Are IPOs Underpriced?

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First Draft: August 2001
This Draft: April 2002

Comments Welcome

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Abstract

This paper studies the valuation of initial public offerings (IPO) using comparable firm multiples. In a sample of more than 2000 IPOs from 1980 to 1997, we find that the median IPO is *overvalued at the offer* by about 50% relative to its industry peers. This overvaluation is robust over time, across technology and non-technology IPOs, to different price multiples, industry classifications, and matching firms. In the cross-section, overvalued IPOs earn 5% to 7% higher first day returns than undervalued IPOs but earn 20% to 50% lower returns over the next five years. The long-run underperformance of overvalued IPOs is robust to various benchmarks and return measurement methodologies including the Fama-French three-factor model. Overvalued IPOs exhibit higher sales growth rates temporarily but earn persistently lower profit margins and return on assets than undervalued IPOs over the next five years suggesting that any projected growth opportunities implicit in the initial valuation fail to materialize subsequently. Our results are inconsistent with asymmetric information models of IPO pricing and provide support for behavioral theories based on investor overconfidence.

1. Introduction

In this paper, we examine the pre-market valuation of initial public offerings (IPO) using comparable firm multiples. IPOs earn large first-day returns (between 10% and 15%) after going public.[1] This phenomenon is widely referred to as IPO *underpricing*. But if there is underpricing, what is the underpricing with respect to? One possibility is that the underpricing is with respect to fair value. The notion issuers intentionally underprice IPOs and offer them at prices below their fair value is prevalent in the theoretical literature on IPOs (see the asymmetric information models of Rock (1986), Benveniste and Spindt (1989), Allen and Faulhaber (1989), Welch (1989), and Grinblatt and Hwang (1989)). Since the market price reflects fair value in an efficient market, the increase in IPO stock prices on the first day of trading is taken as evidence of underpricing (or more accurately undervaluation) at the offer. Thus, the terms underpricing and undervaluation are interchangeable in this context.[2] An alternate view of underpricing (in an inefficient market) is that issuers underprice IPOs with respect to the maximum price they could have charged given the observed demand in the pre-market but not necessarily with respect to the long-run fair value. In other words, IPOs may be underpriced but not undervalued. This notion of underpricing underlies the studies on the long-run underperformance of IPOs (see Loughran (1993), Loughran and Ritter (1995), and Brav and Gompers (1997)).

In this paper, we examine whether IPOs are underpriced with respect to fair value.[3] Since we do not assume price necessarily equals value in our analysis, we henceforth use the terminology *undervaluation* or *overvaluation* to refer to the notion of pricing IPOs below or above fair value. We value IPOs using price multiples, such as price-to-EBITDA, price-to-sales, and price-to-earnings of industry peers and then compare this *fair* value to the offer price.[4] Industry groupings are based on the 48 industries defined in Fama and French (1997) and industry peers are selected

[1] See Logue (1973), Ibbotson (1975), and Ibbotson, Sindelar, and Ritter (1994) for early evidence of large first-day returns defined as the offer price to close return. See also the survey by Ibbotson and Ritter (1995) for an exhaustive review of the academic literature on IPOs.

[2] See popular MBA textbooks (see Brealey and Myers (2000) (Chapter 15: pages 414-416), Ross, Westerfield, and Jaffe (1996) (Chapter 13: pages 354-356), and Copeland and Weston (1988) (Chapter 11: pages 377-380)) which also describe first-day returns of IPOs as underpricing (or undervaluation) with respect to fair value.

[3] Kim and Ritter (1999) examine the valuation of IPOs using comparable IPO transaction multiples. Their focus however, is on determining the accuracy of these multiples in predicting offer prices by examining absolute prediction errors, not on IPO underpricing. Also, their study is limited to 190 firms that went public in 1992-1993.

[4] EBITDA stands for *Earnings before Interest, Taxes, and Depreciation and Amortization*. It is also referred to as *Operating income before depreciation and amortization*.

based on their closeness to the IPO firms in terms of their sales and EBITDA profit margin (EBITDA/Sales).[5] Examining IPO valuation at offer is important on several fronts. First, it provides a direct way of testing the predictions of asymmetric information models of IPO pricing which predict that IPOs should be undervalued at the offer with respect to fair value. Secondly, it can help clarify the risk vs. mispricing explanations of the long-run underperformance of IPOs by relating *ex ante* valuation to *ex post* returns both in the short run and in the long run. Thirdly, it can help distinguish among alternate behavioral theories (see Figure 4) of IPO pricing; those that predict initial undervaluation of IPOs followed by subsequent overvaluation and reversals (see Barberis, Shleifer, and Vishny (1998) and Hong and Stein (1999)) and those that predict initial overvaluation followed by subsequent overvaluation and reversals (see De Long, Shleifer, Summers, and Waldmann (1990) and Daniel, Hirshleifer, and Subrahmanyam (1998)).

Our analysis reveals the surprising result that IPOs are systematically *overvalued* at the offer with respect to fundamentals. We find that, in a sample of more than 2,000 relatively large-capitalization IPOs from 1980 to 1997, the median IPO firm is *overvalued* by about 50% relative to its industry peers. These results are robust to alternate price multiples, industry classifications, and matching firm selection procedures. The overvaluation is observed over time and across IPOs in technology and non-technology sectors and also in a sub-sample of about 250 IPOs for whom industry peers can be chosen based on past sales growth in addition to past sales and EBITDA margin. These results are inconsistent with the notion of underpricing with respect to fair value, which pervades most rational models of IPO pricing. The extent of IPO overvaluation at offer is surprising given that IPOs are valued with respect to industry peers who themselves might be overvalued in a *hot* market. The overvaluation is, however, consistent with the long-run underperformance of IPOs documented by Ritter (1991), Loughran (1993) and Loughran and Ritter (1995) and suggests that not all of the underperformance can be due to risk or problems in measuring long-run abnormal returns.

There are significant differences in the way overvalued and undervalued IPOs (based on ex ante valuations) perform in the after-market. Rational theories of IPO underpricing (see Rock (1986), Benveniste and Spindt (1989), Allen and Faulhaber (1989), Welch (1989), and Grinblatt and

[5] Later we will show that our results are robust to other reasonable approaches to choosing comparable firms.

Hwang (1989)) predict that the most undervalued (i.e., underpriced) IPOs should earn the highest first-day returns compared to overvalued IPOs.[6] Our results indicate the opposite. We find that the first-day returns earned by overvalued IPOs exceed that of the undervalued IPOs by about 5% to 7%.[7] In other words, IPOs that are initially overvalued with respect to fundamentals get even more overvalued in the after-market thus exhibiting positive price momentum (note that based on first day returns these IPOs would be characterized as the most underpriced).[8] This result is inconsistent with asymmetric information models of IPO pricing and is also inconsistent with behavioral theories based on underreaction since these theories would predict that the most undervalued IPOs should exhibit the most positive price momentum in the after market (see Figure 4).

If our valuation procedure does a reasonable job of distinguishing among undervalued and overvalued IPOs (in a relative sense) then overvalued IPOs should earn lower returns than undervalued IPOs. Indeed, this is what we find. Various abnormal return measurement methodologies including buy-and-hold abnormal returns (BHAR) and the Fama and French (1993) three factor model show that overvalued IPOs underperform undervalued IPOs by about 20% to 50% over the next five years. This underperformance begins in the second year after the offer date and continues up to the fifth year. The long run results are robust to various benchmarks that include market portfolios and control firms and are robust to parametric and non-parametric tests and bootstrap simulation methodologies.[9]

A valid concern about our long run results is that they could be due to the B/M effect documented by Fama and French (1992, 1993) and Lakonishok, Shleifer, and Vishny (1994). Specifically, the concern is that the undervalued IPOs could be *high B/M* stocks and overvalued IPOs could be *low B/M* stocks, which could help explain the difference in long run returns. An examination of the distribution of the IPOs in our sample across the Fama-French size and B/M quintiles (see Table 10) reveals that while about 80% of our sample resides in the two lowest

[6] See Michaely and Shaw (1994) for a comprehensive empirical examination of the various IPO theories.
[7] Over- or under-valuation is based on P/V ratios where P stands for the offer price and V is an estimate of fair value obtained from comparable firm multiples.
[8] Using data up to year 2000, Loughran and Ritter (2001) report that first-day returns have increased over time accompanied by increasing offer price-to-sales multiples.

B/M quintiles only about 9% of the sample is in the two highest B/M quintiles. Most IPOs in our sample are *glamour* stocks. More importantly, the IPOs in the two lowest B/M quintiles are almost uniformly distributed across low, medium, and high P/V portfolios (28% are low P/V, 35% are medium P/V and 37% are high P/V) indicating only a weak correlation between P/V ratios and B/M characteristics. Brav and Gompers (1997) note that Fama-French three-factor regressions tend to give statistically significant negative intercepts for small firms with low B/M ratios. Are our high P/V IPOs small firms with low B/M ratios? The answer is in the negative. Only 37% of the high P/V IPOs are small firms with low B/M ratios. This number is quite close to the percentage of low P/V IPOs (28%), which are also small firms with low B/M ratios. Moreover, the magnitude of the intercepts reported in our paper for overvalued IPOS (+17% for the six month period and -7.6% for the subsequent 4 ½ year period on an annualized basis) is much larger than that reported by Fama and French (1993) for small firms with low book-to-market ratios (an annualized intercept of only -4%). The complex pattern of high returns on the first day of trading, continuing positive momentum during the first 6 months and subsequent reversals over the long run is hard to reconcile with the traditional B/M effect. Finally, there is no significant difference in the long run buy-and-hold abnormal returns earned by low, medium, and high B/M IPO portfolios. If our long run results were driven by B/M ratios then one would expect high B/M IPOs to outperform low B/M IPOs. In contrast, we find that low B/M IPOs outperform (although insignificantly) high B/M IPOs.

Are the long run results consistent with risk? Traditional risk-return explanations would suggest overvalued IPOs should be less risky than the undervalued IPOs. The Fama-French factor regressions reveal that overvalued IPOs have higher market betas and small firm betas compared to undervalued IPOs. Overvalued IPOs do, however, have significantly lower book-to-market betas than the undervalued IPOs. Regardless of whether one views the book-to-market factor as a measure of risk (see Fama and French (1993)) or mispricing (see Lakonishok, Shleifer, and Vishny (1994)), the key result is that the overvalued IPOs still underperform controlling for such effects.[10]

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[9] See Barber and Lyon (1997), Kothari and Warner (1997), Fama (1998), and Brav (2000).

[10] It is also important to note that there is much controversy over whether Fama-French three-factor model has the power to measure abnormal performance even when there is one. A related issue is the contamination of the factors

We examine the ex post operating performance of IPOs to gain further insights into the risk and growth characteristics of overvalued and undervalued IPOs. Examining future growth rates allows us to determine if the high valuation of overvalued IPOs is the result of a *rational growth premium*. Our results reveal that the overvalued IPOs experience higher growth in sales in the first year after going public but this higher growth declines rapidly and by the fifth year is not appreciably different from that of the undervalued IPOs. At the same time, overvalued IPOs earn (significantly) lower return on assets and profit margins than undervalued IPOs each year during the five-year period. Overvalued IPOs reinvest their operating profits at roughly the same rate as undervalued IPOs, suggesting that there is not a significant difference in capital expenditures across the two groups of IPOs. Overvalued IPOs also have roughly the same ex post cash flow volatility (computed using both levels and changes in EBITDA) as undervalued IPOs suggesting that overvalued IPOs are not less risky than undervalued IPOs based on this measure of risk.

The evidence on growth rates and profitability suggests that extreme expectations about the level and persistence of future growth rates and the subsequent disappointments might be at the root of the initial IPO overvaluation and the long run underperformance.[11] In other words, any projected growth opportunities implicit in the initial IPO valuation does not seem to bear out in the long run. Daniel and Titman (2001) suggest investors tend to overreact to *intangible* information, which is defined as information that cannot be gleaned from past accounting statements. Since future growth opportunities of IPO firms cannot be estimated from past accounting data, it is plausible that investors would overreact to information about growth rates. Overall, our long-run results are consistent with the *windows of opportunity* hypothesis of Loughran and Ritter (1995) and the *divergence of opinion* hypothesis of Miller (1977). They are also consistent with the overconfidence behavioral theory of Daniel, Hirshleifer, and Subrahmanyam (1998) (see Figure 4(c)), which predicts initial stock price overreaction to (possibly intangible) information, followed by continuing overreaction and long-run reversals. The price changes that occur during the registration period seem to support the notion of initial momentum caused by overreaction. We find that during the registration period (prior to the offer date), the offer price increases by

on the right hand side by the IPO firms used on the left hand side. See Loughran and Ritter (2000) for an extended discussion of these issues.

[11] See Rajan and Servaes (1997) who find that IPOs with high analyst growth expectations underperform IPOs with low analyst growth expectations in the long run.

about 2% from the mid-point of the initial filing range to the final offer price for overvalued IPOs while it declines by about 4% to 5% for the undervalued IPOs. Furthermore, over-allotment options are more likely to be exercised for overvalued IPOs than for undervalued IPOs. These findings suggest that the overvalued IPOs face excess demand and positive price momentum in both the registration period and the after-market.

Do our results rule out strategic underpricing on the part of underwriters in order to leave money on the table for the initial IPO investors? Not necessarily, since it is possible that underwriters tend to underprice with respect to the maximum price (which may be far above the fair value) they could have charged the IPO investors given their (excess) demand for IPO shares. Thus, for instance, an IPO could have a fair value of $10, maximum offer price of $20, and an actual offer price of $15. There is underpricing with respect to $20 but overvaluation with respect to $10. This view of underpricing is consistent with the agency explanation of Loughran and Ritter (2000) who emphasize the benefits such as higher brokerage commissions that underwriters receive from buy-side clients in return for allocating IPOs at prices below the maximum attainable. Yet, our results suggest that the issuers do manage to receive a price above fair value for their stock. Thus, there is no dilution of their equity *à la* Myers and Majluf (1984).

The rest of the paper proceeds as follows. Section 2 describes the IPO sample and the IPO valuation methodology. Section 3 presents valuation results. Section 4 presents results on first-day returns and long-run performance. Section 5 discusses ex post operating performance of IPOs. Section 6 examines whether our long run results are just a restatement of the B/M effect and Section 7 discusses the implications of our findings for rational and psychological theories of IPO pricing and concludes.

2. Sample Selection and IPO Valuation Methodology

2.1. Sample Selection

We obtain data on IPOs from 1980 to 1997 from the Securities Data Corporation (SDC) database and where appropriate, we have updated the data from SDC using the corrections listed in Professor Jay Ritter's web page: *http://bear.cba.ufl.edu/ritter/SDCCOR.PDF*. For inclusion in our sample, an IPO has to satisfy the following criteria:

a) The IPO should be listed in the CRSP (Center for Research in Security Prices) database.
b) The IPO should issue ordinary common shares and should not be a unit offering, closed-end fund, real estate investment trust (REIT) or an American Depository Receipt (ADR).[12]
c) The IPO should have information on Sales (data item 12 in *Compustat*) and EBITDA (earnings before interest, taxes, depreciation and amortization – data item 13 in *Compustat*) available in *Compustat* industrial files (both active and research) for the prior fiscal year.
d) The IPO should have positive EBITDA in the prior fiscal year.
e) The IPO should be a non-financial firm.
f) The IPO should have an offer price of at least $5.

There are 2,288 IPOs from 1980 to 1997 that satisfy these criteria and forms our final sample. It is important to note here that our selection criteria eliminate many of the smaller IPOs, which are more likely to underperform in the long run. As a result, the magnitude of the long-run underperformance in our sample is likely to provide a lower bound of that in the larger sample. The choice of the sample period is restricted by the availability of Compustat data for the year prior to going public. Table 1 provides summary statistics on our IPO sample and matching firms. The median offer price is $12, median net proceeds (net of underwriter fees and commissions) are $21.6 million and median shares purchased by underwriters through the exercise of the over-allotment options is about 12% as a percentage of shares sold in the offering. The median sales of the IPOs in our sample is $40 million, median EBITDA is about $5 million and median net income is $1.56 million. These features of our IPO sample are roughly in line with other research (see Loughran and Ritter (2001) and Krigman, Shaw, and Womack (1999)). Not surprisingly, our matching firms also share similar characteristics since we choose them based on these characteristics. We now turn to explaining the procedure for choosing matching firms.

2.2 Choosing Matching Firms in the Same Industry

For each IPO in our sample we find an industry peer with comparable sales and EBITDA profit margin that did not go public within the past three years. We match on (appropriately defined)

[12] We do not rely on SDC classifications alone for identifying IPOs of ordinary shares since SDC occasionally identifies ADRs as ordinary shares. We independently verify the share type using CRSP codes.

industry because this is where an issuer or underwriter would look for comparable firms and this is also where one is likely to find matching firms with *similar operating risks, profitability, and growth*. We match on sales because the level of sales is an ex ante measure of size. We also attempted to match on past sales growth but abandoned that approach since only about $1/10^{th}$ of our sample had sales data available for two prior fiscal years in Compustat (however, we have checked the robustness of our results in a small sub-sample of IPOs for which prior sales growth is available; see Section 3). In any event, our use of industry should provide a reasonable control for growth since firms in the same industry tend to share similar growth opportunities (in Section 5 we examine the ex post growth rates of our IPO firms to evaluate their impact on our valuation). Finally, we match on EBITDA profit margin to control for differences in profitability across firms and to ensure that our matching firms are as close as possible to the IPO on fundamentals. EBITDA profit margin represents operating profits and is a more stable measure of profitability than net profit margin, which is affected by non-operating items. In addition, many of our IPOs have positive EBITDA but negative net income, which makes the use of net profit margin more restrictive.

Our matching approach is similar in spirit to Bhojraj and Lee (2001) who show that adjustments to industry median multiples based on firm operating performance improve valuation accuracy.[13] Our approach is a balance between matching merely on industry or sales which is very approximate and trying to match on so many accounting ratios that it becomes impossible to find matching firms. Also, very few IPOs have detailed accounting data in *Compustat* for the fiscal year prior to going public. Therefore, we settle on industry, sales and EBITDA profit margin to find matching firms for the IPOs in our sample.[14]

To select an appropriate matching firm, we first consider all firms in *Compustat* active and research files for the fiscal year prior to the IPO year. From these, we eliminate firms that went public during the past three years, firms that are not ordinary common shares, REITs, closed-end funds, ADRs, and firms with stock price less than five dollars as of the prior June or December,

[13] See also Kim and Ritter (1999) who argue for controlling for differences in growth and profitability.
[14] In section 3, we discuss alternate matching procedures that choose matching firms based on industry median, industry and size, and industry, sales, and return on assets. We find similar results using the alternate matching procedures.

whichever is later.[15] For the remaining firms, we obtain SIC codes from CRSP as of the end of the prior calendar year. We group these firms into 48 industries using the industry classifications in Fama and French (1997), which are constructed, by grouping various four-digit SIC codes.[16] We group firms in each industry into three portfolios based on past sales and then each sales portfolio into three portfolios based on past EBITDA profit margin (defined as EBITDA/Sales) giving us a maximum of nine portfolios in each industry based on past sales and profit margin. If there are not enough firms in an industry, we limit ourselves to a 3 by 2 or a 2 by 2 classification.

Each IPO is matched to the industry-sales-EBITDA margin portfolio to which it belongs. From this portfolio, we find a matching firm that is closest in sales to the IPO firm.[17] We ensure that each IPO gets a unique matching firm in a given cohort year. We do not restrict the same matching firm from being chosen in subsequent years. However, for all practical purposes almost all firms in our sample get unique matching firms. We value IPOs based on the price multiples of these matching firms. We describe this valuation methodology in the next section.

2.3 IPO Valuation Using Price Multiples

For each IPO firm, we compute a price-to-value (P/V) ratio where P is the offer price and V is the fair/intrinsic value computed from comparable firm's market multiples and IPO firm's sales, EBITDA, or earnings. We use price-to-sales (P/S) because sales are commonly available. We use price-to-EBITDA (P/EBITDA) because EBITDA measures operating cash flow and is less subject to accounting distortions. We use price-to-earnings (P/E) multiples because they are popular. Many IPO firms, however, do not have positive earnings, which limits the IPO sample size when using earnings. We do not use book value multiples because book values tend to be rather low for IPO firms prior to going public and also because book value multiples tend to do poorly in terms of valuation accuracy (see Liu, Nissim, and Thomas (1999)).[18]

[15] We do not eliminate firms that might have had a seasoned equity offering (SEO) in the previous three years. To the extent, these firms tend to issue stock when their stock is overvalued, our valuation should be biased toward finding less overvaluation. Also, since SEOs underperform in the long run (see Loughran and Ritter (1995)), our long-run results should be biased toward zero for the overall sample.

[16] We have replicated all our results using both CRSP and Compustat two-digit SIC codes and the results are similar.

[17] We have also chosen matching firms randomly and based on closest EBITDA margin within each portfolio and the results are similar.

[18] Liu, Nissim, and Thomas (1999) find that earnings and cash flow multiples perform the best in terms of relative valuation accuracy. Multiples based on book value of equity and sales are the worst.

The P/V ratio for the IPO is computed by dividing the IPO offer price multiple by the comparable firm's market multiple. The offer price multiples for IPOs are computed as follows:

$$\left(\frac{P}{S}\right)_{IPO} = \frac{\text{Offer Price} \times \text{CRSP Shares Outstanding}}{\text{Prior Fiscal Year Sales}}$$

$$\left(\frac{P}{EBITDA}\right)_{IPO} = \frac{\text{Offer Price} \times \text{CRSP Shares Outstanding}}{\text{Prior Fiscal Year EBITDA}}$$

$$\left(\frac{P}{E}\right)_{IPO} = \frac{\text{Offer Price} \times \text{CRSP Shares Outstanding}}{\text{Prior Fiscal Year Earnings}}$$

All fiscal year data end at least three months prior to the offer date. *Earnings* refer to net income before extraordinary items. *CRSP Shares Outstanding* refers to the shares outstanding at the end of the offer date. The price multiples for matching firms are computed as follows:

$$\left(\frac{P}{S}\right)_{Match} = \frac{\text{Market Price} \times \text{CRSP Shares Outstanding}}{\text{Prior Fiscal Year Sales}}$$

$$\left(\frac{P}{EBITDA}\right)_{Match} = \frac{\text{Market Price} \times \text{CRSP Shares Outstanding}}{\text{Prior Fiscal Year EBITDA}}$$

$$\left(\frac{P}{E}\right)_{Match} = \frac{\text{Market Price} \times \text{CRSP Shares Outstanding}}{\text{Prior Fiscal Year Earnings}}$$

Market price is the CRSP stock price and *CRSP Shares Outstanding* is the number of shares outstanding for the matching firm at the close of the day prior to the IPO offer date. The P/V ratios of the IPO firm based on various price multiples are computed as follows:

$$\left(\frac{P}{V}\right)_{Sales} = \frac{(P/S)_{IPO}}{(P/S)_{Match}} \quad (1)$$

$$\left(\frac{P}{V}\right)_{EBITDA} = \frac{(P/EBITDA)_{IPO}}{(P/EBITDA)_{Match}} \quad (2)$$

$$\left(\frac{P}{V}\right)_{Earnings} = \frac{(P/E)_{IPO}}{(P/E)_{Match}} \quad (3)$$

2.4 Computing Long Run Abnormal Returns

We compute long run abnormal returns for IPO firms using the buy-and-hold abnormal returns (BHAR) approach. Barber and Lyon (1997) argue that BHAR approach is superior to the *cumulative abnormal return* (CAR) approach because (a) CAR is positively biased and (b) BHAR better represents the returns earned over the long-run by the average or median sample firm. The second argument is especially appropriate for IPO firms since they tend to run-up in the beginning and lose all initial gains in the long run. Since CAR would add an initial 50% gain to a subsequent 50% loss and conclude that the average return is zero, it would be biased against finding long-run IPO underperformance. For these reasons, it is customary in the IPO literature to compute long-run returns using the BHAR approach (see Loughran and Ritter (1995), Brav and Gompers (1997), Krigman, Shaw, and Womack (1999), and Michaely and Womack (1999)). We do the same and report buy-and-hold returns for issuing firms and matching firms (we also compute average abnormal returns using the Fama and French (1993) three factor model; more on this later).

The buy-and-hold returns of an IPO firm *i* and the benchmark firm/portfolio *m* are computed as follows:

$$R_{iT} = \prod_{t=offer\ date+1}^{\min[T,delist]} (1+r_{it}) - 1$$
$$R_{mT} = \prod_{t=offer\ date+1}^{\min[T,delist]} (1+r_{mt}) - 1 \qquad (4)$$

where r_{it} and r_{mt} are the daily returns of issue *i* and benchmark firm *m* respectively on date *t*, *T* is the end date up to which buy-and-hold returns are computed, and *delist* is the delisting date of the IPO firm. Equation (4) shows that returns are truncated at the earlier of the delisting date or the end date.

The BHAR for the IPO firm is computed as the difference between the buy-and-hold returns of the issuing firm and the matching firm/portfolio:

$$BHAR_{iT} = R_{iT} - R_{mT}$$

The mean BHAR and t-statistic under the assumption of independence of returns are computed as follows:

$$\overline{BHAR}_T = \frac{1}{N} \times \sum_{i=1}^{N} BHAR_{iT} \quad (5)$$

$$t(BHAR) = \sqrt{N} \times \overline{BHAR}_T \Big/ \sigma(BHAR_{iT}) \quad (6)$$

where N is the number of IPOs in our sample and $\sigma(BHAR_{iT})$ is the sample standard deviation of BHAR computed under the assumption of independence. In addition to reporting mean BHAR, we also report median BHAR for the various IPO portfolios. We test the null hypothesis that the median return is zero using the non-parametric Wilcoxson rank sum test (see DeGroot (1984)) also computed under the independence assumption.

In Tables 4, 5, 6, and 7 we compute differences in mean and median returns between low and high P/V IPO portfolios. We test for the equality of mean returns using a two-sample t-test computed under the assumption of independence within and across populations with common unknown variance (see DeGroot (1984)). We test for the equality of median returns using the non-parametric Wilcoxson-Mann-Whitney ranks test (see DeGroot (1984)). Since all these test statistics are likely to be misspecified in small samples when applied to long-run returns (see Barber and Lyon (1997), Kothari and Warner (1997) and Fama (1998)), *we compute critical t-statistics using bootstrap Monte Carlo simulation (see Noreen (1989)) techniques*.[19] We describe this procedure in more detail in Section 4. We use several benchmarks for computing long-run abnormal returns. We use widely used market indices as well as control firms. Barber and Lyon (1997) show that the control firm approach yields better specified statistics than do control portfolios. The benchmarks are:

- NYSE/AMEX/NASDAQ value-weighted market index.
- S&P 500 index excluding dividends.

[19] The misspecification arises from several sources: (a) the limited number of independent observations (b) autocorrelations in overlapping long-run returns and (c) cross-correlation among long-run IPO returns referred to as "clustering."

- Industry, Sales, EBITDA based matching firms: These are the same firms that were used to value the IPOs (see Sections 2.2 and 2.3).
- Size matched control firms: These are firms whose market capitalization as of prior June or December, whichever is later, is closest to the market capitalization of the IPO firm at close on the offer date.

If a control firm delists before the end date or the IPO delisting date, we replace it with another control firm with similar characteristics. If this firm also delists, we replace it with another firm and so on. Notice that we have not included a size and book-to-market matched control firms above. This is mainly because the pre-IPO book values of equity tend to be tiny and often negative for many of the IPOs. Moreover, there is a big jump in book value right after the IPO. This distorts the book-to-market ratios. Therefore, we control for book-to-market effects using the Fama and French (1993) three-factor model, which avoids the problems with individual book-to-market ratios (see discussion in Section 4.5).

3. IPO Valuation

This section presents the first key findings of this paper, that IPOs are systematically overvalued. Panels A, B, and C of Table 2 present the 25^{th}, 50^{th}, and the 75^{th} percentiles of the cross-sectional distributions of P/V ratios based on P/S, P/EBITDA, and P/E multiples respectively. The table provides the p-value from the Wilcoxson rank sum test for testing the null hypothesis that the median P/V is equal to 1. The median P/V multiple for the entire sample is about 1.5 and is significantly different from 1. Moreover, the median P/V ratio, regardless of the price multiple, significantly exceeds 1 every year from 1980 to 1997. Figure 1 captures this fact graphically. The vertical bars representing the P/V ratios exceed 1 every year, suggesting systematic and persistent overvaluation of IPOs. Figure 1 also suggests some possible mean reversion in IPO valuations. The P/V ratios were quite high in the early eighties, the late eighties and the mid-nineties. They were relatively low in the mid-eighties and the early nineties.

The cross-sectional distribution of P/V ratios in Table 2 exhibits significant positive skewness, which suggests that some IPOs tend to get extremely overvalued. This is not surprising since there is much hype associated with highly “successful” IPOs. Valuations based on P/EBITDA

and P/E multiples, however, exhibit less skewness than those based on P/S multiples which is not surprising since valuations based on P/S multiples tend to be less accurate (see Liu, Nissim, and Thomas (1999)).

Panel D reports pooled time-series and cross-sectional Spearman rank correlations among P/V ratios based on P/S, P/EBITDA and P/E multiples. All pair-wise correlations are positive, above 0.5 and statistically significant. This is encouraging since this suggests that the valuations are not too far apart. Valuations based on P/S multiples and P/E multiples exhibit their highest correlations with valuations based on EBITDA multiples and their lowest correlations with each other. This should be expected since EBITDA is intermediate to sales and net income in the income statement.

We examine the robustness of our findings by experimenting with alternate matching procedures that choose comparable firms within the industry based on:

(a) Industry median multiple.
(b) Industry and market capitalization (size) where IPO market capitalization is based on the mid-point of the initial filing range of offer prices and the CRSP shares outstanding on the first day. Our matching firm is a non-IPO firm in the same industry with roughly the same market capitalization as of the prior June or December whichever is closest to the offer date.
(c) Industry, Sales, and Return on Assets (EBITDA/Total Assets).

The selection procedure is similar to the one employed for the industry, sales, and EBITDA profit margin procedure discussed in Section 2. The industries are based on Fama-French 48 industry classifications. Valuations based on these alternate sets of matching firms (provided in Panel A of Table 3) indicate comparable or higher IPO overvaluation. The results in Panel A of Table 3 are based on P/EBITDA multiples but those based on P/S and P/E multiples are similar (not reported). The median P/V ratios based on industry median multiple, industry and size, and industry, sales, and return on assets are 1.82, 1.83, and 1.53 respectively. The medians are all significantly different from 1. The key result is that our overvaluation results are robust to various matching firm selection procedures. Since choosing comparable firms based on sales and

profitability is theoretically more appealing, we retain our original industry-sales-EBITDA margin based matching firms. All our results are qualitatively similar, however, using these alternate sets of matching firms. Our results are also robust to industry classifications based on two-digit SIC codes and CRSP or Compustat SIC codes and to including IPOs with offer prices less than $5; the P/S valuations are also robust to including negative EBITDA firms.

Panel B of Table 3 presents IPO valuations among technology and non-technology firms. We define technology firms as those that belong to the CRSP four-digit SIC codes included under industry groups referred to as *Entertainment, Printing and Publishing, Telecommunication, Computers, Electronic Equipment, and Measuring and Control Equipment* in Fama and French (1997). We include *Entertainment, Printing and Publishing* because of the increasing integration of these companies with Internet and other technology companies. The rest we define as non-technology firms. There are 488 IPOs classified as technology using these definitions. The only group of firms that would be considered as technology but not included in the above list is biotechnology firms, which are not listed separately under Fama and French (1997) industry classifications. We suspect that they would be part of the *pharmaceuticals* industry group. The results show that the technology IPOs are more overvalued than the non-technology ones. The median P/V ratio among technology IPOs is 1.63 while the median among non-technology firms is 1.5. The addition of biotechnology firms to our group of technology firms should only widen this difference. The fact that overvaluation is stronger among technology IPOs is consistent with our priors since technology IPOs tend to be among the most talked about and widely followed IPOs.

3.1 Does our valuation miss a growth premium in the pricing of IPOs?

One concern about our IPO overvaluation result is that the apparent overvaluation may be due to a growth premium priced into the valuations of IPOs. Thus, if IPOs are expected to grow much faster than their industry comparables, the premium we observe may be justifiable. Since our matching procedure does not control for growth, our intrinsic value estimates could be too low. In response to this concern, we first note that all our comparable firms are from the same industry as the IPO firm. Firms of similar size in the same industry should share similar growth characteristics. Secondly, expectations of impossibly high growth rates may be at the root of the

observed IPO overvaluation. La Porta (1996) finds stocks with high growth expectations (proxied by consensus analyst growth forecasts) earn much lower returns in the future compared to stocks with low growth expectations. Lakonishok, Shleifer, and Vishny (1994) present evidence that suggest investors tend to extrapolate past growth too far into the future in overvaluing high growth firms. Chan, Karceski, and Lakonishok (2001) find that there is very little persistence in earnings growth rates and suggest that valuations based on high growth rates over long periods are likely to be erroneous. Given this evidence, matching on past growth may simply turn up comparable firms that also tend to be overvalued. Thus, it is not obvious that matching on past growth necessarily leads to more accurate valuations.

Thirdly, the documented long-run underperformance of IPOs suggests that IPOs have great difficulty meeting such high growth and profitability expectations in the future. Indeed, Jain and Kini (1994) document that IPOs experience a significant decline in their operating performance (measured by operating return on assets and earnings per share) during the three years after going public (see Table 9 for more recent evidence). Thus, in reality, the high expectations based on which IPOs are priced seem to be hardly ever met. Indeed, Rajan and Servaes (1997) find that IPOs with high analyst growth expectations underperform IPOs with low analyst growth expectations in the long run. If there are expectations of high growth and profitability in the pricing of these IPOs, clearly these IPOs are having a tough time meeting them.

All the same, we address this concern directly by examining a sub-sample of 250 IPOs in our overall sample for which past one year sales growth can be computed. For these 250 IPOs, we find matching firms in the same industry with roughly the same sales, EBITDA margin, and past sales growth. The median P/V ratios in this sub-sample based on various price multiples are as follows: 1.12 based on P/S multiple, 1.16 based on P/EBITDA multiple and 1.49 based on P/E multiple. The medians are all significantly different from 1 with p-values less than 0.0001.

3.2 Are IPOs less risky than their matching firms?

Another concern about our IPO overvaluation result is that IPOs may be less risky than their matching firms. If this is the case, then IPOs may look overvalued while in fact the overvaluation simply reflects the lower risk premium. This is an important concern since valuation approaches

based on multiples do not directly control for risk. In our matching procedure, we control for risk mainly through industry matching. Is industry an adequate control for risk? Gebhardt, Lee, and Swaminathan (2001) find that the industry risk premium is an important risk control when computing the cost of capital for individual firms; in their paper, the inclusion of the industry risk premium turns beta, a direct measure of systematic risk, insignificant.

We examine the risk characteristics of IPO firms and their matching firms by computing their cash flow volatility for the five-year period after the offer date. We measure cash flow volatility over the subsequent five years in a couple of ways: (a) as the standard deviation of EBITDA divided by the mean EBITDA over the same period and (b) standard deviation of EBITDA growth rates. Our analysis reveals that the cash flows of IPO firms are not less volatile than their matching firms. The cross-sectional average EBITDA volatility for IPO firms is 105% as against 86% for matching firms. The median volatility is 48% and 35% respectively for IPO firms and their matching firms. The cross-sectional mean and median volatility of EBITDA growth rates for IPO firms are 70% and 35% while the corresponding values for matching firms are 80% and 34% (additional evidence that in the cross-section overvalued IPOs are not less risky than undervalued IPOs is discussed in Section 5). Thus, even if issuers price IPOs expecting that they would less risky, our results suggest that, on average, these expectations are not realized.

Overall, the results in Tables 2 and 3 call into question the notion that IPOs are underpriced with respect to fair value. Our results show that IPOs are systematically overvalued at offer. The overvaluation results are especially compelling since firms tend to time their offers to take advantage of industry-wide overvaluation; yet, we find IPOs are overvalued even when compared to their already overvalued industry peers. The high first-day return seems to be a continuation of this overvaluation momentum and not a rational market reaction to initial undervaluation. In the next section, we explore the relation between IPO overvaluation and after-market returns.

4. IPO Valuation and After-Market Returns

4.1 Short-Run Returns

IPOs tend to earn large first-day returns. This is traditionally referred to as IPO underpricing. Our results, however, show that the median IPO is overvalued. What is the relationship between IPO valuations and their first-day returns? Asymmetric models of IPO underpricing would predict that IPOs that are most undervalued, in our context those with lower P/V ratios, should earn the highest first-day return. We test this hypothesis by examining the cross-sectional relationship between P/V ratios and the first-day returns.

We allot IPOs to three portfolios based on P/V ratios as follows. First, we construct a cross-sectional distribution of P/V ratios using the P/V ratios of firms in our sample that went public during the prior 24 months.[20] We divide these IPOs into three equal groups and use the 1/3rd and 2/3rd percentiles of this distribution to assign IPOs in the current month to one of three P/V portfolios. This procedure is repeated every month starting in 1982 and ending in 1997. We refer to the group of IPOs with the highest P/V ratios as the *High P/V* portfolio, the group with intermediate P/V ratios as the *Medium P/V* portfolio, and the group with the lowest P/V ratios as the *Low P/V* portfolio. We use this procedure to ensure that there is no peek-ahead bias in forming portfolios.

Table 4 reports median and mean first-day returns earned by the three P/V portfolios. In this and subsequent tables, we present only results based on EBITDA valuations. This is mainly to avoid clutter in presentation. We chose P/EBITDA chiefly because it is based on operating cash flows and should, therefore, lead to more accurate valuations. The results based on P/S and P/E multiples, however, are qualitatively similar. The t-statistics for equality of means are based on simple two-sample t-statistics computed under the assumption of independence; we use the Wlicoxson-Mann-Whitney test (also under the assumption of independence) for testing the equality of medians. We use the Wilcoxson rank sum test for testing the null hypothesis that the medians are zero (See Section 2.4).

[20] We have repeated our analysis using prior 5 years, 10 years, and the cumulative sample up to that period. Our results are similar.

For our entire sample of IPOs, the median and mean first-day abnormal returns (with respect to the VW NYSE/AMEX/NASDAQ index) are 5.3% and 11.4% respectively. This is lower than what is reported in prior research (see Ibbotson, Sindelar, and Ritter (1994)) primarily because our sample contains larger IPOs (our numbers are similar to those in Loughran and Ritter (2001)). The results for the three IPO portfolios based on P/V ratios are much more interesting. Contrary to the traditional underpricing models based on signaling theories, we find that it is the *Low P/V* (undervalued) IPOs (median P/V ratio = 0.55) that earn the lowest first-day return. In our sample, *Low P/V* IPOs underperform *High P/V* (overvalued) IPOs (median P/V ratio = 4.5) by 5% to 7% on the first day of trading. Figure 2a illustrates the first-day results graphically. The first-day results are robust to different definitions of industry, alternate matching firm selection procedures within the same industry, and valuation using different price multiples. The results suggest a continuation of the overvaluation momentum from the pre-market to the after-market.

Additional results in Table 4 show that high P/V IPOs experience upward revisions of about 2% in offer price from the mid-point of the initial filing range to the final offer price. In contrast, low P/V IPOs experience downward revisions of about 4% to 5%. More shares are overallotted as a percentage of shares sold in the offering for high P/V IPOs than low P/V IPOs. The shares of high P/V IPOs also show a greater tendency to turnover on the first day than low P/V IPOs. These results suggest that high P/V IPOs experience higher demand for their shares than low P/V IPOs both before the offer date and after the offer date. Finally, high P/V IPOs and low P/V IPOs both have similar operating profit margins in the fiscal year prior to going public. High P/V IPOs, however, have lower sales and higher market capitalization as of the first-day close.

4.2 Long-Run Returns

Overvalued IPOs earn higher returns than undervalued IPOs on the first day of trading. This could be either because overvalued IPOs continue to get even more overvalued in the after-market or because the issuers price these IPOs at a premium given their private information about the future growth prospects of these IPOs. If the market agrees with them and believes that the future prospects are even better then their prices would run-up further in the after-market. The only way to resolve this issue is to look at the long-run returns earned by high and low P/V IPOs. If high P/V IPOs are overvalued then they should underperform low P/V IPOs in the long

run. On the other hand, if they are appropriately priced in anticipation of superior operating performance in the future then there should be no difference in the long run risk-adjusted returns earned by the two groups of IPOs.

Table 5 presents the five-year buy-and-hold abnormal returns (BHAR) earned by high, medium and low P/V IPOs with respect to the various benchmarks discussed in Section 2.4. For comparison, the table also reports the long run returns for the entire sample. Panel A provides median returns and Panel B provides equal-weighted mean returns. We report medians because medians are more robust for distributions (such as five-year buy-and-hold returns) that are highly skewed. The mean results are larger in magnitude.

Since the small sample distribution of buy-and-hold returns tends to be highly misspecified (see Barber and Lyon (1997), Kothari and Warner (1997), Fama (1998) and Brav (2000)), we compute critical t-statistics for testing two-sample means and medians (at the 90^{th}, 95^{th}, and 99^{th} percentiles for upper tail tests) using a *randomization (sampling without replacement) procedure*. We take each yearly cohort of IPOs and shuffle their P/V ratios so that the P/V ratios are randomly assigned to the IPOs. Using this pseudo-sample, each year we form three IPO portfolios based on their pseudo P/V ratios. We pool the yearly portfolios and compute abnormal returns and parametric and non-parametric t-statistics for differences in means and medians. *This procedure preserves the skewness, time-series autocorrelation and cross-correlation (clustering) properties of the original sample.* We repeat this procedure 5000 times to generate a small-sample distribution for the t-statistics under the null hypothesis of equality of means and medians. We use this empirical distribution in subsequent statistical inferences.

Regardless of the benchmark used to compute BHAR or the choice of median or mean returns, the results show a consistent pattern. *Low P/V* IPOs earn significantly higher returns than *High P/V* IPOs (see Figure 2b for a graphical illustration of these findings) over the next five years. The difference in median raw returns (see Panel A) is 29.1% while the difference in mean returns (see Panel B) is 35.7%. The difference in abnormal median returns varies from 28% in the case of size matched control firms to 35.7% in the case of NYSE/AMEX/NASDAQ value-weighted market index. Mean abnormal returns vary from 40% to 50%. The median differences are all

statistically significant based on either the non-parametric Wilcoxson-Mann-Whitney test or the traditional t-test. In spite of the fact the differences in mean returns (in Panel B) are larger in magnitude the t-statistics of the differences are smaller. This is due to the negative bias in t-statistics (see equation 6) arising from the positive skewness in buy-and-hold abnormal returns (see Barber and Lyon (1997)). As a result, the t-statistics in Panel B are significant only at the 10% level (one-sided test). The statistical significance is stronger for other tests involving mean returns (see Tables 6, 7, and 8).

The row entitled *All IPO Firms* in each panel provides the long-run buy-and-hold abnormal returns for the entire IPO sample. The results confirm the findings of prior literature that as a group IPOs tend to underperform their benchmarks (excluding book-to-market controls) in the long run. We have replicated all our findings using P/V ratios based on P/S and P/E multiples and for valuations based on alternate matching firm procedures discussed in Table 3. These results are qualitatively similar. Median results are statistically more significant than mean results. These results are not reported in the paper.

4.3 Five-Year Buy-and-Hold Abnormal Returns by Cohort Year

In Table 6, we report the (equal-weighted) five-year buy-and-hold abnormal return differential between low P/V and high P/V IPOs by cohort year. Panel A reports cross-sectional median returns and Panel B reports cross-sectional mean returns. In each panel, we also report the time-series averages of cross-sectional means or medians and corresponding t-statistics to test the null hypothesis that the time-series average is equal to zero. The t-stats are corrected for the autocorrelation induced in five-year buy-and-hold returns from the use of overlapping observations using the Newey-West-Hansen-Hodrick correction with four lags. The t-statistics also take into account the cross-correlation among returns of IPOs in the same cohort year.

The results show that low P/V IPOs outperform high P/V IPOs in 11 to 14 years out of the sixteen cohort years. This suggests that these strategies are not risk-free. The time-series averages of median buy-and-hold abnormal returns range between 27% and 54% depending on the benchmark used. The mean returns are more stable ranging between 40% and 46%. The t-statistics are significant at the 1% significance level in 5 out of 8 cases (4 benchmarks in each

panel), 5% level in 2 cases and 10% level in one case where all tests are based on one-sided tests. Overall, the results in Table 6 confirm the long-run results in Table 5.

4.4 Three-Factor Time-Series Regressions

In this section, we report the abnormal returns from time-series regressions of monthly Low P/V, High P/V, and Low P/V – High P/V portfolio returns on Fama and French (1993) security market factors. The monthly portfolio returns are computed as follows. Each IPO is allotted to one of three P/V portfolios and held for either six months starting the beginning of the first calendar month after the IPO or 4 ½ years from the end of the sixth month after the offer date. The division of the five year period into these two periods allows us to get a better understanding of when the underperformance of high P/V IPOs begins. At the end of the each holding period the IPO drops out of its portfolio. Once all IPOs are allotted in this manner, we compute equal-weighted average returns across all stocks for each calendar month from the beginning of 1983 to the end of 2000. This procedure avoids the autocorrelation problems present in using overlapping five-year buy-and-hold returns and takes into account the cross-correlation among returns across clustered events.

The three-factor model (which is equivalent to the average abnormal returns (AAR) approach), thus, suffers from fewer misspecification problems than the BHAR approach. It also provides a way of controlling for book-to-market effects in situations in which the control firm approach is difficult to use because individual book-to-market ratios are noisy (as in the case of IPOs). On the other hand, it suffers from low power to reject the null of no abnormal returns (see Barber and Lyon (1997) and Loughran and Ritter (2000)). In addition, it should be noted that the three-factor model is an empirical model based on observed security market patterns not a theoretical equilibrium model. It is useful in determining whether or not event-related abnormal returns are driven by existing security market patterns that may or may not be related to risk. It cannot be used to make unambiguous statements about risk versus mispricing. The three-factor model is given below:

$$r_{pt} - r_{ft} = a_p + b_p\left(R_{mt} - R_{ft}\right) + s_p\, SMB_t + h_p\, HML_t + u_t \qquad (7)$$

r_{pt} is the monthly portfolio returns, r_{ft} is the one-month T-bill return, $(R_{mt} - R_{ft})$ is the monthly excess return on the NYSE/AMEX/NASDAQ value weighted index, SMB is the return on small firms minus the return on large firms in month *t*, and HML is the return on high book-to-market stocks minus the return on low book-to-market stocks in month *t*. a_p is the monthly risk-adjusted abnormal return in percent and b_p, s_p, and h_p are factor-loadings.

Table 7 presents the regression results. Panel A presents results for the six-month holding period and Panel B presents results for the 4 ½ year holding period. The results (in both panels) show that high P/V IPOs have significantly negative HML betas, behaving like *glamour* stocks while low P/V IPOs do not have a significant exposure to HML (except in Panel B where the HML beta is positive and marginally significant). The two portfolios have similar exposures to the market and the SMB factors. Overall, there is very little evidence that the two portfolios differ much on systematic risk. The only source of uncertainty is whether HML is a risk or a mispricing factor.

The key result is the difference in the "risk-adjusted" abnormal return (the intercept a_p) earned by the high P/V portfolio at the six-month and the 4½ year horizon. At the six-month horizon (Panel A), the high P/V portfolio earns *positive* 16% (1.34% times 12 months) on an annualized basis and outperforms the low P/V portfolio by about 17% (1.45 times 12) on an annualized basis. In contrast, the low P/V IPO earns negative 1.32% per annum, which is statistically insignificant. At the 4 ½ year horizon, the "risk-adjusted" abnormal returns of the high P/V portfolio is –7.6% (0.63 times 12) per annum which is also statistically significant. The returns earned by the low P/V IPOs are marginally negative and insignificant. In sum, all of the significant findings are about overvalued IPOs. They exhibit significant positive momentum in the short-run and large reversals in the long run. Figure 3 graphically illustrates these findings by plotting the annual returns earned by low and high P/V IPOs over the next five years.

The magnitude of the difference in intercepts between low and high P/V IPOs is much larger than the premium on the HML factor or the market factor over the last forty years (see Fama and French (1993)). This suggests that the initial six-month momentum and the subsequent reversals of overvalued IPOs is an economically significant result that cannot be explained by size or

book-to-market effects. Overall, these results reinforce the view that high P/V IPOs are overvalued at the offer, get even more overvalued in the after-market, and revert back to fundamentals in the long run.

5. IPO Valuations and Ex Post Operating Performance

The long-run results indicate high P/V IPOs underperform low P/V IPOs. A rational explanation of this result is that high P/V IPOs are firms with higher expected growth rates, margins and return on capital while at the same time facing lower systematic risk. We evaluate this possibility by examining the ex post operating performance of these firms. On average, if expectations are rational, realizations should be close to expectations.

Table 8 reports the median ex post operating performance over the next five years for low, medium, and high P/V IPO portfolios. Panel A reports annual sales growth rates. Panel B reports annual return on assets defined as the ratio of EBITDA to total assets. Panel C reports annual EBITDA profit margin defined as the ratio of EBITDA to sales. Panel D reports annual asset turnover ratios defined as the ratio of sales to total assets. Panel E reports reinvestment rates defined as (capital expenditures + acquisitions)/EBITDA which measures the proportion of cash flows reinvested in the company. Panel F reports book leverage ratios defined as the ratio of total debt to total assets. Each panel reports raw performance as well as industry-median-adjusted performance. The numbers in parentheses are Wilcoxson-Mann-Whitney non-parametric test statistic for testing the equality of medians and simple t-statistics for testing the equality of means. All accounting numbers are from Compustat annual file and the appropriate data item numbers are reported in Table 8.

The following patterns standout in Table 8. The sales of high P/V IPOs grow faster than that of low P/V IPOs immediately after going public. In Year 1, the growth rates for high P/V and low P/V IPOs are respectively 44.86% and 21.37%, which are significantly different from each other. But, the higher growth rates do not persist for long. By the end of the fifth year, there is no appreciable difference in growth rates across the two portfolios. The growth rates of the two portfolios in the fifth year are now respectively 13.49% and 11.62%. But, even with the higher growth rates, the median sales of high P/V IPOs in the fifth year do not exceed that of low P/V

IPOs. Why? Because in Year 0 (see Table 5), the median sales of high P/V IPOs is only $26 million while the median sales of low P/V IPOs is $58 million. Compounding the Year 0 sales at the median annual growth rates gives us, by the fifth year, sales figures of $126 million for low P/V IPOs and $86 million for high P/V IPOs. Thus, the higher growth rates are not high enough for the high P/V IPOs to catch up to or exceed the sales of low P/V IPOs even after five years.

The mean sales growth rates also exhibit the same patterns as median growth rates. The mean sales growth rates in years 1 through 5 for low P/V IPOs are 30.22%, 32.83%, 24.07%, 18.61%, and 15.66% respectively while growth rates for high P/V IPOs are 72.06%, 54.53%, 41.83%, 31.15%, and 18.69% respectively. The difference in growth rates in the fifth year is not significantly different from zero. The industry median-adjusted numbers tell the same story as the raw numbers. The sales of high P/V IPOs grow faster than the industry in the first few years after going public but this high growth reverts rapidly to industry levels by the fifth year. For instance, the industry-adjusted sales growth rate of high P/V IPOs is 32.55% in Year 1 but is only 3.35% in Year 5. The simple message is that IPOs are unable to sustain their initial high growth rates in the long run.

Lower sales numbers should not matter much if high P/V IPOs earn higher return on assets (ROA) or EBITDA profit margins than lower P/V IPOs. The results in Panels B and C show that not only do high P/V IPOs earn lower ROA and profit margins than low P/V IPOs in the fiscal year prior to going public they do so every year over the next five years. For instance, the difference in ROA between low and high P/V IPOs is a significant 3.26% in Year 0 and a still significant 1.86% in Year 5. The difference in profit margins is 2.5% in Year 0 and 2.29% in Year 5 both numbers significantly different from zero. High P/V IPOs also have lower asset turnover ratios than low P/V IPOs suggesting that they utilize their assets much less effectively than low P/V IPOs. The industry-adjusted results show that while initially both low P/V and high P/V IPOs earn significantly higher margins and return on assets than the industry, by the fifth year only the low P/V IPOs continue to earn abnormal returns. High P/V IPOs perform about the same as the industry. Once again, the performance of high P/V IPOs quickly reverts to mean. Overall, these results reveal that the growth stories on which most IPOs are initially priced fail to materialize in the long run.

High P/V IPOs generate lower sales, earn lower returns on them, and find that their growth rates revert to that of the low P/V IPOs by the fifth year. Does this imply that they generate lower free cash flows than the low P/V IPOs? Not necessarily, since their capital expenditures could be lower than those of the low P/V IPOs. Recall that free cash flows are defined as after-tax operating profits less net new investments. Panel E reports the ratio of capital expenditures and acquisitions to EBITDA, which is a rough measure of the proportion of operating profits reinvested. The reinvestment rates are comparable across the two IPO portfolios although the reinvestment rate of low P/V IPOs is slightly higher. This suggests that differences in capital expenditures cannot help generate higher free cash flows for high P/V IPOs. In any event, faster growing firms should reinvest more not less.

Lower free cash flows alone do not necessarily mean lower valuation because high P/V IPOs could face significantly lower systematic risk. The results in Table 7 showed that the two portfolios were comparable in terms of their market betas and small firm (SMB) betas. The only difference was in the book-to-market betas. If book-to-market factor is a measure of earnings distress risk, then it is possible that high P/V IPOs face significantly lower earnings distress risk than low P/V IPOs. The fact that low P/V IPOs earn higher margins and ROA and seem to generate higher free cash flows suggests that they are unlikely to face greater risk of earnings distress. However, if their earnings and cash flows are much more volatile then it is possible that they could face a greater risk of earnings distress even if their average cash flows are higher. We look at several measures to evaluate earnings volatility.

We use two measures of cash flow volatility: (a) coefficient of variation of EBITDA which is the annual standard deviation of EBITDA divided by annual mean computed using the next five years' data and (b) the standard deviation of EBITDA growth rates. The median coefficients of variation are 38%, 44%, and 63% respectively for low, medium, and high P/V IPOs. The median standard deviations of EBITDA growth rates are 30%, 37%, and 33% respectively. Thus, there is no evidence that the earnings or cash flows of high P/V IPOs are less volatile. In fact, the evidence suggests that they may be more volatile.

Finally, we examine the book leverage ratios of the two groups of IPOs to see if low P/V IPOs have significantly higher leverage than high P/V IPOs. Panel F reports debt-to-total assets ratios. Low P/V IPOs have slightly higher leverage ratios than high P/V IPOs although the leverage ratios of both groups are less than 25%. The market leverage ratios are likely even lower. The actual difference in leverage ratios between the two groups of IPOs ranges between 0.08 and 0.12. For a company with $25 million in total assets (close to the sample median), this translates to a difference of $2 to $3 million in debt which is unlikely to cause significant differences in financial risk and cost of equity. In any event, the operating risk of the high P/V IPOs (based on the volatility of cash flows) seems higher which might be the reason for their lower leverage. Therefore, it is not obvious that lower leverage necessarily means lower overall systematic risk (business + financial) and of equity. We conclude differences in leverage cannot be the reason for the large differences in ex ante valuations and ex post returns. Overall, the evidence presented in Table 8 and elsewhere in the paper does not support the notion that high P/V IPOs are less risky than low P/V IPOs or that they face higher long run growth opportunities. The evidence seems more consistent with mispricing.

6. Are the long run results a restatement of the B/M effect?

A valid concern about our long run results is that they could be due to the B/M effect documented by Fama and French (1992, 1993) and Lakonishok, Shleifer, and Vishny (1994). Specifically, the concern is that the undervalued IPOs are likely *high B/M* stocks and overvalued IPOs are likely *low B/M* stocks and, thus, our findings may be a relabeling of an existing result.

A close examination of our return findings (see Fama and French factor regressions in Table 7 for reference) reveals that this is unlikely to be the case. Recall that high P/V IPOs earn positive abnormal returns (from the three-factor model) of about 16% per annum during the first 6 months after the IPO but earn negative abnormal returns of about 7.6% per annum during the next 4 ½ years. The complex pattern of high returns on the first day of trading, continuing positive momentum during the first 6 months and subsequent reversals over the long run is unlike anything reported for the B/M effect and hence is hard to reconcile with the traditional B/M effect. In addition, the magnitudes of the "risk-adjusted" returns are much larger than the premium on the market, SMB, or the HML factor over the past 40 years.

To further examine the possibility that our results are driven by the B/M effect, in Panel A of Table 9, we report the distribution of the IPOs in our sample across the Fama-French size and B/M quintiles. The panel shows that while roughly 80% of our sample resides in the two lowest B/M quintiles only 9% of the sample is in the two highest B/M quintiles. Most IPOs in our sample are *glamour* stocks and there are hardly any *value* stocks. More importantly, the IPOs in the two lowest B/M quintiles are almost uniformly distributed across low, medium, and high P/V portfolios (28% are low P/V, 35% are medium P/V and 37% are high P/V) indicating only a weak correlation between P/V ratios and B/M characteristics.

Brav and Gompers (1997) note that the Fama and French (1993) three-factor regressions tend to give statistically significant negative intercepts for small firms with low B/M ratios. Are our high P/V IPOs small firms with low B/M ratios? The answer is in the negative. Only 37% of the high P/V IPOs are small firms with low B/M ratios. This is quite close to the 28% of low P/V IPOs, which are also small firms with low B/M ratios. Moreover, the magnitudes of the intercepts reported in our paper for overvalued IPOs (+17% for the six month period and -7.6% for the subsequent 4 ½ year period on an annualized basis) are much larger than that reported by Fama and French (1993) for small firms with low book-to-market ratios (an annualized intercept of only -4%).

To further examine the role of the B/M effect, Panel B of Table 9 reports the risk-adjusted abnormal returns (intercepts) from Fama-French three factor regressions for the low, medium, and high P/V IPOs in the smallest size, lowest B/M portfolio. The results indicate that most of the underperformance among small size, low B/M IPOs is concentrated among high P/V IPOs. While the risk-adjusted abnormal returns are a statistically significant –7.3% on an annualized basis for high P/V IPOs they are an insignificant –3% for low P/V IPOs. These results show that the relationship between P/V ratio and long-run IPO returns is not a relabeling of the B/M effect. The complex pattern of high returns on the first day of trading, continuing positive momentum during the first 6 months and subsequent reversals over the long run is hard to reconcile with the traditional B/M effect.

As a final test to see whether the B/M effect can reproduce our findings, we form three IPO portfolios based on B/M ratios in the same manner as we form P/V portfolios. The five-year BHAR for the low, medium, and high B/M IPO portfolios are provided in Panel C of Table 9. The BHAR is computed with respect to industry, sales, EBITDA profit margin based control firms. The results in Panel C show that there are no significant differences in the long run abnormal returns earned by low, medium, and high B/M IPO portfolios. If our long run results were driven by B/M ratios then one would expect high B/M IPOs to outperform low B/M IPOs. In contrast, we find that low B/M IPOs outperform (although insignificantly) high B/M IPOs. We conclude that our results are not driven by the traditional B/M effect.

7. Discussion and Conclusions

Let us summarize the key results of the paper:

1) The median IPO in a sample of more than 2000 IPOs from 1980 to 1997 is overvalued by 50% relative to its industry peers. This overvaluation is robust to alternate price multiples, industry definitions, and matching firm selection procedures.
2) In the cross-section, the most overvalued (High P/V) IPOs earn 5% to 7% higher first-day return than undervalued (Low P/V) IPOs. Overvalued IPOs also experience upward revisions in offer price from the mid-point of the filing range while the undervalued IPOs experience downward revisions. Overvalued IPOs also experience higher exercise of overallotment options compared to undervalued IPOs.
3) Overvalued IPOs underperform undervalued IPOs by 20% to 50% (depending on the benchmark and whether median or mean return is used) over the next five years. The underperformance starts in the second year after the offer and persists all the way up to the fifth year. The underperformance of overvalued IPOs is robust to various benchmarks and the Fama and French three-factor model.
4) Overvalued IPOs earn lower profit margins and return on assets than undervalued IPOs. Their sales grow faster immediately after going public but the higher growth does not persist for long. The evidence suggests that overvalued IPOs do not face higher growth opportunities in the long run and that they do not face lower risk.

What do these results imply for the rational theories of IPO pricing? Traditional asymmetric information theories of IPO pricing (see Rock (1986), Benveniste and Spindt (1989), Allen and Faulhaber (1989), Welch (1989), and Grinblatt and Hwang (1989)) are all based on the notion that IPOs are undervalued. Indeed, all of them attempt to explain the "underpricing" puzzle. Our finding that IPOs, in aggregate, are overvalued runs against the fundamental premise of these models. Our cross-sectional finding that the most overvalued IPOs (not the most undervalued) earn the highest first-day return is also inconsistent with these theories since they predict just the opposite. Since the rational theories do not make any predictions about the long-run performance of IPOs it is hard to evaluate them on the basis of long run returns. One rational explanation of the long run results, however, is that IPOs are less risky than their matching firms. We discuss this explanation later.

What about behavioral theories? Our results are broadly consistent with the *windows of opportunity* hypothesis of Ritter (1991) and Loughran and Ritter (1995). This hypothesis suggests that IPOs come to market at opportune times when their equity may be overvalued. Our result that high P/V IPOs earn high returns in the short-run but low returns in the long run is consistent with this general idea. It is also consistent with Miller (1977) who argues that investors who are the most optimistic about an IPO will be its initial buyers. Over time, as more information become available and pessimists begin selling or shorting, the stock prices fall.

These hypotheses, however, are not full-fledged behavioral theories in the sense that they are not based on micro-foundations of behavioral psychology. For that, we turn to recent behavioral theories of Barberis, Shleifer, and Vishny (1998) (BSV), Daniel, Hirshleifer, and Subrahmanyam (1998) (DHS), and Hong and Stein (1999) (HS). We focus on these three papers since these are the first theory papers to arrive in this literature in order to explain broad security market predictability patterns. All these three papers make one common prediction: stock prices should exhibit initial momentum and subsequent reversals. Even though they all arrive at the same destination in terms of their final prediction, the routes they take to arrive there are quite different.

Figure 4 illustrates these differences. Figure 4(a) plots the efficient market response to the arrival of new information. Figure 4(b) illustrates a pure underreaction hypothesis (see Foster, Olsen and Shevlin (1984), Bernard and Thomas (1989), Jegadeesh and Titman (1993) and Chan, Jegadeesh, and Lakonishok (1996)) where stock prices underreact to new information and take time to adjust to the full information price. Figure 4(c) illustrates theories that predict both initial momentum and subsequent reversals (see BSV, DHS, and HS and also DeLong, Shleifer, Summers and Waldmann (1990) (DSSW)). But notice the manner in which initial momentum is achieved in DSSW and DHS as opposed to BSV and HS. This difference is crucial to understanding potential security market behavior related to IPOs.

7.1 Initial underreaction and subsequent overreaction

In BSV and HS, stock prices exhibit momentum because of initial underreaction to information and ultimately overreact leading to reversals. In BSV underreaction is achieved through *conservatism* bias and in HS underreaction is through slow diffusion of private information among a population of investors. In the context of IPOs, this theory would predict undervalued IPOs would earn high returns initially (positive momentum) but low returns in the long run. This is equivalent to a stock worth $10 being offered at $5, its stock price rising to $10 in the initial underreaction phase, continuing to rise above $10 in the overreaction phase and then reversing in the long run. Our findings are inconsistent with this explanation. We find that the overvalued IPOs earn the highest return in the short run and the lowest return in the long run.

7.2 Initial overreaction and subsequent overreaction

In DSSW and DHS, stock prices initially overreact to information. In DSSW, this is due to positive feedback trading. In DHS, this is due to investor overconfidence. We focus on DHS since it is based on a well-established psychological bias. Overconfident investors overreact to private information causing stock prices to also overeact. Biased self-attribution on the part of these investors (where they attribute success to their ability and failure to external factors) causes stock prices to overreact further with the arrival of public information (they underreact to public information but further overreact to initial private information). This initial overreaction and subsequent overreaction gives rise to momentum in stock prices. In the long run, the continual

arrival of public information brings prices back to fundamentals leading to reversals. Thus, momentum in DHS (and DSSW) is due to overreaction, not underreaction (see Figure 4(c)).

In the context of IPOs, the DHS model would predict that the overvalued IPOs should earn higher first-day returns due to short-run positive momentum and lower long-run returns. The converse would be true for undervalued IPOs. This is equivalent to a stock worth $10 being offered at $15, continuing to run up in the aftermarket and then reversing in the long run. Our findings are consistent with this prediction. How might overconfidence enter the picture? It might enter through the (excess) demand of investors who are most interested in these IPOs initially. This is in the spirit of Miller (1977) who argues that investors who are the most optimistic about an IPO would be its initial buyers. DHS argue that overconfidence induced mispricing should be strongest in securities, which are most difficult to value, or where feedback on future fundamentals takes long to arrive. IPOs seem to fit this description well. In other words, overconfident IPO investors could be betting that every IPO will be the next Cisco, Intel or Microsoft.

Consider the following scenario. Investors are overconfident about the future success of IPOs. Their excess demand for these IPOs leads issuers/underwriters to overvalue them. This overconfidence carries over to the aftermarket causing additional overvaluation. In the long run, fundamental information about the company arrives and prices fall back to fair value. This seems to be a plausible explanation of what happens to IPOs.

Overconfidence need not be the only source of IPO overvaluation. Underwriters aggressively market IPOs through road shows. Such marketing strategies may also play an important role in creating excess demand for IPOs. Welch (1992) presents a model of cascades in which investors pay attention not only to their information but also to whether other investors are interested in the IPO. This could happen through informal discussions among institutional investors during road shows. Thus, an assessment early on by a few influential investors that an IPO is attractive (just as a Ph.D. candidate may be judged to be outstanding by a few influential universities early in the job market) could trigger a cascade and induce other investors to buy shares in the IPO. The resulting excess demand would be reflected in the high offer price. Welch (1992) suggests

issuers strategically underprice IPOs to induce a few influential investors to buy initially. It is possible that the marketing strategies employed by investment banks early in an IPO process also play a major role in triggering such cascades.

7.3 Alternate Interpretations of IPO Underpricing?

One interpretation of our results may be that issuers are not underpricing IPOs relative to the value of comparable firms but are underpricing them with respect to the maximum price (far above the fair value) these IPOs would bring in the after-market. It is hard to empirically test this hypothesis before the fact unless otherwise we can see the underwriters' book. Nevertheless, it is still possible that the underwriters set offer prices at values lower than what the market (irrationally) would bear even though the final offer price turns out to be higher than the market valuations of peer firms in the industry.

This view of underpricing is consistent with the agency explanation of Loughran and Ritter (2000) who emphasize the benefits such as higher brokerage commissions that underwriters receive from buy-side clients in return for allocating IPOs at prices below the maximum attainable. It is also consistent with the overreaction/overvaluation explanation. Thus, for instance, an IPO could have a fair value of $10, maximum offer price of $20, and an actual offer price of $15. While there may yet be underpricing in this sense, our results suggest that the issuers do receive an offer price above fair value for their stock. Thus, there is no dilution of their equity *à la* Myers and Majluf (1984).

7.4 Conclusion

Are IPOs underpriced? The results in our paper suggest IPOs are overvalued relative to the valuations of peer firms in the same industry. They continue to get even more overvalued in the after-market. Thus, the first-day return could be alternatively referred to as *after-market overpricing*. One could call the first-day return underpricing only in the following sense. They might be underpriced with respect to what the initial IPO investors and the market (irrationally) are willing to pay.

Our findings have significant implications for the theory of IPO pricing. Much of the theoretical research heretofore has focussed on explaining IPO underpricing. Our results suggest that an equally interesting phenomenon that needs to be explained is IPO overvaluation. As we argue in Section 7.2, behavioral theories may provide the answer. On the other hand, any rational explanations of our findings need to take into account the overvaluation relative to industry peers and the relation between overvaluation, first-day returns, and long run returns.

Our results also suggest directions for future research. The relation between IPO overvaluation, analyst recommendations of IPOs (see Michaely and Womack (1999)) and institutional investor flipping (see Krigman, Shaw, and Womack (1997)), and accruals (see Siew Hong Teoh, Welch, and Wong (1998)) is one place to start. For instance, our results suggest that flipping should be concentrated among overvalued IPOs. Our results also suggest that analyst recommendation bias should be most evident for the overvalued IPOs and accrual effects should be stronger. It would also be interesting to compare the valuation of venture-backed and non-venture backed IPOs using our valuation methodology. Of additional interest, would be the behavior of stock prices around lock-up expiration period for overvalued and undervalued IPOs. We leave these and other issues for future research.

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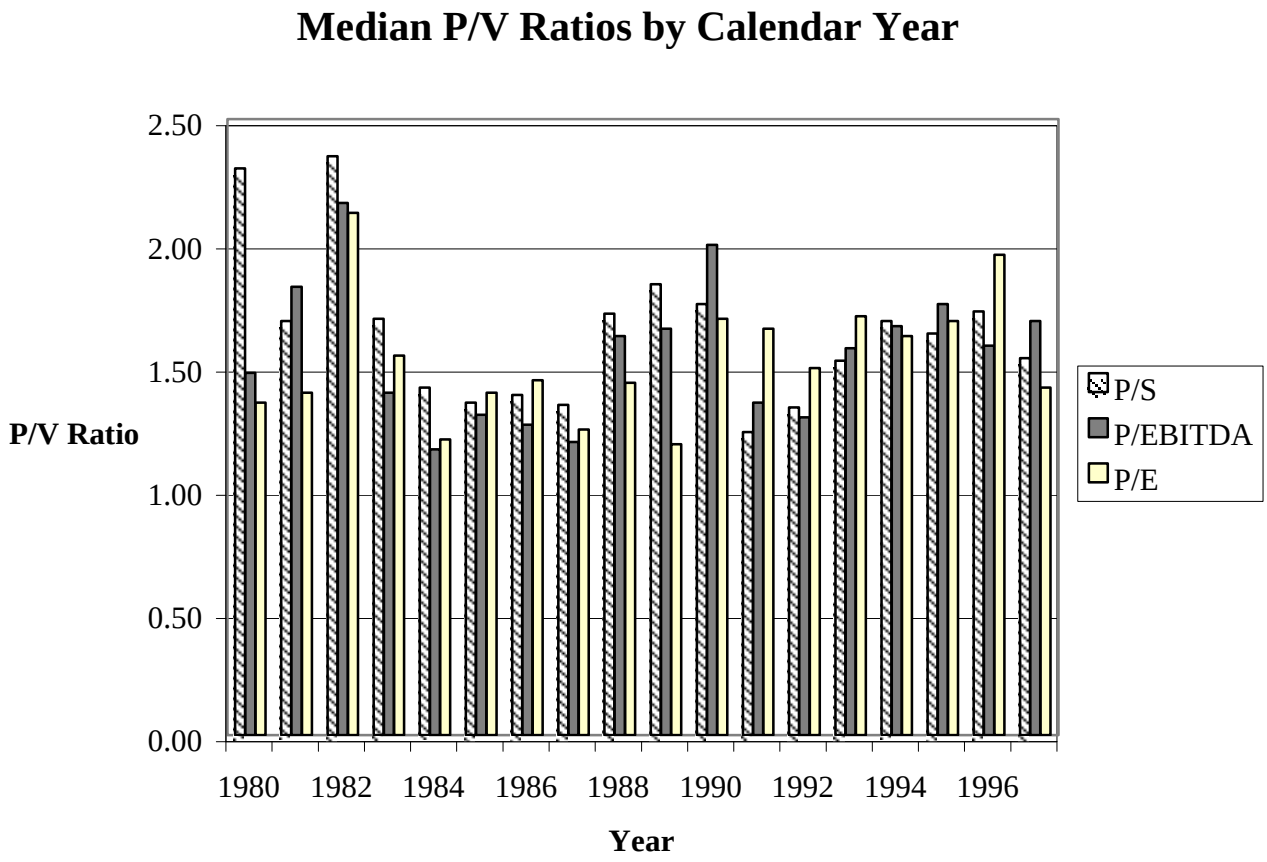

Figure 1: **Median P/V Ratios of Calendar Year Cohorts of IPOs**. The table graphs median P/V ratio for annual cohorts of IPOS based on P/S, P/EBITDA and P/E multiples. P refers to the offer price and V is the intrinsic value based on comparable firm multiples.

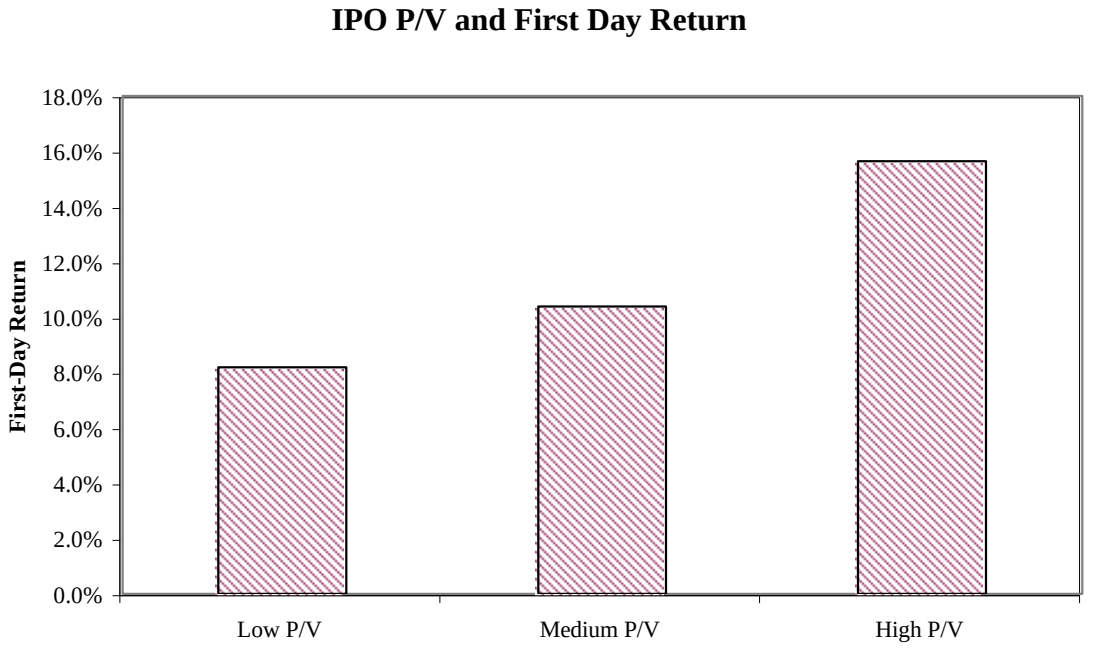

Figure 2a: **P/V Ratio and First-Day Return**. This figure graphs the median and mean first-day returns for the low, high, and medium P/V ratios. The P/V ratios are based on P/EBITDA multiples. P refers to the offer price and V is the intrinsic value based on comparable firm multiples.

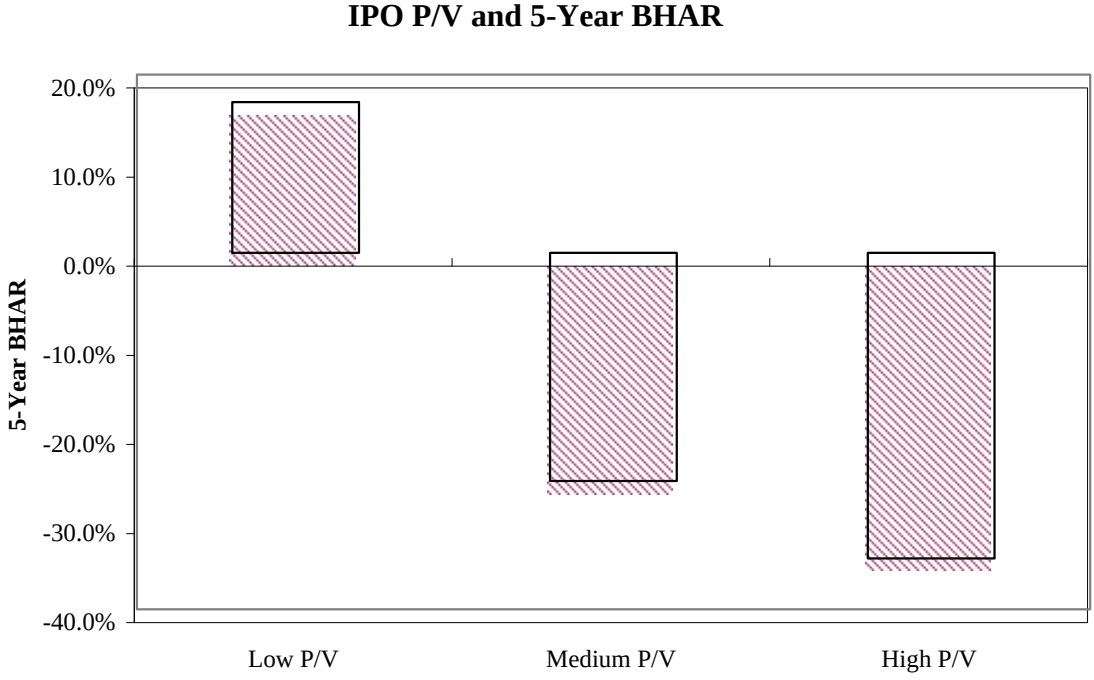

Figure 2b: **P/V Ratio and 5-Year BHAR**. This figure graphs the mean five year buy-and-hold abnormal returns (BHAR) measured with respect to size matched control firms for the low, high, and medium P/V ratios. The P/V ratios are based on P/EBITDA multiples. P refers to the offer price and V is the intrinsic value based on comparable firm multiples.

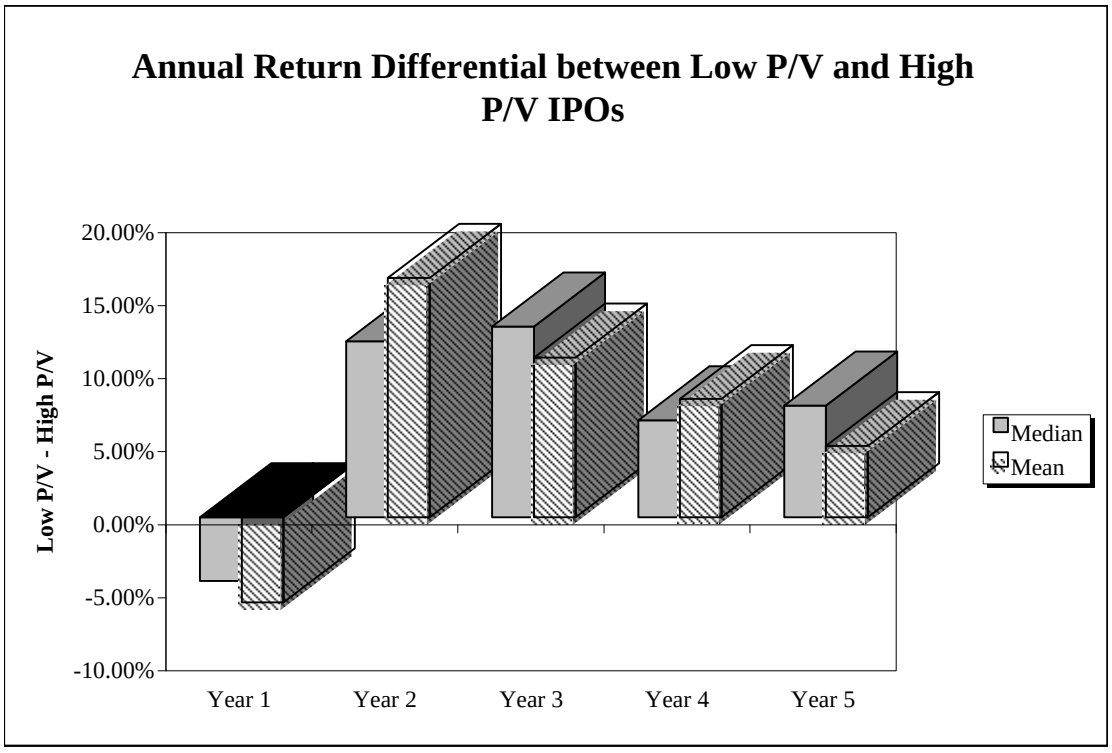

Figure 3: Annual abnormal return differential between Low P/V and High P/V IPOs. This figure plots the annual abnormal return differential between Low P/V and High P/V IPOs. The abnormal returns are computed with respect to the size matched control firms. Year 1 refers to the first twelve-month compounded returns from the close of the offer date, Year 2 refers to second twelve-month compounded returns, Year 3 to third twelve-month compounded returns, Year 4 to the fourth twelve-month compounded returns and Year 5 to the fifth twelve-month compounded returns.

Figure 4a. Efficient market hypothesis

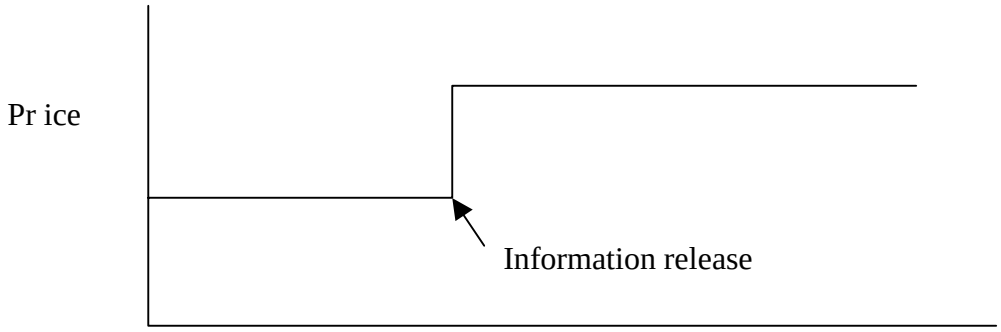

Figure 4b. Simple Underreaction *(Price adjusts to news signals with a lag)*

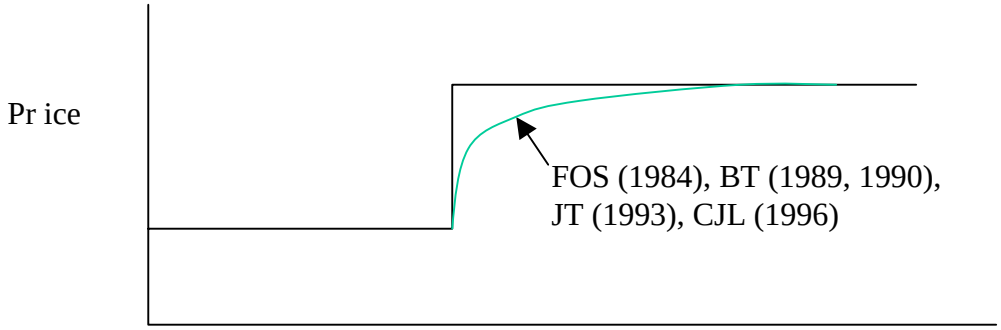

Figure 4c. Eventual Overreaction ***(Price eventually overreacts to news signals)***

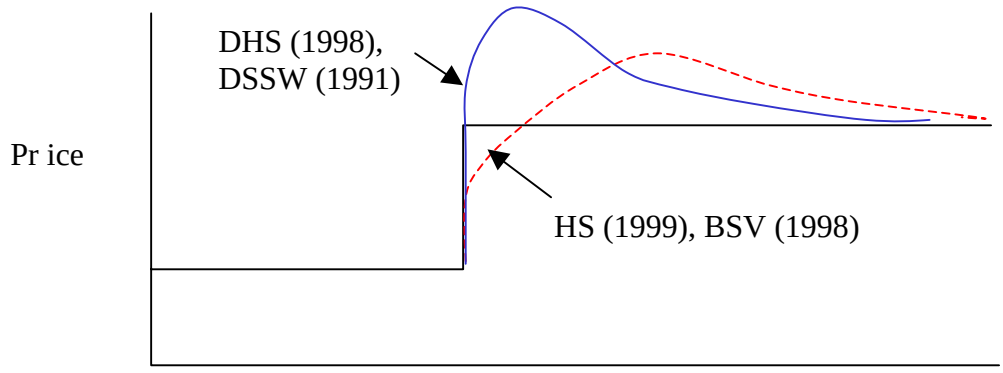

Figure 4: This figure contrasts the efficient market hypothesis (Figure 4a) with pure underreaction in Figure 4b and underreaction followed by overreaction (dotted line) and overreaction followed by continuing overreaction (continuous line) in Figure 4c.

Table 1
Description of the IPO Sample

This table reports descriptive statistics on our sample of IPOs from 1981 to 1997. Panel A provides statistics on the key variables of the offering, which are obtained from the Securities Data Corporation (SDC) database. Panel B compares the firm fundamentals of IPO firms with their matching firms. Sales, EBITDA, and Net Income numbers are obtained from Compustat. EBITDA stands for Earnings Before Interest Taxes and Depreciation & Amortization.

Panel A: Descriptive Statistics (Number of Issues = 2,288)

Variable	Mean	25%	Median	75%
Offer Price in $	12.08	8.50	12.00	15.00
Net Proceeds in Millions of $	40.93	10.58	21.60	41.70
Overallotment options exercised as a percent of shares sold in the offering	8.62	0.00	11.73	15.00

Panel B: Characteristics of IPO Firms and Matching firms

Characteristics	IPO firms				Matching firms			
	Mean	25%	Median	75%	Mean	25%	Median	75%
Net Sales, $ Millions	162.79	16.26	40.12	112.07	179.96	21.60	47.04	120.74
Operating Profits (EBITDA), $ Millions	20.49	2.00	4.99	13.31	23.51	2.60	6.06	15.29
Net Income, $ Millions	2.07	0.49	1.56	4.10	8.12	0.82	2.16	5.62

Table 2

IPO Valuation based on Comparable Firm Multiples

This table reports cross-sectional distribution of *offer price-to-value* (P/V) ratios for IPOs from 1980 to 1997. The value is the *fair value* of the IPO firm computed based on *market price-to-sa*les (P/S), *market price-to-EBITDA, or market price-to-earnings* ratio of an industry peer. EBITDA is the sum of earnings before interest and taxes (EBIT) and depreciation and amortization (DA) and represents operating cash flows. The industry peer is a comparable publicly traded firm in the same Fama and French (1997) industry as the IPO firm and has the closest sales and EBITDA profit margin (EBITDA/Sales) in the most recent fiscal year. P/V is the ratio of the *offer price-to-sales, offer price-to-EBITDA, or offer price-to-earnings* divided by the corresponding *price-to-sales, price-to-EBITDA, or price-to-earnings* of the comparable firm. The table presents the 25th, 50th, and 75th percentiles of the cross-sectional distribution of P/V each year from 1980 to 1997. *Wilcoxon p-value* corresponds to the Wilcoxon rank sum test for median equal to 1. *Overall* represents the aggregate sample of IPOs across years. The statistics corresponding to overall are based on pooled time-series, cross-sectional data. The IPOs are from Security Data Corporation (SDC) and all other data are from Center for Research in Security Prices (CRSP) and Compustat.

Year	**Panel A: P/V Ratio Based on P/S Multiple**					**Panel B: P/V Ratio Based on P/EBITDA Multiple**					**Panel C: P/V Ratio Based on P/E Multiple**				
	No. of Issues	25%	Median P/V	75%	Wilcoxon p-value	No. of Issues	25%	Median P/V	75%	Wilcoxon p-value	No. of Issues	25%	Median P/V	75%	Wilcoxon p-value
1980	21	1.06	2.30	10.33	0.0003	21	0.91	1.47	5.36	0.0132	18	0.89	1.35	4.92	0.0483
1981	72	0.73	1.68	3.75	0.0001	72	0.82	1.82	3.45	0.0001	69	0.58	1.39	3.03	0.0002
1982	20	1.09	2.35	4.92	0.0010	20	1.19	2.16	4.37	0.0001	17	1.51	2.12	3.30	0.0003
1983	141	0.95	1.69	3.29	0.0001	141	0.81	1.39	3.03	0.0001	132	0.81	1.54	3.11	0.0001
1984	67	0.84	1.41	2.31	0.0001	67	0.65	1.16	2.38	0.0026	61	0.68	1.20	2.15	0.0032
1985	66	0.69	1.35	3.20	0.0002	66	0.65	1.30	3.10	0.0002	60	0.77	1.39	2.79	0.0001
1986	151	0.69	1.38	2.74	0.0001	151	0.60	1.26	2.41	0.0001	138	0.94	1.44	2.86	0.0001
1987	129	0.66	1.34	2.33	0.0001	129	0.60	1.19	2.19	0.0001	115	0.65	1.24	2.50	0.0001
1988	42	0.65	1.71	2.89	0.0004	42	0.76	1.62	2.36	0.0005	39	0.82	1.43	2.99	0.0012
1989	43	0.94	1.83	3.10	0.0001	43	0.80	1.65	3.08	0.0001	34	0.71	1.18	2.39	0.0341
1990	47	0.95	1.75	3.33	0.0001	47	1.00	1.99	3.12	0.0001	39	0.91	1.69	2.89	0.0001
1991	129	0.70	1.23	2.64	0.0001	129	0.70	1.35	2.52	0.0001	102	0.86	1.65	3.69	0.0001
1992	183	0.60	1.33	2.94	0.0001	183	0.66	1.29	2.61	0.0008	137	0.64	1.49	3.07	0.0001
1993	253	0.75	1.52	3.10	0.0001	253	0.86	1.57	2.86	0.0001	194	0.84	1.70	4.29	0.0001
1994	200	0.77	1.68	2.92	0.0001	200	0.83	1.66	3.21	0.0001	158	0.80	1.62	3.26	0.0001
1995	200	0.72	1.63	3.61	0.0001	200	0.84	1.75	4.21	0.0001	150	0.89	1.68	4.21	0.0001
1996	294	0.74	1.72	3.42	0.0001	294	0.70	1.58	3.31	0.0001	213	0.82	1.95	3.96	0.0001
1997	230	0.80	1.53	3.04	0.0001	230	0.87	1.68	3.31	0.0001	167	0.76	1.41	3.12	0.0001
Overall	2288	0.75	1.54	3.09	0.0001	2288	0.75	1.49	3.04	0.0001	1843	0.79	1.54	3.24	0.0001

Panel D: Spearman Correlation among P/V Ratios		
	P/V (EBITDA)	P/V (Earnings)
P/V (Sales)	0.85	0.61
P/V (EBITDA)	-------	0.71

Table 3
IPO Valuation: Robustness Tests
Panel A: Alternate Matching Firms

This panel presents P/V ratios based on P/EBITDA multiples using alternate matching firm selection procedures. *Industry Median* procedure chooses the cross-sectional industry (based on Fama-French 48 industries) median multiple as the comparable firm multiple. *Industry, Size* chooses comparable firms in the same Fama-French industry with roughly the same market capitalization (based on the mid-point of the offer file range) as the IPO firm. *Industry, Sales, ROA* chooses comparable firms in the same industry with roughly the same sales, and return on assets (EBITDA/Total Assets) during the prior fiscal year as the IPO firm.

Matching Criteria	25%	Median PV*	75%
Industry Median	1.08	1.82	3.36
Industry, Size	0.82	1.83	4.19
Industry, Sales, ROA	0.76	1.53	3.20

* All medians are significantly different from 1 at the 1% level.

Table 3 Continued..

Panel B: Valuation of Technology and Non-Technology IPOs

This panel reports median P/V ratios for technology firms and all other non-technology firms in our sample. Technology firms are defined as those in Fama and French (1997) industry groups referred to as *Entertainment, Printing and Publishing, Telecommunication, Computers, Electronic Equipment, and Measuring and Control Equipment*. Software firms are included in the computer industry.

	Technology (IPOs = 488)			Non-Technology (IPOs = 1800)		
Year	Based on P/S	Based on P/EBITDA	Based on P/E	Based on P/S	Based on P/EBITDA	Based on P/E
1980	5.14	5.89	3.21	1.09	1.72	1.02
1981	1.26	1.39	1.09	2.23	1.88	1.68
1982	2.09	2.37	3.84	2.23	1.49	1.85
1983	1.42	1.70	1.60	1.39	1.69	1.45
1984	1.67	1.93	1.47	1.10	1.30	1.16
1985	1.29	1.27	1.22	1.30	1.49	1.42
1986	1.21	1.42	1.51	1.30	1.36	1.42
1987	1.79	1.68	2.02	1.17	1.20	1.21
1988	2.36	2.78	3.09	1.27	1.24	1.27
1989	1.88	2.48	1.38	1.27	1.57	0.95
1990	3.17	2.36	3.24	1.97	1.64	1.68
1991	1.42	1.24	1.06	1.35	1.23	1.73
1992	0.87	0.91	1.23	1.37	1.40	1.50
1993	1.75	1.43	1.45	1.54	1.53	1.71
1994	2.46	1.91	2.67	1.54	1.65	1.44
1995	1.76	1.74	2.02	1.74	1.55	1.51
1996	1.33	1.44	1.86	1.65	1.76	1.99
1997	2.31	1.85	2.47	1.43	1.43	1.29
Overall	1.67	1.63	1.79	1.45	1.50	1.49

Table 4
IPO Portfolios Based on P/V Ratios, First-Day Return and Other Characteristics

This table reports first-day returns, trading volume, and other firm-specific characteristics for the three portfolios of IPO firms based on P/V ratios. The price is the *offer price* and value is the *estimated value* based on price-multiples of comparable firms. The procedure is described in detail in the text. The table reports results for P/V portfolios based on P/EBITDA multiples. *First Day Return* represents the equal-weighted average first day return earned by the firms in the IPO portfolio relative to the NYSE/AMEX/NASDAQ value-weighted index: $R_i - R_{VW}$. *Filing-to-Offer Return* represents percentage change from the mid-point of the filing range to the final offer price. *Median Overallotment* represents the shares overallotted as a percentage of shares sold in the offering. *First Day Turnover* is the ratio of first day trading volume to shares outstanding at the end of the first day. *Sales,* and *EBITDA Margin* are the sales and EBITDA profit margin for the most recent fiscal year. *Size* is the median market capitalization computed as of the end of the first trading day after the IPO. Events are allotted to IPO portfolios based on the historical distribution of P/Vs over the past eight quarters. The numbers in parentheses are simple t-statistics computed under the assumption of independence of observations. Those for differences in medians are based on the Wilcoxon-Mann-Whitney statistic also under the assumption of independence. *Sales and Size* are in millions of dollars.

IPO Portfolio	Median P/V	Median First Day Return	Mean First Day Return	Filing-to-Offer Return Median	Filing-to-Offer Return Mean	Median First Day Turnover	Median Overallot-ment	Median Sales	Median EBITDA Margin	Median Size	No. of Issues
Low P/V	0.55	3.1%	8.2%	-4.0%	-5.0%	7.54%	10.00%	57.77	13.19%	65.65	734
Medium P/V	1.49	5.0%	10.4%	0.0%	-2.2%	8.25%	10.56%	47.66	13.40%	87.84	733
High P/V	4.50	8.5%	15.6%	0.0%	1.9%	8.82%	14.93%	25.73	10.63%	88.96	728
Low P/V - High P/V		-5.4%	-7.5%	-4.0%	-6.8%	-1.3%	-4.9%	32.04	2.56%	-23.31	
		(-7.90)	(-7.72)	(-7.97)	(-7.80)	(-1.26)	(-3.98)	(10.74)	(6.36)	(-4.69)	
All IPOs	1.49	5.3%	11.4%	0.0%	-1.8%	8.16%	11.73%	42.01	12.32%	79.01	2195

Table 5

5-Year Buy-and-Hold Abnormal Returns of Low, Medium, and High P/V Portfolios of IPOs

This table reports *median* and *(equal-weighted) mean* five-year buy-and-hold abnormal returns (BHAR) earned by IPOs in portfolios formed on the basis of their P/V ratios computed from P/EBITDA multiples. The BHARs are computed with respect to (a) the CRSP NYSE/AMEX/Nasdaq value weighted index (b) Standard & Poors 500 Index without dividends (c) matching firms based on industry and first day closing market capitalization and (d) matching firms based on industry, sales growth, and EBITDA profit margin (the same firm that was used to value the IPO). Panel A presents median BHAR. Panel B reports equal-weighted mean BHAR. In Panel A, the numbers in parentheses below the row titled (Low P/V – High P/V) are Wilcoxson-Mann-Whitney non-parametric t-statistics for testing differences in medians under the assumption of independence of observations. The numbers in parentheses in Panel B are simple t-statistics for differences in mean also computed under the assumption of independence of observations. *Critical t-stats* are the percentiles for an upper tail test computed from a Monte Carlo simulation. The one-to-one correspondence between P/V ratios and 5-year BHARs are rearranged within each annual IPO cohort by using a randomization procedure (sampling without replacement). This generates a sample of pseudo P/V values and returns. High and low P/V portfolios are formed from this pseudo sample and the difference in returns between low and high P/V IPOs and the corresponding t-statistic under the independence assumption are computed. We repeat this procedure 5000 times and generate the empirical t-distribution. The 90^{th}, 95^{th}, and 99^{th} percentile from this distribution for an upper tail test are provided below.

IPO Portfolio	NYSE/Amex/ Nasdaq VW Index			Standard & Poors 500 Index			Industry, Sales and Profit Margin matched			Size matched		
	Issuers	Bench.	BHAR	Issuers	Bench.	BHAR	Issuers	Bench.	BHAR	Issuers	Bench.	BHAR
Panel A: Median 5-Year Buy-and-Hold Abnormal Returns												
Low P/V	3.8%	82.8%	-79.8%	3.8%	71.0%	-70.3%	3.8%	7.9%	1.0%	3.8%	19.6%	-6.5%
Medium P/V	-3.4%	86.8%	-89.1%	-3.4%	72.6%	-79.8%	-3.4%	19.3%	-23.9%	-3.4%	31.6%	-25.3%
High P/V	-25.3%	90.6%	-115.5%	-25.3%	78.2%	-105.2%	-25.3%	14.3%	-20.4%	-25.3%	26.7%	-34.7%
Low P/V - High P/V	29.1%	-7.8%	35.7%	29.1%	-7.2%	34.9%	29.1%	-6.4%	21.4%	29.1%	-7.1%	28.2%
			(4.84)			(4.75)			(3.33)			(4.00)
Critical t-stats based	*90%*	*95%*	*99%*	*90%*	*95%*	*99%*	*90%*	*95%*	*99%*	*90%*	*95%*	*99%*
on randomization	1.45	1.85	2.43	1.41	1.81	2.33	1.52	1.91	2.61	1.08	1.50	2.14
All IPO Firms	-7.9%	86.6%	-96.6%	-7.9%	73.2%	-86.4%	-7.9%	14.2%	-13.8%	-7.9%	25.7%	-23.5%
Panel B: Mean 5-Year Buy-and-Hold Abnormal Returns												
Low P/V	96.2%	91.2%	5.0%	96.2%	82.3%	13.9%	96.2%	64.0%	32.8%	96.2%	79.3%	16.9%
Medium P/V	71.3%	92.5%	-21.3%	71.3%	83.4%	-12.1%	71.3%	68.7%	2.6%	71.3%	96.9%	-25.6%
High P/V	60.5%	96.9%	-36.4%	60.5%	88.0%	-27.5%	60.5%	66.5%	-5.7%	60.5%	94.8%	-34.3%
Low P/V - High P/V	35.7%	-5.8%	41.5%	35.7%	-5.7%	41.4%	35.7%	-2.5%	38.5%	35.7%	-15.5%	51.2%
			(1.64)			(1.63)			(1.40)			(1.34)
Critical t-stats based	*90%*	*95%*	*99%*	*90%*	*95%*	*99%*	*90%*	*95%*	*99%*	*90%*	*95%*	*99%*
on randomization	1.31	1.67	2.22	1.34	1.66	2.26	1.37	1.70	2.21	1.36	1.70	2.38
All IPO Firms	76.1%	93.6%	-17.5%	76.1%	84.5%	-8.5%	76.1%	66.4%	10.0%	76.1%	90.3%	-14.3%

Table 6
5-Year Buy and Hold Return Differential Between Low and High P/V Portfolios of IPOs by Cohort Year

This table reports five-year BHAR differential between low and high P/V IPO portfolios formed each year. The valuations are based on P/EBITDA multiple. The BHAR differential is equal to BHAR (Low P/V) – BHAR (High P/V). The *mean* is the time-series mean of annual cross-sectional mean or median cohort returns. The t-statistics are Hansen-Hodrick-Newey-West corrected t-statistics for time-series mean with autocorrelation adjustment for four lags. *# of positive returns* refers to number of positive return differential among the 16 yearly cohorts from 1982 to 1997.

Panel A: Median 5-Year BHAR Differential between Low P/V and High P/V IPOs

Year	NYSE/AMEX/Nasdaq VW Index	Standard & Poors 500 Index w/o dividends	Industry, Sales, & EBITDA Margin	Size Matched
1982	357.5%	365.3%	410.9%	112.37%
1983	41.3%	67.1%	31.6%	23.28%
1984	25.9%	46.3%	56.1%	32.06%
1985	65.3%	65.2%	52.8%	31.66%
1986	-10.0%	-10.4%	15.9%	22.28%
1987	65.6%	62.5%	50.2%	38.27%
1988	67.4%	49.0%	-5.5%	-3.10%
1989	25.2%	25.7%	39.8%	35.52%
1990	-13.3%	3.8%	-22.7%	-50.75%
1991	-19.7%	-13.9%	-2.0%	25.59%
1992	91.7%	76.2%	40.9%	-1.97%
1993	71.6%	69.8%	63.4%	98.15%
1994	22.9%	20.4%	-18.3%	-38.82%
1995	16.6%	17.2%	24.2%	-3.57%
1996	31.4%	28.0%	25.0%	77.21%
1997	26.9%	24.4%	-8.1%	26.28%
# of Positive Returns	13/16	14/16	11/16	11/16
Mean	54.1%	56.0%	47.1%	26.5%
t-stat	2.74	2.12	1.47	3.19

Panel B: Mean 5-Year BHAR Differential between Low P/V and High P/V IPOs

Year	NYSE/AMEX/Nasdaq VW Index	Standard & Poors 500 Index w/o dividends	Industry, Sales, & EBITDA Margin	Size Matched
1982	283.9%	291.9%	372.4%	159.09%
1983	20.2%	19.8%	18.8%	17.48%
1984	23.6%	25.8%	-18.6%	34.89%
1985	-41.8%	-44.3%	-35.2%	-36.38%
1986	18.9%	18.1%	27.6%	23.97%
1987	76.2%	74.7%	92.9%	77.36%
1988	153.0%	148.7%	88.2%	148.83%
1989	-14.6%	-15.9%	0.9%	-43.76%
1990	-145.5%	-144.6%	-237.5%	-109.70%
1991	29.9%	30.0%	35.1%	58.72%
1992	10.3%	8.3%	19.0%	-73.96%
1993	86.3%	87.1%	72.1%	131.34%
1994	138.6%	139.2%	175.6%	106.24%
1995	25.6%	27.2%	-13.4%	20.31%
1996	44.0%	43.7%	57.5%	147.46%
1997	20.3%	19.8%	-9.0%	45.31%
# of Positive Returns	13/16	13/16	11/16	12/16
Mean	45.6%	45.6%	40.4%	44.2%
t-stat	2.76	2.69	1.77	2.77

Table 7

Fama-French Three Factor Time-Series Regressions

This table reports the results of Fama and French (1993) three-factor regressions involving equal-weighted monthly calendar time returns of Low, High, and Low – High IPO portfolios. The portfolios are constructed by allocating IPOs to low, medium, or high P/V portfolios as they become. Panel A reports results based on the first six-month returns (computed from the beginning of the next calendar month after the IPO). Panel B reports results based on the next 4 ½ years. IPOs drop out of the portfolios at the end of the holding period. The regression model is given below:

$$r_{pt} - r_{ft} = a_p + b_p\left(R_{mt} - R_{ft}\right) + s_p\, SMB_t + h_p\, HML_t + u_t$$

r_{pt} is the monthly portfolio returns, r_{ft} is the one-month T-bill return, ($R_{mt} - R_{ft}$) is the monthly excess return on the NYSE/AMEX/NASDAQ value weighted index, SMB is the return on small firms minus the return on large firms in month *t*, and HML is the return on high book-to-market stocks minus the return on low book-to-market stocks in month *t*. a_p is the monthly risk-adjusted abnormal return in percent and b_p, s_p, and h_p are factor loadings.

Panel A: Monthly returns over the first six months					
IPO Portfolio	a	b	s	h	Adj.R^2
Low P/V	-0.11	1.22	1.31	0.05	68.9%
	(-0.35)	(14.16)	(10.05)	(0.36)	
High P/V	1.34	1.32	1.26	-0.51	68.2%
	(3.42)	(12.85)	(8.11)	(-2.87)	
Low P/V - High P/V	-1.45	-0.09	0.05	0.56	5.0%
	(-3.09)	(-0.81)	(0.26)	(2.65)	
Panel B: Monthly returns over the next 4 1/2 years					
IPO Portfolio	a	b	s	h	Adj.R^2
Low P/V	-0.23	1.06	0.81	0.12	80.5%
	(-1.21)	(21.23)	(13.08)	(1.62)	
High P/V	-0.63	1.12	0.88	-0.18	79.2%
	(-2.67)	(18.15)	(11.52)	(-1.93)	
Low P/V - High P/V	0.40	-0.06	-0.07	0.30	14.7%
	(1.93)	(-1.12)	(-1.07)	(3.71)	

Table 8
IPO Valuation and Operating Performance

This table reports *median* growth rates, profitability measures, and other accounting ratios for Low, Medium, and High P/V IPO portfolios. *Return on Assets* is EBITDA/Total Assets, *EBITDA Profit Margin* is EBITDA/Sales, *Asset Turnover* is Sales/Total Assets and *Quick Ratio* is the ratio of (cash and short-term investments + accounts receivables)/Current Liabilities. Compustat annual data item numbers are: Sales (12), EBITDA (13), Total Assets (6), Cash and short-term investments (1), Accounts receivables (2), Current liabilities (5), Capital expenditures (128), Acquisitions (129), Total debt (9). The numbers in parentheses are Wilcoxson-Mann-Whitney test statistic for difference in median between Low P/V and High P/V portfolios (Low P/V – High P/V). The numbers presented in the table are medians. *Industry Adjusted* numbers are computed as the difference between the raw medians and industry (based on Fama-French industries) medians for the corresponding year.

Portfolios	Raw - Unadjusted						Industry Adjusted					
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Panel A : Annual Growth Rate in Sales												
Low P/V	----	21.37%	21.19%	15.62%	14.55%	11.62%	----	10.78%	9.01%	4.11%	3.72%	0.73%
Medium P/V	----	29.79%	25.91%	19.16%	15.58%	11.33%	----	19.16%	13.89%	7.99%	5.44%	2.87%
High P/V	----	44.86%	37.09%	24.88%	16.99%	13.49%	----	32.55%	23.17%	14.04%	6.39%	3.35%
Low P/V - High P/V	----	-23.49%	-15.90%	-9.26%	-2.44%	-1.87%	----	-21.77%	-14.16%	-9.94%	-2.67%	-2.62%
		(-12.97)	(-8.73)	(-4.00)	(-0.73)	(-0.86)		(-13.21)	(-8.98)	(-4.02)	(-0.93)	(-1.23)
Panel B : Return on Assets												
Low P/V	19.93%	17.68%	15.67%	14.98%	13.83%	13.73%	9.12%	6.59%	4.12%	3.61%	2.67%	2.61%
Medium P/V	20.12%	17.30%	14.55%	13.46%	12.90%	13.00%	8.99%	6.00%	3.57%	2.38%	1.81%	1.85%
High P/V	16.67%	14.36%	13.37%	11.86%	12.29%	11.87%	5.61%	3.55%	2.50%	1.19%	1.41%	0.80%
Low P/V - High P/V	3.26%	3.32%	2.30%	3.12%	1.54%	1.86%	3.51%	3.04%	1.63%	2.42%	1.27%	1.81%
	(5.69)	(6.67)	(5.15)	(4.98)	(3.42)	(3.31)	(5.49)	(6.26)	(4.85)	(4.61)	(3.26)	(3.36)
Panel C : EBITDA Profit Margin												
Low P/V	13.15%	14.23%	13.33%	12.63%	11.65%	11.08%	4.38%	5.03%	4.02%	3.37%	1.89%	2.45%
Medium P/V	13.40%	14.51%	13.21%	11.29%	10.44%	9.56%	4.09%	5.29%	3.49%	2.29%	1.81%	0.81%
High P/V	10.65%	12.56%	11.49%	10.18%	9.61%	8.79%	1.57%	3.87%	2.65%	1.32%	1.05%	0.69%
Low P/V - High P/V	2.50%	1.67%	1.84%	2.45%	2.04%	2.29%	2.81%	1.16%	1.37%	2.05%	0.84%	1.76%
	(6.35)	(3.42)	(3.53)	(3.80)	(3.56)	(3.49)	(6.40)	(3.13)	(3.05)	(3.38)	(2.87)	(2.85)
Panel D: Asset Turnover Ratio												
Low P/V	1.62	1.28	1.21	1.23	1.21	1.24	0.39	0.10	0.05	0.05	0.08	0.07
Medium P/V	1.63	1.21	1.16	1.17	1.21	1.27	0.39	0.03	-0.01	0.01	0.06	0.06
High P/V	1.66	1.09	1.11	1.13	1.18	1.18	0.46	-0.10	-0.04	0.00	0.01	0.00
Low P/V - High P/V	-0.04	0.19	0.10	0.10	0.03	0.06	-0.07	0.20	0.09	0.05	0.07	0.07
	(-1.43)	(4.88)	(3.33)	(1.97)	(1.19)	(1.24)	-1.47	5.95	3.84	2.26	1.75	1.72
Panel E : (Capital Expenditure+Acquisitions)/EBITDA Ratio												
Low P/V	35.45%	40.84%	54.89%	56.42%	47.34%	42.26%	-0.99%	5.03%	16.75%	16.48%	9.91%	4.97%
Medium P/V	34.07%	41.80%	65.39%	60.52%	50.73%	46.17%	-0.61%	5.98%	26.86%	19.87%	14.47%	9.00%
High P/V	49.92%	41.30%	53.75%	51.45%	44.21%	39.08%	15.22%	7.52%	20.83%	15.65%	8.75%	5.94%
Low P/V - High P/V	-14.47%	-0.46%	1.14%	4.97%	3.13%	3.18%	-16.21%	-2.49%	-4.08%	0.83%	1.16%	-0.97%
	(-5.56)	(-0.76)	(0.49)	(1.33)	(2.10)	(0.30)	(-6.44)	(-1.60)	(-0.05)	(1.13)	(2.02)	(-0.41)
Panel F : Debt/Total Assets Ratio												
Low P/V	24.78%	12.59%	14.39%	17.93%	17.83%	18.05%	12.11%	1.32%	3.39%	4.44%	2.68%	3.79%
Medium P/V	21.62%	8.04%	11.77%	12.16%	15.04%	18.47%	8.54%	-1.72%	-0.37%	0.00%	1.17%	4.06%
High P/V	12.87%	3.77%	3.47%	5.32%	6.80%	7.49%	1.37%	-4.18%	-3.08%	-2.30%	-2.15%	-1.59%
Low P/V - High P/V	11.91%	8.82%	10.92%	12.61%	11.03%	10.56%	10.74%	5.50%	6.47%	6.74%	4.83%	5.38%
	(6.32)	(8.31)	(7.52)	(6.29)	(5.15)	(4.46)	(6.86)	(9.07)	(8.41)	(6.59)	(5.10)	(4.69)

Table 9

Panel A: Distribution of IPOs by Size-B/M Quintiles

This table reports the distribution of IPOs across Fama-French size and B/M quintiles. The table also reports the distribution of low, medium, and high P/V IPOs in each size-B/M portfolio. Book value of equity is for the fiscal year just after the IPO and the market value is as of the closing on the first trading day after going public. IPOs with negative book values are excluded. The size-B/M portfolios are based on the Fama and French (1993) procedure. The total number of IPOs in this sample is 2,129.

Size	IPO	B/M					
	Portfolio	Low	2	3	4	High	Size alone
Small	Low P/V	9.1%	8.0%	3.1%	2.0%	2.5%	24.8%
	Medium P/V	10.4%	8.7%	3.3%	0.9%	0.3%	23.7%
	High P/V	12.5%	8.2%	2.0%	0.4%	0.5%	23.7%
	All	32.0%	24.9%	8.5%	3.3%	3.4%	72.1%
2	Low P/V	2.3%	1.6%	0.8%	0.3%	0.6%	5.6%
	Medium P/V	3.8%	1.6%	0.7%	0.3%	0.0%	6.4%
	High P/V	5.0%	1.6%	0.6%	0.2%	0.0%	7.3%
	All	11.0%	4.7%	2.1%	0.8%	0.7%	19.4%
3	Low P/V	0.4%	0.6%	0.2%	0.1%	0.0%	1.4%
	Medium P/V	1.5%	0.8%	0.2%	0.1%	0.0%	2.5%
	High P/V	1.6%	0.3%	0.1%	0.1%	0.0%	2.0%
	All	3.4%	1.6%	0.5%	0.4%	0.0%	6.0%
4	Low P/V	0.5%	0.2%	0.0%	0.1%	0.1%	0.9%
	Medium P/V	0.6%	0.1%	0.0%	0.0%	0.0%	0.7%
	High P/V	0.3%	0.1%	0.0%	0.0%	0.0%	0.5%
	All	1.4%	0.4%	0.0%	0.1%	0.1%	2.1%
Big	Low P/V	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Medium P/V	0.2%	0.0%	0.0%	0.0%	0.0%	0.3%
	High P/V	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
	All	0.4%	0.0%	0.0%	0.0%	0.0%	0.5%
B/M alone	Low P/V	12.3%	10.4%	4.2%	2.5%	3.3%	32.7%
	Medium P/V	16.5%	11.2%	4.3%	1.4%	0.4%	33.7%
	High P/V	19.4%	10.1%	2.8%	0.8%	0.5%	33.6%
	All	48.2%	31.8%	11.2%	4.7%	4.2%	100.0%

Panel B: Intercepts from Fama-French 3-Factor Regressions for Low, Medium, and High P/V IPOs in Small Size, Low B/M Portfolio

This table reports the intercepts from Fama-French 3-factor regressions for low, medium, and high P/V IPOs in the smallest size, lowest book-to-market portfolio. The t-statistics are in parentheses. The intercepts are based on a holding period of four and a half years starting six months from the offer date.

Portfolio	Intercept
Low P/V	-0.25
	(-0.89)
Medium P/V	-0.42
	(-1.50)
High P/V	-0.81
	(-2.39)

Table 9 continued..

Panel C: 5-Year BHAR for IPO Portfolios based on B/M Ratios

This table reports the buy-and-hold abnormal returns relative to control firms for IPO portfolios based on B/M ratios. The control firms are chosen based on Fama-French industry groups, sales, and EBITDA profit margins. The t-stat is a simple t-statistic for differences in mean computed under the assumption of independence of observations.

	Issuers	Bench	BHAR
High B/M	75.4%	72.0%	3.4%
Medium B/M	77.3%	56.0%	21.3%
Low B/M	77.5%	63.1%	14.4%
High - Low	-2.1%	8.9%	-11.0%
t-stat			-0.47