

Working Paper

INITIAL PUBLIC OFFERINGS AND PRE-IPO SHAREHOLDERS: ANGELS VERSUS VENTURE CAPITALISTS

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At the time of an initial public offering, shares in a firm are typically held by venture capitalists, insiders, corporate investors, and angel investors. We examine the role of angel investors in the IPO process. We find that angel investors provide equity capital in industries that venture capitalists are less likely to serve and that shareholders in angel backed IPO firms are more likely to sell their shares at the time of the offering. Where venture capital backed IPO firms have higher underpricing, angel backed IPO firms do not, implying that angels may be the preferred investors for early-stage firms.

Keywords: Business angels, venture capital investors, initial public offerings, underpricing

1. Introduction

Prior to an initial public offering, the equity of the firm is held by a combination of investors including founders, venture capitalists, managers of the firm, and angel investors. Much of the previous research has examined the role of venture capitalists in

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pre-IPO firms and in the process of taking these private firms into the public equity markets. A venture capitalists' influence on the firm's valuation, post-IPO performance and underpricing in the IPO have been studied by a number of researchers (Lerner, 1995; Gompers, 1996; Ljungqvist and Wilhelm, 2003; Loughran and Ritter, 2004; Chemmanur and Loutskina, 2006; Brav and Gompers, 1997). Further, pre-IPO investors often have seats on the board of directors and should have considerable power in setting the offer price for the IPO firm (Lerner, 1995). Noticeably absent from the research is the role and influence of angel investors in the IPO. Since angels invest in more firms than their venture capital counterparts, and often at an earlier stage, they likely have a substantial influence on the growth and survival of the firm (Sohl, 1999; 2007). These gaps in the literature have been noted (Lerner, 1998; Sjögren and Zackrisson, 2005; Knyphausen-Aufsess and Westphal, 2008) and are often based on the difficulty in obtaining reliable data on angel investment activity. One major difference between angels and venture capitalists is that angels invest their own money where venture capitalists invest capital provided by limited partners to their venture capital fund (Avdeitchikova, 2009; Paul, Whittam and Wyper, 2007). This fundamentally changes the incentives of the venture capitalists. Pre-IPO investors are concerned about two main things: the liquidity provided to their investment by taking the firm public and the return on their investment.¹ Where angels are primarily concerned most about the return of their investment, venture capitalists must also consider the incentives to raise additional funds, take other portfolio firms public, and ultimately, to maximize the management fees they can obtain from their current, and future, venture funds. The literature has shown, for instance, that venture capitalists will actually sell the shares of IPO firms at lower prices to enhance their ability to raise future funds, so-called grand standing (Gompers, 1996; Lee and Wahal, 2004). In contrast, angel incentives are more closely aligned with other pre-IPO shareholders who wish to maximize the proceeds of the firm. Regarding angels and IPOs, one recent study by Bruton, Chahine and Filatotchev (2009) examines IPO underpricing in a sample of UK entrepreneurial IPOs where founders retain a significant ownership share and combines both IPO signaling and agency perspectives. However, the institutional differences between European markets and the US are likely to be considerable. Angel and venture capital investors are much more common in US markets relative to the rest of the world, making a study on the US market likely to add new insight into early-stage investment. Our paper focuses on the IPOs of firms in the US, the industry characteristics determining early-stage investments and the influence of angels on the IPO.

One of the main difficulties with comprehensive research involving angels is the lack of reliable data concerning angel investors. Much of the angel research has involved survey data (see, for instance, Freear, Sohl and Wetzel (2002), Avdeitchikova (2009), Morrissette (2007) and Wong (2002)) which is subject to data response bias and concerns

¹ Pre-IPO investors in general and managers in particular may also care about share ownership dispersion and control (Booth and Chua, 1996). For instance, managers may have incentives to hold large blocks of shares to enhance their control of the firm.

about accuracy. We utilize a unique method to gather our sample by focusing on the initial public offerings of private firms. At the time of an IPO, SEC regulation S-K item 403 requires a firm to disclose all principal and selling shareholders.² We utilize the data contained in the IPO firm's prospectus to classify shareholders in the IPO as being angel investors, venture capitalists, firm managers, or other investors. This allows us to avoid the problems inherent in survey based data. Also, our data allows us to focus on the firm, creating a dataset more amenable to studying entrepreneurial finance decisions.

This paper adds to the literature in several important ways. First, the paper examines the important role that angel investors play in providing much needed capital to small entrepreneurial firms before they go public. Second, we are the first paper to our knowledge studying angels to utilize data that is reported to the SEC, making the reliability of the data much higher than most previous work studying angel investors. Previous research on angels has almost exclusively relied on survey based methods. Third, this research examines the interaction between angel investors and venture capitalists and shows, in part, industry characteristics are important determinants of the source of financing for the IPO firm. It also presents new evidence on the costs associated with angel versus venture capital investments. Fourth, the paper adds to the literature by focusing on an important segment of the exit strategy for those angel backed firms, namely those that exit through an IPO, and compares these firm characteristics with venture capital backed IPOs and non-angel and non-venture capital backed IPOs. Since investors do not randomly choose the firms they invest in, the study of IPO firm underpricing and pre-IPO investors is plagued by endogeneity (Lee and Wahal, 2004). We utilize 2SLS to disentangle the endogeneity caused by the sample selection that occurs when angel and venture investors choose the firms they invest in.

The paper is organized as follows. In section 2 we provide an introduction and develop several empirical hypotheses with respect to various important characteristics of firms and their obtaining angel and/or venture capital financing. Section 3 presents the data and some summary statistics, and section 4 outlines our results. In section 5 we provide robustness checks on our results and we conclude in section 6.

2. Hypotheses Development

In this section, we discuss the relationship between certain types of pre-IPO investors and IPO firm characteristics. Specifically, we consider the types of firms certain investor classes are likely to invest in, the size of investments by various types of investors, the impact of investor type on primary versus secondary share sales, and the impact of pre-IPO investors on IPO underpricing.

Private firms may have difficulty in obtaining financing from traditional sources such as banks or public debt markets because either the firms are very uncertain or the

² <http://www.sec.gov/divisions/corpfin/guidance/execcomp403interp.htm> describes the requirement to disclose stock ownership in the prospectus of the IPO firm.

firms have too much information asymmetry. As such, these firms will turn to equity investors who can take controlling positions in the firm (Lerner, 1995). But these equity investors will also have preferences for certain types of investment opportunities. If the investors can hold a diversified portfolio of equity in private firms in the way that a venture capitalist can (Sahlman, 1990; Baum and Silverman, 2004; Petty and Gruber, 2011), then the risk tolerance of the investor for any one investment is likely to be higher than if the investor cannot diversify their portfolio. Unlike a venture capital fund, the individual angel investor tends to concentrate their investments in a smaller number of firms. This increased diversification for venture capitalists along with the ability to raise capital from limited partners should make the optimal investment size for venture capital investors larger than for angel investors. The difference in diversification between angel investors and venture capitalists should result in angel investors taking smaller positions in the IPO firms relative to the average venture capital investor.

This idea is directly opposed to the assumption in Chemmanur and Chen (2006) that venture capitalists invest in less diversified portfolios than angel investors. However, the assumption of Chemmanur and Chen (2006) is predicated on the premise that venture capitalists add value to the relationship and angels only add capital. We propose that both, angel and venture capitalist, can add value to the relationship.

As pointed out by Bodnaruk, Kandel, Massa, and Simonov (2008) investors with a less diversified portfolio are more likely to liquidate at least part of their pre-IPO share holdings in the IPO. Since angel investors are less diversified than venture capitalist, we expect to see a substantially larger number of secondary share sales for firms backed by angel investors. Another reason to expect angels to sell more secondary shares than venture capital firms is that absent share sales, angels will still have to hold the shares until the end of the lock-up. In contrast, the venture capital firm can gain diversification simply by distributing the shares to their limited partners (Gompers and Lerner, 1998; Colombo and Grilli, 2010; Bertoni and *et al.*, 2011). This additional option by venture capital firms further reduces their costs to hold the shares. Thus, we propose the following hypothesis.

H1: IPO firms backed by angel investors will be more likely to have mixed offerings (primary plus secondary shares) relative to IPO firms backed by only venture capitalists or IPO firms without any backing. Also, the larger the share holdings by angels, the larger the number of shares sold by pre-IPO investors.

Venture capitalists have skills in preparing IPO firms to go public, a skill that should make venture capital backed IPOs go public at a younger age, relative to unbacked IPOs. Although angel investors also have skills in taking firms public, they have less pressure to take the firm public early as they are not under pressure to raise money for future venture capital funds or pressure from limited partners to exit an investment and demonstrate a positive return. In addition, venture capitalists have the ability to screen through the private firms they wish to invest in. Since we can expect them to “cherry pick,” or invest in only the highest quality private firms, the firms venture capitalists and angels invest in should have a lower age at the time of their IPO,

compared to unbacked firms. This leads to a testable implication for IPO firm age at the time of the offering.

H2: IPO firms backed by venture capitalists will be younger than IPO firms unbacked by outside investors.

As pointed out by Ljungqvist and Wilhelm (2003), the dilution caused by underpricing is much more damaging for investors selling their shares at the time of the IPO. This is because selling in the IPO causes investors to sell at the lower offering price rather than the higher closing price on the first day of trading. For investors who plan to sell their shares, they will bargain much harder concerning the offering price relative to shareholders who plan to hold their shares after the offering (or distribute shares to their limited partners). This result would imply that angel backed IPO firms would have lower underpricing compared to venture capital backed IPOs since angel investors are more likely to sell shares at the time of the IPO.

In addition, where angels are attempting to maximize the returns on their investments (conditional on taking the firm public), venture capitalists have incentives to take firms public earlier to gain a reputation for bringing firms to the IPO market (see Gompers (1996); Sørensen (2007); and Lee and Wahal (2004)).³ Taking the firm public in this manner may mean that the venture capitalist is forced to underprice the firm more to alleviate information asymmetry. This leads to our third hypothesis.

H3: Firms backed by angel investors will on average have lower underpricing than firms backed by venture capitalists.

This result is particularly important in that it implies that it matters where entrepreneurs get their financing: from venture capitalists or from angels. Gompers (1996) and Sørensen (2007) state that older venture capitalists for whom reputation matters less than for younger venture capitalists would grandstand less. Thus an owner-manager looking for equity financing would be better off going to an older venture capitalist to obtain financing rather than a younger venture capitalist. If our conjecture is correct, then an entrepreneur may be better off avoiding a venture capitalist and only going to an angel to obtain their financing.

3. Sample and Data Collection

The initial sample of IPOs is obtained from the Security Data Corporation (SDC) new issues database from 2001 to 2007. We begin our sample in 2001 for several reasons. Although electronic prospectus data for IPO firms is available from the Securities Exchange Commission in earlier years, we are concerned that the time period from 1999-2000 may not be representative of the overall market for IPOs (Ljungqvist and Wilhelm,

³ Angel investors do still have the same incentives as venture capitalists to accept a lower than “fair market value” for their investment to enhance the liquidity of their position. But this incentive to accept a less than “fair market value” applies to all pre-IPO investors: venture capitalists, angels, and firm management.

2003). We eliminate all unit offerings, closed-end funds, Real Estate Investment Trusts (REITs), American Depository Receipts (ADRs), demutualizations, IPO firms headquartered outside the US, and firms with an offer price below \$5 from the sample. These screens yield a total sample of 799 IPOs.

To gather the information related to manager, venture capital, and angel ownership, we examine the prospectus of each firm. We therefore require firms to have an electronic prospectus filing with the Edgar database of the Securities Exchange Commission, further reducing our sample to 636 firms. We collect information in the offering prospectus about the stock ownership by managers, venture capitalists, and other investors from the “Management” and “Principal and Selling Shareholders” sections of the IPO prospectus. We categorize the identity of each investor owning greater than 2 percent of the shares of the IPO firm, gathering information from the prospectus to ascertain if the stock holder is a manager, a corporate entity, an employee, or a venture capitalist. As noted by Gompers and Lerner (2004), “In many cases individual investors (often called angels) will describe themselves as venture capitalists. Groups of individual investors often make their investments through partnerships that are given names not unlike those of venture capital organizations.” Because Gompers and Lerner (2004) are most concerned about correctly labeling venture capitalists, they only consider an investor to be a venture capitalist if the investor shows up in *Pratt’s Guide to Venture Capital Sources*. In contrast, we are most concerned with correctly labeling angel investors so we eliminate as angels any firms with names containing “venture”, “partners”, “limited partners”, “LP”, or “LLP”. We recognize that this process will eliminate some angel investors from our sample, but the benefit is that it will prevent us from incorrectly classifying venture capitalists as angel investors.

We then conduct some additional checks on the identity of our angel investors to ascertain that the individual investors are not associated with the founders or senior managers. This is similar to the process conducted by Bruton, Chahine and Filatotchev (2009) in their study on the IPO market in the United Kingdom and the methodology for identifying external investors’ ownership at the time of the IPO. As such, we eliminate all investors with the same last name as the CEO or founder of the firm. These investors likely fit into the category of friends and family of the entrepreneur and should not be considered in the same category as angel investors. We then look up each possible angel investor in *Pratt’s Guide to Venture Capital Sources* to further re-classify the angel investors as venture capitalists where appropriate. This process eliminates a total of 162 individuals as angels, reclassifying them as venture capitalists. Finally, we use Marquis’s *Who’s Who in Finance and Business* to eliminate 17 additional venture capitalists from our sample. Individuals who get through these screens are classified as angel investors⁴.

⁴ Our technique will classify any venture capitalist who also invests as an angel as a venture capitalist. This is because the individual making the angel investment will show up as a venture capitalist in either *Pratt’s* or *Who’s Who*. Our classification is conservative in this sense because even angel investments by partners in a venture capitalist will be eliminated as potential angel investors.

This results in a final dataset of 636 firms with a total of 523 angel investors. This is a conservative approach to identifying angel investors and will potentially underestimate the presence of angels, but given the difficulty in uncovering angel investors this is also a prudent approach and one that has been adopted in the literature (Bruton, Chahine and Filatotchev, 2009).

4. Results

4.1. Descriptive statistics

We examine the firms and IPO offering characteristics of our sample in Table 1. Our initial sample consists of N=279 firms with no angel or venture backing, N=37 firms with angel backing only, N=268 with venture backing only, and N=52 firms with angel and venture backing. We find that the offering size for IPOs with venture capital backing (\$115 million) is larger than firms with only angel backing (\$86 million) but not for firms with angel plus venture capital backing (\$124 million). But the proceeds of IPO firms without angel or venture capital backing are substantially larger, at \$268 million. The offer price revision for the firms tends to be negative and our results show that venture capital backed IPO firms have a significantly more negative offer price revision in this time period. We also find that the IPO underpricing for firms with venture capitalists is significantly higher than IPOs without venture capitalists, regardless of angel backing, consistent with Lee and Wahal (2004). The average underpricing, number of IPO offerings, and pre-IPO market price return are all similar to the historical pre-1999 average.

We also calculate the industry concentration of IPO firms using a Herfindahl index calculation for IPO firms without angel or venture capital backing, with angel backing, with venture capital backing, and with both angel and venture capital backing. To calculate this value, we use the percent of firms in each industry going public in each state/industry (Fama and French, 1997) to calculate the index (see Appendix A). We find that IPO firms with venture capital backing have a higher industry concentration (more firms in the same industries) whether the firms have angel backing (Herfindahl=0.10) or not (Herfindahl=0.12). In contrast, IPO firms without angel or venture capital backing and IPO firms with only venture capital backing have industry concentrations of 0.03 and 0.04, respectively.⁵

In Table 1 we also report the IPO firm characteristics across the four classes of IPO firms: IPO firms with no angel or venture capital backing, IPO firms with angel backing, IPO firms with venture capital backing, and IPO firms with angel and venture

⁵ Note that because these Herfindahl measures use the entire sample to make the calculation we cannot do any statistical analysis on the differences between the groups. This is because we cannot get an individual firm measure of the geographic or industry diversification, only for the group as a whole.

Table 1. Sample characteristics

The sample is comprised of 636 IPOs reported in the Securities Data Corporation (SDC) New Issues database between 2001 and 2007. All REITs, unit offerings, closed-end funds, ADRs, firms not covered by CRSP, banks, savings and loans, utilities, non-US based IPOs, and IPOs with an offer price below \$5 are removed from the sample. We use the SDC database and preliminary prospectus from the SEC's EDGAR web site to determine if the IPO is backed by a venture capitalist or a private investor. We define a private backed IPO as any firm with stock ownership at or above the 2 percent level by an individual who is neither affiliated with the firm as an employee, is not related to the firm management, and who is not affiliated with a venture capital firm. To determine the statistical significance of each variable across groups, we conduct the following multivariate regression:

$$\text{IPO firm characteristic} = \alpha + \beta_1 \text{ angel dummy} + \beta_2 \text{ vc dummy} + \beta_3 \text{ angel dummy} \times \text{vc dummy} + \varepsilon$$

We report the statistical significance for β_1 , β_2 , and β_3 in the columns for IPO firms with angel backing, IPO firms with venture capital backing, and IPO firms with angel and venture capital backing, respectively. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level respectively.

	IPO firms without angel or vc backing (N=279)	IPO firms with angel backing (N=37)	IPO firms with vc backing (N=268)	IPO firms with angel and vc backing (N=52)
Average deal and time series characteristics				
IPO proceeds (\$ millions)	268.23	85.65**	115.11**	124.30**
Underwriter rank	8.00	7.19	8.32	8.29
Non-exchange traded (dummy)	0.01	0.03	0.01	0.02
Spread	6.72%	6.90%**	6.91%**	6.88%
Offer price revision	-4.08%	-6.51%	-9.13%**	3.83%**
Underpricing	9.84%	13.78%	12.77%**	23.29%
Average underpricing	11.58%	12.72%	12.55%**	12.67%
IPO frequency	24.23%	24.73%*	23.07%	25.42%
Pre IPO market return	0.00	0.50%	0.43%	-0.03%
Fama and French (1997) 48 industry concentration (Herfindahl index)	0.03	0.04	0.12	0.10
Average IPO firm characteristics				
IPO market capitalization (\$ millions)	888.94	342.61	495.03***	565.76
Percent of shares held by angels	0.00%	8.64%***	0.00%	8.08%
Percent of shares held by venture capital firms	0.00%	0.00%	39.39%***	33.64%
Percent of shares sold by angels in offering	0.00%	4.18%***	0.00%	2.30%**
Percent of shares sold by venture capital firms in offering	0.00%	0.00%	3.80%***	5.32%
Number of angel backers	0.00	3.70***	0.00	2.85
Number of venture capital backers	0.00	0.00	4.50***	4.27
Shares per angel	0.00	3.56%***	0.00	3.33%
Shares per venture capitalist	0.00	0.00	12.93%***	12.38%
Median Industry characteristics in IPO founding year				
Industry Tobin's Q	1.57	1.65	2.11***	1.86**
Industry leverage	0.44	0.42	0.38***	0.41**
Industry R&D/assets	0.03	0.07**	0.10***	0.08**
Industry PPE/assets	0.29	0.22	0.19***	0.17

capital backing. We find that the market capitalization of the IPO firms without angel or venture capital backing (\$889 million) and IPO firms with angel backing (\$343 million) tends to be substantially different than IPO firms with venture capital backing (\$495 million) and angel plus venture capital backing (\$566 million). This result is likely to be due to the mix of firms that the venture capitalists versus angels are investing in.

We find that the percent of shares held by all the pre-IPO angels is 8.64 percent of the firm where the percent of shares held by venture capitalists is 39.4 percent. For IPO firms that are angel plus venture capital backed, angels hold 8.1 percent of the shares and venture capitalists hold 33.6 percent of the shares. The difference between these two values is statistically significant indicating that the venture capitalists take larger positions in the firms than angels. In other words, for the 52 firms with both angel investors and venture capitalists, the venture capitalists have larger positions, on average (t -statistic=5.48). Also, for the universe of firms, the venture capital ownership of firms is substantially larger on average than the angel ownership (t -statistic=16.41). In addition, unbacked firms have on average 2.9 percent of shares held by investment banks, 17.7 percent of shares held by corporations, and 32.2 percent of shares held by managers. Thus, on average angels hold a smaller percentage of the firm's equity than do venture capitalists and conversely, with angel backing the entrepreneur retains a larger ownership share at IPO than for firms with venture capital backing.

When we consider the percent of shares sold in the offering by the angels versus the venture capitalists, we find that angels sell 4.2 percent of the shares outstanding, on average, where venture capitalists sell 3.8 percent of the shares outstanding. For firms backed by both angels and venture capitalists, the difference between the angel shares outstanding sold (2.3 percent) and the venture capital shares outstanding sold (5.3 percent) is significant (t -statistic =3.27). However, it is misleading to simply look at the percent of shares sold as a percent of the shares outstanding. This is because the initial position taken by the angels is less than half the position taken by the venture capital firms. These results support our hypothesis H1, that angel investors will sell more of their shareholdings in the offering compared to the venture capitalists.

On average, there are 3 angel investors in angel backed firms and in angel plus venture capital backed firms. There are 4 venture capital investors on average in venture capital backed firms and 4 venture capitalists in venture capital plus angel backed firms. On a per investor basis, each angel holds an average of 3.6 percent of the IPO firm and 3.3 percent of the IPO firm for IPO firms with angel backing and angel plus venture capital backing. Venture capitalists hold 12.9 percent of the shares individually for venture capital backed firms and 12.4 percent of the shares for angel plus venture capital backed firms.

We also examine the IPO industry characteristics in the year of the IPO firm founding. We find in general, that venture capital backed firms are from industries with significantly higher growth rates as proxied for by Tobin's Q, significantly lower leverage, significantly higher intangible assets as proxied for by R&D/assets, and significantly lower tangible assets (property, plant, and equipment/assets). Angel backed

IPO firms have only slightly higher R&D/assets compared to non-backed IPO firms.

4.2. Angel and venture capital backing and firm age

We now examine the firm age and its relationship with backing by angels and venture capitalists. We report in Table 2 Panel A the relationships between backing and firm age at the time of the IPO. Lee and Wahal (2004) report that venture capital backed IPOs have an average age of 7.0 years where non-VC backed IPOs have an age of 14.7 years. Table 2 panel A shows that firm ages are very closely correlated with venture capital backing in that IPO firms without angel or venture capital backing are on average 27.1 years old, IPO firms with angel backing are 19.2 years old, IPO firms with VC backing are 13.3 years old, and IPO firms with angel plus venture capital backing are 9.8 years old.⁶ We find that there is a statistically significant difference between IPO firm ages for firms backed versus not backed by venture capitalists. There is no statistically significant difference between the ages of firms that are angel backed versus not angel backed firms whether the firms are venture capital backed or not. The fact that firms are marginally younger when they are backed by angel investors is consistent with our hypothesis H2. These results imply that either angel investors are less able to quickly prepare firms to go public earlier in their lifecycle relative to venture capitalists, or else that they have fewer pressures to take firms public earlier.

Our results suggest that IPO firms with venture capital backing are younger firms compared to non-venture capital backed firms. This result could have three explanations. First venture capitalists may select firms with the highest quality management and the best business plans (the cherry picking hypothesis). Thus, firms may be able to go public sooner because the firms are of higher quality even before the venture capitalist invests in the IPO. This result would imply that venture capitalists have some skill in picking good quality private firms to invest in (de Bettignies and Brander, 2007).

On the other hand, pre-IPO investors (venture capitalists) may be better able to nurture firms and get them ready for an IPO sooner (the nurturing hypothesis). This hypothesis would imply that venture capitalists are very valuable in the process of assisting a firm in the going-public process. They may provide many things that the pre-IPO firm requires including industry expertise, contacts with potential customers, general business knowledge, or even just the ability to provide the capital needed by the firm.

Alternatively, venture capitalists have access to a large pool of capital and make significantly larger investments, per deal, than angel investors (Sohl, 2010). Thus, these larger investments by venture capitalists, combined with their propensity to invest in later stage deals, implies that the additional capital needed to go public can be provided by the

⁶ The correlation between the venture backing dummy variable and firm age is -0.25, significant at the 1 percent level. The correlation between the angel backing dummy variable and firm age is -0.10, also significant at the 1 percent level.

Table 2. Firm age of IPOs by angel and venture capital backing

The sample is comprised of 636 IPOs reported in the Securities Data Corporation (SDC) New Issues database between 2001 and 2007. All REITs, unit offerings, closed-end funds, ADRs, firms not covered by CRSP, banks, savings and loans, utilities, non-US based IPOs, and IPOs with an offer price below \$5 are removed from the sample. We use the SDC database and preliminary prospectus from the SEC's EDGAR web site to determine if the IPO is backed by a venture capitalist or a private investor. We define a private backed IPO as any firm with stock ownership at or above the 2 percent level by an individual who is neither affiliated with the firm as an employee, is not related to the firm management, and who is not affiliated with a venture capital firm. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level respectively.

<i>Panel A: Age of IPO firms at the time of their IPO (years)</i>			
	IPOs without vc backing (N)	IPOs with vc backing (N)	Difference t-statistic
IPOs without angel backing (N)	27.07 (N=279)	13.26 (N=268)	13.79 6.69***
IPOs with angel backing (N)	19.16 (N=37)	9.77 (N=52)	9.36 2.90***
Difference t-statistic	7.89 1.58	3.49 1.46	
<i>Panel B: Percent of pure primary IPO firms (IPO firms selling no secondary shares)</i>			
	IPOs without vc backing (N)	IPOs with vc backing (N)	Difference t-statistic
IPOs without angel backing (N)	60.22% (N=279)	68.66% (N=268)	-8.44% 2.06**
IPOs with angel backing (N)	45.95% (N=37)	40.38% (N=52)	5.56% 0.52
Difference t-statistic	14.27% 1.66*	28.27% 3.97***	
<i>Panel C: Percent of primary shares sold / total shares sold in the offering</i>			
	IPOs without vc backing (N)	IPOs with vc backing (N)	Difference t-statistic
IPOs without angel backing (N)	81.51% (N=279)	90.64% (N=268)	-9.14% 4.20***
IPOs with angel backing (N)	79.50% (N=37)	82.55% (N=52)	-3.04% 0.67
Difference t-statistic	2.00% 0.38	8.09% 2.84***	

venture capitalist rather than capital acquired internally by the firm through sales and revenue growth.

Finally, venture capitalists may simply pressure the firm to go public earlier and thus, provide liquidity to their portfolio (the liquidity hypothesis). This hypothesis would imply that there is some cost to having these early stage investors. The liquidity

hypothesis would predict that pre-IPO investors will also cause the IPO to go public with higher underpricing, since these shareholders will not bargain for as high an offering price as would otherwise seem prudent since the main goal of these pre-IPO investors is to see some return on their initial investment.

4.3. Percent of primary versus secondary shares sold

One important difference between private or angel investors and venture capitalists is that angel investors are much less well diversified compared to venture capital investors. As Sahlman (1990) points out, a typical large venture capital firm may invest in 12 firms per year. This suggests that the portfolio of investments for venture capital firms should be much more diversified compared to an angel investor, who typically only invests in one to three firms. This difference in diversification makes it much more advantageous for the angel investor to sell shares as soon as possible, to diversify their holdings. In contrast, even if the venture capital firm holds a concentrated position in the IPO, they can distribute their shares to the limited partners and thus, eliminate any idiosyncratic risk to the venture capital firm from share price declines (see Gompers and Lerner, 1998). If pre-IPO investors decide to hold rather than sell part of their holdings as secondary shares in the IPO, then the investors must hold the shares through the lock-up period, typically 6-12 months. The diversification benefit to angel investors means that they will typically wish to liquidate a much larger percentage of shares relative to venture capital firms (Bodnaruk, Kandel, Massa and Simonov, 2008).

To this end, we examine the percent of pure primary offerings, IPO offerings where only newly created shares are sold in the IPO. In contrast, a mixed offering (primary offering plus secondary offering) occurs when some of the pre-IPO investors sell shares in the offering with the proceeds of these sales going to the investors, not the firm. We expect to see that angel backed IPOs will sell a large percentage of their shares as secondary shares compared to venture capitalists, consistent with H1. We see in Table 2 Panel B that IPO firms without angel or venture capital backing are pure primary offerings 60.2 percent of the time where IPO firms with only angel backing are pure primary offerings only 46.0 percent of the time, a difference that is statistically significant at the 10 percent level. Likewise, the percentage of pure primary offerings for venture capital backed IPOs is substantially lower if the firm is also angel backed (40.4 percent) compared to non-angel backed (68.7 percent). There is a statistically significant difference between venture capital backed and non-venture capital backed IPO firms only if the firms are not angel backed. The correlation between a pure primary dummy variable and an angel backing dummy variable is a statistically significant -0.19. The correlation between a pure primary dummy variable and venture capital backing dummy variable is a statistically insignificant 0.05. This indicates that a mixed offering is more likely when the firm is angel backed and this provides the opportunity for angels to liquidate some of their shares at the IPO.

We also examine the average percent of primary shares sold as a function of angel and venture capital backing in Table 2 Panel C. Not surprisingly, the percent of primary shares offered tends to be lower for angel backed IPOs and higher for venture capital backed IPOs. These results are generally consistent with our conjecture that angel investors will typically sell some part of their pre-IPO shares if possible, to increase their portfolio diversification (H1).

Next we use multivariate regressions to determine the impact of angel and venture capital backing on the sale of primary and secondary shares in the IPO (Appendix B). Consistent with Huyghebaert and Van Hulle (2006), we find that log (proceeds) is negative and significantly related to a pure primary offering (Table 3). In addition, we find that the coefficient on the angel dummy variable is negative and significant, supporting the idea that angel investors are much more likely to sell shares in the offering compared to venture capitalists. If instead of dummy variables for angel and venture capital backing, we use the number of angel and venture capitalists (model (2)) or the aggregate shares held by angel and venture capitalists (model (3)), we find similar results. When angels hold shares in the IPO, when there are more angels, or when angels collectively hold more shares, there are more likely to be secondary shares sold in the offering. In models (4)-(6) we include the accounting variables ROA and Total assets and find that there are no appreciable changes to the models.^{7,8}

4.4. Multivariate analysis of underpricing

One of the largest costs faced by the firm in the going-public process is the implicit costs of underpricing. In the sample of IPOs from 2001-2007, underpricing averages 12.1 percent and the proceeds of the offerings average \$179.4 million. As such, the average firm, and the entrepreneur, leaves \$21.7 million “on the table,” or 12.1 percent of the offering proceeds. Since we are concerned with the influence of pre-IPO shareholders on the offering, we now examine underpricing in a regression format to determine if our univariate results showing venture capital backed IPOs as having higher underpricing hold (Appendix C).

In Table 4, we tabulate the results of our regressions. We find that underpricing is positively related to the offer price revision, the size of the offering, a dummy variable

⁷ If we wish to explain the percent of primary shares sold in the offering rather than a dummy variable of whether or not the firm is a pure primary offering, we can use a similar technique. However, now there is data censoring at zero (you cannot sell more than 100 percent primary shares) so a Tobit model is necessary. We find qualitatively similar results using a Tobit model setup.

⁸ We choose not to present regressions using investors as the unit of observation. This is for two main reasons. First, we observe very little concerning each investor not allowing us to control for investor characteristics in the way that Bodnaruk, Kandel, Massa, and Simonov (2008) can. Second, the investor observations are clearly not independent, but are highly correlated within a firm. Thus, there are data problems and econometric problems with presenting a regression predicting individual shareholder sales based on if the individual is an angel or venture investor.

Table 3. Logit models to examine the whether a firm is a pure primary offering and the percent of primary shares sold in the offering

The sample is comprised of 636 IPOs reported in the Securities Data Corporation (SDC) New Issues database between 2001 and 2007. All REITs, unit offerings, closed-end funds, ADRs, firms not covered by CRSP, banks, savings and loans, utilities, non-US based IPOs, and IPOs with an offer price below \$5 are removed from the sample. We use the SDC database and preliminary prospectus from the SEC's EDGAR web site to determine if the IPO is backed by a venture capitalist or a private investor. We define a private backed IPO as any firm with stock ownership at or above the 2 percent level by an individual who is neither affiliated with the firm as an employee, is not related to the firm management, and who is not affiliated with a venture capital firm. The dependent variable in Panel A is a dummy variable taking a value of 1 if the IPO is a pure primary offering and zero otherwise. The dependent variable in Panel B is the number of primary shares sold in the IPO divided by the total shares sold in the IPO. Standard errors clustered by industry are reported below the coefficients. ***, **, and * indicates significance at the 1 percent, 5 percent, and 10 percent level, respectively.

<i>Logit regression to determine if the IPO is a pure primary offering</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
Offering and IPO Characteristics						
Log (1+age)	-0.033 (0.055)	-0.010 (0.065)	0.011 (0.052)	0.000 (0.049)	0.018 (0.055)	0.035 (0.043)
Log (proceeds)	-0.584*** (0.108)	-0.556*** (0.101)	-0.511*** (0.093)	-0.438*** (0.144)	-0.426*** (0.159)	-0.393*** (0.141)
IPO frequency	0.001 (0.008)	0.000 (0.009)	0.001 (0.008)	0.006 (0.014)	0.002 (0.014)	0.005 (0.013)
Pre-IPO market return	6.600 (5.719)	7.625* (4.464)	8.265* (4.401)	2.538 (4.944)	6.911 (4.326)	6.743* (4.014)
ROA				-4.784*** (0.879)	-4.948*** (0.959)	-4.892*** (0.858)
Total assets (\$ millions)				0.090 (0.076)	0.104* (0.061)	0.128* (0.069)
Pre-IPO shareholder structure						
Venture capital backing (dummy)	-0.303 (0.244)			-0.244 (0.247)		
Angel backing (dummy)	-1.113*** (0.286)			-1.358*** (0.311)		
Number of venture capitalists		-0.011 (0.037)			-0.006 (0.030)	
Number of angel investors		-0.255*** (0.040)			-0.329*** (0.024)	
Percent of aggregate vc shares held			-0.002 (0.003)			-0.002 (0.005)
Percent of aggregate angel shares held			-0.038 (0.046)			-0.092** (0.037)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	636	636	636	499	499	499
Pseudo R ²	11.11	11.25	8.89	22.41	21.18	18.31

Table 4. OLS regression model to examine the determinants of IPO firm underpricing

The sample is comprised of 636 IPOs reported in the Securities Data Corporation (SDC) New Issues database between 2001 and 2007. All REITs, unit offerings, closed-end funds, ADRs, firms not covered by CRSP, banks, savings and loans, utilities, non-US based IPOs, and IPOs with an offer price below \$5 are removed from the sample. We use the SDC database and preliminary prospectus from the SEC's EDGAR web site to determine if the IPO is backed by a venture capitalist or a private investor. We define a private backed IPO as any firm with stock ownership at or above the 2 percent level by an individual who is neither affiliated with the firm as an employee, is not related to the firm management, and who is not affiliated with a venture capital firm. The dependent variable is the IPO closing price minus the offering price divided by the offering price. Standard errors clustered by industry are reported below the coefficients. ***, **, and * indicates significance at the 1 percent, 5 percent, and 10 percent level, respectively.

	(1)	(2)	(3)	(4)
Offering and IPO Characteristics				
Offer price revision	0.279*** (0.057)	0.269*** (0.059)	0.265*** (0.058)	0.265*** (0.059)
Log(proceeds)	0.021* (0.012)	0.025** (0.012)	0.026** (0.012)	0.026** (0.012)
Underwriter spread	0.014 (0.009)	0.018 (0.011)	0.018* (0.010)	0.017* (0.010)
High ranking underwriter (dummy)	0.029* (0.016)	0.035** (0.015)	0.030* (0.016)	0.030* (0.016)
Non-exchange traded (dummy)	0.033 (0.073)	0.021 (0.084)	0.029 (0.079)	0.029 (0.078)
Average underpricing	0.799*** (0.202)	0.816*** (0.202)	0.791*** (0.199)	0.794*** (0.204)
IPO frequency	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Log(1+age)	-0.016 (0.014)	-0.018 (0.014)	-0.015 (0.015)	-0.015 (0.014)
Pre-IPO market return	0.270 (0.466)	0.328 (0.506)	0.345 (0.484)	0.351 (0.481)
Technology firm (dummy)	-0.004 (0.013)	-0.002 (0.013)	-0.010 (0.013)	-0.011 (0.013)
Pre-IPO shareholder structure				
VC backing (dummy)	0.041*** (0.014)	0.058** (0.025)	0.039*** (0.013)	0.036** (0.015)
Angel backing (dummy)			0.056** (0.024)	0.045 (0.041)
VC backing x Angel backing				0.018 (0.041)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
N	636	636	636	636
Adjusted R ²	35.88	36.09	36.86	36.89

for a high underwriter rank, the average level of underpricing around the IPO, and a dummy variable for the firm being in the technology industry. These results are largely consistent with the previous literature.

In addition, we find that IPO firms with venture capitalists have higher underpricing, consistent with H3. This result, from model (1) indicates that underpricing is on average, 4.1 percent higher when the IPO firm has a venture capitalist before the IPO. In model (2) we find that IPO firms also have higher underpricing if the firm is angel backed. The results in model (2) suggest that if a firm is backed by an angel, underpricing is higher by 5.8 percent. Finally, in model (3) we see that including both, the dummy variable for angel backing and venture capital backing does not appreciably alter our results. These results are somewhat surprising with respect to angel backing since angel investors should bargain harder for lower underpricing since they anticipate to sell their shares in the offering. Model (4) examines the possibility of an additive effect, that firms backed by both angels and venture capitalists behave differently from other firms. However, the coefficient on the interaction term is insignificant indicating this is not the case.⁹ We then repeat our tests including a dummy variable for pure primary offerings. Since there is a high correlation between the pure primary offering and angel backing, this control variable may be important in our regressions. The inclusion of the pure primary dummy, Fama and French (1997) industry dummies, or both has little impact on the significance of the angel backing dummy variable. However, we can see in all cases that the venture capital backing dummy is always significant, suggesting that venture capital backed firms have consistently higher underpricing.

These results would appear to suggest that firms may have higher underpricing when the firm has angel backing, contradicting our hypothesis H3. However, as recognized by Megginson and Weiss (1991) and Lee and Wahal (2004), the investment decision by pre-IPO investors is endogenous and should be controlled for selection bias and omitted variable bias.¹⁰ For instance, it is possible that an unobservable variable is correlated with the presence of a venture capital or angel investor as well as the underpricing of the IPO firm. This would lead to biased estimates in our OLS regressions previously reported. As such, it is necessary to utilize an econometric technique with exogenous instruments to control for this endogeneity.

We utilize a two-stage least squares approach to control for this endogeneity problem. We first make use of exogenous instruments to estimate the presence of backing by angel or venture capital investors in a way that eliminates endogeneity. Since it is known that investment decisions by venture capitalists are driven by the location of the IPO firm (Tian, 2011; Chen *et al.*, 2010) and other industry characteristics (Gompers and Lerner, 2000), we utilize these sets of variables as instruments in our regressions. We then use these estimated variables in the second stage regression, alleviating the

⁹ When we repeat our analyses using a “pure primary” indicator as an explanatory variable, we still find qualitatively similar results.

¹⁰ Earlier research focuses on venture investments. We are obviously concerned with both angel and venture investments.

Table 5. Regression models to examine the relationship between underpricing and angel and venture capital backing controlling for endogeneity

The sample is comprised of 636 IPOs reported in the Securities Data Corporation (SDC) New Issues database between 2001 and 2007. All REITs, unit offerings, closed-end funds, ADRs, firms not covered by CRSP, banks, savings and loans, utilities, non-US based IPOs, and IPOs with an offer price below \$5 are removed from the sample. We use the SDC database and preliminary prospectus from the SEC's EDGAR web site to determine if the IPO is backed by a venture capitalist or a private investor. We define a private backed IPO as any firm with stock ownership at or above the 2 percent level by an individual who is neither affiliated with the firm as an employee, is not related to the firm management, and who is not affiliated with a venture capital firm. The first stage regression is a bi-variate probit model used to predict private equity and venture capital backing. The second stage regression has IPO firm underpricing as the dependent variable. Standard errors robust clustered by industry are reported below the coefficients. ***, **, and * indicates significance at the 1 percent, 5 percent, and 10 percent level, respectively.

	2SLS Model		
	First Stage Bivariate probit		Second Stage OLS
	VC backed (dummy)	Angel backed (dummy)	Underpricing
Offering and IPO Characteristics			
Offer price revision	0.194 (0.286)	1.110*** (0.357)	0.037* (0.019)
Log(proceeds)	-0.150* (0.086)	-0.538*** (0.114)	-0.005 (0.034)
Underwriter spread	-0.090 (0.105)	-0.253** (0.126)	0.631** (0.239)
High ranking underwriter (dummy)	0.405*** (0.126)	0.043 (0.151)	0.001 (0.002)
Non-exchange traded (dummy)	2.235** (1.057)	1.071 (1.300)	0.018 (0.014)
Average underpricing	-0.010* (0.006)	0.011 (0.008)	0.247*** (0.083)
IPO frequency	-0.249*** (0.074)	-0.098 (0.101)	0.006 (0.020)
Log(1+age)	-1.355 (3.906)	-2.001 (4.531)	0.491 (0.615)
Pre-IPO market return	-0.174*** (0.057)	-0.009 (0.072)	-0.045* (0.026)
Technology firm (dummy)	0.014 (0.145)	0.179 (0.168)	-0.175** (0.076)
Instrumental variables			
Industry Q	0.075 (0.128)	-0.162 (0.150)	
Industry leverage	-0.291 (0.720)	0.050 (0.902)	
Industry R&D/assets	2.929** (1.464)	0.281 (1.756)	
Industry PPE/assets	-0.742** (0.363)	-0.762* (0.401)	
Big venture capital backing state (dummy)	0.328*** (0.127)	0.172 (0.151)	

Table 5 (continued)

Pre-IPO shareholder structure		0.294*
		(0.172)
Instrumented Venture capital backed IPO (dummy)		0.035
		(0.186)
Instrumented Angel backed IPO (dummy)		
Industry dummies	No	Yes
Year dummies	No	Yes
N	636	636
Log pseudolikelihood	-577.255	
R ²		3.15

possibility that our results are driven by endogeneity. We follow the empirical setup of Tian (2011) in utilizing geography and industry characteristics as instruments in our 2SLS regressions. We utilize this approach because it allows us to eliminate the possibility that our results are driven by selection or omitted variables bias. Note that our model does not allow for sequencing of the investment decision, but rather is meant to predict, from the time of the IPO firm founding, the likelihood that the IPO firm will be either venture capital or angel backed or backed by angels and venture capitalists.

Since we are interested in the determination of whether a firm is angel backed, venture capital backed, or both angel and venture capital backed, we must use a system of non-linear equations in the first stage regression to predict the pre-IPO investors (Appendix D). The purpose of using a system of equations rather than independent probit models is that it allows us to control for the relationship between angel and venture capital financing.

We estimate the system of probit equations to determine the probability of any firm having angel or venture capital backing based on the control variables and instrumental variables already discussed. We find in Table 5 that controlling for characteristics that influence the IPO underpricing, the following instruments are significantly related to a firm being venture capital backed: industry Tobin's Q in the IPO founding year, industry leverage in the year of the IPO founding, and industry R&D/assets in the IPO founding year. Being located in a state with a high concentration of venture capital firms is significantly related to having venture capital backing at the 10 percent level. We find in Table 5 that angel backing is only correlated with the leverage of the IPO industry in the year of the IPO firm founding and being located in California or Massachusetts.

In the second-stage regression, we utilized predicted values from the system of probit equations as instruments for the angel backing and venture capital backing dummy variables to examine underpricing. In Table 5 we find that, unlike the OLS regressions, an instrumental variables approach leads to higher underpricing for venture capital backed IPOs only; angel backed IPO firms do not have higher underpricing once we control for endogeneity. This result suggests that IPO firms with angel backing may have

higher underpricing than IPO firms without angel backing (as suggested by our OLS results), but angels are not causing this additional underpricing. Rather angel investors either select firms that have higher underpricing *ceteris paribus*, or another factor is correlated to both, angel backing and underpricing (such as pure primary offerings). However, in the case of venture capital backing, it is clear that IPO firms that are venture capital backed have a higher degree of underpricing even once we control for endogeneity, consistent with Gompers (1996) and Lee and Wahal (2004). These results are novel in that they show angel investors as unique and distinct in their influence on IPO firm underpricing relative to venture capitalists.

5. Robustness Checks

To insure that our results are robust, we duplicate our multivariate analysis using various alternative model specifications. For instance, we vary our definition of what it means for a state to be considered a “big venture capital backing” state. In our tabulated results, we use the definition as any firm located in California or Massachusetts. However, if we define a “big venture capital state” as any firm located in California alone, then our results in Table 5 for our first stage regression shows that the angel dummy is significantly related to this variable at the 10 percent level but the venture capital dummy is unrelated to this variable once we control for the other firm characteristics. Our second stage regression shows that underpricing is significantly (5 percent level) related to venture capital backing but unrelated to angel backing, once we control for endogeneity.¹¹

It is also possible that our results are influenced in part by differences in residual variance (heteroskedasticity) across firms with angel backing and/or venture capital backing. To be sure that our results are not unduly affected by such a possibility, we repeat our results clustering the standard errors by angel and venture capital backing and find qualitatively similar results. In addition, we conduct tests of underpricing differences utilizing a Welch (1947) t-statistic approximation and find no influence on our overall results.

We also examine the impact of omitting year dummy variables in our 2SLS regressions in Table 5. We find that our results are not significantly impacted by removing the year dummies either in the second stage regression alone, or in the first and second stage. Second stage regressions always have the instrumented venture capital dummy significant at the 10 percent level or better in all combinations, but the instrumented angel dummy variable is never significant.

6. Conclusions

¹¹ Likewise, defining a “big venture state” as California, Massachusetts, or New York does not appreciably impact our results.

We find that a substantial portion of IPO firms that go public are backed by angel investors. In fact, many IPO firms (13.4 percent) have angel investors as their only significant outside shareholders. We show that geography and industry characteristics, in particular, industry growth rates as proxied by Tobin's Q, firm R&D, and being located in California or Massachusetts are strong determinants of venture capital backing of IPO firms. In contrast, angel backing is most strongly related to being in California or Massachusetts and industry leverage.

We also show that while venture capitalists are prone to underprice IPO firms, reducing the proceeds from the offering, angel investors have incentives more aligned with non-venture capital pre-IPO shareholders. Our results suggest that prior to making a decision about obtaining angel versus venture capital financing, private firm management should also consider the consequences of such early investors on IPO firm proceeds raised in an eventual IPO.

Appendix A. Construction of Variables

Variable	Data sources	Description
IPO proceeds	SDC	Offer proceeds.
High ranking underwriter (dummy)	Ritter	Dummy variable taking a value of one if the underwriter rank is 9 and zero otherwise. We thank Jay Ritter for providing this data on his web site at http://bear.cba.ufl.edu/ritter/ipodata.htm
Underwriter spread	SDC	Percent of the offering paid to the underwriter.
Offer price revision	SDC	Change from range midpoint to final offer price.
Underpricing	SDC, CRSP	The percent return from the offer price from SDC to the IPO day closing price (CRSP).
IPO frequency	SDC	Number of IPOs in month of issue and the previous month.
Average underpricing	SDC, CRSP	Average IPO underpricing for all IPOs in the month of issue and the previous month.
Pre-IPO market return	CRSP	Average market return on the CRSP value-weighted index from 3 weeks before the issuance to the issuance.
IPO market capitalization	CRSP	Shares outstanding times the closing price on the offer date.
Age	Ritter, Field	The difference between the IPO calendar year and the firm founding starting year. We thank Jay Ritter for providing this data on his web site at http://bear.cba.ufl.edu/ritter/ipodata.htm
Big VC state	COMPUSTAT	Dummy variable taking a value of one if the IPO firm is principally located in California or Massachusetts, and zero otherwise.
ROA or return on assets	COMPUSTAT	Calculated as COMPUSTAT data item 172/data item 6 in the fiscal year of the IPO.
Total assets	COMPUSTAT	COMPUSTAT data item 6 in the fiscal year of the IPO.
Percent of shares held by angels	Prospectus	Cumulative shares held by angels.
Percent of shares held by vc firms	Prospectus	Cumulative shares held by venture capitalists.
Number of angel backers	Prospectus	Count of angel investors owning shares in the firm.
Number of vc backers	Prospectus, SDC	Count of venture capitalists owning shares in the firm.
Non-exchange traded	SDC, COMPUSTAT	A dummy variable taking a value of one if the stock is not traded on the NASDAQ, MYSE, or AMEX and zero otherwise.
Shares per	Prospectus	The average percent of shares held by angel

angel		investors.
Shares per venture capitalist	Prospectus	The average percent of shares held by venture capitalists.
Technology industry (dummy)	COMPUSTAT	A dummy variable taking a value of one if the IPO firm is in a technology industry based on Loughran and Ritter (2004) Appendix D.
Herfindahl Index		Normalized Herfindahl-Hirschman index as defined by the sum of the squared market shares of all participants in the same industry as the IPO firm, normalized such that $H^* = (H - 1/N) / (1 - 1/N)$.
Industry Tobin's Q	COMPUSTAT	The median Tobin's Q for the Fama and French (1997) 48 industry classification in the founding year of the IPO firm as defined by $(\text{data 6} - \text{data 60} + \text{data 24} * \text{data 25})/\text{data 6}$.
Industry leverage	COMPUSTAT	The median leverage for the Fama and French (1997) 48 industry classification in the founding year of the IPO firm as defined by $(\text{data 5} + \text{data 9})/\text{data 6}$.
Industry R&D/assets	COMPUSTAT	The median R&D/assets for the Fama and French (1997) 48 industry classification in the founding year of the IPO firm as defined by $(\text{data 46})/\text{data 6}$.
Industry PPE/assets	COMPUSTAT	The median PPE/assets for the Fama and French (1997) 48 industry classification in the founding year of the IPO firm as defined by $\text{data 8}/\text{data 6}$.
Industry assets	COMPUSTAT	The median assets for the Fama and French (1997) 48 industry classification in the founding year of the IPO firm as defined by data 6 .

Appendix B. Non-linear logit model

We use a non-linear logit model to examine the relationship between a dummy variable for a pure primary offering and various control variables. The model we utilize is similar to Huyghebaert and Van Hulle (2006).

$$\begin{aligned}
 \Pr(\text{pure primary} = 1 | X = x) = & \alpha + \delta_1 \text{Log}(1 + \text{age}) + \delta_2 \text{Log}(\text{proceeds}) + \delta_3 \text{IPO frequency} \\
 & + \delta_4 \text{Pre-IPO market return} + \delta_5 \text{ROA} + \delta_6 \text{Total assets} \quad (\text{B.1}) \\
 & + \delta_7 \text{Venture backing} + \delta_8 \text{Angel backing} + e
 \end{aligned}$$

In Table 3 models 1-3, we omit the accounting variables, ROA and Total assets as there are observations missing, reducing the overall sample size from N=636 to N=499. To support H1, the idea that less diversified angels are more likely to sell secondary shares in the offering, we would expect to see a negative and significant δ_8 .

Appendix C. Multivariate regression format

We use a multivariate regression format with control variables similar to Cliff and Denis (2004), Ljungqvist and Wilhelm (2003), and Loughran and Ritter (2004). Our regression model is as follows:¹²

$$\begin{aligned} \text{Underpricing} = & \alpha + \gamma_1 \text{revision} + \gamma_2 \log(\text{proceeds}) + \gamma_3 \text{spread} + \gamma_4 \text{high rank} \\ & + \gamma_5 \text{non-exchange traded} + \gamma_6 \text{average underpricing} + \gamma_7 \text{IPO frequency} + \gamma_8 \log(1 + \text{age}) \quad (\text{C.1}) \\ & + \gamma_9 \text{pre-IPO market return} + \gamma_{10} \text{technology dummy} \\ & + \gamma_{11} \text{angel backing dummy} + \gamma_{12} \text{venture backing dummy} + \varepsilon \end{aligned}$$

To test the hypothesis H3, we would expect to find γ_{12} to be positive and significant. On the other hand, since angel investors are selling more shares in the offering in the form of secondary sales, we expect angels to bargain harder over underpricing (Ljungqvist and Wilhelm, 2003). Therefore, we expect γ_{11} to be insignificant or possibly negative.

¹² Due some inconsistency of the influence of a pure primary dummy variable on underpricing as documented by Loughran and Ritter (2004), we omit this variable from our initial regression model. Later regressions will include this variable to be sure our results are not appreciably influenced by its inclusion.

Appendix D. Probit equations

The model involves the following system of probit equations:

$$\Pr(\text{angel backed} = 1 \mid X = x, Z = z) = \alpha + \gamma x + \delta z + e \quad (\text{D.1})$$

$$\Pr(\text{venture backed} = 1 \mid X = x, Z = z) = \alpha + \gamma x + \delta z + e$$

Where angel backed and venture capital backed are dummy variables taking a value of one if the IPO firm is angel or venture capital backed, respectively, x is a matrix of control variables, and z is a matrix of exogenous instruments. For our instruments to be valid, we make the assumption that $E(z\varepsilon) = 0$ where z is our matrix of instruments and ε is the residual from equation 3. Our instruments should be correlated to the IPO firm backing by angel or venture capital investors, but not correlated to the residual from the second stage underpricing regression.

The IPO literature has generated many important control variables (in matrix x) in models to explain IPO underpricing (see for instance, Cliff and Denis, 2004). For our instruments, we are particularly interested in the IPO industry characteristics. However, if the angel or venture capitalist has some ability to time markets (as suggested by Lerner, 1994) then the industry characteristics at the time of the IPO may be endogenous as well. We therefore calculate the industry characteristics for the IPO firm in the founding year of the IPO firm.¹³ At the time of the IPO, the average time the firm has been in existence is 19.7 years. As such, industry characteristics in the IPO founding year are unlikely to

have an impact on the IPO underpricing. However, many investors in the firm will make decisions concerning purchasing equity positions within a few years of the IPO founding, implying that industry characteristics at the time of IPO founding should help to explain who invests in the firm. The industry characteristics we consider are IPO industry average Tobin's Q, leverage, R&D/assets, and Property, plant and equipment (PPE)/assets in the year that the IPO firm is founded. It should be noted that since the IPO firm is not publicly traded in the year it is founded, the IPO firm characteristics are not included in the mean industry characteristics in the year of IPO founding.

Our justification for these particular industry characteristics as instruments is as follows. Venture capitalists are more likely to value growth firms over value firms as well as firms investing in high levels of intangible assets. Therefore, venture capital backed firms should come from industries with high Tobin's Q, high R&D/assets, and low PPE/assets. In contrast, angel investors are likely to value investments in firms with the ability to raise financing from non-equity sources. This results from the desire of angels to avoid future rounds of equity financing which would result in angel cram-down and general loss of control of the firm.¹⁴ Therefore, angel investors are likely to prefer investments in industries that can raise funding from banks, firms with high tangible asset values. Likewise, this preference for firms able to obtain loans will lead angels to invest in industries with higher leverage.

Finally, since Lerner (1998) and Lee and Wahal (2004) find that there is some geographical concentration of venture capital backed firms in certain states. Specifically, firms from California and Massachusetts are more likely to be venture capital backed. Therefore, we use a dummy variable taking a value of one if the IPO firm is in these states and zero otherwise as an instrumental variable as well.

¹³ 57 of our IPO firms out of 636 have a founding year prior to 1950. Rather than use the industry characteristics in the year of the IPO founding, for these firms, we use the IPO characteristics in 1950. Of these firms, the average age is 90.0 years but the time of the IPO after 1950 is 54.3 years. Our results are robust to the elimination of these 57 firms.

¹⁴ Unlike venture firms, angel investors are not likely to be able to self-finance future rounds of equity in the firms they invest in. As such, any future investments of equity will likely be made by other investors who will take preferential positions in the firm and dilute the original angel investment substantially. Venture investors do not face these same constraints because they are able to raise more funding from their partners for future rounds of financing.

Working Paper

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