification effects, which to our knowledge have not been examined in the extant literature, and we confirm that IB continue to have significant certification effects after controlling for IC and CB shareholdings. In addition, we find that the bank loan size, over and above the presence of FI lenders, has a significant certification effect. In summary, the regressions in Table 4A and 4B show clear evidence that FI holdings of equity and loans are associated with a reduction in underpricing, consistent with independent certification effects for venture investments in equity and loans by each major class of FIs.

### *4.2. Sensitivity Analysis*

#### *4.2.1 Analysis of Underpricing across IPO Subsamples*

To evaluate the robustness of our results, we examine subsamples of IPOs conditioning on several additional issuer characteristics that proxy for the asymmetric information between IPO issuers and investors. As a stronger test of the certification hypothesis, we segment the IPO sample into issuers with high and low asymmetric information. The certification hypothesis predicts that FI shareholdings

[16] In contrast, the coefficient estimates of IB shareholdings are unchanged.

[17] Our evidence is weakly consistent with the theory developed by Puri (1999), who predicts a fall in underpricing when there is underwriter ownership in an issuer. She also observes that as underwriters' investments in an issuer increase, so do their incentives to underwrite weak issues. However, this effect is based on her model's assumption that underwriters are able to quickly sell their shares following IPOs. The ability of underwriter-venture investors to quickly exit the stock is often constrained by a conventional IPO lock-up clause that contractually binds pre-IPO investors to retain their shares for an extended period, typically six months following the IPO. In addition, subsequent sales of stock by underwriters can be further limited by SEC disclosure regulations and NASD Rule

have a larger negative effect when asymmetric information is high. Following Beatty and Ritter (1986) and many subsequent studies, we estimate the level of asymmetric information associated with an IPO issue by the standard deviation of aftermarket daily stock returns, measured over trading days +21 to +270.[18] We then create indicators for IPOs which are above and below the median level of return volatility and interact these two indicators with the shareholdings of each major FI class.

The first column of Table 4C presents estimates of FI certification effects when issuer information asymmetry is high and low. Assuming that IPOs with high return volatility have greater information asymmetry, FI certification should exhibit a larger effect when it is interacted with a high asymmetric information indicator. The results are quite striking. FI share and loan holdings consistently have significant negative effects for issuers with high information asymmetry, but the effects are insignificant for issuers with relatively low information asymmetry.[19]

If VC reputation improves a FI's certification ability, then when we separate FI shareholdings into those with high and low VC reputation, we should expect a larger reduction in IPO underpricing when its VC reputation is high. In column 2 of Table 4C, we separate the shareholdings of a class of FIs by whether an individual FI venture investor has backed more IPOs than the sample median investor or not. When two or more FIs in the same class are equity investors in an IPO issuer, where one at least has a high VC reputation and one has a low VC reputation, we separate the shareholdings of the FI class into shares held by high and low VC reputation FIs in that class. In column 2, we find that shareholdings of FIs with better VC reputations are associated with significantly less underpricing. For shareholdings of FIs with weaker VC reputations, we find that ICs are associated with a significant, but smaller reduction in IPO underpricing. These results support the conclusion that venture investments by FIs with better reputations have greater certification effects.

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2710, which tightly restricts subsequent sales of stock by underwriters. Our evidence suggests that these mechanisms effectively protect IPO investors from an underwriter moral hazard problem.

[18] The estimation period begins 21 trading days after the IPO to avoid most price stabilization activity, which could bias stock return volatility downward. Studies of stabilization activity by Ellis, Michaely and O'Hara (2002) and others report that it is generally limited to the first four weeks following the IPO.

[19] In sensitivity analysis, we obtain virtually identical results with alternative measures of information asymmetry, such as the proportion of tangible assets, IPO firm age, or residual return variance (calculated from a one-factor market model using the CRSP value-weighted market index).

In columns 3 and 4 of Table 4C, we break up our sample into two four-year sub-periods. The second sub-period includes the bubble period, where we expect issuers in general to have higher information asymmetry. The signs of the parameter estimates of FI equity holdings are all negative and significant in both sub-periods, though the size of the FI coefficient estimates in the earlier period are only one half to one third as large as in the later period. A similar result holds for bank loans. These results are not surprising given the later sub-period has much larger average IPO underpricing and potentially higher information asymmetry.

*4.3.2 Controlling for Endogeneity*

In the earlier analysis, we treat FI shareholdings at the IPO date as exogenous, but there are plausible reasons to believe otherwise. For example, FI equity ownership is a consequence of its venture investment evaluation process, both when the FI first invests in the IPO issuer and in each subsequent period that it retains its venture investment position [e.g., Lee and Wahal (2004)]. At each venture funding round, a FI venture investor must decide whether to continue investing, allow its investment position to be diluted or exit from its venture investment. Just prior to an IPO, a FI has to make another decision about whether to sell some or all of its shares in a secondary offering that can piggyback on an IPO primary offering [Delaney (2005)].

It is well known that endogeneity can result in inconsistent model estimates. The evidence in Table 2 shows a nonrandom distribution of IPO issuer characteristics across VC backed IPO issues with and without FI equity ownership, which is consistent with FI venture capitalists using somewhat different investment criteria than traditional VCs in determining their on-going investment levels. This suggests that endogeniety is a potentially serious concern. To illustrate this possibility, suppose that FIs tend to make initial and continuing venture investments in firms with greater transparency and that these investments do not alter FIs' access to proprietary information about these firms. If greater information transparency leads to less underpricing, then a negative relation between FI equity ownership and underpricing could be spurious, and simply proxy for a FI's investment criteria. In this case, the OLS

regressions of IPO underpricing would be misleading and the coefficient estimates for FI equity ownership would be inconsistent.

To address the potential endogeneity of FI shareholdings, we estimate a two-equation treatment model [Maddala (1983)].[20] The endogenous venture investment decision is modeled using a treatment equation. Suppose there is an unobservable underlying variable, *FI Shares**, that determines the size of post-IPO FI equity ownership in an issuer, the treatment rule for *FI Shares** is

$$FI\ Share_i^* = M_i' b_i + \varepsilon_i \tag{1a}$$

$$FI\ Share_i = \begin{cases} 100 & when\ \ 100 \le FI\ Share_i^* \quad (1b) \\ FI\ Share_i^* & when\ \ 0 < FI\ Share_i^* \le 100 \quad (1c) \\ 0 & when\ \ FI\ Share_i^* \le 0 \quad (1d) \end{cases}$$

where *FI Shares** is a latent variable observed only when FIs have post-IPO equity ownership in issuer *i*; $M_i$ represents a vector of determinants of post-IPO FI equity ownership; $b_i$ is a vector of coefficients multiplying the elements of $M_i$; and $\varepsilon_i$ is a disturbance term assumed to have a standard normal distribution. If *FI Shares** exceeds 100, then the actual observed FI percentage shareholding (*FI Shares*) in an issuer will equal to 100; if *FI Shares** drops below 0, *FI Shares* in an issuer will equal to 0; otherwise *FI Shares** equals to *FI Shares*. Since there is substantial density at *FI Shares* = 0, we treat this as a censored variable. Hence, we estimate *FI Shares* as a double boundary Tobit variable, which is constrained between 0 and 100.

The second equation in the simultaneous system examines IPO underpricing and uses the same regression specification as in column 2 of Table 4B, except that the insignificant Big 6 auditor is omitted. After controlling for a number of other issue characteristics, we obtain the estimated marginal effects of FI shareholdings on IPO underpricing from the following equation:

$$Underpricing = c_0 + c_1 \cdot FI\ Shares + c_2 \cdot Bank\ Loans + c_3 \cdot Inverse\ Mill's\ Ratio + c_4 \cdot Control\ Variables + u. \tag{2}$$

where for simplicity we omit the IPO issuer subscript from the variables.

We improve on the existing literature by adjusting for endogeneity of FI shareholdings. We also use a Tobit model, instead of a probit model, to control for selection bias caused by FI equity investment

criteria. We limit the Tobit model regressors to issuer and FI characteristics known at the time of the IPO to avoid look-ahead bias. It is well known that individual VCs generally specialize in a few industries or technologies and prefer to invest in firms near their offices. Consistent with this perspective, we find that issuers of VC-backed IPOs cluster by industries, headquarters states and years [e.g., Lee and Wahal (2004)]. To take these aggregate VC investment patterns into account, we include industry indicators for each issuer's two-digit SIC code, state of incorporation and offer year. As one measure of an IPO's credibility with investors, we include lead underwriter reputation. If there are co-leads, then we average the reputations of the lead underwriters. Issuer size and issue complexity are measured by pre-IPO total assets and an indicator for global offerings respectively. NYSE listing is correlated with more analysts and business press coverage for the stock and firm, which reduces asymmetric information. An indicator for younger firms below the median age of our IPO issuer sample is included in the regression to capture the degree of information asymmetry between issuers and outside investors. The percentage of secondary shares in an IPO is included as a control for the incremental information effect of insiders selling shares. We include traditional VC shareholdings and the number of venture funding rounds to control for the size and intensity of total VC investment activity in an issuer. We use aggregate value of U.S. VC portfolio holdings (Sand Hill Index) in the quarter prior to the IPO filing as a measure of expected VC returns. Finally, all of the significant regressors in the first step Tobit model, which are omitted from the second step regressions, are statistically insignificant in unreported second step regressions, supporting their use as instrumental variables.[21]

It is well known that an IPO is the most attractive VC exit since it typically generates significantly higher profits than alternative exits. The size of a VC's post-IPO equity ownership commitment can have crucial impact on investor response to the IPO. As VCs sell more shares at the IPOs, perceived information asymmetry rises, and prior studies show that higher information asymmetry cause public investors to demand higher discounts on IPO shares they buy. Thus, VCs are reputed to frequently accept lockup restrictions to enhance investor demand and limit IPO underpricing. These

[20] For an application of this model, see Nelson and Olsen (1978).
[21] A lead VC is defined as the venture investor having the largest pre-IPO stockholdings. In a vast majority of cases, that would correspond to the VC making the largest investment.

trading restrictions allow information asymmetry to dissipate prior to the VC funds exiting from these IPO issuers [Gompers and Lerner (2004)].

We now explore post-IPO venture investment decisions of FIs in greater detail. Since VCs affiliated with FIs have similar incentives to other VCs, we expect company age, underwriter reputation, aggregate value of VC portfolio holdings (Sand Hill Index) in the quarter prior to the IPO, and the IPO's secondary offering proportion to have negative effects on post-IPO FI share ownership, because these variables are likely to proxy for reduced information asymmetry between issuers and VC investors. Since longer operating and financial histories generally reduce information asymmetry, issuer age is included as a control. Use of higher ranked underwriters reduces investor information asymmetry by credibly certifying issue quality. Higher values of aggregate VC portfolio holdings in the prior quarter (Sand Hill Index) can raise investor expectations about the quality of VC-backed IPOs. Optimistic expectations about the performance of firms in the private equity market can cause investors to discount the importance of information asymmetry in IPOs, thereby enabling FIs to liquidate their equity holdings more easily following lockup expirations. The size of IPO secondary offerings is likely to be higher when underwriters are optimistic about investor demand for the issue and are less concerned about information asymmetry, so they do not object to insider sales at the IPO date.

Turning to the other control variables, we expect the number of venture funding rounds, global offerings, underwriter syndicate leadership, and total assets to all have positive effects on FI ownership. Global offerings are more complex than purely domestic IPOs and face a wide array of multinational securities regulations and can entail greater information asymmetry for foreign investors. The FIs equity owners who are also underwriters are likely to have even greater information advantage over public investors than do other FI equity owners. These FIs are likely to maintain larger equity ownership positions to avoid the appearance of conflicts of interest with IPO investors. Since large firms are less risky, FIs are more likely to retain larger investment positions in these issuers. Finally, the larger are the

equity holdings of traditional VCs, the smaller the level of VC investments that FIs are likely to make, due to competition from the traditional VCs to meet the IPO issuers earlier funding needs. [22]

We estimate the two-equation treatment model using a Heckman two-stage estimation procedure. Our selectivity adjusted estimates of FI venture ownership are reported in Table 5. They show that regardless of whether or not the inverse Mills ratio is statistically significant, our prior conclusions about the effects on IPO underpricing of FI holdings of issuer equity and debt remain unchanged.

*4.3.3 Adjusting for Price Stabilization*

Several recent studies of price stabilizations by Aggarwal (2000), Ellis, Michaely, and O'Hara (2000), and Lewellen (2006) document that underwriters create short positions in the stocks they underwrite by overselling the IPO issues. While they can close their short positions by exercising their overallotment options, in many weak IPOs they cover their short positions with aftermarket share purchases, which can artificially raise IPO aftermarket prices. Lewellen (2006) documents that price stabilization creates significant price rigidity at or below the offer price and raises equilibrium stock prices in the short run. To assess whether our results are distorted by price stabilization, we replace the one-day IPO returns as the dependent variable with five-day, ten-day and twenty-day returns. The resulting FI venture investment effects observed in these untabulated estimates are qualitatively the same as those found for the one-day IPO returns.

Using proprietary underwriter records, Aggarwal documents that IPOs with weak initial returns of 5% or less exhibit a disproportionately large amount of price stabilization activity. We use this finding

[22] We also include a variety of other control variables that could affect the decision about the post-IPO equity ownership of brokerage firms. We also include matched market returns (NYSE or Nasdaq), number of IPOs, and average underpricing of IPOs over the prior three months, as well as the days between filing and issuing dates, to measure information momentum. We examine an indicator for big six auditor and measures of VC reputation such as lead VC age and the number of IPOs backed by the lead VCs to control for the reputation of intermediaries involved in the issuers. A lead VC is defined as having the largest pre-IPO stockholdings. In a vast majority of cases, that would correspond to the VC making the largest investment. We consider issuer size and prominence with market capitalization calculated at the offer prices and an indicator for NYSE listings. We control for issue size with gross proceeds and the percentage of new shares offered. We include tangible assets as a percentage of fixed assets and indicators for Internet bubble period and the existence of lockup agreements to control for information asymmetry. We control for ownership of VCs other than those of brokerage firms and for VC share sales. We include the percentage of secondary shares in the offering to control for secondary selling. We also include indicators for Internet, technology, financial, and utility companies. We also control for industry fixed effects using

to develop several alternative proxies to control for stabilization. Re-estimating regression (2) of Table 5 after excluding all IPOs with initial returns of 5% or less, we find that our prior results are robust to this restriction. We find similar results when we exclude IPOs with non-positive initial returns or offer prices below the filing range [Aggarwal (2000)]. [23] Thus, our findings are not significantly influenced by price stabilization.

*4.3.4 Other Sensitivity Tests*

We also explore the sensitivity of our initial findings to several alternative measures of underpricing and FI share ownership. The earlier regressions are re-estimated when one-day IPO returns are based on the midpoints of closing bid and ask quotes, instead of closing prices. This procedure extracts any bid-ask bounce effect from initial IPO returns, an effect which Lease, Masulis, and Page (1991) find represents a significant portion of public offering date returns for SEOs. In further analysis, we use VC age as an alternative measure of VC reputation and include a number of alternative control variables that further describe IPO issue characteristics without changing our basic conclusions.[24] When we replace bank lending by non-bank lending or total lending, we find the reduction in underpricing is less significant, suggesting that bank certification is more credible. To ensure that our results are not driven by outliers, we estimate quantile regressions and alternatively winsorize our sample at 1% and 5% levels. We find very similar qualitative results for all these additional tests. As a further robustness test, we decompose IB and CB shareholdings according to whether a FI venture investor is also an underwriter in the IPO. We find that equity investment by CB underwriters relative to non-underwriters is associated

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the forty-eight Fama-French industries. Given that these control variables are insignificant and that including them does not affect our results, the results are not tabulated but are available upon request.

[23] Other earlier studies on stabilization commonly use initial IPO returns equal to zero or below (IPO overpricing) as a proxy for IPOs experiencing stabilization.

[24] Other control variables include the percentage ownership that FIs sell, post-IPO share trading volume, share turnover, stock return standard deviation, equity capitalization, average underpricing of IPOs and the total number of IPOs over the prior three months, a financial industry indicator, a utility indicator, a technology indicator, a NYSE indicator, a Section 20 bank indicator, an overallotment indicator, a lockup indicator, equity ownership by managers other than CEOs and by directors, equity sales by all the major financial intermediaries, CEO, and other manager, lead underwriter warrants, IPO firm age, VC reputation measured by VC age and the number of IPOs backed by the lead VC in the prior year, and the log of tangible assets (measured by property, plant and equipment) and tangible assets as a percentage of total assets. Of these variables, only trading volume is statistically significant. We also use these control variables for absolute price revisions and long-term return on assets and obtain similar results.

with a measurably larger reduction in underpricing, though this difference is not statistically significant. Finally, we redefine the indicators of shareholdings by classes of FIs to only equal one when shareholdings reach a minimum threshold level. The indicators become more significant as the threshold levels are raised, which is also consistent with the certification effects increasing with the size of FI venture holdings.

**5. Absolute IPO Price Revisions and Financial Institution Investments in Issuers**

Next we test the predictions of our hypotheses for absolute IPO offer price revisions. Under the certification hypothesis, FI venture investors should reduce absolute price revisions. The moral hazard hypothesis predicts the opposite. Table 6 presents estimates of the relation between the size of FI venture investments and absolute offer price revisions, controlling for a number of other issue characteristics found to be significant in earlier analyses of IPO price revisions as well as yearly fixed effects to capture secular trends and hot and cold market conditions. [Ljungqvist and Wilhelm (2003)].

Regression 1 on Table 6 presents estimates of aggregate issuer shareholdings by three major classes of FIs on absolute offer price revisions.[25] The estimates show that shareholdings by all three FI classes significantly reduce absolute price revisions. Adding three additional control variables for underwriter reputation, Big 6 auditors and global offerings in column 2 does not alter our conclusions. In column 3, we add an inverse Mill's ratio from Table 5 to adjust for selection bias in FI shareholdings using a Heckman two step procedure. The coefficient estimate of the inverse Mill's ratio is negative and significant, though we find similar FI shareholding effects.

To assess the economic significance of aggregate FI shareholdings and to facilitate a comparison with our earlier results on underpricing, we estimate its marginal effect. Multiplying the coefficient estimate of -0.15 from column 1 by its standard deviation of 14.4%, we obtain a -2.16% marginal effect. We see that a one-standard deviation increase in FI aggregate shareholdings reduces average absolute

[25] In another sensitivity test, we also use a log transformation as the dependent variable to take account potential skewness in absolute price revisions. We add one before taking logs to avoid losing observations where the offer price equals the filing range midpoint. The results are qualitatively the same for this transformation.

price revisions by about 10.85% (=-2.16/19.9), given that the mean absolute price revision is 19.9% as reported in Table 2.

In column 4 we replace aggregate FI shareholdings with the number of major classes of FIs making private equity investments in an IPO issuer, which captures the independent certification effects of venture investments by each major class of FIs. We find that shareholding by each additional class of FIs significantly reduces absolute price revisions by 1.70 percentage points.

In column 5, we jointly examine the separate impacts of equity investments by IBs, CBs and ICs, plus bank loans. Both IB and CB shareholdings exhibit significant negative effects on absolute offer price revisions**.** With respect to issuer bank loan size, we find a small, but significant reduction in absolute offer price revisions in all the regressions. To assess the relative importance of different classes of FI ownership, we multiply the coefficient estimates of IB and CB shareholdings and bank loans by their respective standard deviations (i.e. 11.34%, 7.76%, and 30.76% respectively) to obtain their respective marginal effects of -1.59%, -1.09%, and -0.31%. Obviously, IB shareholdings have the largest marginal impact on IPO price revisions among the four classes of FI investments. In column 6, we add an inverse Mill's ratio from Table 5 to adjust for selection bias in the choice of FI venture investments and obtain similar results. The findings that IPOs with FI venture investors have smaller absolute price revisions give further support to the certification hypothesis. In contrast, the moral hazard hypothesis appears inconsistent with the evidence.

The overall explanatory power of these cross-sectional models compares favorably to the existing literature, with adjusted R-squares ranging between 16% and 18%. Nearly all of the control variables have statistically significant coefficients and their signs are consistent with prior studies. Specifically, we find that absolute offer price revision is negatively related to new shares issued, total assets and the registration period, while it is positively related to global offers, and technology and Internet issuers. We also observe that a stronger lead underwriter reputation is associated with greater absolute offer price revisions, which is consistent with higher ranked underwriters being more willing and able to shepherd riskier issues to market. Finding larger IPOs tend to have lower absolute price revisions is consistent with underwriters pursuing more thorough due diligence investigations as their exposure to potential

underwriting losses rises. Larger prior market returns are associated with larger absolute price revisions, which is consistent with offer prices only partially adjusting to new information uncovered in the registration period; a result first reported in Hanley (1993).

Although Table 6 only presents results for the size of FI venture investments, we find in untabulated results that the impacts of individual classes of FIs making venture investments on absolute price revisions are similar to their impacts on underpricing. We also find that the reduction in absolute price revisions is much greater in the presence of multiple classes of FI investments. However, the significance of these FI ownership indicators largely disappears when the size of these FI holdings are also included in the regressions.

In other untabulated results, we find that the earlier results are robust to a variety of alternative specifications and control variables. For example, we find that high asymmetric information issuers that have FI shareholders experience significantly lower absolute offer price revisions. We also find a stronger certification effect for FIs with high VC reputations. Further, when we include an indicator for extra warrant compensation to lead underwriters, we find a significantly positive coefficient. This finding is consistent with warrant compensation being associated with riskier IPOs, which have a greater likelihood of significant news releases over the registration period. However, the effects of FI shareholdings are invariant to including warrants in the regressions.

In other untabulated sensitivity tests, we estimate quantile regressions and winsorize our sample at the 1% and 5% levels to extract the effects of outliers. We also examined IPOs in the 1993-1996 and 1997-2000 subintervals and find stronger results for the 1997-2000 sub-period. This stronger relation in the 1997-2000 period is consistent with our finding for underpricing. Finally, we also examine raw offer price revisions and find qualitatively similar results. After examining all these alternatives, we conclude that our earlier results are robust to an array of alternative specifications and estimation approaches.

## 6. Long-Run Operating Performance Following IPOs

We next examine issuer long-run operating performance measured by industry-adjusted ROA over the initial five year post-IPO period, conditional on FI venture investments.[26] The certification hypothesis predicts higher issuer long-run operating performance for IPOs with FI shareholders who have access to proprietary issuer information as a consequence of their venture investments. In contrast, the moral hazard hypothesis predicts lower ROA levels for IPOs having FI venture investors.

To examine the association between FI venture investments and issuer operating performance, we use ROA defined as earnings before interest and taxes (EBIT) divided by total assets over the 5-year post-IPO period. To eliminate biases induced by industry concentration within the IPO sample, we adjust issuer ROA for any industry effects by subtracting out the industry mean. Industry composition is based on Fama and French (1997) industry classification and ROA availability in the Compustat annual database. Industry adjustments are made to ensure that our results are not driven by a combination of varying industry representation across IPO subsamples and significant differences in industry mean ROA levels. We also control for yearly fixed effects to capture secular trends and hot and cold market conditions. Requiring the availability of annual earnings and total assets in the Compustat database for the five year post-IPO period reduces our sample to 693 observations.

Columns 1 - 3 of Table 7 present the effect of aggregate shareholdings by FIs on industry-adjusted ROA. The evidence in column 1 supports the conclusion that FI shareholdings have a positive effect on issuer long term performance. We see that larger FI shareholdings are associated with higher issuer ROA levels. Adding additional control variables in column 2 does not affect the results. In column 3, we add an inverse Mill's ratio from Table 5 to control for selection bias due to an FI's venture investment criteria. The coefficient estimate of the inverse Mill's ratio is positive and significant, yet our qualitative conclusions remain unchanged.

To assess economic significance and facilitate a comparison with the earlier underpricing results, we multiply the coefficient estimate for aggregate FI shareholdings in column 1 of 0.29 by its standard deviation for the sample with ROA data of 9.76%, to obtain a 2.83% marginal effect. Given an average

[26] While other studies have analyzed long run stock performance, this evidence is generally greeted with skepticism due to the generally recognized inadequacies of the risk adjustment benchmark problems discussed in a number of

ROA level of 14.4% (as reported in Table 2), a one standard deviation increase in FI aggregate shareholdings reduces average ROA by about 20%.

In column 4 we replace aggregate FI shareholdings with the number of FI classes holding shares in an IPO issuer. The number of FI classes captures the independent certification effect of adding one more class of FI venture investors. We find that an additional class of FI shareholders significantly raises issuer ROA by 4.48%.

In column 5, we jointly examine the individual effects of shareholdings by IBs, CBs and ICs and bank loans on long-run IPO issuer operating performance. Both IB and CB shareholdings exhibit a significant positive effect on issuer ROA**.** To assess their relative importance, we multiply the coefficient estimates on IB and CB shareholdings by their respective standard deviations (i.e. 7.27% and 5.83%) to obtain their marginal effects of 2.69% and 1.75%. We clearly see that IB shareholdings have a larger marginal impact. In column 6, we add an inverse Mill's ratio from Table 5 to control for selection bias associated with FI shareholdings and obtain qualitatively similar, though economically stronger results.

Examining the coefficient estimates of the control variables, we find that a large majority have significant coefficients and signs, which are consistent with the findings of prior studies. All these regression equations show good explanatory power with adjusted R-squares of at least 18%. Overall, the evidence in this table is clearly supportive of the long-term predictive power of certification by FI venture investors as a whole and it supports independent certification by individual classes of FIs. The evidence is inconsistent with the moral hazard hypothesis.

Although Table 7 only presents results for the size of FI venture investment, in untabulated results we also find that the impacts on long-run operating performance of the presence of multiple classes of FI venture investors and find the estimates are consistent in sign with the impact of aggregate FI investment. The reduction in ROA is much greater in the presence of multiple classes of FI investors. However, the significance of indicator variables for the presence of individual FI investor classes largely

studies including Fama (1998), Eckbo, Masulis and Norli (2000) and Mitchell and Stafford (2000). Also, see Eckbo, Masulis and Norli (2007) for more recent evidence and further discussion of these issues.

disappears when we also include measures of their investments levels, though the latter ownership variables are significant.

We find in untabulated results that our long run performance evidence is robust to an array of sensitivity tests. For example, we find that high stock volatility IPO issuers with IB or CB shareholders experience significantly better mean ROA levels than low stock volatility issuers with IB or CB shareholders. Interestingly, low stock volatility issuers with IB or CB shareholders have higher mean ROA levels than those without IB or CB shareholders. In other tests, we add the control variables used in the Table 5 for robustness analysis, divide the IPO sample by FIs with high and low reputation VCs, estimate quantile regressions and winsorize the sample at the 1% and 5% level to limit the effects of outliers. In all of these cases, we find our conclusions are unaltered and are consistent with those reported in Table7. For example, we find stronger certification effects for FIs with high VC reputations and for IPOs with greater asymmetric information. We also divide the IPO sample into 1993-1996 and 1997-2000 sub-periods, and again find stronger results for the 1997-2000 sub-period. When we examine the results of interacting the FI class indicators, as we did for underpricing, we find that these interaction terms are stronger than the indicators for individual FI classes, as we find for underpricing.

As a further robustness test, we estimate the likelihood of delisting using a probit model, where the dependent variable equals one when the stock is delisted because of financial distress (i.e. does not meet listing requirements) over the five year post-IPO period. Over this sample period, we find 218 IPOs in our sample are delisted for financial problems, defined as CRSP delisting codes between 500 and 600. In addition, only two companies in our sample are liquidated within five years of their IPO dates. When we examine the probit model estimates, we find insignificant effects for FI holdings on the issuer delisting probability, which is consistent with Gompers and Lerner (1999) who report insignificant results for an indicator of underwriters having a prior venture investment. This suggests that survivorship bias is not a serious problem for our analysis of long term operating performance. We also find similar results to the 5 year ROA evidence when we examine long term operating performance using only 3 year ROA levels, where we only require ROA data for the 3 year post-IPO period. This also indicates that survivorship bias is not driving our results.

## 7. Conclusions

We evaluate several hypotheses concerning the effects of venture investments by different classes of FIs on the IPO underwriting process. Under the basic certification hypothesis, the existence of any FI investments in issuers reduces the asymmetric information faced by IPO investors since FIs have access to proprietary issuer information and are concerned about the risks and expected returns of their investments. Thus, FI venture investment is predicted to raise the prices that IPO investors are willing to pay. We also test whether the strength of FI certification of issuers rises with the size of FI investments since FIs have greater incentives to monitor issuers more closely when they have greater capital at risk. As a further extension, we examine whether there are independent certification effects when multiple classes of FIs make venture investments in the same issuer and whether some FI classes produce greater certification effects.

The moral hazard hypothesis offers a counterpoint to the certification hypothesis. The moral hazard hypothesis predicts that a venture investment by an FI can create an underwriter conflict of interest with IPO investors. The reasoning is that an FI benefits from an IPO since it strengthens an issuer's financial condition, which in turn raises the expected value of the FI's venture investment. If the FI venture investor is an underwriter or can influence the underwriter through its ongoing business relationships, then the underwriter can be more willing to bring weaker firms public. Given these incentives, rational investors will be more skeptical of underwriter certification when there are FI venture investments in an IPO issuer, which is predicted to increase IPO underpricing.

To summarize our findings, we observe that the size of venture investments in issuer shares and loans by classes of FIs are associated with significantly less IPO underpricing and absolute price revisions and with significantly higher IPO issuer returns on assets in the post-IPO period. We find that venture investments by multiple classes FIs have independent and incremental impacts on the IPO process. The marginal effect of venture holdings by different classes of FIs is noticeably changed when multiple classes of FIs are venture investors in the same issuer. In addition, the presence of a class of FI venture investors largely loses its statistical significance when we also include the size of its venture investment,

which suggests that information contained in the existence of FI classes of venture investors is subsumed by its corresponding investment levels. These results are also robust to adjustments for selection bias caused by the FIs' venture investment criteria. Moreover, the impact of FI venture investment positions is greater for IPO stocks with more information asymmetry, which is further support for the certification effect of FI venture investments. Likewise, the impact of FI venture investment positions is greater and more significant for IPO stocks backed by more reputable VCs, who are better able to reduce the asymmetric information problem facing outside investors. Finally, in periods with larger IPO underpricing, which are likely to represent periods of greater asymmetric information, FI investments also have stronger effects.

Overall, our evidence is consistent with the size of venture investments by FIs acting as a credible certification mechanism for IPO issuers, and it is inconsistent with FI venture investments creating a serious moral hazard problem for IPO investors. In addition, our evidence highlights that various classes of financial intermediaries have significant incremental certification effects, which is consistent with these FIs independently producing evaluations of IPO issuer quality. One fruitful avenue for future research is to explore in greater detail the information production processes of FIs with respect to privately held firms and how they use this information to affect the IPO underwriting process.

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**Table 1. Variable definitions**

| | |
|---|---|
| Underpricing (%) | (Closing Price on Trading Day 0 / Offer Price) – 1 |
| Price Revision (%) | (Offer Price - Midpoint of Initial Filing Range) / Midpoint of Initial Filing Range |
| Delisting 5-Year Rate | Indicator Equals 1 if the IPO Issuer is Delisted for not Meeting Exchange Requirements Within 5 Years of the IPO Date, and 0 Otherwise. |
| Return on Assets in 5 Years (%) | Average of Annual EBITDA / Total Assets Over the Five Years After the IPO Adjusted by the Average Industry Level Based on Fama-French (1997) industry classifications |
| FI Shares (%) | Post-IPO Issuer Shares Held by Major FIs: IBs, CBs, and ICs |
| IB Shares (%) | Percentage of Post-IPO Share Held by IBs |
| CB Shares (%) | Percentage of Post-IPO Share Held by CBs |
| IC Shares (%) | Percentage of Post-IPO Share Held by Insurance Companies |
| IB Share Indicator | Investment Bank Pre-IPO Shareholdings of at least k% |
| CB Share Indicator | Commercial Bank Pre-IPO Shareholdings of at least k% |
| IC Share Indicator | Insurance Company Pre-IPO Shareholdings of at least k% |
| IB and CB Share Indicator | Investment Bank Pre-IPO Shareholdings of at least k% |
| IB and IC Share Indicator | Investment Bank and Insurance Company Pre-IPO Shareholdings of at least k% |
| CB and IC Share Indicator | Commercial Bank and Insurance Company Pre-IPO Shareholdings of at least k% |
| Share Sales by Pre-IPO Investors (%) | Number of Shares Sold by Pre-IPO Investors / Pre-IPO Shares Outstanding |
| Bank Loans (%) | Bank Lending / Total Assets |
| Stock Return Standard Deviation (%) | IPO Stock Return's Standard Deviation Over Event Days +21 to +270 |
| VC Shares (%) | Percentage of Post-IPO Share Held by Traditional and Corporate Venture Funds |
| VC Selling (%) | Shares sold in IPO by VC Funds as a Percentage of Pre-IPO Shares Outstanding |
| CEO Shares (%) | Percentage of Post-IPO Share Held by CEO |
| Total Assets | Issuer Total Assets in the Fiscal Year-end Prior to IPO ($Millions) |
| Offer Size ($Millions) | Offer Price x Shares Offered (Prior to Exercise of Overallotment Options) |
| New Shares Issued (%) | Total Number of IPO Shares Issued / Post-IPO Shares Outstanding |
| Prior Market Return (%) | Average Nasdaq or NYSE Market Return over Event Days -270 to -21 |
| Recent IPO Activity | Total Number of IPOs over the Prior 3 Months |
| Prior Sand Hill Index | The Level of Sand Hill Index, a Measure of the Value of Aggregate VC Portfolio Holdings, Three Months Before IPOs |
| Number of Financing Rounds | Number of VC Financing Rounds before IPOs |
| Registration Period Duration | Trading Days between an IPO's Initial Filing Date and Actual Issuance Date |
| Underwriter Reputation | Investment Bank Rankings of Lead Underwriters from Ritter and Loughran (2004) |
| Big 6 Auditor | Indicator Equals 1 if Auditor Is a Big 6 Auditor, and 0 Otherwise |
| Syndicate Size | Number of Lead Underwriters and Co-Managers |
| NYSE | Indicator Equals 1 if IPO Is Listed on the NYSE |
| Underwriter | Indicator Equals 1 if a Lead or Co-manager Has Shareholdings in the IPO Issuer |
| VC Age | Age of VC at IPO |
| Issuer Age | Age of Issuer at IPO from Ritter and Loughran (2004) |

| | |
|---|---|
| Global Offering | Indicator Equals 1 if IPO Is a Simultaneous Global Offering, and 0 Otherwise |
| Internet | Indicator Equals 1 for Internet Issuers Defined in Ritter and Loughran (2004) |

## Table 2. Mean values of issue characteristics

Descriptive statistics are reported for our sample of venture-backed IPOs completed between January 1993 and December 2000 by U.S. issuers. Variable definitions are given in Table 1. FI Equity represents IPOs that have post-IPO shareholdings by at least one FI in the following classes: commercial banks, investment banks or insurance companies, whereas No FI Equity represents the remaining IPOs. Bank Loans represents IPOs that have bank loans, whereas No Bank Loan represents the remaining IPOs. We also conduct *t*-tests on the differences of IPO characteristics between IPOs with FI equity and IPOs without them, and between IPOs with commercial bank loans and IPOs without them. ** and * indicate that the *t*-statistics are significant at the 1%, and 5% levels, respectively.

| | All | No FI Equity | FI Equity | No Bank Loans | Bank Loans |
|---|---|---|---|---|---|
| **Dependent Variables:** | | | | | |
| Underpricing (%) | 39.40 | 44.24 | 35.26 *** | 39.92 | 39.14 |
| Offer Price ($) | 13.12 | 13.24 | 13.02 | 12.92 | 13.22 |
| Price Revision (%) | 7.31 | 9.16 | 5.73 ** | 6.43 | 7.76 |
| Abs Price Revision (%) | 19.90 | 20.97 | 18.99 * | 20.75 | 19.47 |
| Return on Asset (5-Year) (%) | -14.38 | -13.69 | -14.99 | -30.05 | -7.84*** |
| **Issue Characteristics:** | | | | | |
| Total Assets ($Millions) | 90.88 | 42.73 | 132.09 *** | 59.34 | 106.89 |
| Issuer Age | 8.73 | 8.46 | 8.96 | 5.80 | 10.21*** |
| Offer Size ($Million) | 57.85 | 53.24 | 61.80 | 60.96 | 56.28 |
| New Shares Offered (%) | 36.16 | 35.21 | 36.97 *** | 32.20 | 38.16*** |
| Global Offering (%) | 25.96 | 24.34 | 27.35 | 29.92 | 23.96*** |
| VC Age | 14.80 | 14.97 | 14.65 | 13.67 | 15.38*** |
| Underwriter Reputation | 7.84 | 8.01 | 7.69 *** | 7.83 | 7.84 |
| Big 6 Auditor (%) | 88.51 | 90.03 | 87.20 * | 85.34 | 90.11*** |
| Syndicate Size | 2.76 | 2.72 | 2.80 * | 2.84 | 2.73** |
| NYSE | 0.04 | 0.02 | 0.05 *** | 0.01 | 0.05*** |
| Registration Period Duration | 57.64 | 56.78 | 58.37 | 61.07 | 55.90** |
| Recent IPO Activity | 145.36 | 145.99 | 144.83 | 143.94 | 146.08 |
| Prior Market Return (%) | 6.95 | 7.07 | 6.84 | 7.60 | 6.62 |
| Prior Sand Hill Index | 661.42 | 629.57 | 688.68 * | 816.16 | 582.87*** |
| Number of Financing Rounds | 4.24 | 4.12 | 4.34 | 4.63 | 4.04*** |
| Return Standard Deviation (+21, +270) (%) | 5.88 | 5.76 | 5.98 * | 6.54 | 5.54*** |
| Internet Firms (%) | 21.97 | 20.82 | 22.96 | 27.51 | 19.16*** |
| Total Number of IPOs | 1479 | 682 | 797 | 498 | 981 |

## Table 3. Frequencies of IPOs with FI ownership by year and by classes of FIs

This table reports the frequency of IPOs by year and by different types of post-IPO FI ownership, as well as the aggregate ownership by major classes of FIs. Panel A reports the number of IPOs by year in total and the numbers of IPOs with post-IPO equity or loan ownership by year. We also report the numbers of IPOs with equity or loan ownership as a percentage of total number of IPOs. In Panel B, we separate IPOs into cases with FI shareholdings or loans and IPOs with both. In Panel C, we examine shareholdings of separate classes of FIs and the frequency of IPOs with multiple classes of FI shareholders. Panel D reports the total number of IPOs with post-IPO ownership by the class of financial institutions and the average percentage shareholdings of the class of financial institutions in the IPO issuers with post-IPO ownership by these institutions. For example, Shares are FI shares as a percentage of post-IPO shares outstanding and Bank Loans are bank loans as a percentage of total assets.

Panel A. Frequency of IPOs by Year

| | | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| VC backed IPOs | (No.) | 210 | 131 | 183 | 256 | 127 | 76 | 268 | 228 | 1479 |
| IPOs with FI Equity | (No.) | 130 | 62 | 90 | 127 | 68 | 43 | 137 | 140 | 797 |
| | (%) | 61.9 | 47.3 | 49.2 | 49.6 | 53.5 | 56.6 | 51.1 | 61.4 | 53.9 |
| IPOs with Bank Loans | (No.) | 160 | 95 | 136 | 178 | 76 | 52 | 173 | 111 | 981 |
| | (%) | 76.2 | 72.5 | 74.3 | 69.5 | 59.8 | 68.4 | 64.6 | 48.7 | 67.5 |
| IPOs with FI Equity | (No.) | 193 | 115 | 163 | 222 | 105 | 71 | 217 | 182 | 1268 |
| or Bank Loans | (%) | 91.9 | 87.8 | 89.1 | 86.7 | 82.7 | 93.4 | 81.0 | 79.8 | 85.7 |

Panel B. Frequency of IPOs by Types of FI Venture Investments

| | Any FI Venture Investments | Shareholdings Only | Loans Only | Both Shareholdings and Loans |
|---|---|---|---|---|
| Number of IPOs | 1268 | 287 | 471 | 510 |
| Percentage of IPOs | 85.7 | 19.4 | 31.8 | 34.5 |

Panel C. Frequency of Venture Equity Holdings by Classes of FIs

| | Any FIs | IBs Only | CBs Only | ICs Only | Multiple FIs |
|---|---|---|---|---|---|
| Number of IPOs | 797 | 411 | 140 | 54 | 192 |
| Percentage of IPOs | 53.9 | 27.8 | 9.5 | 3.7 | 13.0 |

Panel D. The Size of FI Equity and Loan Ownership in IPOs

| Venture Holdings | | IBs | CBs | ICs |
|---|---|---|---|---|
| Shareholdings | (No.) | 587 | 288 | 123 |
| | Mean Share (%) | 8.2 | 8.0 | 8.3 |
| Bank Loans | (No.) | | 981 | |
| | Mean Loans (%) | | 37.8 | |

## Table 4. Effect of financial institutions' ownership in an issuer on IPO underpricing

This table presents estimates of the relation between IPO underpricing and financial institutions' ownership. Our sample is based on venture-backed IPOs completed between January 1993 and December 2000 by U.S. issuers. Panels A and B present results of estimating the model for the full sample: $Underpricing = a_0 + a_1 \cdot FI\ Shares + a_2 \cdot Bank\ Loans + a_3 \cdot Control\ Variables + \varepsilon$. *Underpricing* represents the IPO first-day percentage return. *FI Share* represents post-IPO percentage shareholdings of classes of financial institutions. *Classes of FI Equity Investors* is a count variable ranging from 0 to 2 for the total types of share ownerships among commercial and investment banks. *Inverse Mill's Ratios* are based on Table 4 estimates. Other variable definitions are given in Table 1. In Panel C, columns (1)-(2) present results for the 1993-1996 and 1996-2000 periods, respectively, and columns (3) presents results for the model: $Underpricing = a_0 + a_1 \cdot FI\ Shares \cdot Information\ Asymmetry + a_2 \cdot Bank\ Loans \cdot Information\ Asymmetry + a_3 \cdot Control\ Variables + \varepsilon$. *Information Asymmetry* is measured by two indicator variables based on stock return variance over event days +21 through +270 following the IPO. HV represents variance above the sample median and LV represents variance below the sample median. Columns (4) present results for the model: $Underpricing = a_0 + a_1 \cdot FI\ Shares \cdot VC\ Reputation + a_2 \cdot Control\ Variables + \varepsilon$. *VC Reputation* is measured by two indicator variables based on the number of IPOs that the VCs had previously backed. *High VC Reputation* indicates that the number of IPOs backed by a VC up to the year of the current IPO above the median and *Low VC Reputation* indicates that the number of IPOs backed by a VC is below the median based on the VentureXpert population of VC firms. The models are estimated with ordinary least squares, and heteroscedasticity-consistent t-statistics adjusted for Fama-French industry clustering are reported. We find that yearly fixed effects are statistically significant, though for brevity they are not reported.

| | Panel A. Indicators for FI Ownership | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | **7** | | **8** | |
| | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** |
| FI Share Indicator | -10.37 | -3.27 | -9.81 | -3.12 | | | | | | | | | | | | |
| Classes of FI Equity Investors | | | | | -7.26 | -3.55 | | | | | | | | | | |
| IB Share Indicator* | | | | | | | -7.61 | -2.32 | | | | | -6.55 | -1.97 | -7.82 | -1.93 |
| CB Share Indicator* | | | | | | | | | -9.04 | -2.28 | | | -8.29 | -2.09 | -9.80 | -1.72 |
| IC Share Indicator* | | | | | | | | | | | -5.08 | -1.57 | -4.20 | -1.29 | -4.40 | -0.88 |
| IB and CB Share Indicator | | | | | | | | | | | | | | | -14.99 | -2.61 |
| IB and IC Share Indicator | | | | | | | | | | | | | | | -14.46 | -2.49 |
| CB and IC Share Indicator | | | | | | | | | | | | | | | -21.49 | -3.38 |
| Bank Loan Indicator | | | | | | | | | | | | | -8.57 | -2.62 | -10.48 | -0.98 |
| VC Shares | -0.10 | -1.72 | -0.12 | -2.09 | -0.12 | -2.09 | -0.10 | -1.85 | -0.09 | -1.63 | -0.07 | -1.38 | -0.11 | -1.97 | -0.12 | -2.15 |
| Log (Total Assets) | 0.59 | 0.68 | -2.78 | -2.80 | -2.64 | -2.64 | -3.14 | -3.21 | -2.82 | -2.87 | -3.21 | -3.29 | -3.07 | -2.94 | -2.54 | -2.55 |
| New Shares Issued | -0.26 | -3.48 | -0.18 | -3.08 | -0.18 | -3.06 | -0.18 | -3.05 | -0.17 | -2.99 | -0.18 | -3.04 | -0.18 | -3.10 | -0.17 | -3.05 |
| Internet Firms | 27.90 | 4.04 | 23.88 | 3.56 | 23.98 | 3.57 | 24.02 | 3.56 | 23.55 | 3.52 | 23.34 | 3.48 | 24.29 | 3.64 | 23.85 | 3.53 |
| Prior Market Return | 1.21 | 6.08 | 1.19 | 6.05 | 1.20 | 6.08 | 1.20 | 6.09 | 1.20 | 6.08 | 1.20 | 6.06 | 1.21 | 6.13 | 1.19 | 6.03 |
| Registration Period Duration | -0.10 | -4.58 | -0.08 | -3.80 | -0.08 | -3.83 | -0.08 | -3.80 | -0.08 | -3.81 | -0.08 | -3.78 | -0.07 | -3.69 | -0.08 | -3.84 |
| Underwriter Reputation | | | 2.59 | 3.26 | 2.76 | 3.58 | 2.67 | 3.31 | 3.29 | 4.40 | 3.14 | 4.17 | 2.81 | 3.45 | 2.72 | 3.30 |
| Big 6 Auditor | | | -12.58 | -1.58 | -12.23 | -1.54 | -12.58 | -1.58 | -11.79 | -1.48 | -11.97 | -1.50 | -12.56 | -1.58 | -12.22 | -1.54 |
| Global Offering | | | 25.83 | 5.18 | 25.78 | 5.17 | 25.91 | 5.19 | 25.31 | 5.09 | 25.27 | 5.07 | 26.07 | 5.24 | 25.90 | 5.21 |
| Intercept | 69.00 | 9.61 | 52.90 | 5.32 | 50.47 | 5.17 | 49.73 | 5.01 | 42.72 | 4.41 | 42.34 | 4.38 | 46.78 | 4.74 | 50.87 | 5.04 |
| Adjusted $R^2$ | 0.29 | | 0.31 | | 0.31 | | 0.31 | | 0.31 | | 0.31 | | 0.32 | | 0.32 | |
| Number of Observations | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | |

* In regression 8, these indicators are redefined to represent shareholdings by only one FI class and exclude cases where multiple classes of FIs are shareholders.

| | Panel B. Actual Percentage of and Indicators for FI Ownership | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | **7** | | **8** | |
| | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** |
| FI Shares | -0.72 | -5.72 | -0.71 | -5.58 | | | | | | | | | | | | |
| IB Shares (%) | | | | | -0.65 | -4.18 | | | | | | | -0.65 | -4.12 | -0.57 | -2.85 |
| CB Shares (%) | | | | | | | -0.61 | -3.31 | | | | | -0.69 | -3.76 | -0.54 | -2.45 |
| IC Shares (%) | | | | | | | | | -0.65 | -2.58 | | | -0.80 | -3.02 | -1.11 | -2.55 |
| Bank Loans (%) | | | | | | | | | | | -0.05 | -3.39 | -0.04 | -2.63 | -0.05 | -3.10 |
| IB Share Indicator | | | | | | | | | | | | | | | -2.35 | -0.59 |
| CB Share Indicator | | | | | | | | | | | | | | | -3.69 | -0.79 |
| IC Share Indicator | | | | | | | | | | | | | | | 4.64 | 0.87 |
| Bank Loan Indicator | | | | | | | | | | | | | | | -10.04 | -3.01 |
| VC Shares | -0.15 | -2.43 | -0.17 | -2.81 | -0.13 | -2.21 | -0.10 | -1.80 | -0.08 | -1.44 | -0.07 | -1.21 | -0.16 | -2.63 | -0.16 | -2.59 |
| Log (Total Assets) | 1.40 | 1.50 | -2.10 | -2.08 | -2.71 | -2.75 | -2.89 | -2.95 | -3.22 | -3.30 | -2.07 | -1.93 | -1.14 | -1.03 | -1.41 | -1.25 |
| New Shares Issued | -0.26 | -3.46 | -0.17 | -3.04 | -0.17 | -3.01 | -0.18 | -3.03 | -0.18 | -3.03 | -0.18 | -2.96 | -0.17 | -2.99 | -0.17 | -3.03 |
| Internet Firms | 26.77 | 3.90 | 22.71 | 3.42 | 23.32 | 3.49 | 23.06 | 3.45 | 23.26 | 3.47 | 22.69 | 3.38 | 22.11 | 3.32 | 22.69 | 3.40 |
| Prior Market Return | 1.24 | 6.28 | 1.23 | 6.25 | 1.21 | 6.15 | 1.21 | 6.14 | 1.20 | 6.08 | 1.21 | 6.14 | 1.24 | 6.30 | 1.25 | 6.35 |
| Registration Period Duration | -0.10 | -4.55 | -0.08 | -3.78 | -0.08 | -3.77 | -0.08 | -3.77 | -0.08 | -3.80 | -0.08 | -3.96 | -0.08 | -3.93 | -0.08 | -3.82 |
| Underwriter Reputation | | | 2.91 | 3.87 | 2.86 | 3.78 | 3.27 | 4.35 | 3.12 | 4.14 | 3.05 | 4.04 | 2.84 | 3.74 | 2.71 | 3.30 |
| Big 6 Auditor | | | -12.95 | -1.64 | -12.88 | -1.62 | -12.14 | -1.53 | -11.95 | -1.50 | -11.86 | -1.49 | -12.71 | -1.60 | -13.06 | -1.65 |
| Global Offering | | | 25.41 | 5.13 | 25.57 | 5.14 | 25.28 | 5.08 | 25.21 | 5.06 | 25.96 | 5.16 | 25.89 | 5.18 | 26.50 | 5.31 |
| Intercept | 66.13 | 9.29 | 48.62 | 5.01 | 47.36 | 4.84 | 41.91 | 4.35 | 42.75 | 4.41 | 38.80 | 4.01 | 45.68 | 4.67 | 43.90 | 4.47 |
| Adjusted $R^2$ | 0.29 | | 0.32 | | 0.31 | | 0.31 | | 0.31 | | 0.31 | | 0.32 | | 0.32 | |
| Number of Observations | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | |

| | Panel C. Robustness Tests | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Information Asymmetry | | | | VC Reputation | | | | Subsample Periods | | | |
| | HV | | LV | | High | | Low | | 1993-1996 | | 1997-2000 | |
| | 1 | | | | 2 | | | | 3 | | 4 | |
| | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| IB Shares | -1.17 | -4.75 | -0.27 | -2.19 | -0.42 | -1.86 | -0.21 | -0.33 | -0.37 | -2.83 | -0.81 | -3.70 |
| CB Shares | -0.80 | -1.72 | -0.60 | -3.46 | -0.41 | -2.40 | 0.08 | 0.21 | -0.49 | -3.55 | -0.79 | -2.90 |
| IC Shares | -1.09 | -1.77 | -0.59 | -3.03 | -0.47 | -2.18 | -0.35 | -1.79 | -0.65 | -2.48 | -0.92 | -2.12 |
| Bank Loans | -0.07 | -3.47 | -0.03 | -2.31 | -0.02 | | -3.57 | | -0.02 | -1.30 | -0.05 | -3.63 |
| VC Shares | -0.15 | | -2.43 | | -0.15 | | -2.17 | | -0.15 | | -2.51 | |
| Log (Total Assets) | -1.72 | | -1.56 | | -2.68 | | -2.48 | | -1.22 | | -1.10 | |
| New Shares Issued | -0.17 | | -3.00 | | -0.18 | | -3.83 | | -0.17 | | -2.99 | |
| Internet Firms | 21.93 | | 3.26 | | 22.52 | | -3.37 | | 21.68 | | 3.24 | |
| Prior Market Return | 1.24 | | 6.23 | | 1.22 | | 6.18 | | 1.24 | | 6.32 | |
| Registration Period Duration | -0.07 | | -3.60 | | -0.08 | | -3.69 | | -0.08 | | -3.99 | |
| Underwriter Reputation | 2.91 | | 3.84 | | 3.46 | | 3.97 | | 2.84 | | 3.74 | |
| Big 6 Auditor | -14.19 | | -1.78 | | -13.06 | | -1.65 | | -12.79 | | -1.61 | |
| Global Offering | 25.95 | | 5.17 | | 25.48 | | 4.98 | | 25.90 | | 5.16 | |
| Intercept | 49.75 | | 4.95 | | 45.55 | | 4.48 | | 46.94 | | 4.79 | |
| Adjusted $R^2$ | 0.32 | | | | 0.32 | | | | 0.32 | | | |
| Number of Observations | 1479 | | | | 1479 | | | | 1479 | | | |

## Table 5. Effect of FI equity ownership on IPO underpricing adjusting for endogeneity

This table presents the estimates of a two-equation treatment model [Maddala (1983)]. The endogenous venture investment decision is modeled using a Tobit model in which *FI Shares* is the dependent variable.

$$FI\ Share_i^* = M_i' b_i + \varepsilon_i$$

$$FI\ Share_i = \begin{cases} 100 & when \quad 100 \le FI\ Share_i^* \\ FI\ Share_i^* & when \quad 0 < FI\ Share_i^* \le 100 \\ 0 & when \quad FI\ Share_i^* \le 0 \end{cases}$$

where *FI Shares** is a latent variable observed only when FIs have post-IPO equity ownership in issuer *i*; $M_i$ represents a vector of determinants of post-IPO FI equity ownership; $b_i$ is a vector of coefficients multiplying the elements of $M_i$; and $\varepsilon_i$ is a disturbance term assumed to have a standard normal distribution. *FI Share* represents post-IPO percentage shareholdings of classes of financial institutions and is a double boundary Tobit variable constrained at 0 and 100. We calculate an inverse Mill's ratio from this selection model. The second step equation examines IPO underpricing and uses the following specification.

$$Underpricing = c_0 + c_1 \cdot FI\ Shares + c_2 \cdot Bank\ Loans + c_3 \cdot Inverse\ Mill's\ Ratio + c_4 \cdot Control\ Variables + u.$$

Issuer age indicator is a dummy variable that equals one if issuer age is greater than median issuer age and zero otherwise. Other variable definitions are given in Table 1. For simplicity we omit issuer subscript from the variables. The Tobit model is estimated with maximum likelihood method and the second equation is estimated with ordinary least squares with heteroscedasticity-consistent t-statistics adjusted for Fama-French industry clustering. Our sample is based on venture-backed IPOs completed between January 1993 and December 2000 by U.S. issuers.

| | **First Stage: Tobit Model** | | | **Second Stage: OLS Model** | |
|---|---|---|---|---|---|
| | **Coeff.** | **t-stat** | | **Coeff.** | **t-stat** |
| Underwriter | 11.75 | 16.84 | FI Shares | -0.63 | -4.74 |
| Secondary Shares | -0.12 | -3.81 | Bank Loans | -0.04 | -2.61 |
| Prior Sand Hill Index | 0.00 | -2.29 | VC Shares | -0.04 | -0.61 |
| Financing Rounds | 0.50 | 3.48 | Log (Total Assets) | -3.51 | -3.13 |
| Issuer Age Indicator | -1.55 | -1.53 | New Shares Issued | -0.18 | -3.18 |
| VC Shares | -0.20 | -11.40 | Internet Firms | 22.69 | 3.40 |
| Log (Total Assets) | 1.87 | 5.15 | Prior Market Return | 1.22 | 6.23 |
| New Shares Offered | 0.03 | 2.22 | Registration Period | -0.08 | -3.73 |
| Underwriter Reputation | -0.57 | -1.85 | Underwriter Reputation | 3.59 | 4.45 |
| NYSE | 10.34 | 4.75 | Big 6 Auditor | -12.99 | -1.64 |
| Syndicate Size | 0.02 | 0.04 | Global Offering | 25.22 | 5.08 |
| Intercept | -0.85 | -0.34 | Inverse Mill's Ratio | -10.53 | -1.97 |
| | | | Intercept | 50.98 | 5.05 |
| Pseudo $R^2$ | 0.26 | | Adjusted $R^2$ | 0.32 | |
| Number of Observations | 1479 | | Number of Observations | 1479 | |

## Table 6. Effect of financial institutions' ownership on absolute IPO price revisions

This table presents estimates of the effect of financial institutions' ownership on the absolute value of the percentage IPO price revisions for a sample of venture-backed IPOs completed between January 1993 and December 2000 by U.S. issuers. The model is the following one: *Absolute Price Revision* = $a_0 + a_1 \cdot$ *FI Shares* + $a_2 \cdot$ *Bank Loans* + $a_3 \cdot$*Control Variables* + $\varepsilon$. *FI Share* represents post-IPO percentage shareholdings of classes of financial institutions. *Classes of FIs Investing* is a count variable ranging from 0 to 2 for the total types of share ownerships among commercial and investment banks. *Inverse Mill's Ratios* are based on Table 6 estimates. Other variable definitions are given in Table 1. We find statistically significant IPO year fixed effects, but for brevity do not report them. The models are estimated with ordinary least squares and t-statistics are based on heteroscedasticity-consistent standard errors, adjusted for Fama-French industry clustering.

| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** |
| FI Shares | -0.15 | -3.23 | -0.14 | -3.06 | -0.13 | -2.58 | | | | | | |
| Classes of FI Equity Investors | | | | | | | -1.70 | -2.07 | | | | |
| IB Shares | | | | | | | | | -0.14 | -2.41 | -0.10 | -2.50 |
| CB Shares | | | | | | | | | -0.14 | -2.39 | -0.15 | -2.53 |
| IC Shares | | | | | | | | | -0.01 | -0.07 | -0.02 | -0.14 |
| Bank Loans | | | | | | | | | -0.01 | -3.10 | -0.02 | -3.60 |
| VC Shares | -0.02 | -1.10 | -0.03 | -1.35 | 0.03 | 0.96 | -0.02 | -0.97 | -0.03 | -1.18 | 0.04 | 1.43 |
| Log (Total Assets) | -0.18 | -0.47 | -1.13 | -2.70 | -1.74 | -3.62 | -1.25 | -3.05 | -0.77 | -1.71 | -1.42 | -2.88 |
| New Shares Issued | -0.07 | -2.54 | -0.05 | -2.12 | -0.06 | -2.31 | -0.05 | -2.13 | -0.05 | -2.09 | -0.06 | -2.34 |
| Internet Firms | 8.34 | 3.86 | 7.51 | 3.55 | 7.44 | 3.51 | 7.81 | 3.64 | 7.32 | 3.46 | 7.13 | 3.37 |
| Prior Market Return | 0.29 | 4.14 | 0.29 | 4.09 | 0.29 | 4.08 | 0.28 | 4.02 | 0.29 | 4.14 | 0.29 | 4.13 |
| Registration Period Duration | -0.02 | -2.55 | -0.02 | -2.02 | -0.02 | -1.96 | -0.02 | -2.05 | -0.02 | -2.16 | -0.02 | -2.14 |
| Underwriter Reputation | | | 1.37 | 4.39 | 1.67 | 4.91 | 1.33 | 4.25 | 1.34 | 4.31 | 1.71 | 4.97 |
| Big 6 Auditor | | | -2.67 | -1.02 | -2.67 | -1.02 | -2.55 | -0.98 | -2.63 | -1.00 | -2.56 | -0.98 |
| Global Offering | | | 3.38 | 1.99 | 3.25 | 1.92 | 3.49 | 2.04 | 3.60 | 2.11 | 3.43 | 2.03 |
| Inverse Mill's Ratio | | | | | -5.03 | -2.28 | | | | | -6.02 | -2.64 |
| Intercept | 29.87 | 11.66 | 21.62 | 5.85 | 23.10 | 6.05 | 22.13 | 6.10 | 20.46 | 5.50 | 22.06 | 5.78 |
| Adjusted $R^2$ | 0.16 | | 0.17 | | 0.17 | | 0.17 | | 0.17 | | 0.17 | |
| Number of Observations | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | | 1479 | |

## Table 7. Effect of financial institutions' ownership on long-run operating performance

This table presents estimates of the relationship between investments in IPO issuers by classes of financial institutions and long-run operating performance for venture-backed IPOs completed between January 1993 and December 2000 by U.S. issuers. Long term operating performance is measured by post-IPO 5 year rate of return on assets adjusting for the industry mean:

*Return on Assets* = $a_0 + a_1 \cdot$*FI Shares* + $a_2 \cdot$ *Bank Loans* + $a_3 \cdot$*Control Variables* + $\varepsilon$.

where the dependent variable is Fama-French 48-industry adjusted post-IPO returns on assets over 5-year post-IPO period. Returns on assets are measured by the mean of the annual EBITDA divided by total assets. *FI Shares* measures post-IPO percentage equity holdings in issuers by major classes of financial institutions. *Classes of FI Equity Investors* is a count variable ranging from 0 to 2 for the total types of share ownerships among commercial and investment banks. *Inverse Mill's Ratios* are based on Table 5 estimates. Other variable definitions are given in Table 1. We find statistically significant IPO year fixed effects, but for brevity do not report them. The models are estimated with ordinary least squares and the t-statistics are based on heteroscedasticity-consistent standard errors, adjusted for Fama-French industry clustering.

| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** |
| FI Shares | 0.29 | 2.28 | 0.33 | 2.54 | 0.39 | 3.03 | | | | | | |
| Classes of FI Equity Investors | | | | | | | 4.48 | 2.46 | | | | |
| IB Shares | | | | | | | | | 0.37 | 2.11 | 0.42 | 2.44 |
| CB Shares | | | | | | | | | 0.30 | 2.06 | 0.36 | 2.53 |
| IC Shares | | | | | | | | | 0.01 | 0.03 | 0.09 | 0.23 |
| Bank Loans | | | | | | | | | -0.02 | -1.33 | -0.01 | -0.83 |
| VC Shares | 0.14 | 2.02 | 0.12 | 1.87 | -0.16 | -1.61 | 0.10 | 1.67 | 0.13 | 1.91 | -0.15 | -1.42 |
| VC Sellings | -0.25 | -2.95 | -0.22 | -2.51 | -0.20 | -2.38 | -0.20 | -2.30 | -0.23 | -2.51 | -0.20 | -2.28 |
| CEO Shares | 0.23 | 1.92 | 0.24 | 2.01 | 0.19 | 1.54 | 0.22 | 1.87 | 0.24 | 2.01 | 0.19 | 1.57 |
| Log (Total Assets) | 7.02 | 2.88 | 5.26 | 2.54 | 8.06 | 3.37 | 5.24 | 2.56 | 5.85 | 2.41 | 8.31 | 3.17 |
| New Shares Issued | -0.09 | -1.82 | -0.03 | -0.56 | 0.01 | 0.18 | -0.02 | -0.34 | -0.03 | -0.53 | 0.01 | 0.21 |
| Underwriter Reputation | | | 3.95 | 2.24 | 2.45 | 1.42 | 4.23 | 2.37 | 3.99 | 2.25 | 2.54 | 1.44 |
| Big6 Auditor | | | -0.45 | -0.07 | -0.41 | -0.06 | -0.92 | -0.14 | -0.67 | -0.10 | -0.52 | -0.08 |
| Return Standard Deviation | -5.18 | -3.69 | -5.01 | -3.55 | -5.15 | -3.66 | -5.13 | -3.60 | -5.20 | -3.80 | -5.25 | -3.84 |
| Log (1 + Firm Age) | 7.23 | 3.38 | 7.73 | 3.57 | 5.79 | 2.64 | 7.16 | 3.38 | 7.64 | 3.56 | 5.81 | 2.64 |
| Inverse Mill's Ratio | | | | | 26.01 | 3.94 | | | | | 25.13 | 3.84 |
| Intercept | -42.94 | -1.83 | -72.08 | -2.24 | -76.94 | -2.38 | -74.68 | -2.29 | -73.01 | -2.24 | -77.64 | -2.38 |
| Pseudo $R^2$/Adjusted $R^2$ | 0.18 | | 0.19 | | 0.19 | | 0.19 | | 0.19 | | 0.19 | |
| Number of Observations | 814 | | 814 | | 814 | | 814 | | 814 | | 814 | |