The Impact of Fundamentals on IPO Valuation

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Abstract: We examine how IPO valuation has changed over time by focusing on three time-periods: 1986-1990, January 1997 through March 2000 (designated as the boom period), and April 2000 through December 2001 (designated as the crash period). Our goal is to see whether there were systematic changes in the valuation of fundamental factors over time. Using a sample of 1,655 IPOs, we find that firms with more negative earnings have higher valuations than do firms with less negative earnings and firms with more positive earnings have higher valuations than firms with less positive earnings. This V-shaped pattern to the relation between value and earnings suggests that inference based solely on firms with positive earnings is incomplete. This is especially true for the boom and crash periods, suggesting that there were systematic shifts in the valuation of fundamentals. Our results suggest that negative earnings are a proxy for growth opportunities for internet firms and that such growth options are a significant component of IPO firm value. We also find that investment bankers and first-day investors assign different weights to post-IPO ownership and changes in ownership around the IPO for different classes of pre-IPO shareholders (CEOs, VCs, other blockholders, and officers and directors) when pricing the IPO.

JEL classification: G1; G32; M41

Key words: Initial public offerings, equity valuation, insider ownership, investment banker prestige, new economy

Valuation of initial public offerings, IPOs, occupies an important place in finance, perhaps because an IPO provides public capital market participants their first opportunity to value a set of corporate assets. Valuation of IPOs is also quite relevant from an economic efficiency perspective: the IPO is the first opportunity that managers of such (usually young) companies get to observe price signals from the public capital markets. Such signals can either affirm or repudiate management's beliefs regarding the firm's future growth opportunities, which have obvious implications for real economic activity—e.g., employment and corporate investment.

The valuation of IPOs in the late 1990s has generated significant interest in the popular press in addition to the financial press. Part of the reason for the popular interest in IPO valuation in the late 1990s was the public's interest in the "new *e*-conomy." In the latter half of 1990s, the stock market experienced unprecedented gains, powered by technology and internet companies (see, for example, Ofek and Richardson (2003)). These enormous price surges caused several commentators to raise questions about whether traditional valuation methods remained valid in this period. McCarthy (1999) reports an example of this concern in a statement by Jerry Kennelly, Chief Financial Officer of Inktomi, "Early profitability is not the key to value in a company like this (Inktomi)." Such claims were more common in the context of IPOs. For example, Gove (2000) remarks, "But valuations are just as often based on gut feel. As one entrepreneur told me, 'It's as if everybody just settles on a number that they are comfortable with.' "

In this study, we examine whether, and to what extent, there were shifts in the valuation of IPOs in the new economy period. We consider the valuation of a sample of 1,655 IPOs during two distinct periods: 1986-1990 (hereafter, the eighties), and 1997-2001. The choice of two distinct periods for our study is motivated by our interest in understanding IPO valuation in the new economy. This new economy has a temporal and industry characterization to it. During the late 1990s, technology companies - especially those with an internet focus – were in the vanguard of this new economy. Examining IPOs during 1986-1990 allows us to construct a baseline "traditional" IPO valuation model. The variables we include in our model are income, book value of equity, sales, R&D, industry price-to-sales ratio, insider retention and investment banker prestige ranking.

We then compare this valuation model with the valuation during the new economy period, 1997-2001. Given the dramatic collapse of NASDAQ and other stock markets in March 2000, some observers have argued that the market for new economy stocks, and especially IPOs, was significantly altered after March 2000. Therefore, we break down the period 1997-2001 into two sub-periods, January 1997 through March 2000, and April 2000 through December 2001. We label these as the boom and crash periods, respectively. We also investigate valuation differences between technology and non-technology companies, and internet and non-internet companies.

We use the valuation model of Abel and Eberly (2005), which explicitly incorporates the possibility that firms may upgrade to or adopt a new technology, to motivate our choice of explanatory variables. In their model, the value of the firm is comprised of three components: the replacement cost of the firm's physical capital, the net present value of the firm's expected future cash flows from assets in place, and the value of growth options associated with future technological upgrades. The key point in their model is how close the firm is to a technological upgrade. The closer the firm is to a technological upgrade, the more of firm value will be reflected in the technological upgrade growth option and less will be reflected in existing physical capital or (positive) firm cash flows. Because the late 1990s were a period of rapid technological change, this model of firm valuation seems particularly well-suited to capture the salient determinants of value.

Because we do not directly observe technological upgrades, we use several proxies that should be consistent with firms undergoing technological upgrades. We hypothesize that the internet period generally was one of rapid technological upgrades. Internet firms that were going public were, almost by definition, engaging in a technological upgrade. This would imply that for these firms there were few existing assets in place and few projects using the existing technology and hence little cash flow. Second, we hypothesize that firms with negative earnings are likely to be investing in, among other things, technological upgrades (they could also be investing in market share, organizational capabilities, advertising, and other intangible assets). As a third measure, we consider R&D spending to also be a form of expenditures associated with technological upgrades.

We find that the replacement cost of physical capital (book value) only matters for IPO valuation during the crash period, consistent with the notion that tangible or physical assets became more

important after the IPO bubble popped. For expected future cash flows from assets in place, we find that income of IPO firms is weighted more and sales are weighted less when valuing IPOs in the boom period compared to the late 1980s. This result is contrary to anecdotes in the financial press. Our findings for growth options are somewhat mixed. In general, proxies for growth options such as R&D spending or industry price-to-sales comparables are associated with greater IPO firm value. Somewhat surprisingly, these measures of growth options are not consistently correlated with value more highly in the boom period or in internet or tech firms. Instead, we find that firms with larger negative earnings (another proxy for growth options) have higher valuations.

We note that sample sizes in many prior studies are small, based on one industry, the internet, or consider only IPOs with positive earnings and hence limit the generalizability of their conclusions. In this paper we consider the valuation of IPOs with positive *and negative* earnings. Whereas only about twenty percent of the IPOs during 1986-1990 had negative earnings, during 1997-2001 sixty three percent of the IPOs had negative earnings. Eighty percent of the IPOs during 1999 had negative earnings, and eighty-five percent of the IPOs during 2000 had negative earnings. Additionally, and perhaps more importantly, the data suggest that IPOs with negative earnings are correlated with value differently than IPOs with positive earnings. While income of IPOs with positive earnings is correlated with value positively, income of IPOs with negative earnings is correlated with value negatively. As a result, there is a V-shaped relation between firm value and earnings. Firms with more negative earnings are associated with higher valuations than firms with less negative earnings, consistent with these negative earnings representing investments in valuable growth options. Thus, inference based only on firms with positive earnings provides an incomplete picture of IPO valuation.

Finally, prior research has shown that ownership retention by pre-IPO shareholders has a significant impact on firm value, consistent with the model of Leland and Pyle (1977). While controlling for this important determinant of firm value, we also extend this research by studying the value implications of the ownership of different classes of shareholders, such as CEOs, other officers and directors, venture capitalists, and other blockholders.[1] Indeed, we find that investment bankers and first-

[1] Ljungqvist and Wilhelm (2003) and Li and Masulis (2006) provide a rich analysis of the impact of different types of shareholders on IPO *underpricing*. We view our analysis of the impact of different types

day investors assign different weights to ownership signals of different classes of shareholders when valuing IPOs.

Before turning to the rest of the paper, a few words about the scope of this paper would be in order. During the late 1990s, the popular press regularly and prominently argued that valuations of companies were irrationally high. This "irrationally high valuation" phenomenon has been compared to the tulip mania of the sixteenth century and the South Sea bubble of the seventeenth century. Our objective in this study is to understand whether and how the valuation function for IPOs has changed over time. Whether these shifts in the valuation function reflect rational or irrational pricing by investment bankers and/or investors is a subject that we do not explore. In light of the relatively high market valuations in the late nineties, evaluating market efficiency would be a very interesting topic. However, we believe that describing systematic shifts in valuation is a useful first step that should precede examinations of efficiency.

The remainder of the paper is organized as follows. The next section reviews the prior literature on IPO valuation. In section two, we discuss empirical estimation issues. Our results are presented in section three. The final section concludes with a summary.

1. Extant Literature on IPO Valuation

1.1. Corporate Ownership Structure and IPO Valuation

Leland and Pyle (1977) propose a valuation model in which the current value of the firm is positively related to the percentage of equity retained by the entrepreneur taking the firm public. In their signaling model, the entrepreneur knows more about the expected cash flows of the firm than do potential investors. Further, it is costly for the entrepreneur to retain shares in the firm because by doing so he foregoes the benefits of diversifying his personal portfolio. Therefore, he will retain shares in the IPO only if he has private information that expected cash flows are likely to be high. Thus, the model implies that greater equity ownership by pre-IPO shareholders sends a credible signal of their confidence about the company's prospects to the investment banker and to potential investors, and leads to higher IPO values.

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of shareholders on IPO *valuation* as complementary to the analysis in Ljungqvist and Wilhelm, and Li and Masulis.

Moral hazard provides an alternative, but not mutually exclusive, explanation for this positive relation. Under this perspective, stock ownership aligns managerial incentives with those of shareholders; consequently, managers with high levels of stock ownership work harder and generate higher cash flows. New investors in the IPO anticipate this and hence high-ownership firms are valued more than low-ownership firms.

A third explanation for a positive relation between IPO values and post-IPO retention is based on the assumption of a downward-sloping demand curve for shares (see Ofek and Richardson (2001)). Under this assumption, higher retention levels imply fewer shares available for trading. Consequently, shares become a scarce commodity and their price increases.

Downes & Heinkel (1982), Ritter (1984), and Feltham, Hughes, and Simunic (1991), among others, provide evidence on the value of ownership retention. In general, consistent with the theoretical predictions, these studies document a positive relation between IPO valuation and ownership retention. In this study, we go a step further by asking whether different types of owners—CEOs, other officers and directors, venture capitalists, and other blockholders—have differential impacts on IPO valuation.

1.2. Valuation of Accounting Data

While there have been numerous papers that have investigated the value relevance of accounting information for publicly traded stocks, there have been very few papers that have conducted a detailed study of the relevance of accounting information for IPO firms. These papers are briefly reviewed below.

Klein (1996) examines the relation between the price per share (at the offer date and at the end of the first day of trading) and various variables for a sample of 193 IPOs with *positive* pre-IPO income from the years 1980-1991. She finds that the price per share is positively related to pre-IPO earnings per share and pre-IPO book value of equity per share.[2]

Kim and Ritter (1999) investigate the relation between firm-level price-earnings (PE) ratios and the industry-median PE ratios for a sample of 190 IPOs that had *positive* pre-IPO income and completed

[2] Beatty, Riffe, and Thompson (2000) consider the valuation of IPOs with *positive* pre-IPO income and book value of equity for the years 1987-1998.

in the years 1992-1993. They document that firm-level and industry-level PE ratios are positively related, but that the adjusted R^2 of their regression is only five percent. Their model's explanatory power improves when they consider forecast earnings for the next year instead of pre-IPO historical earnings. They conclude that industry comparables based on historical accounting information are of limited value for understanding IPO pricing.

In an insightful paper, Purnanandam and Swaminathan (2004) compare the offer price to sales, offer price to EBITDA (earnings before interest, taxes, depreciation and amortization), and offer price to earnings of a sample of 2,288 IPOs during 1980-1997 IPOs that had *positive* pre-IPO EBITDA with similar valuation ratios of industry peers. Interestingly, they find using the above valuation metrics that IPOs tend to be overvalued. Also, in the cross-section, more overvalued IPOs have lower profitability, higher accruals, and higher analyst growth forecasts.

Kim and Ritter (1999) and Purnanandam and Swaminathan (2004) focus on *relative* valuation of IPOs that have a *positive* pre-IPO income. In another recent paper, Houston, James, and Karceski (2005) also consider the *relative* valuation of a sample of 153 IPOs during 1996-2000. As noted above, when analyzing IPO valuations, especially in the late 1990s and early 2000, it would be inappropriate to exclude IPOs with negative earnings from the sample. In this paper we consider the *total offer value* of IPOs with positive *and negative* earnings.

1.3. Internet IPO Valuation Studies

Motivated by the popular interest in internet valuations in the late 1990s, several studies have attempted to understand the valuation of internet companies in general. Of these studies, Hand (2003) and Bartov, Mohanram, and Seethamraju (2002) examine valuation around the IPO date. Hand (2003) examines a sample of 116 internet IPOs from the years 1997-1999 whose pre-income book value of equity is positive and income before non-recurring items is negative. Using a logarithmic specification, he finds that IPO valuation (based on offer price and first-day closing price) is positively and linearly related to the pre-income book value of equity, but negatively and concavely related to income before non-recurring items. Consistent with the argument that large R&D and marketing costs are intangible assets

and not period expenses, he documents that offer values are increasing and concave in R&D and marketing costs.

Bartov, Mohanram, and Seethamraju (2002) focus on the valuation of 98 internet IPOs and 98 offer-date and size-matched non-internet IPOs that were completed during 1996-1999. For internet IPOs, they find that cash flows, sales, and sales growth are significantly related to offer prices (at the filing date and at the offer date). In contrast, earnings, book value of equity, and R&D per share do not bear a significant relation to offer prices. Cash flows and earnings bear an asymmetric relation with offer prices – when they are positive, they are positively related to offer prices; when they are negative, they are negatively related to prices—similar to the results we find. For non-internet IPOs, offer prices are positively related to earnings, cash flow, and sales, but first-day closing prices do not bear a significant relation with any of the financial variables.

Several studies examine the valuation of publicly traded firms during the late nineties and early 2000. For example, Core, Guay, and Buskirk (2003) compare the explanatory power of a valuation model in the new economy period (1995-1999) relative to earlier years for a large cross-section of publicly traded firms. They find that while the explanatory power of their model has declined in the new economy period, model coefficients have not shifted. They interpret their findings as consistent with valuations in the new economy being more uncertain and volatile around the traditional but stable valuation model.

In the context of internet valuations, Schultz and Zaman (2001) and Ofek and Richardson (2003) provide evidence that in the late 1990s, the post-IPO valuations of internet IPOs were far greater than those of seasoned publicly traded stocks. Also, Demers and Lev (2001) and Keating, Lys, and Magee (2003) compare the valuation of internet stocks before and after March 2000. Our focus, by contrast is to examine the valuation of IPOs at the time of the IPO.

2. IPO Valuation Model: Empirical Estimation Issues and Hypotheses

2.1. Choice of Dependent Variable: Price-earnings Ratio, Offer Price, or Total Offer Value?

A critical issue in the specification of an IPO valuation model is the designation of the dependent variable. Some authors, notably KR and PS, have designated the offer price or first-day closing price per share deflated by earnings per share as the dependent variable. The problem with using earnings as the

divisor is that it leads to the elimination of firms with negative values of earnings, and thus reduces the generalizability of the findings. This criticism is also relevant to book value of equity, although to a lesser extent – 41% of the 1997-2001 sample has negative pre-IPO book values of equity. We reject a third deflator, sales, because some IPO firms have no sales or extremely small values for sales. This small denominator problem induces considerable non-normality in the price-to-sales ratio. For example, for our sample, the skewness of the cross-sectional distribution of price-to-sales ratio is 26.9 and the kurtosis is 856.5.

A second candidate for the dependent variable is the offer price per share. On econometric grounds, the offer price has attractive properties in that it has a close-to-normal distribution. Additionally, deflation by shares outstanding is likely to reduce heteroscedasticity in regression residuals. However, we believe that it is deficient on theoretical and empirical grounds. First, investment bankers estimate total offer value first and *then* partition it somewhat arbitrarily into price per share and shares offered. Second, since most IPOs have an offer price between $10-18, earnings-per-share will be large for IPOs with poor growth opportunities, and small for firms with good growth opportunities. Unless one can completely control for growth opportunities, there will be an omitted variable bias that will bias the coefficient on earnings-per-share towards zero.

Because it is total offer value that investment bankers estimate, we consider total offer value defined as offer price multiplied by the post-IPO shares outstanding as the dependent variable.[3] Unfortunately, total offer value is afflicted with the non-normality problem (skewness = 10.6, kurtosis = 217.4) that we observe for price-to-sales ratios, as well as with the heteroscedasticity problem. To mitigate these problems, we employ the logarithm of total offer value as the dependent variable. For our sample, log total offer value has a skewness of 0.07 and a kurtosis of only –0.30.[4]

[3] Consistent with Ljungqvist and Wilhelm (2003), the post-IPO shares outstanding excludes the shares related to the over-allotment option. Aggarwal (2000) notes that many IPOs have an over-allotment option that allows underwriters to sell additional shares upto 15 percent of the offering size for 30 days after the offering. Aggarwal documents a positive relation between the over-allotment option and first-day returns. In our valuation regressions we consider two dependent variables: total offer value, and total market value at the end of first day (which equals offer value plus the first day return). Our conclusions are not sensitive to the choice of the dependent variable, suggesting that consideration of the over-allotment option would not significantly impact our conclusions.

[4] Historically, valuation studies have adopted a linear specification. Recently, however, Hand (2003) provides evidence that the log-linear model provides a better fit than the traditional linear model.

In addition to offer price-based valuation, we also model IPO valuation based on first-day closing prices. The difference between first-day closing price (market value) and the offer price can be considered as the amount by which the investment bankers underprice the IPO. However, as noted earlier, the focus of this paper is on understanding the determinants of the levels of IPO values and not those of underpricing.

2.2. Hypotheses and Empirical Determinants of IPO Valuation

One of the objectives of this study is to investigate whether the IPO valuation function has shifted in the late 1990s (the new economy) relative to the 1980s. Our sample is drawn from two distinct periods: 1986-1990 and 1997-2001. Whereas the 1986-1990 period is arguably a more stable valuation regime, the 1997-2001 period was characterized by a historically unusual rise and fall in stock market valuations. Specifically, after a dramatic and prolonged rise in stock prices in the late 1990s, the NASDAQ and other stock markets collapsed in March 2000. This led some observers to argue that the market for new economy stocks, and especially IPOs, was significantly altered after March 2000. Therefore, we divide the years 1997-2001 into two sub-periods, January 1997 through March 2000, and April 2000 through December 2001. We define two dummies, BOOM and CRASH, corresponding to these two sub-periods. BOOM equals one if an IPO was conducted during January 1997 through March 2000, and zero otherwise; CRASH equals one, if an IPO was conducted during April 2000 through December 2001, and zero otherwise. The coefficients on the two dummies measure the incremental valuation associated with IPOs in the boom and crash periods relative to the 1980s.

To motivate our discussion of IPO valuation, we use the valuation model of Abel and Eberly (2005), which explicitly incorporates the possibility that firms may upgrade to or adopt a new technology. In their model, the value of the firm is comprised of three components: the replacement cost of the firm's physical capital, the net present value of the firm's expected future cash flows from assets in place, and the value of growth options associated with future technological upgrades. Because the late 1990s were a period of rapid technological change, this model of firm valuation seems particularly well-suited to capture the salient determinants of value.

Relatedly, Burgstahler and Dichev (1997) and Fischer and Verrechia (1997) argue for a non-linear

We need proxies for the components of value in the Abel and Eberly (2005) model. First, we use the book value of equity to proxy for the replacement cost of the firm's assets (most of our IPO firms do not have any long-term debt). We hypothesize that firm value is increasing in book value. Second, estimating the expected future cash flows for most companies is non-trivial. This task is even more challenging for IPO firms given that, in general, less is known about their past performance and there is greater uncertainty about their future prospects. Instead of directly estimating future cash flows and the cost of capital to discount these cash flows, we construct proxies for the cash flows and discount rates. The two proxies for cash flows are sales and net income at the end of the year before the offering date (year -1). We hypothesize that firm value is increasing in sales and net income.

Our proxies for changes in the cost of capital are the boom period and the crash period. The logic here is that during the boom period, firms had dramatically increased access to capital implying that investors required a lower equity risk premium and that the cost of capital was lower. As a result, we hypothesize that firm valuation was higher in the boom period. Conversely, during the crash period, the equity risk premium increased, thereby increasing the cost of capital and reducing access to capital. As a result, we hypothesize that firm valuation was lower in the crash period.

Third, growth opportunities are especially critical for IPOs given that much of an IPO's value is based on them. We use four proxies to measure the growth opportunities of our IPO firms: whether the firm is a technology or internet firm, research & development (R&D) costs, the median price-to-sales ratio of recent IPOs in the same industry, and whether a firm has negative earnings. In the Abel and Eberly (2005) model, growth opportunities pertain specifically to the opportunity to adopt a new technology. This possibility defined many of the internet and technology firms that went public in the late 1990s. Thus, we include Internet and technology dummies as our first proxy for growth opportunities. Several studies in accounting and finance have used R&D as a proxy for growth opportunities (Smith and Watts (1992), Gaver and Gaver (1993), Baber, Janakiraman, and Kang (1996)).[5]

Industry price-to-sales ratios are another proxy for growth because firms from the same industry tend to have similar growth opportunities. Of course, they may also capture industry-level variation in

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relationship between market value and net income.

[5] With issues regarding measurement of R&D expenditures and its impact on valuation, see Bhagat and Welch (1995), Lev and Sougiannis (1996), and David, Hall, and Toole (2000).

other factors that influence valuation, such as differences in the cost of capital. Many of the firms that went public during the boom and crash periods had negative earnings, presumably because they were still investing in technological capabilities (for example, R&D expense). To mention one example, Amazon.com developed a new supply-chain model that was reflected in accounting statements as "fulfillment expense." As a result of this (and other items), Amazon had substantial negative earnings that represented adoption of a technological upgrade. Thus, negative earnings are another measure of growth opportunities. We hypothesize that firm value is increasing in all of these measures of growth opportunities.

In addition to the firm valuation variables based on fundamentals described above, we consider two other variables as well. The ownership retained by pre-IPO shareholders and investment banker prestige can serve as signals of an IPO's quality. As a result, they could also be important determinants of the IPO's realized value.[6] For completeness, we also include these two variables on the right hand side of our valuation function.

As with our dependent variable, we apply the log transformation to all the independent variables except the boom and crash dummies, insider retention, and investment banker prestige. To retain negative values of income and book value of equity in our analysis, we use the transformation, L(.), proposed by Hand (2003):

$L(W) = \log_e(1+W)$ when $W \geq 0$ in \$millions;

$L(W) = -\log_e(1-W)$ when $W < 0$ in \$millions.

The transformation is monotone and one-to-one and ensures that L(W) is defined when W is zero or close to zero.

In light of the above discussion, our basic econometric valuation model is (the usual error term is omitted):[7]

[6] Loughran and Ritter (2003), Ljungqvist and Wilhelm (2003), Carter, Dark and Singh (1998), and Beatty and Ritter (1986) consider the relation between investment banker reputation and IPO *underpricing*. Leland and Pyle (1977) discuss the relation between insider retention and IPO valuation.

[7] We also considered marketing costs as an additional variable that could influence IPO values, but did not incorporate them because of data availability considerations. Based on a random sample of the IPOs for which we have complete data, we find that most IPO firms do not disclose separate amounts for marketing costs in their prospectuses; instead they combine marketing costs with general and administrative costs.

$$L(OV)i = \alpha_0 + \alpha_1 BOOM_i + \alpha_2 CRASH_i + \alpha_3 L(INCBRD)_i + \alpha_4 L(BV)_i + \alpha_5 L(SALES)_i + \alpha_6 L(R \& D)_i + \alpha_7 L(INDPS)_i + \alpha_8 INSRET_i + \alpha_9 IBPREST_i \quad (1)$$

where,

OV	= Offer price time shares outstanding on completion of IPO,
BOOM	= One, if IPO is completed between January 1997 and March 2000, and zero otherwise,
CRASH	= One, if IPO is completed between April 2000 and December 2001, and zero otherwise,
INCBRD	= Income before extraordinary items and R&D in year –1, where year 0 is the IPO year,
BV	= Book value of equity at the end of year –1,
SALES	= Sales for year –1,
R&D	= Research and development costs in year –1,
INDPS	= Median industry price-to-sales ratio of recent IPOs,
INSRET	= Percentage of the post-IPO firm owned by pre-offering shareholders,
and	
IBPREST	= Investment bank prestige ranking.

The right hand side variables in equation (1) (as well as equation (2) below) are proxies for future cash flows, growth opportunities, and discount rates. Hence, we can only make statements about the correlations of these variables with IPO valuations; no causation is implied.

In Eq. (1), INSRET captures the aggregate post-IPO retention levels of pre-IPO shareholders. The ownership structure of IPO firms displays considerable variation. On the one extreme, we have highly concentrated structures where the management or a single blockholder holds a significant majority of the stock; on the other end, we have less concentrated ownership structures where ownership is distributed among management, venture capitalists, and other blockholders. Because each of these classes of shareholders has different information about future prospects, their ownership retention levels could differentially affect offer values. Aside from informational issues, these classes of shareholders have a differential ability to impact future cash flows and, hence, IPO value. CEOs and other top managers have a greater ability through the efforts they expend on behalf of the firm to directly affect cash flows. Venture capitalists and blockholders could potentially play a monitoring role that is valued by prospective investors (Megginson and Weiss (1991), and Morsfield and Tan (2003)). Therefore, we also estimate an expanded version of Eq. (1) where we replace INSRET with eight variables.

The first four variables are post-IPO ownership of the CEO, of non-CEO managers as a group, of venture capitalists as a group, and of other five percent blockholders as a group. We predict a positive

relation between these four post-IPO ownership variables and IPO value. The next four variables are changes in these ownership percentages around the time of the IPO; changes might convey incremental information not contained in levels. We define changes in percentage ownership as ownership percentage immediately before the IPO less the percentage immediately after the IPO. A larger change in percentage ownership implies a larger decrease in ownership which signals lower confidence about future prospects, and a lesser alignment of their interest with outside investors. Therefore, we predict a negative relation between change percentages and IPO value. Declines in ownership percentages at the IPO date could be caused by the issuance of new shares by the IPO firm (primary offerings) or by the sale of shares by the pre-IPO shareholders to the prospective investors (secondary offerings). We do not disentangle the impacts of these two factors on IPO valuation.

2.3. Are the Fundamentals Valued Differently Over Time and Across Industries?

Eq. (1) assumes that model coefficients are constant inter-temporally and across the cross-section of IPOs. Next, we expand our specification to allow coefficients to vary across time-periods, between technology and non-technology firms, between internet and non-internet firms, and between loss firms and non-loss firms. Our goal is to isolate instances in which we hypothesize more weight will be placed on growth options. In the context of the Abel and Eberly model, this implies that firms are closer to technological upgrades.

To test for differences in valuation of the independent variables in Eq. (1) across time periods, we interact BOOM and CRASH with each of the seven independent variables in that equation. These interaction terms allow us to test whether IPO fundamentals were valued differently in the boom and crash periods, relative to a more stable period (1986-1990). We hypothesize that during the boom period, firm value was more dependent on growth options. During the crash period, firm value was more dependent upon assets in place and cash flows from existing technology.

Ritter and Welch (2002) document that the percentage of technology (hereafter, tech) firms increased from twenty-five percent of the IPO market in the 1980s and early 1990s to thirty-seven percent after 1995 and then to seventy-two percent during the internet bubble before returning to twenty-nine percent in 2001. To allow for the possibility that cross-sectional differences in offer values could be

associated with these dramatic shifts in the proportion of tech IPOs, we include a dummy for whether or not a firm is a tech firm (TECH). Because tech firms are more R&D-intensive than are other firms, and payoffs to R&D investments are more uncertain than those from other tangible investments (Kothari, Laguerre, and Leone (2002)), we expect that earnings and sales of tech firms to be valued less than those of other firms. To allow for these slope differences, we include interactions of TECH with INCBRD, SALES, INSRET, and IBPREST. For consistency, we also include the interactions of TECH with BV, R&D, and INDPS as additional control variables.

In light of the evidence in Hand (2003) and BMS, we expect internet IPOs to be valued differently from other firms. Therefore, we include a dummy (INTERNET) that equals one if the firm is an internet firm, and zero otherwise. As with tech firms, we include interactions of INTERNET with each of the seven variables, INCBRD, BV, SALES, R&D, INDPS, INSRET, and IBPREST. Our motivation for including these interaction terms parallel those for the tech firms. We wish to point out that tech firms include internet firms.[8]

Hayn (1995) and Basu (1997) hypothesize and find evidence that in stock returns-earnings regressions, coefficients on negative earnings are smaller in absolute value than those on positive earnings. The intuition underlying this prediction is that losses are less likely to persist; this is either because firms that suffer losses are more likely to be liquidated or because of conservative accounting rules. Motivated by these findings, we define an indicator variable (LOSS) that equals one if income before extraordinary items is negative, zero otherwise, and include it and its interaction with INCBRD as additional explanatory variables.

Based on the above discussion, our extended model is:

[8] The Spearman correlation between the internet and tech dummy is 0.54, suggesting that they are distinct variables. There are no internet firms during 1986-1990. There is a considerable overlap between internet and technology firms during 1997-2001; however, not all technology firms are in the internet industry.

$$
\begin{aligned}
L(OV)i = {} & \alpha_0 + \alpha_1 BOOM_i + \alpha_2 CRASH_i + \alpha_3 L(INCBRD)_i + \alpha_4 L(BV)_i + \alpha_5 L(SALES)_i \\
& + \alpha_6 L(R\ \&\ D)_i + \alpha_7 L(INDPS)_i + \alpha_8 INSRET_i + \alpha_9 IBPREST_i + \sum_{j=10}^{16} \alpha_j BOOM_j \times Z_j \\
& + \sum_{j=17}^{23} \alpha_j CRASH_j \times Z_j + \alpha_{24} TECH_j + \sum_{j=25}^{31} \alpha_j TECH_j \times Z_j + \alpha_{32} INTERNET_j \\
& + \sum_{j=33}^{39} \alpha_j INTERNET_j \times Z_j + \alpha_{40} LOSS_j + \alpha_{41} LOSS_j \times L(INCBRD)_j \\
& + \alpha_{42} LOSS_j \times INSRET_j \qquad (2)
\end{aligned}
$$

where TECH, INTERNET, and LOSS are respectively indicators for technology, internet, and loss firms, Z is the matrix composed of the following seven column vectors: L(INCBRD), L(BV), L(SALES), L(R&D), L(INDPS), INSRET, and IBPREST, and the × operator represents column-by-column multiplication.

3. Results

3.1. Sample and Data

Sample construction

We obtain our initial sample of U.S. IPOs by non-financial companies for the years 1986-1990 and 1997-2001 from the Thomson Financial Securities Data Company database (SDC). The initial sample excludes best efforts offerings, IPOs with proceeds of less than $5 million, IPOs of units of shares and warrants, spin-offs and equity carveouts, IPOs of financial companies, and IPOs by limited partnerships. After these exclusions, we are left with 699 IPOs from the late eighties and 1,381 IPOs from the late nineties. Next, we read the prospectus of each IPO firm in the initial sample to identify and eliminate IPOs that are misclassified by SDC. Our final sample, after these exclusions, consists of 1,655 IPOs that have complete data on all the variables employed in our regressions.

Offering Data

Data on offer date and offer price come from SDC. For IPOs from 1986-1990, pre-IPO and post-IPO shares outstanding are hand-collected from prospectuses. For 1997-2001, pre-IPO and post-IPO shares outstanding were either obtained from Professor Alexander Ljungqvist at New York University or hand-collected from prospectuses. We believe that it is important to use hand-collected data for shares

outstanding because Ljungqvist and Wilhelm (2003) point out that there are several errors in this variable in the SDC database.

Financial Statement Data

We employ four financial statement variables in our analysis: sales, income before extraordinary items, research and development expenditures (R&D), and book value of equity. For all our sample firms, we hand-collect the data for these variables from prospectuses for three years: the fiscal year before the offering date (year -1) and the two preceding years (years -2 and -3). If a firm did not have operations for an entire year or commenced its operations in the middle of a year, we code the three income statement variables for that year as missing. We record book value of equity at the end of the year whenever a firm reports it.[9] With respect to R&D, if a firm reports a full year of financial results, but R&D is undisclosed for that year, we assume that it equals zero. To minimize the possibility of error, whenever possible, we crosschecked our data with COMPUSTAT.[10]

Stock Price and Return Data

Consistent with recent research, CRSP, and not SDC, is our source for first-day closing prices. We also obtain pre-offering market returns and one-year post-IPO firm returns from CRSP. Pre-offering market returns are buy-and-hold returns on the value-weighted market portfolio compounded over the 15 trading days (three weeks) before the offer date. Post-IPO returns are also buy-and-hold returns, compounded daily over the 260 trading days beginning from the day after the date of the offering.

Industry Price-to-Sales Comparables

Similar to Kim and Ritter (1999) the industry median price-to-sales is based on the price-to-sales ratios of five or fewer most recent IPOs during the past two years that have the same three-digit SIC code as the IPO firm.

Ownership Retention

Consistent with Schultz and Zaman (2001) we measure aggregate post-IPO ownership retention of pre-IPO shareholders, INSRET, as (shares outstanding after offering – primary and secondary shares issued) / shares outstanding after offering. Data on primary and secondary shares are from SDC.

[9] We use pre-issue book value of equity. Given the large inflow of capital from the IPO issuance, the post-issue book value would lead to a mechanical relation between offer value and book value.

We also examine the impact of ownership retention of different types of pre-offering shareholders. We consider post-IPO ownership percentages and changes in these percentages around the IPO date for four classes of shareholders: the CEO, officers and directors excluding the CEO, venture capitalists (VCs), and other five percent blockholders. Because SDC provides little information on ownership structure, we hand-collect this data from prospectuses. When calculating percentage ownership of outside directors, we exclude shares that the outside director owns on behalf of VC firms and other five-percent blockholders.[11] Outside directors refer to board members who are not employees of the firm.

VC firms were identified by comparing the names of the pre-offering shareholders disclosed in the prospectus with the list of VC firms in the annual volumes of the Pratt's Guide to Venture Capital Sources (1984-2001). To measure VC ownership, we aggregate the ownership percentages held by each VC firm that held at least five percent of the pre-offering outstanding shares. All shareholders who own at least five percent of the pre-IPO firm and who are not VCs or employees are classified as other blockholders. As we do for VCs, we aggregate blockholder ownership percentages to arrive at a single number for this category. When calculating ownership percentages of VCs or blockholders, we include shares held by outside directors as their representatives on the board. When a firm has no VC (blockholder) ownership, VC (blockholder) percentage ownership equals zero.

The above detailed ownership data allows us to make a unique contribution to the IPO valuation and corporate governance literature. We are able to examine the impact of different types of shareholders on IPO valuation. Post-IPO ownership and change in ownership convey different signals about the confidence of the particular shareholder class in the firm's future prospects. Also, the four classes of shareholders have a differential ability through their effort and/or monitoring to impact future cash flows and, hence, IPO value.

Investment Banker Prestige and Industry Classification

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[10] COMPUSTAT reports data for year -1 for a high proportion of the firms in our sample. Data on year –2 and year –3, however, are always missing on COMPUSTAT.

[11] Outside directors own shares on their own account, and sometimes on behalf of VC firms or other five-percent blockholders. If the outside director owns the share on behalf of a VC, we attribute the shares to the VC category. Similarly, if the outside director owns the share on behalf of a five-percent blockholder, we attribute the shares to the five-percent blockholder category.

We use the investment banker prestige rankings and the internet/non-internet, and technology/non-technology classification as in Loughran and Ritter (2004). Consistent with Ljungqvist and Wilhelm (2003), technology firms include internet firms.

3.2. Data Description

Table 1 presents year-by-year means (Panel A) and medians (Panel B) of the offer value, first-day closing value (hereafter, market value), and the main independent variables used in our regressions. Median offer values and market values of IPOs have increased considerably in recent years relative to the years 1986-1990. The median offer value was $77.6 million in 1990. By 1998, this number had increased to $147.5 million before shooting up to $291.7 million in 1999 and $377.9 million in 2000; it then falls to $321.5 million in 2001. The median industry price-to-sales multiple ranged from 1.7 to 3.0 between 1986 and 1990, increased to 3.9 in 1998 before jumping to 31.7 in 1999 and 39.2 in 2000. In 2001, however, it had dropped back to 3.0.

Median sales ranged from $26.1 million to $33.6 million in the 1980s; however, from 1997 through 2000 it has a declining trend, with an especially sharp drop in 1999. In 2001, the trend reverses with median sales increasing to a relatively large $68 million. Median income before extraordinary items in the 1980s was quite small and ranged from $1.1 million to $1.9 million. Beginning from 1998, as was widely noted in the financial press, median income turned negative. The second column of Panel C provides related data on the frequency of firms reporting losses in the year before they went public. In the late 1980s, this number was stable and ranged from 19.6 to 22.1 percent. By 1997, this number had increased to 42.7 percent and continued to increase until 2000 when nearly eighty-five percent of the completed IPOs were unprofitable. In 2001, however, this number came down to about sixty-nine percent.

Returning to Panel B, until 1998, median R&D is zero or very close to zero. This reflects the fact that, until that year, significant fractions of the sample were non-tech firms that spent little or no funds on R&D. As the third column in Panel C indicates, in the 1980s, the frequency of tech firms completing IPOs was 20.4 to 33.8 percent. This number increased in 1997 and 1998 before becoming greater than fifty percent in both 1999 and 2000. Consequently, median R&D turns positive in the latter two years. In

2001, the percentage of tech firms drops to thirty-five percent and median R&D once again equals zero.[12] The higher R&D levels for 1999 and 2000 provide a partial explanation for the increased lack of profitability of the IPOs from those years. The years 1998-2000 were the heady years of the internet. This is reflected in the high percentage of internet IPOs in those years, which is reported in the last column in Panel C. In 2001, however, the fraction of IPOs that were internet-related dropped to 5.9 percent.

Turning to the last two columns of Table 1, median insider retention was stable in the 1980s, ranging from seventy to seventy-five percent; in 1999, however, it increased moderately from seventy-three to eighty-one percent. After increasing slightly to eighty-two percent in 2000, it drops to seventy-six percent in 2001. Investment banker prestige rankings are above eight throughout the sample period, and are at their highest during 1999-2001.

3.3. Basic Model of IPO Valuation

Table 2 reports two regression results; the dependent variables are the logarithm of offer value and the logarithm of first day closing value. Recall that there are three components that affect firm value in the Abel and Eberly model: physical assets in place, cash flows associated with the existing technology or assets, and growth opportunities associated with future technologies. We find that book value of equity has no bearing on IPO valuation; this is in contrast to the prior findings for publicly traded firms (e.g., Collins, Maydew and Weiss (1997)). Since book value is our proxy for assets in place, this finding suggests that for IPO firms, assets in place are not the critical component of value.

Intriguingly, income is reliably and negatively correlated to offer values. At first glance, this result seems counter-intuitive because income is a proxy for future cash flows. However, Hand (2003) provides evidence that suggests that when internet firms lose money, these losses reflect strategic expenditures such as investment in intangibles, or, more generally, growth opportunities. Hence, for these firms, greater losses are valued more positively. Therefore, the negative coefficient on income might be associated with loss firms. In subsequent analysis, we expand our specification to include a dummy

[12] The Spearman correlation between the TECH dummy and R&D is 0.51, suggesting these two variables are distinct. So, while the fraction of tech firms in a given year is a determinant of the median R&D expenditures in that year, it is *not* the sole driver.

variable for loss firms (LOSS) and an interaction term between LOSS and income. As for other growth opportunities, R&D is positively related to offer values. The other growth proxy, price-to-sales comparable, also has the expected positive coefficient.

Table 2 also indicates that sales of IPO firms are correlated positively with valuation by the underwriter (and first-day investors) – a one standard deviation increase in sales is associated with a 0.36 standard deviation (0.30 percent) increase in offer values (first-day closing values).[13] Thus, this proxy for cash flows does have the predicted sign. In addition, IPO values are positively related to the two non-financial variables, investment banker prestige and insider retention as well.

We also find that IPO values are higher during the boom and crash periods relative to the baseline period 1986 to 1990. This could be because both the boom and crash periods had lower costs of capital in absolute terms than the late 1980s.[14] This could also result from other differences between the boom and crash periods and the late 1980s. For example, were growth opportunities more important in the boom and crash periods and, as a result, was there an incremental nonlinear increase in value associated with the late 1990s? We next turn to a further exploration of such differences.

3.4. Differences in IPO Valuation Across Time-periods and Industries

The regressions in Table 2 constrain the coefficients of the financial and non-financial variables to be constant across time-periods and industries. Next, we relax this constraint and examine the impact of allowing the slope coefficients on our independent variables to vary across time periods, for tech and internet firms, and for loss firms. Before we turn to our findings, we wish to clarify one aspect of our regression that will aid interpretation. We include dummy variables for the boom and crash periods, tech and internet firms, and for loss firms. Therefore, the base group consists of firms whose IPO was completed in the years 1986-1990 which are profitable and which belong to non-tech industries. The

[13] See Gujarati (2003) for details on the calculation. The economic significance of the other variables noted below, namely, R&D, price-to-sales comparable, investment banker prestige, and insider retention are of similar magnitude.

[14] 10-year Treasury yields in the late 1980s were around 8.5% whereas in the late 1990s, they were around 6% Also, Damodaran (2006) finds that the equity premium in the U.S. during 1999-2000 was the lowest for the period 1962-2005; specifically the equity premium was in the range 2.0% to 2.1% for 1999-2000, 2.9 % for 2001, and in the 3.6% to 4.0% range during 1986-1990.

coefficients on our seven basic independent variables (income, book equity, sales, R&D, industry comparables, investment banking prestige, and insider retention) are interpreted accordingly.

Table 3 contains the main findings of the paper. Because the results for offer value and first-day market values are similar for most variables, we discuss results for offer value alone and highlight only the differences for the two dependent variables. Recall that, following the valuation model of Abel and Eberly (2005), we predict that firm value is increasing in the book value of equity, net income, and sales to capture the effects of physical capital and future cash flows. We predict that firm value is higher in the boom period and lower in the crash period (relative to the boom period) to capture differences in the cost of capital over time. We predict that firm value is higher for tech and internet firms, firms with higher R&D spending, firms in industries with higher price-to-sales comparables, and loss firms. All of these are proxies for growth opportunities.

We begin by discussing results related to assets in place, as proxied by book value. From Table 2, we know that book value is not an important determinant of IPO value. For profitable non-tech firms in the late 1980s, book value continues to not be a significant determinant of value. When we interact book value with the dummy variables for boom, crash, internet, and tech, we find that book value is only marginally significant for the crash period. The result that book value is significant for the crash period is consistent with the view that physical assets became more important relative to growth opportunities.

Second, we consider the relative importance of cash flows. When compared to the results in Table 2, we find that now income as a proxy for cash flows from assets in place is positively and significantly related to firm value. This result applies to profitable non-tech firms in the late 1980s. For both the boom and crash periods, income is positively related to firm value.[15] This is also true for tech firms, but there is no incremental effect for internet firms above the tech effect. For internet firms, this result is consistent with the view that more of their value is embodied in growth opportunities associated with the new technology. Perhaps the most surprising result related to income is that for loss firms, greater losses result in greater value (a coefficient of -0.49). Including the loss interaction with income

[15] One interesting note about this result—that income was associated with higher valuations in the late 1990s relative to the late 1980s—is that it is contrary to the assertions in the financial press that income became a less important value indicator in the new *e*-conomy period.

explains the difference in coefficients between Table 2 and Table 3 for the income variable. We will discuss this interaction term in greater detail below when we consider proxies for growth opportunities.

Our second proxy for cash flows, sales, is an obviously noisier measure. For profitable non-tech firms in the late 1980s, sales are positively and significantly related to firm value. Incrementally, during the boom and crash periods, sales are valued less. This stands in contrast to the finding that income was valued more during the boom and crash periods, and suggests that the variable more closely related to cash flows (net income) mattered more. We also find that sales were valued incrementally less for internet firms, again consistent with the view that cash flows mattered less for internet firms and growth opportunities mattered more.

Last, we consider our proxies for growth opportunities. R&D spending and the industry price-to-sales comparable are positively and significantly related to firm value for profitable non-tech firms in the late 1980s, consistent with the results from Table 2. Surprisingly, the incremental effect of R&D spending on value was negative during the boom period, although the incremental effect is positive for internet firms in the market value specification.[16] This suggests that during the boom period, growth opportunities were valued less highly for non-internet firms. The incremental effect of the industry price-to-sales comparable is negative during the crash period and negative for internet firms. We hypothesize that the value of growth opportunities was discounted during the crash period as physical capital became more important to firm value. These results accord with the intuition that "growth" fell out of favor during the crash period relative to "value." We find the result for internet firms to be puzzling.

Our final proxy for growth opportunities is loss firms. Here the notable finding is that loss firms per se do not have higher values—rather it is the interaction with firm income that matters. Firms that lose more (more negative income) have higher values, consistent with the findings of Hand (2003) and Bartov, Mohanram, and Seethamraju (2002) for internet firms. The intuition is that these firms are "investing," but not in traditional physical capital. Instead, these losses reflect strategic expenditures such

[16] Surprisingly, for tech firms, neither measure of growth opportunities (R&D spending or the price-to-sales comparable) matters more for firm value relative to non-tech firms. Even more surprising is that tech firms are associated with smaller valuations than non-tech firms unconditionally with a coefficient of -0.86 on the tech dummy in the offer value specification. This last result suggests that tech itself may not be a good proxy for growth opportunities. Instead, tech may be a better proxy for how risky the firm is.

as marketing costs and other investments in intangible assets and growth options, consistent with Klein and Marquardt (2006) and Darrough and Ye (2006).

In addition to the results discussed above that are related to the Abel and Eberly model, there are several other notable findings in Table 3. Once we include the various interactions, neither the boom nor crash period dummies alone are significant, in contrast to the results in Table 2. Thus, what appears to matter is not shifts in the cost of capital or other unspecified changes in the process of valuation per se, but rather the interaction of shifts in the cost of capital with other fundamental variables. Second, for both the boom and crash periods, investment banker prestige mattered more relative to the late 1980s. There is no significant difference in the importance of insider retention during the boom or crash periods. Third, we note that insider retention is strongly related to firm value for both tech and internet firms, while investment banker prestige is associated with smaller valuations for internet firms relative to non-internet firms.

3.5. Do Different Owners Convey Different Signals to Prospective Investors?

We next delve deeper into the relation between insider retention and IPO valuation. The regressions in Tables 2 and 3 use the level of ownership retention of *all* pre-IPO shareholders as an explanatory variable. We now examine whether levels of and changes in ownership percentages around the IPO date of different classes of shareholders convey different information to prospective investors.

We begin with some descriptive statistics related to detailed ownership structure. Table 4 presents the year-by-year means and medians of the ownership percentages before and after the IPO and the change in ownership percentages of four classes of shareholders: CEOs, officers and directors as a group (not including the CEO), VCs, and other blockholders who are neither officers nor directors nor VCs. Numbers for ownership changes are positive because we defined change as percentage ownership before the offering less percentage ownership after the offering.

Mean pre-IPO CEO ownership is quite large in 1986 (34.6 percent). It declines in 1987 and 1988, exhibits no discernible trend until 1998, and then declines again in 1999 and 2000 before increasing in 2001. The trend in mean pre-IPO ownership of officers and directors other than the CEO mirrors that of the CEO. Mean changes in ownership percentages at the IPO date for these two classes of shareholders

are relatively large in 1986 and 1987 and become progressively smaller over the sample period, reflecting the fact that pre-IPO ownership levels have become smaller to start with.

Whereas mean management ownership exhibits a general decline over our sample period, the ownership percentages of VCs and other blockholders display an increasing trend over the sample period. Mean pre-IPO VC ownership was 7.8 percent in 1986; by 2001, this number has increased to 21.7 percent. Similarly, other blockholders held 13.2 percent, on average, in 1986; at the end of our sample period, in 2001, this percentage has increased to 31.7 percent. Consistent with the increasing levels in ownership, ownership changes for these two groups are also larger in the more recent years. Overall, Table 4 documents a significant shift in the ownership profile of IPO firms in the years 1997-2001 relative to the late 1980s. In recent years, VCs and other blockholders own a greater fraction of the IPO firm both before and after the IPO; in contrast, management owns less of the firm.[17]

In Table 5, we report valuation regressions to assess the significance of the detailed ownership variables. In general, the coefficients on the financial and growth variables are similar to those reported in Table 2 – the inclusion of the detailed ownership variables instead of aggregate ownership retention does not change our inferences.[18] As expected, we find that post-IPO ownership by each of the four classes of shareholders is positively related to offer values. The coefficients related to VCs and blockholders are the largest, followed by that of CEOs and then by that of other officers and directors. These coefficients are economically meaningful. An increase in the VCs' post-IPO ownership by one standard deviation is associated with a .17 standard deviation increase in the IPO valuation. An increase in the CEO's post-IPO ownership by one standard deviation is related to a .12 standard deviation increase in the IPO valuation.

Additionally, as expected, changes in ownership retention for each of the four shareholder categories are negatively associated with offer values implying that smaller changes in retention percentages lead to higher values.[19] The estimated coefficients are statistically and economically significant. A decrease in the change in CEO's ownership retention by one standard deviation is related to

[17] This does not necessarily imply that venture capitalists are investing more in the typical IPO firm. It is also possible that more IPOs are coming from firms that venture capitalists invest in.
[18] The only change is that book value of equity gains statistical significance in this expanded specification. However, the size of its coefficient remains economically small.

a .19 standard deviation increase in the IPO valuation. A decrease in the change in VCs' ownership retention by one standard deviation is related to a .18 standard deviation increase in the IPO valuation. Overall, we conclude that investment bankers and first-day investors assign different weights to post-IPO ownership and changes in ownership around the IPO of different classes of shareholders when pricing the IPO.[20]

3.6. Robustness Checks

We consider the following eight robustness checks to determine that our inferences are not sensitive to our data definition and empirical methodology. First, we consider three alternate definitions of the boom and crash periods. (i) Boom = 1 if the offer date is during 1/1997-12/2000, and 0 otherwise. Crash = 1 if the offer date is during 1/2001-12/2001, and 0 otherwise. (ii) Boom = 1 if the offer date is during 1/1999-3/2000, and 0 otherwise. Crash = 1 if the offer date is during 4/2000-12/2001, and 0 otherwise. (iii) We redefine the Crash dummy to equal one if the IPO is from the period June 2000 through December 2001, excluding IPOs from the months March 2000 through May 2000 from the analysis. Second, because R&D can be viewed as a stock, we also construct an R&D stock variable, assuming an amortization period of three years beginning from the year of the initial investment. Specifically, we define R&D stock as the sum of two-thirds of R&D in year –1 and one-third of R&D in year –2. Third, we use sales growth in year -1 as an additional proxy variable for growth opportunities.

Fourth, we include the level of the Nasdaq composite index, and the three-week return on this index prior to the offering date as additional independent variables in equation (2). Fifth, we consider the inflation adjusted values of offer value, market value, income, book value, sales, and R&D in the valuation equations. Sixth, instead of the logarithmic specification noted in equation (2), we consider a linear specification. Our conclusions are not sensitive to any of these alternative data definitions and empirical specifications.

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[19] Recall that change in ownership is defined as percentage ownership before the offering less percentage ownership after the offering.

[20] The F-statistic to test the equality of the coefficients of the changes in ownership levels across the four classes of shareholders, rejects the null. Similarly, the F-statistic to test the equality of the coefficients of the post-IPO ownership levels across the four classes of shareholders, rejects the null.

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Thus far, we have assumed in our empirical work that insider retention is exogenous to firm valuation. Obviously, models such as Leland and Pyle (1977) that posit a signaling role for insider retention suggest that this is not the case. Further, Ritter (1984) points out that a firm that plans to raise a fixed amount of capital in the IPO would have higher levels of ownership retention as firm valuation increases. This implies that both firm valuation and post-IPO ownership levels are jointly determined endogenous variables, and endogeneity may be a concern even separate from the signaling hypothesis. The same possibility exists for investment banker prestige. If more prestigious investment banks choose higher-valued firms to take public, then IPO valuation and investment banker prestige are also jointly determined endogenous variables even separate from the issue of signaling.

To account for the endogeneity of insider retention and investment banker prestige, our seventh robustness check is to estimate a system of three simultaneous equations. The dependent variables for the three equations are offer value, insider retention, and investment banker prestige. The results indicate that accounting for endogeneity of insider retention and investment banker prestige does not alter our conclusions.[21] In particular, in the offer value regression, both insider retention and investment banker prestige remain positively and significantly related to IPO value. The only impact of using three-stage least squares is that offer value is no longer significantly related to R&D costs.

The most popular estimation method in valuation research is ordinary least squares (OLS). The use of OLS is justified by the fact that it is best linear unbiased estimate of linear model coefficients and the overall best estimate when regression residuals are normally distributed. Unfortunately, with valuation models, normality is the exception rather than the rule, with residuals in general containing outliers generated by fat-tailed distributions. In this situation, OLS may not be the most efficient estimator in the class of linear and non-linear estimators.

Therefore, to confirm that the OLS results in Table 3 are not being driven by outliers, our eighth robustness check is to employ the semi-parametric method of quantile regression (or robust regression), which was first proposed by Koenker and Bassett (1978). As Koenker and Hallock (2001) note, "there is a rapidly expanding empirical quantile regression literature in economics that, taken as a whole, makes a persuasive case for the value beyond models for the conditional mean (OLS)." The finance literature has

[21] Details of the estimation are available from the authors.

incorporated robust regression techniques; for example, see Aggarwal and Samwick (1999), and Chan and Lakonishok (1992). In contrast to OLS, which estimates a conditional mean, robust regressions provide an estimate of the median value of the dependent variable conditional on the set of explanatory variables. Coefficient estimates are not sensitive to outliers. Importantly, when errors are non-normal, quantile regression estimators may be more efficient than least squares estimates.[22]

The robust regression results are in Table 6. We note that the robust "t-ratios" are much larger than the OLS t-statistics for both specifications. This is because the robust regressions give less weight to outliers and hence result in standard errors which are smaller than those of OLS.[23] A second point about the robust estimates is that the distribution of t-ratios is not well specified. Therefore, to evaluate the statistical significance of the robust t-ratios we apply the Chebyshev inequality; this inequality applies to any standard random variable with finite variance, regardless of its distributional properties and sample size (see Mood, Graybill, and Boes (1974)). It implies that, under the null hypothesis, the probability that the absolute value of any random variable (in our case, the t-ratio) is greater than or equal to some constant k is less than or equal to $1/k^2$. For example, the probability of observing a t-ratio of 10 or more is less than $1/(10)^2$, or 0.01. Overall, the robust regression results are quite consistent with our OLS results in Table 3.

4. Summary and Conclusions

In this paper, we make three contributions to the literature on IPO valuation. First, the extant literature on IPO valuation considers only IPOs with positive earnings and this limits the generalizability of their conclusions. We consider the valuation of IPOs with positive *and negative* earnings. During 1986-1990, only about twenty percent of IPO firms had negative earnings, while during 1997-2001, sixty-three percent of IPO firms had negative earnings. Eighty percent of the IPOs during 1999 had negative earnings, and eighty-five percent of the IPOs during 2000 had negative earnings. Additionally, and perhaps more importantly, the data suggest that IPOs with negative earnings are correlated differently

[22] Koenker and D'Orey (1987), Buchinsky (1998), and Koenker and Hallock (2001) provide surveys of the methodological issues related to and applications of the quantile regression approach.
[23] Because OLS standard errors are based on sum of the *squared* residuals, outliers "inflate" the standard error estimates.

with value than IPOs with positive earnings; for example, whereas income of IPOs with positive earnings is correlated positively with valuations, income of IPOs with negative earnings is correlated negatively.

Second, we use the valuation model of Abel and Eberly (2005), which explicitly incorporates the possibility that firms may upgrade to or adopt a new technology, to motivate our choice of explanatory variables. In their model, the value of the firm is comprised of three components: the replacement cost of the firm's physical capital, the net present value of the firm's expected future cash flows, and the value of growth options associated with future technological upgrades. We find that the replacement cost of physical capital (book value) is correlated with IPO valuation during the crash period, consistent with the notion that tangible or physical assets became more important after the IPO bubble popped. For expected future cash flows, we find that income of IPO firms is associated with higher valuations and sales are associated with smaller valuations in the boom period compared to the late 1980s. This result is contrary to anecdotes in the financial press.

Our findings for growth options are somewhat mixed. In general, proxies for growth options such as R&D spending or industry price-to-sales comparables are associated with greater IPO firm value. Somewhat surprisingly, these measures of growth options are not consistently associated with higher valuations in the boom period or in internet or tech firms. Instead, we find that firms with larger negative earnings (another proxy for growth options) are associated with higher valuations.[24]

Third, we find that investment bankers and first-day investors assign different weights to post-IPO ownership and changes in ownership around the IPO of different classes of shareholders (CEOs, VCs, other blockholders, and officers and directors) when pricing the IPO. Overall, our results suggest that a careful examination of how IPO valuation evolves over time is warranted. Obviously, fundamentals change and this has a direct impact on IPO valuation. In addition, changes in fundamentals affect the inference problem for investors searching for signals of IPO quality. We view our results as a potentially promising start for research that focuses on understanding these valuation differences.

[24] Larger negative earnings could also represent other effects, for example, extraordinary items such as restructuring expenses; however, such an explanation seems less likely in the case of IPO firms.

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Table 1
Summary statistics of 1,855 US IPOs during 1986-1990 and 1997-2001

Year	Number of IPOs	Offer value	Market Value	Sales	Income	Book value of equity	R&D	Industry Price-to-sales multiple	Insider retention	Investment banker prestige
Panel A: Means										
1986	230	85.3	94.0	71.5	2.1	7.9	1.0	5.3	0.70	7.7
1987	179	111.6	119.7	79.0	2.1	8.4	1.1	7.8	0.70	7.7
1988	70	118.3	124.2	111.5	4.6	24.6	1.5	2.8	0.73	7.6
1989	77	95.4	103.5	104.5	2.9	9.0	1.7	3.8	0.70	7.9
1990	77	134.8	148.9	277.3	4.3	9.1	1.5	4.7	0.70	8.0
1997	330	168.1	199.2	96.7	-24.3	-14.0	4.7	8.1	0.68	7.2
1998	197	219.3	283.3	82.1	-2.0	61.6	1.9	6.8	0.72	7.5
1999	359	402.9	920.2	42.0	-7.6	-1.5	3.2	72.9	0.79	8.3
2000	285	578.6	1104.0	45.4	-13.0	3.3	5.9	82.5	0.82	8.5
2001	51	467.7	572.3	197.8	-4.8	13.7	5.1	11.6	0.75	8.4
Panel B: Medians										
1986	230	49.0	51.3	27.7	1.1	4.0	0.0	2.5	0.70	8.1
1987	179	58.0	62.1	26.1	1.2	3.7	0.0	2.7	0.72	8.8
1988	70	61.5	72.6	29.3	1.4	3.3	0.0	1.7	0.75	8.8
1989	77	67.5	76.3	33.6	1.9	5.7	0.0	2.7	0.72	8.8
1990	77	77.6	84.0	30.0	1.4	4.9	0.2	3.0	0.71	8.8
1997	330	99.2	106.6	24.2	0.7	4.4	0.0	3.2	0.70	8.1
1998	197	147.5	166.0	22.2	-0.1	2.4	0.0	3.9	0.73	8.1
1999	359	291.7	425.1	8.2	-5.6	-0.2	1.6	31.7	0.81	9.1
2000	285	377.9	473.4	8.6	-8.9	-0.2	3.7	39.2	0.82	9.1
2001	51	321.5	356.4	68.0	-3.7	-2.2	0.0	3.0	0.76	9.1

Panel C: Frequencies

Year	% of loss firms	% of Technology IPOs	% of Internet IPOs
1986	21.7	20.4	--
1987	19.6	25.1	--
1988	21.4	30.0	--
1989	22.1	33.8	--
1990	20.8	31.2	--
1997	42.7	35.8	3.3
1998	53.3	43.7	17.3
1999	80.5	64.9	59.1
2000	84.9	58.2	38.2
2001	68.6	35.3	5.9

Offer value = Final offer price × number of shares outstanding immediately after the IPO (in $millions).
Market value = First-day closing price × number of shares outstanding immediately after the IPO (in $millions).
Income = Income before extraordinary items (in $millions).
R&D = Research and Development costs (in $millions).
Price-to-sales multiples are the median industry price to sales ratio for the five or fewer most recent IPOs within two years before the IPO date.
Insider retention = Percentage (÷100) of post-IPO shares outstanding retained by pre-offering shareholders.
Investment banker prestige is from Loughran and Ritter (2004).
Income, book value of equity, sales, and R&D are measured for year –1 where year –1 is the fiscal year immediately before the offering date.
Loss firms are firms with income before extraordinary items less than zero.
Technology firms and internet firms are classified according to definitions contained in Loughran and Ritter (2004).

Table 2
Relation between IPO values and time period dummies, accounting variables, growth proxies, investment banker prestige, and insider retention
Sample of 1,655 US IPOs completed in 1986-1990 and 1997-2001.

Independent Variables	L(Offer Value)	L(Total Market Value)
Intercept	-0.77* (-6.2)	-1.31* (-8.6)
Boom	0.79* (22.1)	0.92* (22.7)
Crash	0.95* (17.5)	0.90* (13.7)
L(Income)	-0.07* (-5.7)	-0.09* (-6.0)
L(BV)	0.01 (1.4)	0.01 (.9)
L(Sales)	0.15* (10.4)	0.14* (8.3)
L(R&D)	0.07* (3.1)	0.11* (3.8)
L(Price-to-sales Comparable)	0.07* (5.5)	0.10* (6.4)
Investment banker prestige	0.24* (23.9)	0.25* (21.0)
Insider Retention	3.58* (19.3)	4.31* (19.3)
Adjusted R^2	0.743	0.710

Offer value = Final offer price*number of shares outstanding immediately after the IPO (in $ millions).
Market value = First-day closing price * number of shares outstanding immediately after the IPO (in $ millions).
Boom = 1 if the offer date is during 1/1997-3/2000, and 0 otherwise.
Crash = 1 if the offer date is during 4/2000-12/2001, and 0 otherwise.
L(W) is defined as: $L(W)=\log_e(1+W)$ when $W \geq 0$; $L(W) = -\log_e(1-W)$ when $W<0$
Income = Income before extraordinary items and research and development costs in year –1 (in $ millions).
Sales = Revenues in year –1(in $ millions).
BV = Book value of equity at the end of year –1(in $ millions).
R&D = Research and development costs in year -1(in $ millions).
Price-to-sales comparable= Median Industry price-to-sales ratio.
Investment banker prestige is based on Loughran and Ritter (2004).
Insider retention = Percentage of post-IPO shares outstanding retained by pre-offering shareholders.
White heteroscedasticity-consistent t-statistics are in parentheses.
Asterisk (*) implies significance at the 1% level.

Table 3
Inter-temporal differences and inter-industry differences in IPO valuation of accounting variables, growth proxies, investment banker prestige, and insider retention
Sample of 1,655 US IPOs completed in 1986-1990 and 1997-2001.

Independent Variables	**L(Offer Value)**	**L(Market Value)**
Intercept	0.31 (1.5)	0.47 (2.0)
Boom	0.32 (1.2)	-0.13 (-0.5)
Crash	0.60 (1.3)	0.57 (1.0)
L(Income)	0.21* (5.2)	0.21* (4.6)
L(Sales)	0.22* (8.3)	0.22* (7.5)
L(BV)	-0.003 (-.2)	-0.003 (-.2)
L(R&D)	0.13* (3.4)	0.11* (2.5)
L(Price-to-sales comparable)	0.07* (2.7)	0.07* (2.6)
Investment banker prestige	0.15* (11.2)	0.13* (8.9)
Insider retention	2.12* (6.6)	2.17* (6.0)
Boom*L(Income)	0.07 (2.0)	0.06 (1.8)
Boom*L(Sales)	-0.13* (-3.9)	-0.12* (-3.5)
Boom*L(BV)	-0.004 (-.2)	-0.007 (-0.3)
Boom*L(R&D)	-0.15* (-3.4)	-0.14* (-2.8)
Boom*L(Price-to-sales comparable)	0.02 (.6)	0.07 (1.7)
Boom*Investment banker prestige	0.10* (6.4)	0.13* (7.4)
Boom*Insider retention	-0.06 (-.1)	0.27 (0.6)
Crash*L(Income)	0.08 (2.0)	0.08 (1.7)
Crash*L(Sales)	-0.19* (-5.3)	-0.20* (-4.7)
Crash*L(BV)	0.05 (1.9)	0.05 (1.9)
Crash*L(R&D)	-0.06 (-1.1)	-0.03 (-.3)
Crash*L(Price-to-sales comparable)	-0.10* (-2.6)	-0.10* (-2.1)

Crash*Investment banker prestige	0.18* (5.7)	0.23* (5.4)
Crash*Insider retention	-0.51 (-0.9)	-0.96 (-1.4)
Tech*L(Income)	0.05* (2.3)	0.07* (2.7)
Tech*L(Sales)	-0.03 (-1.1)	-0.05 (-1.7)
Tech*L(BV)	-0.02 (-1.3)	-0.02 (-1.2)
Tech*L(R&D)	-0.07 (-1.4)	-0.02 (-.4)
Tech*L(Price-to-sales comparable)	0.01 (0.6)	0.02 (0.7)
Tech*Investment banker prestige	-.02 (-0.9)	-0.01 (-0.5)
Tech*Insider retention	1.40* (4.1)	1.71* (4.0)
Tech	-0.86* (-3.8)	-1.07* (-3.7)
Internet*L(Income)	0.02 (.9)	0.05 (1.3)
Internet*L(Sales)	-0.09 (-2.3)	-0.08 (-2.0)
Internet*L(BV)	0.03 (1.6)	0.04 (1.9)
Internet*L(R&D)	0.07 (1.6)	0.14 (2.2)
Internet*L(Price-to-sales comparable)	-0.06 (-2.2)	-0.10* (-2.6)
Internet*Investment banker prestige	-0.08* (-2.7)	-0.09 (-2.2)
Internet*Insider retention	1.50* (2.7)	2.45* (3.3)
Internet	-0.03 (-0.1)	-0.46 (-0.9)
Loss*L(Income)	-0.49* (-11.3)	-0.48* (-9.1)
Loss* Investment banker prestige	-0.003 (-0.2)	-0.001 (-0.01)
Loss*Insider retention	0.60 (1.6)	0.76 (1.7)
Loss	-0.10 (-0.4)	-0.24 (-0.8)
Adjusted R^2	0.799	0.771

L(W) is defined as: $L(W)=\log_e(1+W)$ when $W \geq 0$; $L(W) = -\log_e(1-W)$ when $W<0$
Offer value = Final offer price*number of shares outstanding immediately after the IPO (in $ millions).
Market value = First-day closing price * number of shares outstanding immediately after the IPO (in $ millions).

Boom = 1 if the offer date is during 1/1997-3/2000, and 0 otherwise.
Crash = 1 if the offer date is during 4/2000-12/2001, and 0 otherwise.
Income = Income before extraordinary items and research and development costs in year –1 (in $ millions).
Sales = Revenues in year –1(in $ millions).
BV = Book value of equity in year –1(in $ millions).
R&D = Research and development costs in year -1(in $ millions).
Price-to-sales comparable= Median Industry price-to-sales ratio.
Investment banker prestige is based on Loughran and Ritter (2004).
Insider retention = Percentage of post-IPO shares outstanding retained by pre-offering shareholders.
Loss = 1 if income before extraordinary items is negative, and 0 otherwise.
Tech = 1 if a firm belongs a technology industry, and 0 otherwise.
Internet = 1 if a firm belongs to an internet industry, and 0 otherwise.
Technology firms and internet firms are classified based on definitions in Loughran and Ritter (2004).
White heteroscedasticity-consistent t-statistics are in parentheses.
Asterisk (*) implies significance at the 1% level.

Table 4
Ownership structure of 1,855 US IPOs during 1986-1990 and 1997-2001

Panel A: Means

Year/Period	Number of IPOs	CEO% Before	CEO% After	CEO% Change	OffDir% Before	OffDir% After	OffDir% Change	VC% Before	VC% After	VC% Change	Block% Before	Block% After	Block% Change
1986	230	34.6	23.5	11.1	31.0	22.1	8.9	7.8	5.8	2.0	13.2	9.1	4.1
1987	179	31.5	22.3	9.2	26.9	18.8	8.1	10.8	7.8	3.0	17.2	11.5	5.7
1988	70	20.0	14.6	5.4	30.0	22.2	7.8	14.7	11.0	3.8	17.4	12.3	5.1
1989	77	25.0	16.8	8.2	27.4	19.3	8.1	12.2	8.9	3.3	20.6	13.4	7.2
1990	77	23.8	16.7	7.1	21.3	14.6	6.7	17.8	12.6	5.2	24.1	16.5	7.6
1997	330	27.1	18.4	8.7	28.2	19.2	9.0	12.7	8.7	4.0	17.0	11.4	5.6
1998	197	24.7	17.1	7.6	24.4	16.7	7.7	12.3	9.1	3.2	21.4	15.0	6.4
1999	359	17.7	13.4	4.3	17.6	13.8	3.8	21.7	17.0	4.8	22.6	17.3	5.3
2000	285	13.4	10.5	2.9	15.2	12.5	2.7	22.7	18.0	4.7	28.0	22.0	6.0
2001	51	18.0	13.4	4.6	14.1	10.6	3.5	21.0	15.2	5.8	31.7	23.2	8.5

Panel B: Medians

Year/Period	Number of IPOs	CEO% Before	CEO% After	CEO% Change	OffDir% Before	OffDir% After	OffDir% Change	VC% Before	VC% After	VC% Change	Block% Before	Block% After	Block% Change
1986	230	27.5	18.4	7.9	26.0	18.6	6.1	0.0	0.0	0.0	4.6	3.1	1.4
1987	179	21.3	13.4	6.4	17.8	13.0	4.8	0.0	0.0	0.0	6.6	4.3	2.3
1988	70	10.4	8.7	2.3	22.0	16.5	4.5	0.0	0.0	0.0	8.1	5.0	2.5
1989	77	14.3	10.5	4.4	18.4	12.3	5.0	0.0	0.0	0.0	14.7	8.2	3.6
1990	77	12.9	9.0	3.3	14.7	8.3	3.2	0.0	0.0	0.0	11.0	8.1	3.1
1997	330	14.0	10.0	4.0	21.0	14.0	5.0	0.0	0.0	0.0	8.0	5.0	2.0
1998	197	14.0	10.0	4.0	17.0	12.0	3.0	0.0	0.0	0.0	11.0	8.0	3.0
1999	359	9.0	7.0	2.0	13.0	10.0	2.0	19.0	15.0	3.0	15.0	12.0	3.0
2000	285	6.0	5.0	1.0	11.0	8.0	2.0	17.0	14.0	3.0	21.0	17.0	4.0
2001	51	6.0	5.0	1.0	10.0	7.0	2.0	9.0	7.0	2.0	25.0	18.0	4.0

CEO% Before = Percentage ownership of CEO before IPO.
CEO% After = Percentage ownership of CEO after IPO.
CEO% Change = CEO% Before – CEO% After.
OffDir% Before = Percentage ownership of officers and directors as a group (but not including the CEO) before IPO.
OffDir% After = Percentage ownership of officers and directors as a group (but not including the CEO) after IPO.
OffDir% Change = OffDir% Before – OffDir% After.
VC% Before = Percentage ownership of VC investors before IPO.
VC% After = Percentage ownership of VC investors after IPO.
VC% Change = VC% Before – VC% After.
Block% Before = Percentage Ownership of 5 percent blockholders (not including officers and directors of the company or VC investors) before IPO.
Block% After = Percentage Ownership of 5 percent blockholders (not including officers and directors of the company or VC investors) after IPO.
Block% Change = Block% After – Block% Before.

Table 5
Relation between IPO values and time period dummies, accounting variables, growth proxies, investment banker prestige, and detailed ownership variables
Sample of 1,655 US IPOs completed in 1986-1990 and 1997-2001.

Independent Variables	L(Offer Value)	L(Total Market Value)
Intercept	1.64* (14.7)	1.57* (12.2)
Boom	.80* (21.0)	.94* (21.7)
Crash	.98* (17.5)	.95* (14.1)
L(Income)	-.08* (-5.7)	-.10* (-5.9)
L(Sales)	.15* (10.3)	.15* (8.4)
L(BV)	.02 (1.8)	.01* (4.6)
L(R&D)	.11* (4.1)	.15* (4.6)
L(Price-to-sales comparable)	.08* (6.0)	.12* (6.7)
Investment banker prestige	.26* (23.1)	.27* (20.8)
CEO% Change	-2.33* (-7.5)	-2.52* (-6.9)
OffDir% Change	-2.00* (-5.4)	-2.38* (-5.58)
VC% Change	-3.45* (-7.4)	-4.73* (-7.8)
Block% Change	-1.50* (-5.2)	-1.96* (-6.0)
CEO% After	.76* (4.2)	.80* (3.7)
OffDir% After	.66* (3.5)	.84* (3.7)
VC% After	1.26* (5.7)	1.76* (6.3)
Block% After	.89* (5.7)	.99* (5.3)
Adjusted R^2	0.709	0.676

L(W) is defined as: $L(W)=\log_e(1+W)$ when $W \geq 0$; $L(W) = -\log_e(1-W)$ when $W<0$
Offer value = Final offer price*number of shares outstanding immediately after the IPO (in $ millions).
Market value = First-day closing price * number of shares outstanding immediately after the IPO (in $ millions).
Boom = 1 if the offer date is during 1/1997-3/2000, and 0 otherwise.
Crash = 1 if the offer date is during 4/2000-12/2001, and 0 otherwise.
Income = Income before extraordinary items and research and development costs in year –1 (in $ millions).
Sales = Revenues in year –1(in $ millions).
BV = Book value of equity in year –1(in $ millions).

R&D = Research and development costs in year -1. (in $ millions).
Price-to-sales comparable= Median Industry price-to-sales ratio
Investment banker prestige is based on Loughran and Ritter (2004);
CEO% Before = Percentage ownership of CEO before IPO.
CEO% After = Percentage ownership of CEO after IPO.
CEO% Change = CEO% Before – CEO% After.
OffDir% Before = Percentage ownership of officers and directors as a group (but not including the CEO) before IPO.
OffDir% After = Percentage ownership of officers and directors as a group (but not including the CEO) after IPO.
OffDir% Change = OffDir% Before – OffDir% After.
VC% Before = Percentage ownership of VC investors before IPO.
VC% After = Percentage ownership of VC investors after IPO.
VC% Change = VC% Before – VC% After.
Block% Before = Percentage Ownership of 5 percent blockholders (not including officers and directors of the company or VC investors) before IPO.
Block% After = Percentage Ownership of 5 percent blockholders (not including officers and directors of the company
or VC investors) after IPO.
Block% Change = Block% After – Block% Before.
White heteroscedasticity-consistent t-statistics are in parentheses.
Asterisk (*) implies significance at the 1% level.

Table 6
Robust regression IPO valuation:
Inter-temporal differences and inter-industry differences in IPO valuation of accounting variables, growth proxies, investment banker prestige and insider retention
Sample of 1,655 US IPOs completed in 1986-1990 and 1997-2001.

	L(Offer Value) **Robust Regression**	**L(Market Value)** **Robust Regression**
Independent Variables		
Intercept	.48* (13.0)	.67* (15.4)
Boom	.11 (2.45)	-.17 (-3.3)
Crash	.68 (7.6)	.39 (3.8)
L(Income)	.23* (33.0)	.25* (30.8)
L(Sales)	.20* (45.0)	.19* (36.4)
L(BV)	.01 (4.50)	.01 (3.3)
L(R&D)	.16* (19.6)	.13* (13.9)
L(Price-to-sales comparable)	.07* (12.6)	.08* (12.2)
Investment banker prestige	.13* (43.5)	.12* (34.3)
Insider retention	1.99* (38.4)	1.96* (32.5)
Boom*L(Income)	.07* (12.1)	.06 (8.0)
Boom*L(Sales)	-.11* (-21.2)	-.11* (-17.0)
Boom*L(BV)	-.02 (-5.2)	-.03 (-7.5)
Boom*L(R&D)	-.17* (-19.3)	-.17* (-16.1)
Boom*L(Price-to-sales comparable)	.03 (4.2)	.06 (7.7)
Boom*Investment banker prestige	.11* (29.7)	.14* (32.2)
Boom*Insider retention	.16 (2.5)	.30 (4.1)
Crash*L(Income)	.09* (13.8)	.09* (10.9)
Crash*L(Sales)	-.17* (-25.7)	-.17* (-22.2)
Crash*L(BV)	.01 (3.8)	.02 (4.4)

Crash*L(R&D)	-.09 (-8.5)	-.05 (-4.2)
Crash*L(Price-to-sales comparable)	-.09* (-12.0)	-.1* (-11.1)
Crash*Investment banker prestige	.17* (22.3)	.23* (25.0)
Crash*Insider retention	-.53 (-4.7)	-.71 (-5.5)
Tech*L(Income)	.06* (17.1)	.05* (13.1)
Tech*L(Sales)	-.05* (-10.1)	-.05 (-9.9)
Tech*L(BV)	-.02 (-6.4)	-.02 (-5.6)
Tech*L(R&D)	-.09* (-13.0)	-.04 (-5.2)
Tech*L(Price-to-sales comparable)	.01 (1.9)	.01 (2.7)
Tech*Investment banker prestige	-.02 (-5.2)	-.01 (-2.4)
Tech*Insider retention	1.55* (26.5)	1.68* (24.6)
Tech	-.87* (-21.8)	-1.02* (-21.8)
Internet*L(Income)	-.01 (-2.5)	.07* (13.9)
Internet*L(Sales)	-.05 (-9.4)	-.08* (-12.3)
Internet*L(BV)	.02 (7.7)	.04* (10.9)
Internet*L(R&D)	.07 (8.1)	.15* (15.6)
Internet*L(Price-to-sales comparable)	-.05 (-9.7)	-.09* (-14.6)
Internet*Investment banker prestige	-.09* (-16.5)	-.09* (-13.4)
Internet*Insider retention	1.54* (16.5)	2.31* (21.3)
Internet	-.12 (-1.9)	-.42 (-5.8)
Loss*L(Income)	-.51* (-70.2)	-.51* (-60.4)
Loss* Investment banker prestige	.02 (4.81)	.01 (3.3)
Loss*Insider retention	.30 (5.2)	.70 (10.3)
Loss	-.01 (-.2)	-.25 (-5.3)
	Number of Simplex iterations for theta= .1,.25,.5,.75,.9 : 289,329,335,406,301	Number of Simplex iterations for theta= .1,.25,.5,.75,.9 : 254,300,307,357,275

L(W) is defined as: $L(W)=\log_e(1+W)$ when $W \geq 0$; $L(W) = -\log_e(1-W)$ when $W<0$.
Offer value = Final offer price*number of shares outstanding immediately after the IPO (in $ millions).
Market value = First-day closing price * number of shares outstanding immediately after the IPO (in $ millions).
Income = Income before extraordinary items and research and development costs in year –1 (in $ millions).
Sales = Revenues in year –1; BV = Book value of equity in year –1 (in $ millions).
R&D = Research and development costs in year -1 (in $ millions).
Price-to-sales comparable = Median Industry price-to-sales ratio.
Investment banker prestige is based on Loughran and Ritter (2004).
Insider retention = Percentage of post-IPO shares outstanding retained by pre-offering shareholders.
Boom = 1 if the offer date is during 1/1997-3/2000, and 0 otherwise.
Crash = 1 if the offer date is during 4/2000-12/2001, and 0 otherwise.
Loss = 1 if income before extraordinary items is negative, and 0 otherwise.
Tech = 1 if a firm belongs a technology industry, and 0 otherwise.
Internet = 1 if a firm belongs to an internet industry, and 0 otherwise.
Technology firms and internet firms are classified according to definitions contained in Loughran and Ritter (2004).
"t-ratio" in parentheses. Distribution of this ratio is not well specified. Asterisk (*) implies significance at the 1% level (minimum) under Chebyshev's inequality.