Are IPOs Underpriced?

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Comments Welcome

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Abstract

This paper studies the valuation of IPOs using comparable firm multiples. In a sample of more than 2000 IPOs from 1980 to 1997, we find that the median IPO is *overpriced at the offer* by about 50% relative to its industry peers. The overpricing is robust to valuation using different price multiples, industry classifications and matching firm selection procedures; the results are also robust over time and across technology and non-technology IPOs. In the cross-section, the median first-day abnormal return of overpriced IPOs *exceeds* that of the underpriced IPOs by about 5% but their median five-year BHAR *trails* that of the underpriced IPOs by up to 30%. The underperformance of the overpriced IPOs begins in the second year and lasts up to the fifth year. Overpriced IPOs also experience larger upward revisions in offer price and higher overallotment. Our results cast doubt on rational theories 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 tend to earn large first-day returns (between 10% and 15%) in the after market after going public.[1] This phenomenon is widely referred to as IPO *underpricing*. The use of this term in the academic literature presumes, however, that issuers intentionally underprice IPOs and offer them at prices well below their fair or intrinsic value.[2] Yet, there is no study in the literature that has rigorously tested this assumption.[3] We, therefore, ask a simple question in this paper. Are IPOs underpriced? We address this question by valuing IPOs using price multiples, such as price-to-EBITDA, price-to-sales, and price-to-earnings of industry peers and then comparing 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 based on their closeness to the IPO firm in terms of their dollar sales and EBITDA profit margin (EBITDA/Sales).[5]

Our analysis reveals the surprising result that IPOs are systematically overpriced at the offer. We find that, in a sample of more than 2000 relatively large-capitalization IPOs from 1980 to 1997, the median IPO firm is *overpriced* by about 50% relative to its industry peers. These results are robust to alternate price multiples, industry classifications, and matching firm selection procedures. The overpricing is observed over time and across IPOs in technology and non-technology sectors and 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. The extent of IPO overpricing is surprising given that IPOs are valued with respect to industry peers who

[1] See Logue (1973), Ibbotson (1975), and Ibbotson, Sindelar, and Ritter (1988) for early evidence of large first-day returns. See also the survey by Ibbotson and Ritter (1995) for an exhaustive review of the academic literature on IPOs.

[2] Popular MBA textbooks such as Brealey and Myers (2000) (see Chapter 15: pages 414-416), Ross, Westerfield, and Jaffe (1996) (see Chapter 13: pages 354-356), and Copeland and Weston (1988) (see Chapter 11: pages 377-380) describe first-day returns of IPOs as the result of underpricing with respect to fair value. The idea is that in an efficient market, investors bid up IPO stock prices to fair value in the after-market.

[3] Kim and Ritter (1991) 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.*

[5] See Bhojraj and Lee (2001) for a more detailed discussion on choosing industry peers based on fundamental analysis.

themselves might be overvalued in a "hot" market. The overpricing result is, however, consistent with the long-run underperformance of IPOs documented in the literature (see Ritter (1991), Loughran (1993), Loughran and Ritter (1995) and Brav and Gompers (1997)).

There are significant differences in the way overpriced IPOs and underpriced IPOs 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 Hwang (1989)) would predict underpriced IPOs should earn higher first-day return compared to overpriced IPOs.[6] Our results indicate the opposite. We find that, in the cross-section, the first-day return earned by overpriced (high P/V) IPOs exceeds that of the underpriced (low P/V) IPOs by about 5% to 7%.[7] In other words, IPOs that are initially overpriced continue to get even more overpriced in the after market exhibiting positive momentum (note that based on first day returns, these IPOs would be characterized as the most underpriced). This result is inconsistent with traditional theories of IPO underpricing. It is also inconsistent with behavioral theories that predict underreaction since underreaction would predict that the underpriced IPOs should exhibit more positive momentum in the aftermarket.

How do overpriced IPOs perform in the long run compared to underpriced IPOs? The median buy-and-hold abnormal return (BHAR) of overpriced IPOs (high P/V) *trails* that of the underpriced (low P/V) IPOs by 10% to 30% over a five-year period. The underperformance (of the high P/V IPOs relative to low P/V IPOs) starts 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. The results are also robust to parametric and non-parametric tests, bootstrap simulation methodologies, and three-factor regressions. All long-run studies need to be interpreted with caution given the various problems associated with computing long-run abnormal returns (see Barber and Lyon (1997), Kothari and Warner (1997), Fama (1998), and Brav (2000)). Regardless, the basic tenor of our results suggests that overpriced IPOs underperform underpriced IPOs in the long run.

[6] See Michaely and Shaw (1994) for a comprehensive empirical examination of the various IPO theories.
[7] P stands for the offer price and V is the value of the IPO obtained from comparable firm multiples.

It is useful to summarize the key results at this point:

- IPOs are overpriced relative to their industry peers with a median overpricing of about 50% in a sample of more than 2000 IPOs from 1980-1997.

- Overpriced IPOs earn roughly 5% to 7% higher returns on the first day of trading compared to underpriced IPOs.

- Overpriced IPOs seem to earn 10% to 30% lower buy and hold abnormal returns over the next five years compared to the underpriced IPOs.

These results suggest an IPO stock price process in which overpriced IPOs continue to get even more overpriced in the short-run exhibiting momentum, but fall back in the long run exhibiting reversals. Underpriced IPOs, on the other hand, earn lower returns in the short run but seem to earn higher returns in the long run. Consistent with the idea of overpricing momentum in the pre-market, we find that the offer price increases by about 2% from the mid-point of the initial filing range to the final offer price for overpriced IPOs. In contrast, underpriced IPOs experience a decline of about 4% to 5% from the mid-point of the initial filing range. Furthermore, for overpriced IPOs, more shares are over-allotted relative to the shares sold in the offering. Thus, overpriced IPOs seem to face excess demand and positive price momentum in both the pre-market and the after-market.

As pointed out earlier, these results are inconsistent with rational theories of IPO underpricing since rational theories predict the most underpriced IPOs should earn the highest first-day return. The rational theories also have very little to say about the long-run underperformance of IPOs. Traditional risk-return explanations are also unlikely to fare well since they cannot accommodate both the short-run and the long-run results at the same time. If the overpriced (high P/V) IPOs are deemed riskier, then the first-day returns may be explained but not the long-run returns. If they were deemed less risky, that would explain long-run returns but not the initial return or the pre-IPO positive momentum. In any event, our results seem robust to standard risk and benchmark adjustments. Our results also suggest that underwriters are not leaving money on the table in any real sense. Since the stocks are offered at prices significantly higher than their fair

values (obtained from the market multiples of industry peers), there is no dilution of equity or transfer of wealth from old shareholders to new shareholders.

We turn to explanations based on investor psychology. Recent behavioral theories (see Barberis, Shleifer, and Vishny (1998) (BSV), Daniel, Hirshleifer, and Subrahmanyam (1998) (DHS) and Hong and Stein (1999) (HS)) suggest two possible explanations. The models of BSV and HS suggest stock prices initially underreact to information giving rise to momentum and subsequently overreact leading to reversals (see the dotted line in Figure 4c). The DHS model (and the model of DeLong, Shleifer, Summers and Waldmann (1990) (DSSW)) suggests stock prices initially overreact to information and continue to overreact giving rise to momentum and subsequent reversals (see the continuous line in Figure 4c). Thus, in DHS and DSSW, unlike BSV and HS, momentum is due to continuing overreaction not underreaction.

Our results are more consistent with the models of DHS and DSSW than with the models of BSV and HS. Recall that our results show that IPOs are overpriced at offer and that the most overpriced IPOs earn the highest first-day return (and also upward revisions from the mid-point of the filing range to the offer price) and the lowest long-run return. This is consistent with initial overreaction leading to initial overvaluation at offer followed by subsequent overreaction in the after-market leading to further overvaluation. In contrast, the underpriced IPOs earn lower first-day return and higher long-run return; BSV and HS would predict the opposite, higher first-day return and lower long-run return.

In DHS, the source of security market overreaction is investor *overconfidence*. They argue that investors would be more overconfident and hence mispricing would be stronger in stocks that are more difficult to value and for whom feedback on fundamentals is ambiguous in the short run. IPOs fit this description quite well. Thus, overconfident investors may be betting that every IPO will turn out to be the next Cisco, Intel or Microsoft. Our results are consistent with this overconfidence explanation.[8] Overconfidence, however, need not be the only source of IPO overvaluation. Other mechanisms such as cascades (see Welch (1992)) induced by aggressive

[8] Miller (1977)'s divergence of opinion (see also Ibbotson and Ritter (1995)) hypothesis, which is based on investor optimism, is similar in spirit to the overconfidence hypothesis.

marketing on the part of issuers may also be at work. Finally, our results suggest that there may be important differences in the future operating performance, analyst coverage, institutional trading behavior, and the market microstructure of overpriced and underpriced IPOs. We leave such issues for future research.

Are IPOs underpriced? Our results suggest that IPOs are overpriced with respect to the valuations of peer firms in the same industry. They get even more overpriced in the aftermarket. Thus, the first-day return may be appropriately referred to as after-market overpricing. One could call this underpricing only in the following sense. They are underpriced with respect to what the market (irrationally) may be willing to pay on the first day of trading. But, this is analogous to calling a glamour stock that used to trade at a P/E multiple of 100 and now trades at 150 as being undervalued at 100. In any event, this raises an interesting conundrum. Can IPOs be overpriced and underpriced at the same time?

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 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. 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).[9]

[9] 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.

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. This list forms our final sample. 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 over-allotted shares are 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 earlier research (see Ritter (1991) 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 a matching firm in the same industry with comparable sales and EBITDA profit margin. We match on (appropriately defined) 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 sales are an ex ante measure of size. We do not want to use first-day IPO market capitalization because it is based on after market data that would not be available to an issuer or underwriter, pricing an IPO just before the offer date. 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.

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 too restrictive.

Our matching approach is similar in spirit to Bhojraj and Lee (2001) who show that adjustments to industry median multiples based on profitability and growth improve valuation accuracy.[10] Our approach is a balance between matching merely on industry or sales which is very approximate and trying to match on too 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.[11]

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 and ADRs, and firms with stock price less than five dollars as of prior June or December which ever is later.[12] 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.[13] 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)

[10] See also Kim and Ritter (1999) who argue for controlling for differences in growth and profitability.
[11] We also experimented with an alternate matching procedure that chose matching firms based on industry and IPO market capitalization where the IPO market capitalization was based on the mid-point of the offer price range from the initial filing. This procedure yielded IPO valuations that were even lower than those obtained using the industry-sales-EBITDA margin approach. We discuss this in more detail in Section 3.
[12] 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 overpricing. Also, since SEOs also underperform in the long run (see Loughran and Ritter (1995)), our long-run results should be biased toward zero for the overall sample. Our cross-sectional results would not be affected.
[13] We have replicated all our results using both CRSP and Compustat two-digit SIC codes and the results are similar.

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.[14] 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 detail next.

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 is 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)).[15]

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:

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

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

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

[15] 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.

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

All fiscal year data end at least three months prior to the offer date. *Earnings* refers 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 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 treats a 50% gain as

equivalent to a 50% loss, it would to 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.

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:

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

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

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 and 5, 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.[16] 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.
- 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).
- Industry-size matched control firms: These are firms in the same industry (based on Fama and French (1997) definitions) 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.

[16] 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."

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.

3. IPO Valuation

This section presents the most important result of this paper, that IPOs are systematically overpriced. 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, exceeds 1 significantly 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 overpricing of IPOs. Figure 1 also suggests some possible mean reversion in IPO valuations. The P/V ratios were quite high in early eighties, late eighties and mid nineties. They were relatively low in mid eighties and early nineties.

We have examined the robustness of these findings by valuing IPOs using a different set of comparable firms. For each IPO, we choose a comparable firm in the same industry with roughly the same market capitalization as the IPO. To ensure that we use only data available before the offer date, we use the mid-point of the initial filing range of offer prices and the CRSP shares outstanding on the first day to compute the IPO market capitalization. Our matching firm is a non-IPO firm in the same industry with roughly the same market capitalization as of prior June or December whichever is closest to the offer date.

Valuations based on these matching firms indicate even more overpricing. The median P/V ratio based on P/S multiples is 2.12 and the median P/V ratio based on P/EBITA multiples is 1.86. 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 this alternate set 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 less than $5 offer price; the P/S valuations are also robust to including negative EBITDA firms.

The cross-sectional distribution of P/V ratios in Table 2 exhibits significant positive skewness, which suggests that some IPOs tend to get extremely overpriced. 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-section Spearman rank correlations among P/V ratios based on P/S, P/EBITDA and P/E multiples. All pair-wise correlations are positive, above 50% 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.

Table 3 presents IPO valuations among technology and non-technology firms. We define technology firms as those that belong to 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). 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 overpriced 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 overpricing 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 overpricing result is that the apparent overpricing 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. 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 overpricing. 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 valuation 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 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. Thus, in reality, the high expectations based on which IPOs may be priced seem to be hardly ever met. In addition, as we note in Section 4.2, the most overpriced IPOs in our sample underperform the most. 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 head-on 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 overpricing result is that IPOs may be less risky than their matching firms. If this is the case, then IPOs may look overpriced while in fact the overpricing 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 industry risk premium is an important risk control when computing cost of capital for individual firms; in their paper, the inclusion of 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 more volatile than their matching firms. The cross-sectional average EBITDA volatility for IPO firms is 1.05 as against 0.86 for matching firms. The median volatility is 0.48 and 0.35 respectively for IPO firms and their matching firms. The cross-sectional mean and median volatility of EBITDA growth rates for IPO firms are 2.77% and 0.54% while the corresponding values for matching firms are 2.40% and 0.42%. All of the means and medians for the IPOs and their matching firms are significantly different from each other at the 1% level (additional evidence that overpriced IPOs are not less risky is provided in Table 8, which contains the results of three-factor time-series regressions). 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 conventional wisdom that IPOs are underpriced. Our results show that IPOs are systematically overpriced. The overpricing results are especially compelling since firms tend to time their offers to take advantage of industry-wide overvaluation; yet, we find IPOs are overpriced even when compared to their already overvalued industry peers. The high first-day return seems to be a continuation of this overpricing momentum and not a rational market reaction to initial underpricing. The results also call into question the notion that underwriters leave money on the table by strategically underpricing IPOs. Since the stocks are offered at prices significantly higher than their fair values (obtained from the market multiples of industry peers), there is no dilution of equity or transfer of wealth from old shareholders to new shareholders. In the next section, we explore the relation between IPO overpricing and after-market returns.

4. IPO Overpricing 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 overpriced. What is the relationship between IPO valuations and their first-day returns? Traditional theories of IPO underpricing would predict that IPOs that are underpriced, 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.[17] 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 staring 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

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

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).

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 (1988)) primarily because our sample contains larger IPOs. The results for the three IPO portfolios based on P/V ratios are much more interesting. Contrary to the traditional underpricing story, we find that it is the *Low P/V* (underpriced) 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* (overpriced) 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 overpricing momentum from the pre-market to the after-market rather than a rational market reaction to strategic underpricing on the part of the issuers/underwriters.

Additional results in Table 4 show that high P/V issues 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

Overpriced IPOs earn higher return than underpriced IPOs on the first day of trading. This could be because overpriced IPOs continue to get even more overvalued in the after-market. Or it could be that the issuers price these IPOs at a premium because they know something about the future growth prospects of these IPOs that we do not know. If the market agrees with them and believes that the future prospects are even better then they 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 overpriced 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, Panel B provides equal-weighted mean returns, and Panel C provides 1% Winsorized equal-weighted mean returns. The winsorization procedure drops the highest and the lowest half a percent of returns in each IPO portfolio. In our long run results, we focus primarily on the median results since they are more robust for distributions (such as five-year buy-and-hold returns) that are highly skewed. The mean and the winsorized mean results are larger in magnitude. The focus on the medians, therefore, is quite conservative.

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 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, mean, or winsorized 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 is 29.1%. The mean and winsorized mean returns in Panels B and C are respectively 35.7% and 24.1%. The difference in abnormal median returns varies from 12% in the case of industry-size matched control firms to 35.7% in the case of NYSE/AMEX/NASDAQ value-weighted market index. The differences are all statistically significant based on the non-parametric Wilcoxson-Mann-Whitney test.

The differences in mean returns in Panel B are larger in magnitude than the differences in median returns. For instance, the difference in buy-and-hold abnormal returns between Low P/V and High P/V IPOs based on industry-size matched control firms is 38.7% while the difference in medians is only 11.9%. Yet, the t-statistics for mean returns 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, all of the t-statistics in Panel B are significant only at the 10% level (one-sided test). The winsorized mean results presented in Panel C also reflect the same general patterns. The magnitudes of the differences are lower than the mean returns in Panel B but higher than the median returns in Panel C. Overall, the median and winsorized mean results suggest that the long-run results for high and low P/V portfolios are not driven by outliers.

The row entitled *All IPO Firms* in each of the panels represents the long-run buy-and-hold abnormal returns for the entire IPO sample. The results suggest that as a group IPOs tend to underperform their benchmarks in the long run although the underperformance in our sample is weaker than reported in prior literature especially for abnormal returns calculated using control firms. This may be due our choice of control firms in the same industry. Since issuing firms tend to time their offers to take advantage of industry-wide mispricing, industry controls are likely to provide weaker evidence of underperformance. By the same token, industry controls make our evidence of IPO overpricing more compelling because it suggests IPOs are overpriced compared to their already overvalued industry peers. We have replicated all our results using P/V ratios based on P/S and P/E multiples. These results are qualitatively similar. Median results are more robust than those based on mean returns. These results are not reported in the paper.

4.4 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 autocorrelation in five-year buy-and-hold returns due to the use of overlapping observations using the Newey-West-Hansen-Hodrick correction with four lags. They also correct for 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. The time-series averages of median buy-and-hold abnormal returns range between 37% and 54% depending on the benchmark used. The mean returns are more stable ranging between 40% and 48%. The t-statistics are significant at the 1%, 5%, or 10% level in 7 out of 8 cases (4 benchmarks in each panel). The only t-statistic that is insignificant corresponds to the median abnormal return with respect to industry and size matched control firms. Overall, the results in Table 6 confirm the long-run results in table 5.

4.3 Annual Returns of IPO Portfolios

We know that low P/V IPOs earn higher returns than high P/V IPOs over the next five years. We would also like to know the evolution of these returns over time. Do Low P/V IPOs earn higher returns early in the five-year period or later? We examine this issue by computing the annual returns earned by the various IPO portfolios from Year 1 to Year 5. Table 7 presents annual returns for low, medium, high P/V IPOs and the difference between low and high P/V IPOs. Panel A presents median abnormal returns with respect to the NYSE/AMEX/NASDAQ value-weighted market index (the results based on other benchmarks exhibit the same patterns). Panel B presents (equal-weighted) mean abnormal returns.

We focus on the median results in Panel A. The mean results are similar. In Year 1 (from close on the offer date), high P/V IPOs outperform low P/V IPOs by an economically insignificant 0.85% (3% in mean returns). This suggests that the overpricing momentum in the pre-market and the first-day of trading continues during the first year (even if only weakly). Starting in Year 2, however, low P/V IPOs begin to outperform high P/V IPOs. The highest returns are in Year 2, when low P/V IPOs outperform high P/V IPOs by 13.78% (10.23% in mean returns). Over the next three years, low P/V IPOs continue to outperform by 5% to 8% per year. Figure 3 graphically illustrates these results. These results suggest an IPO market in which some hot deals get overpriced, continue to get hot in the after-market but come crashing down after a year.

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 four years from the end of the first year to the end of the fifth year after the offer date. We skip the first year since the underperformance of high P/V IPOs starts in Year 2 (see Table 7). At the end of the four-year 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 presents in using overlapping five-year buy-and-hold returns and takes into account the cross-correlation among returns of across events.

As a result, the three-factor model (which is equivalent to the average abnormal returns (AAR) approach) suffers from fewer misspecification problems than the BHAR approach. 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 8 presents the regression results. Panel A presents the results based on the three-factor model. According to the results in Panel A, low P/V IPOs behave like *value* stocks while high P/V IPOs behave like *glamour* stocks; their exposures to the market factor and the small firm factor are similar. The difference in the HML loading between the two portfolios is 0.36, which is significant at the 1% level. This result reinforces the notion that high P/V IPOs are overpriced and low P/V IPOs are underpriced. It is also consistent with our aggregate result that IPOs are overpriced, not underpriced.

The abnormal return differential between low and high P/V IPOs is 3.7% (obtained by multiplying the monthly abnormal return of 0.31% by 12) per annum. This result is economically significant even though statistically it is significant only at the 10% level (t-statistic is 1.54). This is because of the inclusion of HML, which controls for under- and overvaluation effects. To assess the role of HML, in Panel B, we repeat these regressions after dropping HML. Now, the

intercept increases to about 6.1% per annum, which is significant at the 1% level. These results suggest that overpriced IPOs behave like other overvalued stocks and underpriced IPOs behave like other undervalued stocks. The abnormal returns come down once we control for the overvaluation and undervaluation effects, which is not surprising. Overall, these results reinforce our view that high P/V IPOs are overpriced at offer, get even more overpriced in the after market, and revert back to fundamentals in the long run.

Finally, the factor loadings with respect to market and SMB (see Panel B which excludes HML) suggest that high P/V IPOs are at least as risky as low P/V IPOs. This combined with our results on cash flow volatility in Section 3.2 suggests that it is difficult to explain our results (both short-run and long-run) based on risk differences.

5. 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 overpriced by 50% relative to its industry peers. This overpricing is robust to alternate price multiples, industry definitions, and matching firm selection procedures.
2) In the cross-section, the most overpriced (High P/V) IPOs earn 5% to 7% higher first-day return than underpriced (Low P/V) IPOs. Overpriced IPOs also experience upward revisions in offer price from the mid-point of the filing range while the underpriced IPOs experience downward revisions. Overpriced IPOs also experience higher overallotment compared to underpriced IPOs.
3) Overpriced IPOs underperform underpriced IPOs by 10% to 40% (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.

What do these results imply for the rational theories of IPO pricing? Traditional 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 underpriced.

Indeed, all of them attempt to explain the "underpricing" puzzle. Our finding that IPOs, in aggregate, are overpriced runs against the fundamental premise of these models. Our cross-sectional finding that the most overpriced IPOs (not the most underpriced) earn the highest first-day return is plainly inconsistent with these theories since they predict just the opposite.[18] The rational theories do not make any predictions about the long-run performance of IPOs. Therefore, it is hard to evaluate them on that basis. Nevertheless, it suffices to say that our results do not support the predictions of the rational theories.

Our results also suggest that underwriters are not leaving money on the table in any real sense. Since IPOs are offered at prices significantly higher than their fair values (based on the market valuations of industry peers), there is no dilution of equity or transfer of wealth from old shareholders to new shareholders. The question of leaving money on the table is reduced to asking why issuers do not overprice their issues even more? We discuss this question in Section 5.3 below.

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 start selling or shorting, the stock prices fall.

These hypotheses, however, are not full-fledged behavioral theories in the sense that they are 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

[18] Our result that the most overpriced (High P/V) IPOs experience upward revisions and the most underpriced (Low P/V) IPOs experience downward revisions in offer prices from the mid-point of the filing range to the final offer date is inconsistent with the predictions of Benveniste and Spindt (1989).

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 the security market behavior related to IPOs.

5.1 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. The convention when it comes to explaining momentum in cross-sectional equity returns is to assume that it is due to underreaction. In the context of IPOs, this theory would predict overpriced IPOs (low P/V IPOs) should earn low short run returns (negative momentum) and high long run returns (reversals) (see Figure 4(c)). Underpriced IPOs, on the other hand, would earn high returns initially (positive momentum) but low returns in the long run. Our findings are inconsistent with this theory. We find that the overpriced IPOs earn the highest return in the short run and the lowest return in the long run.

5.2 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 overpriced IPOs should earn higher first-day returns due to short-run positive momentum and lower long-run returns. The converse would be true for underpriced IPOs. Our findings are consistent with this prediction. How does overconfidence enter the picture? It enters possibly 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 seem to be betting that every IPO will be the next Cisco, Intel or Microsoft.

Imagine the following. Investors are overconfident about the future success of IPOs. Their excess demand for these IPOs leads issuers/underwriters to overprice them. This overconfidence carries over to the aftermarket causing additional overpricing. 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 overpricing. 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 own 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. Our results suggest issuers may not rely on underpricing as the primary vehicle to achieve such cascades. Studying the marketing strategies employed by investment banks early in an IPO process might help us understand how an IPO becomes sought after.

5.3 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 value these IPOs would bring in the after market. This is an essentially untestable explanation that will always be correct ex post. It also presumes that issuers are good at forecasting market prices. Independent observers, on the other hand, have no way of knowing whether an issue is underpriced until they see what happens in the after market. It is one thing to argue (as do the original underpricing theories) that the market rationally trades up to the fair value but quite another thing to suggest that issuers strategically underprice with respect to an as yet undetermined market price that bears little relation to the fair value. 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 value of peer firms in the industry.

5.4 Conclusion

Are IPOs underpriced? The results in our paper lead to the conclusion that they are not; in fact, our results suggest that IPOs are overpriced relative to the valuations of peer firms in the same industry. They continue to get even more overpriced in the after-market. Thus, the first-day return may be appropriately referred to as after-market overpricing. One could call the first-day return underpricing only in the following sense. They are underpriced with respect to what the market (irrationally) may be willing to pay on the first day of trading. But, this is analogous to calling a glamour stock that used to trade at a P/E multiple of 100 and now trades at 150 as being undervalued at 100. In any event, this raises an interesting conundrum. Can IPOs be overpriced and underpriced at the same time?

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 the interesting phenomenon that needs to be explained is IPO overpricing not underpricing. As we argue in Section 5.2, behavioral theories may provide the answer. On the other hand, any rational explanations of our findings needs to take into account the overpricing relative to industry peers and the relation between overpricing, first-day returns, and long run returns.

Our results also suggest directions for future research. The relation between IPO overpricing, 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 overpriced IPOs. Our results also suggest that analyst recommendation bias should be most evident for the overpriced IPOs. 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 overpriced and underpriced IPOs. We leave these and other issues for future research.

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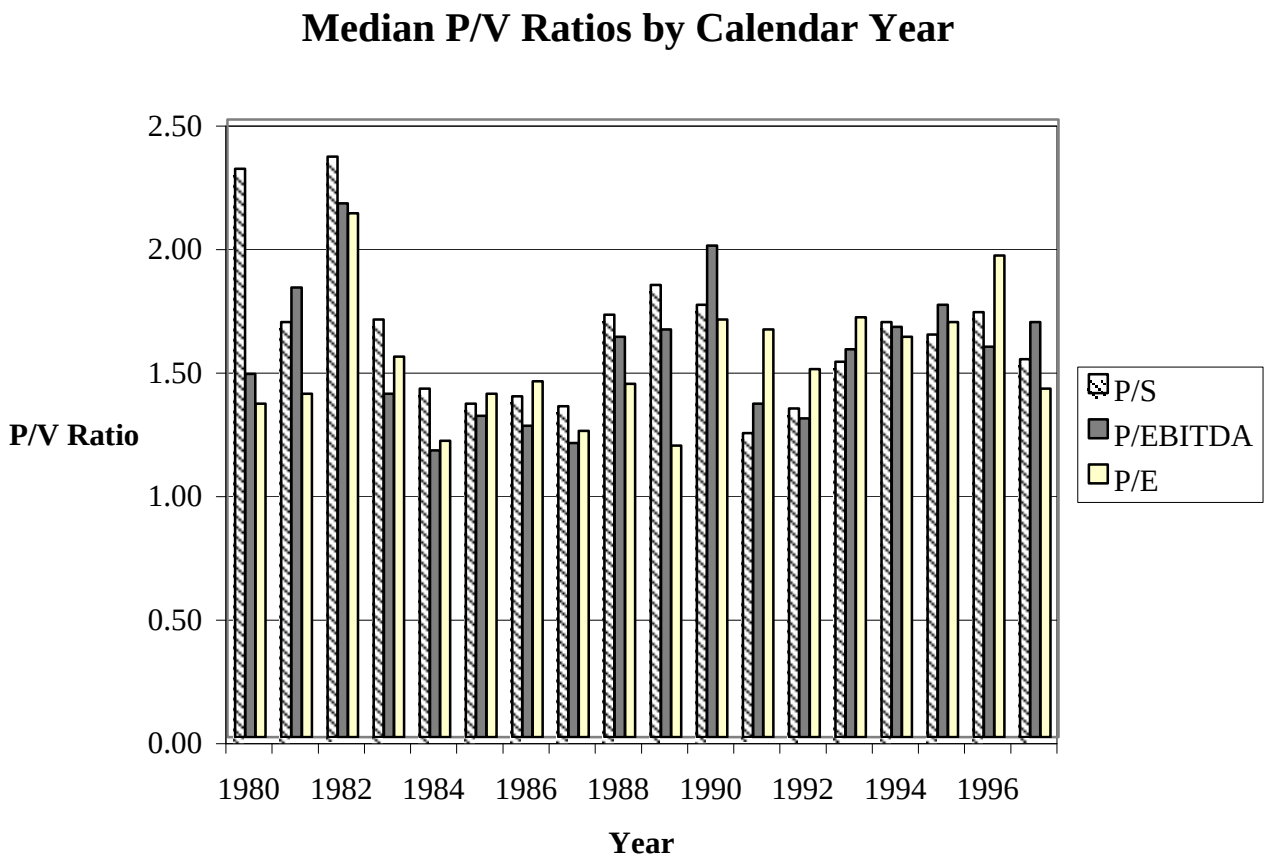

Figure 1: **Median P/V Ratios of Calendar Year Cohorts of IPOs**. The table graphs median P/V ratio for annual cohorts of IPOS based on P/S, P/EBITDA and P/E multiples. P refers to the offer price and V is the intrinsic value based on comparable firm multiples.

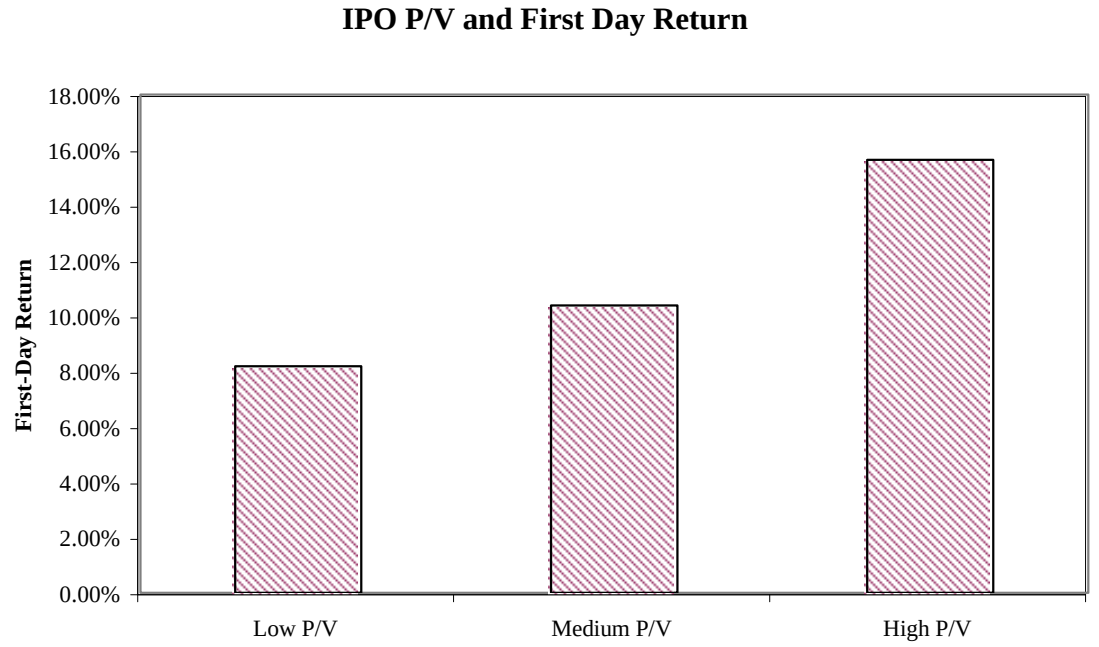

Figure 2a: **P/V Ratio and First-Day Return**. This figure graphs the median and mean first-day returns for the low, high, and medium P/V ratios. The P/V ratios are based on P/EBITDA multiples. P refers to the offer price and V is the intrinsic value based on comparable firm multiples.

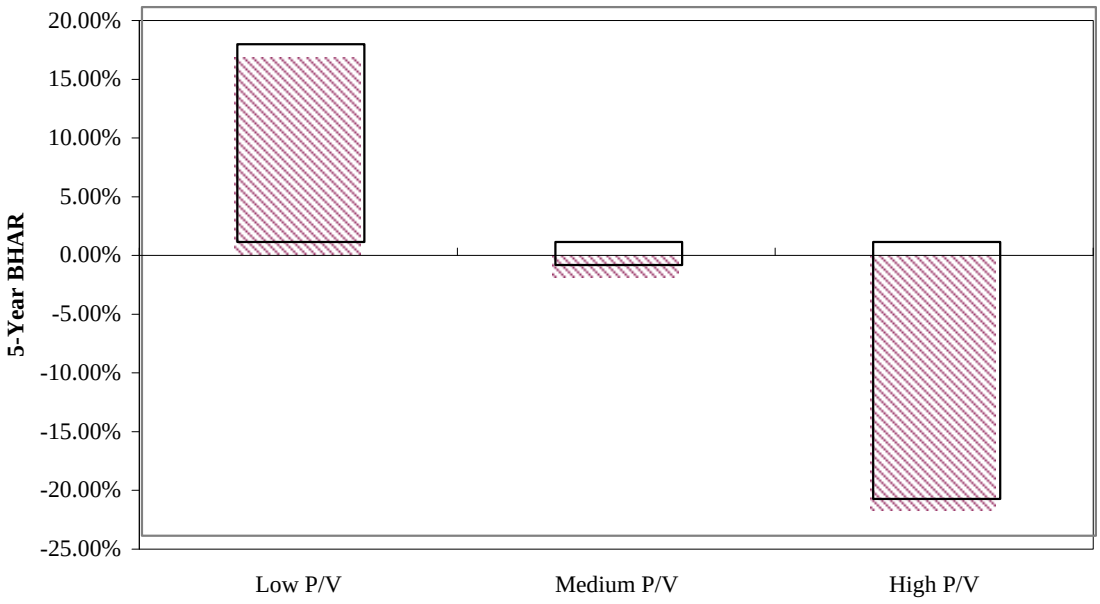

Figure 2b: **P/V Ratio and 5-Year BHAR**. This figure graphs the mean five year buy-and-hold abnormal returns (BHAR) measured with respect to industry-size matched control firms for the low, high, and medium P/V ratios. The P/V ratios are based on P/EBITDA multiples. P refers to the offer price and V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

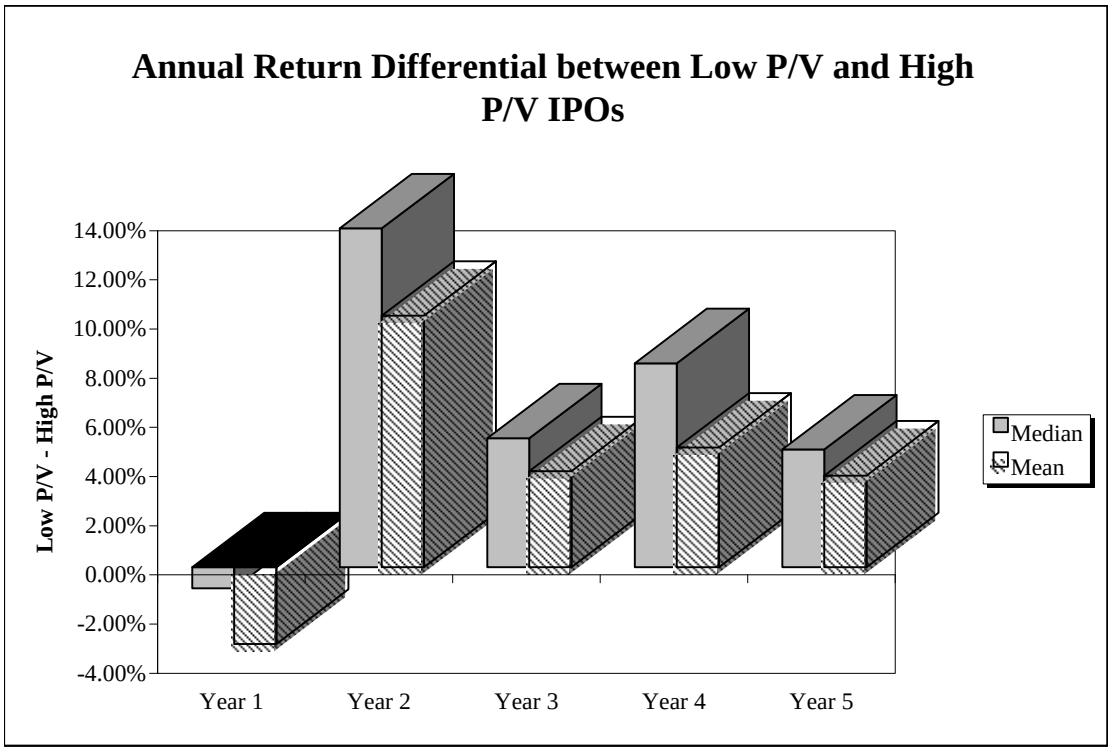

Figure 3: Annual abnormal return differential between Low P/V and High P/V IPOs. This figure plots the annual abnormal return differential between Low P/V and High P/V IPOs. The abnormal returns are computed with respect to the NYSE/AMEX/NASDAQ Value-Weighted Market Index. Year 1 refers to the the first 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

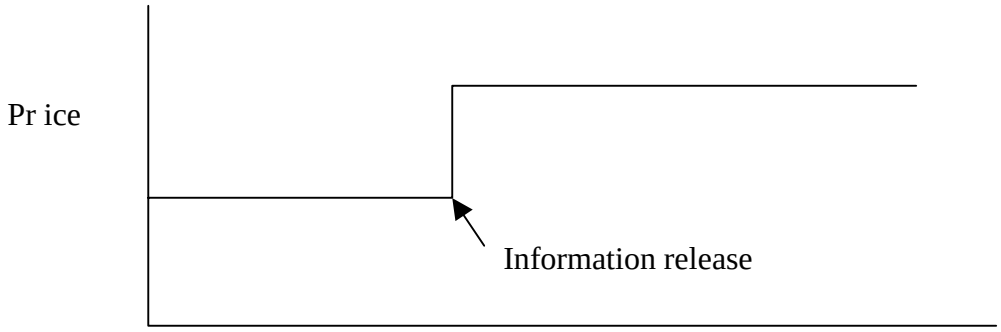

Figure 4b. Simple Underreaction *(Price adjusts to news signals with a lag)*

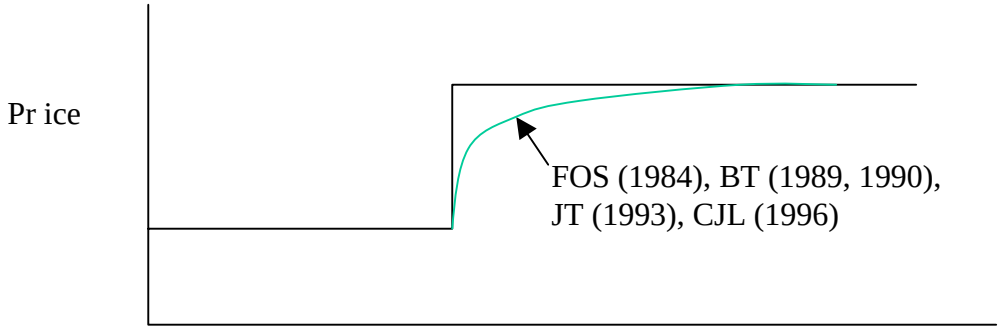

Figure 4c. Eventual Overreaction ***(Price eventually overreacts to news signals)***

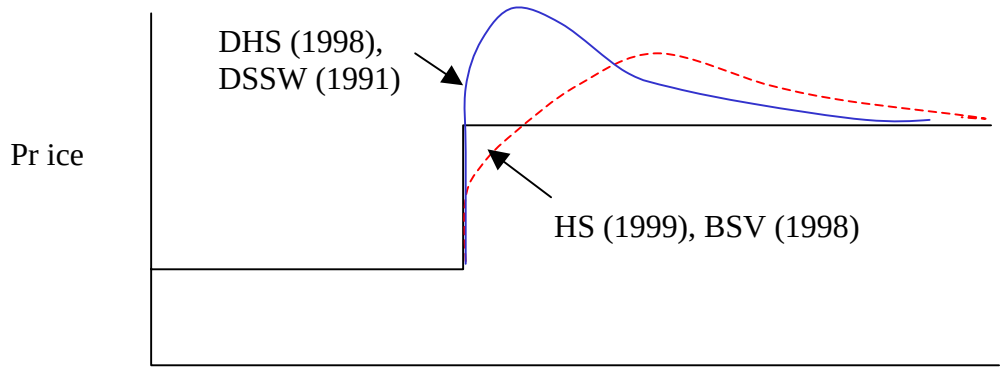

Figure 4: This figure contrasts the efficient market hypothesis (Figure 4a) with pure underreaction in Figure 4b and underreaction followed by overreaction (dotted line) and overreaction followed by continuing overreaction (continuous line) in Figure 4c.

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 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 25^{th}, 50^{th}, and 75^{th} 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)	85.0%	61.0%
P/V (EBITDA)	-------	71.0%

Table 3
Valuation of Technology and Non-Technology IPOs

This table 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 (Issues = 488)			Non-Technology (Issues = 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	2188

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, 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. Panel C reports equal-weighted mean BHAR after eliminating the highest and lowest 0.5% (Winsorized at 1%) of BHARs within each PV portfolio. 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 90th, 95th, and 99th 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, Growth Profit Margin matched			Industry and 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%	18.4%	-12.9%
Medium P/V	-3.4%	86.8%	-89.1%	-3.4%	72.6%	-79.8%	-3.4%	19.3%	-23.9%	-3.4%	24.7%	-25.0%
High P/V	-25.3%	90.6%	-115.5%	-25.3%	78.2%	-105.2%	-25.3%	14.3%	-20.4%	-25.3%	12.7%	-24.7%
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%	5.7%	11.9%
			(4.84)			(4.75)			(3.33)			(2.52)
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	1.35	1.69	2.32
All IPO Firms	-7.9%	86.6%	-96.6%	-7.9%	73.2%	-86.4%	-7.9%	14.2%	-13.8%	-7.9%	18.8%	-20.2%
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%	79.4%	16.8%
Medium P/V	71.3%	92.5%	-21.3%	71.3%	83.4%	-12.1%	71.3%	68.7%	2.6%	71.3%	73.2%	-1.9%
High P/V	60.5%	96.9%	-36.4%	60.5%	88.0%	-27.5%	60.5%	66.5%	-5.7%	60.5%	82.4%	-21.9%
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%	-3.0%	38.7%
			(1.64)			(1.63)			(1.40)			(1.36)
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	1.26	1.60	2.29
All IPO Firms	76.1%	93.6%	-17.5%	76.1%	84.5%	-8.5%	76.1%	66.4%	10.0%	76.1%	78.3%	-2.3%
Panel C: Winsorized (1%) Mean 5-Year Buy-and-Hold Abnormal Returns												
Low P/V	71.0%	91.2%	-19.6%	71.0%	82.4%	-10.6%	71.0%	59.2%	9.9%	71.0%	69.9%	0.4%
Medium P/V	51.2%	92.6%	-41.3%	51.2%	83.4%	-32.0%	51.2%	56.8%	-4.3%	51.2%	66.6%	-17.8%
High P/V	46.9%	96.9%	-49.5%	46.9%	87.9%	-40.6%	46.9%	59.4%	-10.4%	46.9%	75.8%	-27.4%
Low P/V - High P/V	24.1%	-5.7%	29.9%	24.1%	-5.6%	30.0%	24.1%	-0.2%	20.3%	24.1%	-5.9%	27.8%
All IPO Firms	58.1%	93.6%	-34.9%	58.1%	84.6%	-26.0%	58.1%	58.5%	0.4%	58.1%	70.4%	-12.7%

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, Growth & Margin	Industry and Size Matched
1982	357.5%	365.3%	410.9%	393.0%
1983	41.3%	67.1%	31.6%	47.3%
1984	25.9%	46.3%	56.1%	14.4%
1985	65.3%	65.2%	52.8%	27.1%
1986	-10.0%	-10.4%	15.9%	-14.0%
1987	65.6%	62.5%	50.2%	46.4%
1988	67.4%	49.0%	-5.5%	8.9%
1989	25.2%	25.7%	39.8%	-21.8%
1990	-13.3%	3.8%	-22.7%	11.1%
1991	-19.7%	-13.9%	-2.0%	-21.1%
1992	91.7%	76.2%	40.9%	63.1%
1993	71.6%	69.8%	63.4%	28.9%
1994	22.9%	20.4%	-18.3%	-12.5%
1995	16.6%	17.2%	24.2%	13.3%
1996	31.4%	28.0%	25.0%	-9.7%
1997	26.9%	24.4%	-8.1%	14.6%
# of Positive Returns	13/16	14/16	11/16	11/16
Mean	54.1%	56.0%	47.1%	36.8%
t-stat	2.74	2.12	1.47	1.24

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, Growth & Margin	Industry and Size Matched
1982	283.9%	291.9%	372.4%	337.8%
1983	20.2%	19.8%	18.8%	46.9%
1984	23.6%	25.8%	-18.6%	-36.0%
1985	-41.8%	-44.3%	-35.2%	-32.2%
1986	18.9%	18.1%	27.6%	4.2%
1987	76.2%	74.7%	92.9%	82.5%
1988	153.0%	148.7%	88.2%	132.0%
1989	-14.6%	-15.9%	0.9%	-40.6%
1990	-145.5%	-144.6%	-237.5%	-50.1%
1991	29.9%	30.0%	35.1%	4.1%
1992	10.3%	8.3%	19.0%	27.1%
1993	86.3%	87.1%	72.1%	106.2%
1994	138.6%	139.2%	175.6%	139.2%
1995	25.6%	27.2%	-13.4%	1.0%
1996	44.0%	43.7%	57.5%	23.7%
1997	20.3%	19.8%	-9.0%	25.4%
# of Positive Returns	13/16	13/16	11/16	12/16
Mean	45.6%	45.6%	40.4%	48.2%
t-stat	2.76	2.69	1.77	3.10

Table 7

Annual Abnormal Returns of Low, Medium, and High P/V Portfolios of IPOs

This table presents compounded annual returns of Low, Medium, and High P/V portfolios of IPOs. Year 1, 2, 3, 4, and 5 refer to compounded returns earned by IPOs over the first, second, third, fourth, or fifth year after the offer date. The returns are value weighted NYSE/ AMEX/NASDAQ market adjusted abnormal returns computed as the difference between the annual returns of the IPO firm and the annual returns of the market index. Panel A reports median returns and Panel B reports equal-weighted mean returns.

Panel A: Median Annual VW Market Adjusted Abnormal Returns					
Portfolio	Year 1	Year 2	Year 3	Year 4	Year 5
Low P/V	-16.31%	-13.90%	-16.38%	-14.03%	-16.71%
Medium P/V	-14.36%	-19.36%	-21.49%	-18.32%	-15.82%
High P/V	-15.46%	-27.68%	-21.63%	-22.33%	-21.50%
Low P/V - High P/V	-0.85%	13.78%	5.25%	8.30%	4.79%
All IPO Firms	-15.42%	-19.26%	-19.20%	-17.63%	-18.31%
Panel B: Mean Annual VW Market Adjusted Abnormal Returns					
Portfolio	Year 1	Year 2	Year 3	Year 4	Year 5
Low P/V	-3.12%	-3.05%	-3.46%	-1.07%	-0.52%
Medium P/V	-1.63%	-9.75%	-6.45%	-4.09%	-3.14%
High P/V	0.00%	-13.28%	-7.37%	-5.94%	-4.25%
Low P/V - High P/V	-3.12%	10.23%	3.91%	4.87%	3.73%
All IPO Firms	-1.59%	-8.69%	-5.78%	-3.72%	-2.68%

Table 8

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 public over years and holding them for four years skipping the first-year after they go public. 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 reports results from three-factor regressions. Panel B reports results from two-factor regressions involving only market and SMB.

Panel A: All Three Factors					
IPO Portfolio	a	b	s	h	Adj.R^2
Low P/V	-0.15	1.09	0.88	0.17	83.0%
	(-0.83)	(23.09)	(14.90)	(2.41)	
High P/V	-0.46	1.15	0.86	-0.19	80.9%
	(-2.02)	(19.43)	(11.66)	(-2.11)	
Low P/V - High P/V	0.31	-0.06	0.02	0.36	16.0%
	(1.54)	(-1.11)	(0.27)	(4.56)	
Panel B: Only Market and SMB					
IPO Portfolio	a	b	s	h	Adj.R^2
Low P/V	-0.06	1.04	0.81	-----	82.6%
	(-0.32)	(24.94)	(15.41)	-----	
High P/V	-0.56	1.21	0.93	-----	80.6%
	(-2.51)	(23.40)	(14.21)	-----	
Low P/V - High P/V	0.51	-0.18	-0.12	-----	8.2%
	(2.46)	(-3.72)	(-2.02)	-----	