Are IPOs Really Underpriced?

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Abstract

While IPOs have been consistently *underpriced* by 10% or more over the past two decades, we find that in a sample of more than 2,000 IPOs from 1980 to 1997, the median IPO is significantly *overvalued* at the offer price relative to value metrics based on industry peer price multiples. This *overvaluation* ranges from 14% to 50% depending on the peer matching criteria. Cross-sectional regressions show that "overvalued" (high offer price-to-value) IPOs provide high first-day returns but low long-run risk-adjusted returns. These overvalued IPOs have lower profitability, higher accruals, and higher analyst growth forecasts than "undervalued" (low P/V) IPOs. Ex post, the projected high growth of the overvalued IPOs fails to materialize, while their profitability continues to decline from pre-IPO levels. These results suggest IPO investors are deceived by optimistic growth forecasts and pay too little attention to current profitability in valuing IPOs.

The first-day returns of initial public offerings have averaged 10% to 15% in recent decades, giving rise to a well documented phenomenon known as IPO *underpricing* where the underpricing is calculated with respect to the offer price chosen by the issuers and their investment bankers.[1] This underpricing phenomenon has spawned a large theoretical literature, which attempts to justify the large first-day return as a compensation for bearing risk or as the cost of providing information.[2] These theoretical models almost always end with the conclusion that the average IPO is undervalued at the offer price since the first-day market price is, by definition, the indication of "fair value." If security prices, however, are not efficient in the short-run, an alternative view of the observed underpricing is that issuers and their investment bankers underprice the IPO relative to some maximum price they could have charged given the demand they observe at the time of pricing and first trade. In this framework, "value" is (at least temporarily) not identical to the first day market price, but presumably to some notion of long-run fair value.

Therefore, in this paper, in one of the first academic attempts to study the valuation of a broad cross-section of IPOs, we examine how IPOs are priced at the offer relative to their "fair value."[3] We compute fair values for IPOs using price multiples, such as price-to-EBITDA (Earnings Before Interest, Taxes, and Depreciation and Amortization), price-to-sales, and price-to-earnings, of *non-IPO industry peers* and then compare this *fair* value (V) to the offer price (P). 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 firms in terms of their operating characteristics. This approach provides a direct way of testing the IPO theoretical literature which predicts that IPO offer prices should be undervalued relative to fair value. It also allows us to shed light on the risk vs. mispricing explanations of the long-run underperformance of IPOs by relating *ex ante* valuation to *ex post* returns.

Our analysis reveals the surprising result that IPOs are systematically *overvalued* at the offer price relative to peer firms. We find that in a sample of more than 2,000 relatively large-capitalization IPOs from 1980 to 1997, the median IPO is *overvalued* by about 14% to 50% depending on the matching criteria, relative to its industry peers. Matching procedures based on industry, sales (used as a proxy for size), and profitability provide overvaluation of about 50%.

When we add analyst earnings growth forecasts (which tend to be too optimistic) as an additional matching criterion the overvaluation is about 33%. When we match only on analyst growth (in addition to industry and sales) the overvaluation is about 14%. Thus, choosing matching firms based only on analyst earnings growth forecasts without regard to profitability tends to generate valuations closer to offer price (although still significantly above it). This suggests that the IPO investors may be focusing too much on optimistic earnings growth forecasts and too little on current profitability in valuing IPOs.

The overvaluation result is inconsistent with the notion of underpricing/undervaluation with respect to fair value, which permeates most rational models of IPO pricing, but is consistent with the long-run underperformance of IPOs documented by Ritter (1991), Loughran (1993) and Loughran and Ritter (1995). We formally examine the relationship between P/V ratios and ex post returns using cross-sectional regression tests involving individual IPO data. We also use portfolio tests in which we divide IPOs into three portfolios based on their P/V ratios; a portfolio of undervalued IPOs (*Low P/V)*, a portfolio of overvalued IPOs (*High P/V)*, and the rest (*Medium P/V)*; and examine the return earned by a zero-investment portfolio that is long in low P/V IPOs and short in high P/V IPOs. The cross-sectional tests reveal a statistically and economically significant positive relationship between P/V ratios and first-day returns (controlling for the effects of B/M, analyst growth forecasts, and accruals) and a significant negative relationship between P/V ratios and long run risk-adjusted returns.[4] Portfolio tests show that overvalued IPOs provide 5% to 7% higher returns than undervalued IPOs on the first day after going public but provide 20% to 30% lower long-run risk-adjusted returns.[5] The first day results are inconsistent with asymmetric information models of IPO pricing which would predict the most undervalued IPOs to provide the highest returns on the first day. The long run results suggest that our valuation procedure does a reasonable job of distinguishing between undervalued and overvalued IPOs.

What are the differences between overvalued and undervalued IPOs? Overvalued IPOs are characterized by lower initial sales and EBITDA profit margins, higher filing date-to-offer date returns, higher first-day share turnover, higher overallotment, and higher analyst earnings growth forecasts. There are no significant differences in firm age, percentage of stocks held by insiders

after the IPO, underwriter quality, or book-to-market characteristics between undervalued and overvalued IPOs. However, in the Fama and French (1993) three-factor regressions, undervalued IPOs load positively on the book-to-market factor (HML) while overvalued IPOs load negatively (our portfolio results are robust to these differences). Finally, there are no significant differences in ex post cash flow volatility across undervalued and overvalued IPOs. The key differences across the two groups have to do with profitability and expected growth. Overvalued IPOs have lower current profitability but higher anticipated earnings growth while undervalued IPOs have higher current profitability but lower anticipated earnings growth. Ex post, however, the projected high growth rates of the high P/V IPOs do not materialize, while their profitability continues to decline from pre-IPO levels. Finally, overvalued IPOs have higher accruals than undervalued IPOs indicating that their reported earnings are of lower quality.[6]

Overall, our results suggest that IPO investors pay too much attention to optimistic growth forecasts and too little attention to current profitability in valuing IPOs giving rise to overvaluation at the offer price. Yet, our results can also be consistent with initial underpricing if underwriters tend to underprice not with respect to long-run fair value but with respect to the maximum offer price (above the fair value) they could have charged given the observed demand. The key message of our paper is that IPOs could both be overvalued and underpriced at the same time. The rest of the paper proceeds as follows. Section 1 describes the data and the valuation methodology, Section 2 presents the valuation results, Section 3 presents results on the relationship between P/V ratios and first-day returns, Section 4 presents long-run results, Section 5 discusses ex post operating performance and Section 6 concludes.

1. Sample Selection and IPO Valuation Methodology

1.1. 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).[7]
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 form 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. We start in 1980 because before 1980 very few IPOs had data available in Compustat for the fiscal year prior to the IPO date. We did not include IPOs after 1997 since there is not sufficient time ex post to evaluate their long-run performance. 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 (2002a) 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.

1.2 Choosing Matching Firms in the Same Industry

For each IPO in our sample we find a *non-IPO industry peer* with comparable sales and EBITDA profit margin that did not go public within the past three years. We match on industry because this is where we are 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. Next, 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. Finally, 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 do robustness tests in Section 2.1 by matching on ex post analyst earnings growth forecasts.

Our matching approach is similar in spirit to Bhojraj and Lee (2002) who show that adjustments to industry median multiples based on firm operating performance improve valuation accuracy.[8] 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, for our base case, we settle on industry, sales and EBITDA profit margin to find matching firms for the IPOs in our sample.

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, whichever is later.[9] 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. 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 then matched to the appropriate industry-sales-EBITDA margin portfolio. From this portfolio, we find a matching firm that is closest in sales to the IPO firm. We try to make sure that each IPO gets a unique matching firm in a given cohort year. Some times the matching firms get repeated in some portfolios which contain only a few matching firms. Dropping these cases does not appreciably affect our findings. For all practical purposes, however, almost all firms in our sample get unique matching firms in the cohort year. We value IPOs based on the price multiples of these matching firms. We describe this valuation methodology in the next section.

1.3 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 (2002)).[10]

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 immediately 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. IPO Valuation

This section presents the first key finding of this paper, that IPOs are systematically overvalued at the offer price. Panel A of Table 2 presents the 25th, 50th, and the 75th 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.[11]

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. 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 (2002)). Panel B 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.

2.1 Robustness tests by matching on ex post earnings growth forecasts

One concern about the result in the last section is that the apparent overvaluation of IPOs may be due to an omitted variable problem related to future growth. If IPOs are expected to grow much faster than their industry comparables, the premium we observe may be justifiable. In response to this concern, we first note that 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 earn lower returns in the future. 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 (2003) find that there is very little persistence in earnings growth rates and suggest that valuations based on the extrapolation of past high growth rates are likely to be erroneous.

Nevertheless, we examine the robustness of our findings by using alternate matching procedures that take into account growth. Since past earnings or sales growth is available for only 250 firms in our sample, we use ex post analyst earnings growth forecasts as a proxy of the earnings

expectations that exist as of the IPO date. There are several problems with this assumption. Foremost, earnings growth forecasts that become available only several months after the IPO date are likely to be strongly influenced by the information that arrived after the IPO date, information that would not be available to investors at the time of the IPO. This problem is compounded by the fact analysts have strong incentives to issue excessively optimistic forecasts and recommendations for IPOs (see Michaely and Womack (1999)). Indeed, Rajan and Servaes (1997) find that IPOs with high analyst growth expectations underperform IPOs with low analyst growth expectations in the long run suggesting that IPOs with high analyst growth expectations tend to be overvalued. As a result, matching on growth may simply turn up comparable firms that also tend to be overvalued which in turn would reduce the power of the comparable valuation techniques to find mispricing. A final problem is an empirical one; ex post growth forecasts are available only for about 2/3rd of the IPOs in our sample which would reduce the power of our tests. With these caveats in mind, we consider two alternate procedures to choose comparable firms:[12]

(a) Matching on industry, sales, EBITDA profit margin, and ex post consensus analyst growth forecasts.
(b) Matching on industry, sales, and ex post consensus analyst growth forecasts.

When we match on industry, sales, EBITDA profit margin and growth (with a sample size of only 1,530 IPOs) the median IPO overvaluation becomes 1.33. When we match on growth alone (with a sample size of only 1,652 IPOs) the median IPO overvaluation is 1.14. Both numbers are significantly above 1 based on the Wilcoxson rank sum test. In comparison, the median overvaluation for the base case (matching on industry, sales, and EBITDA margin) is 1.49. Thus, choosing matching firms based on analyst growth forecasts tends to generate valuations closer to offer price (although still significantly above 1) with the closest valuation obtained when matching just on growth alone. This suggests that the investors/underwriters may be focusing too much on optimistic earnings growth forecast (which ex post evidence suggests hardly ever gets realized, see Jain and Kini (1994) and Table 9 of our paper) and too little on current profitability in choosing comparable firms to price IPOs. For the rest of our analysis, we retain our base case of industry-sales-EBITDA margin matched IPO sample since it is based on strictly ex ante

information and also because it provides us the largest sample size. But, in Table 8, we present key findings for the alternate matching procedures to confirm the robustness of our findings.[13]

3. IPO Valuation and First-Day Returns

3.1 IPO Valuation, Short-run Returns, and Portfolio Characteristics

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 returns. 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.[14] 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 need 1980 and 1981 to get an initial distribution). 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. Our portfolio formation procedure ensures that there is no calendar time clustering across the three IPO portfolios. We find that (results not reported in a table) each annual cohort of IPOs is distributed fairly uniformly (roughly 1/3rd in each portfolio) across the three P/V portfolios.

We have also examined the distribution of low, medium, and high P/V IPOs among Fama and French (1993) size-B/M quintiles. The results (not reported in a table) show that while about 83% of our sample falls in the two lowest B/M quintiles only about 8% of the sample is in the two highest B/M quintiles. Thus, 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 (24% are low P/V, 29% are medium P/V and 31% are high P/V).

Similarly, the IPOs in the smallest size, lowest B/M portfolio are also uniformly distributed across low, medium, and high P/V portfolios. Thus, there is no clustering of low P/V IPOs in high B/M portfolios and high P/V IPOs in low B/M portfolios indicating only a weak correlation between P/V ratios and B/M characteristics.

Table 3 reports median and mean first-day returns earned by low, medium, and high P/V portfolios. The t-statistics for equality of means are based on simple two-sample t-statistics computed under the assumption of independence; we use the nonparametric Wilcoxson-Mann-Whitney ranks 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 DeGroot (1986)).

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 primarily because our sample contains larger IPOs (our numbers are similar to those in Loughran and Ritter (2002a)). 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. These 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 are also robust over time. The mean differences between the (value-weighted market-adjusted) first-day returns of low P/V and high P/V IPOs for the 1982-86, 1987-91, and 1992-97 sample periods are -5.82%, -3.64%, and -9.29% respectively.

What is different about low P/V and high P/V IPOs? Table 3 reports various characteristics for the IPO portfolios. Low P/V IPOs are characterized by higher initial sales and EBITDA profit margins, lower filing date-to-offer date returns, lower first-day share turnover, lower overallotment, and lower analyst earnings growth forecasts. While the median analyst growth forecast for undervalued IPOs is 20% per year over the next five years, it is 30% for overvalued

IPOs. There are no significant differences in firm age, percentage of stocks held by insiders after the IPO or underwriter quality across undervalued and overvalued IPOs.[15] The high P/V IPOs tend to be younger by 1.8 years and insiders tend to hold a little bit more stock (about 2.7%) in them after the IPO relative to low P/V IPOs. These are not big differences and cannot explain the differences in valuation across the two groups. The key differences across the two groups have to do with profitability and expected growth. Overvalued IPOs have lower current profitability but higher analyst growth forecasts while undervalued IPOs have higher current profitability but lower analyst growth forecasts.

3.2 Cross-sectional regression tests involving P/V ratios and first-day returns

We formally test the cross-sectional relationship between P/V ratios and first-day returns in a multivariate setting using the following regression:

$$\begin{aligned} R(1stDay)_i = {} & a + b \times LnPV_i + c \times LnBM_i + d \times LnGrowth_i \\ & + e \times Accruals_i + f \times LnSales_i + g \times EBITDA\ Margin_i + u_i \end{aligned} \tag{4}$$

The index *i* refers to the IPO firm. R(1st day) is the VW market adjusted first-day return. *LnPV* is the natural log of offer price-to-value ratio. *LnBM* is the natural log of book-to-market ratio where *book* is the book value of equity (COMPUSTAT item number 60) for the fiscal year after the IPO date and *market* is the market value of equity as of the first-day closing. Note that using the first-day closing market cap will introduce a negative correlation between first-day returns and B/M ratio because closing price shows up in both variables. *LnGrowth* is the natural log of (1+consensus analyst earnings growth rate for the IPO). Note that this variable is available only several months after the IPO date. Therefore, one should interpret the slope coefficient corresponding to growth as first-day returns forecasting future growth. The *Accruals* variable is the ratio of accruals to total assets based on the first annual statement after the firm goes public. This variable is constructed from the statement of cash flows for fiscal years after 1987 and from the balance sheet data for the earlier period. Using the cash flow statement, we construct accrual variable as Income Before Extraordinary Items (item 123) minus Cash Flows from Operations (item 308 minus item 124). For the earlier period, we construct the accrual variable as Change in Current Assets (Δ4) minus Change in Cash (Δ1) minus Change in Current Liabilities (Δ5) plus

Change in Debt included in Current Liabilities (Δ34) plus Change in Income Tax Payable (Δ71) minus Depreciation & Amortization (14). The accrual variable is scaled by the average of beginning and year-end total assets (item 6).

LnSales is the log of sales (item 12) for the fiscal year ending at least three months prior to the IPO date and is used as a control for size (using market cap based on mid-point of the filing range does not change the findings). *EBITDA Margin* (item 13 divided by 12) is computed for the same fiscal year as the *LnSales* variable. The regression in (4) is estimated by pooling the time-series and cross-sectional observations and uses the White (1980) standard errors to correct for heteroskedasticity. We estimate regression (4) with and without growth mainly because the sample size is larger when we exclude growth. The numbers in parentheses are White corrected t-statistics.

The results are provided in Table 4. As predicted, the first-day return is significantly positively related to the P/V ratios. The relationship is robust to including or excluding growth. The negative relationship between book-to-market ratios and first-day returns is the result of the fact that the first-day closing price is used to compute both variables. First-day return is negatively related to prior fiscal year sales and negatively related to EBITDA margin. There is a positive relationship between first-day returns and analyst growth forecasts which suggests that higher first-day returns is followed by higher growth forecasts suggesting that these forecasts are indeed affected by after-market performance. Accruals variable is not significant in this regression.

4. IPO Valuation and Long-Run Returns

Overvalued IPOs provide higher returns than undervalued IPOs on the first day of trading. This could be either because IPOs that are overvalued at offer continue to get even more overvalued in the after-market presumably due to investor optimism or because the market believes that these IPOs are worth more and bids them up to the efficient market price. One way to resolve this issue is to examine the cross-sectional relationship between IPO valuations and long-run returns. If our P/V measure does a reasonable job of picking up cross-sectional mispricing among IPOs then high P/V IPOs should earn lower returns 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.

Empirically, though, tests based on long-run returns are fraught with all kinds of measurement issues. There are disagreements over correct methodology (calendar time or event time), correct model to compute risk-adjusted returns (three factor or single factor), and power of various methodologies to detect abnormal performance.[16] Consequently, results based on long-run returns need to be interpreted with caution. In this paper, we rely on several different tests to examine the relationship between P/V ratios and long-run returns. Our primary empirical test is the cross-sectional regression test that we used in Section 3.2. The regression test uses individual IPO data and allows us to examine the relationship between P/V ratios and long-run IPO returns while controlling for the influences of other variables such as B/M ratios, analyst growth forecasts, and accruals that are known to be related to the cross-section of stock returns.

We also use portfolio tests in which we examine the return earned by a zero-investment portfolio that is long low P/V IPOs and short high P/V IPOs. In portfolio tests, we focus on calendar-time regressions based on single-factor and Fama and French (1993) three-factor model since statistically they provide the most reliable results. But, we also provide results based on the buy-and-hold abnormal returns (BHAR) approach in which we use a simulation approach based on randomization techniques to generate empirical critical statistics.

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

We start by first computing the (NYSE/AMEX/Nasdaq value-weighted) market adjusted annual returns earned by the three IPO portfolios over a five-year period after the IPO date. We do this to derive some intuition on the evolution of long-run returns before we turn to more formal tests with stricter benchmarks. Table 5 presents annual market adjusted abnormal returns for low, medium, and high P/V IPOs. It also provides the difference between low and high P/V IPOs. The Year 1 returns are broken up into two six-month periods in light of the fact that lock-up periods typically expire after six months.[17]

Since the small sample distribution of long-run returns in event studies (especially buy-and-hold returns over 3 to 5 years) tends to be highly misspecified, we compute critical t-statistics for testing two-sample means and medians (at the 90th, 95th, and 99th percentiles for upper tail tests) using a *randomization (sampling without replacement) procedure*.[18] 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 20,000 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 statistical inferences involving BHAR.

Panel A of Table 5 presents median abnormal returns and Panel B presents (equal-weighted) mean abnormal returns The numbers in parentheses in Panel A are t-statistics based on the Wilcoxson-Mann-Whitney test for difference in medians and the numbers in parentheses in Panel B are simple t-tests for difference in means (see section 3.1). The empirical p-values from the randomization procedure are reported along the row titled *Empirical p-values*. We focus on the mean results in Panel B. The median results are similar. During the first six months after the IPO (starting from the close on the first day of trading), high P/V IPOs continue to outperform low P/V IPOs by a statistically significant 5.4%. Thus, the overvaluation momentum in IPO stock prices on the first day of trading continues, on average, up to six months after the IPO date until the lock-up period expires. After six months, however, high P/V IPOs begin to underperform low P/V IPOs. Over the next four years, high P/V IPOs underperform low P/V IPOs significantly by 4% to 10% per year with a significant portion of the underperformance being concentrated in Year 2. Figure 2 graphically illustrates these results. The results for *All IPO firms* confirm that IPOs as a group underperform broad market indices.

4.2 Cross-sectional Regression Tests

We estimate the following cross-sectional regression test to formally examine the relationship between P/V ratios and long-run risk-adjusted returns:

$$R_i^* = a + b \times LnPV_i + c \times LnBM_i + d \times LnGrowth_i + e \times Accruals_i + f \times LnSales_i + g \times EBITDA\ Margin_i + u_i \quad (5)$$

The index *i* represents the IPO firm. R_i^* is the long-run risk-adjusted return for each IPO estimated as the intercept from a Fama and French (1993) three factor regression involving individual IPO monthly excess returns starting six months after the IPO month and ending five years after the IPO month. Thus, R_i^* represents the monthly average abnormal return which tends to have better distributional properties and is statistically better behaved than buy-and-hold abnormal returns. The independent variables in equation (5) are defined exactly as in the first-day return cross-sectional regression (see equation 4) discussed in section 3.2.

In regression (5), we include analyst growth forecasts because Rajan and Servaes (1997) find IPOs with high analyst growth expectations subsequently underperform IPOs with low growth expectations. B/M ratios are related to the cross-section of stock returns even though there is no evidence that they are related to the cross-section of IPO returns. Nevertheless, it is important to control for the B/M effect in tests involving long-run returns. The book value of equity is from the first fiscal year after the IPO date and the market value of equity is based on the first-day closing price. We include accruals variable from the first annual statement after the IPO date also as a control since Teoh, Welch, and Wong (1998) find IPOs with high accruals underperform. Finally, we include prior fiscal year sales as a proxy of ex ante size (replacing log sales with log market cap based either on offer price or first-day closing price provides similar results**)** and prior fiscal year EBITDA profit margin as a control for profitability.

Table 6 presents the results of cross-sectional regressions. We estimate the regressions using (a) pooled time-series cross-sectional approach and (b) Fama-MacBeth regression approach. In the Fama-MacBeth approach, we estimate a cross-sectional regression using each annual cohort of IPOs from 1982 to 1997 and then report the time-series average of slope coefficients. In the pooled approach, the standard errors are corrected for heteroskedasticity using the White (1980) correction. In the Fama-MacBeth approach, when computing standard errors, we use four Newey-West lags to correct for any autocorrelation in annual coefficients.

The results in Table 6 show that the P/V ratio is significantly negatively related to long-run risk-adjusted returns. The relationship is robust in both the pooled regressions and in the Fama-MacBeth regressions and is robust to the inclusion or the exclusion of analyst earnings growth. The slope coefficient is in the range of 0.38% to 0.55% per month, which can be interpreted as the return premium corresponding to P/V ratios. A return premium of this magnitude is economically significant. The cross-sectional relationship between P/V and long-run returns is also quite robust over time. In regressions without growth, 12 out of 16 Fama-MacBeth annual regression coefficients corresponding to LnPV are negative. In regressions with growth, this number increases to 15 out of 16 indicating the reliability of this relationship over time.

None of the other variables are reliably related to long-run returns. Analyst growth forecasts and accruals both have the right sign in predicting long-run returns but are not statistically significant in our sample. There is no B/M effect in our sample. In fact, the B/M ratio has the wrong sign in predicting long-run returns. These results clearly show that the relationship we document in Table 6 between P/V ratios and long-run abnormal returns is not driven by B/M ratios, analyst growth rates, or accruals. In the next section, we examine the relationship between P/V ratios and long-run returns using portfolio tests.

4.3 Portfolio tests based on the three-factor model

The evidence in section 4.1 indicates that low P/V IPOs outperform high P/V IPOs over the four years following the year of IPO. This finding, however, is based on market-adjusted abnormal returns, which do not fully control for the various systematic risks or style influences affecting IPO returns. We control for such risks by computing monthly risk-adjusted abnormal returns (alphas) of the zero-investment portfolio (Low P/V – High P/V) based on the Fama and French (1993) three-factor model. We also present results based on the market model and a two-factor model containing only the market and the size factor for comparison.

The monthly portfolio returns are computed as follows. Each IPO is allotted to one of three P/V portfolios and is held for either six months starting from the beginning of the first calendar month after the IPO (six-month returns) or for 54 months from the end of the sixth month after the offer date (long-run returns). The division of the five-year period into these two periods is

based on the fact that lock-up periods typically expire after six months. At the end of the 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.[19]

Estimates based on the three-factor model (which is equivalent to the average abnormal returns (AAR) approach) using monthly calendar time returns suffer from fewer misspecification problems than the BHAR approach. This approach avoids the autocorrelation problems present in using overlapping five-year buy-and-hold returns, takes into account the cross-correlation among returns across clustered events, and presents the most reliable test statistics. 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 tend to be noisy (as in the case of IPOs). On the other hand, there are some issues associated with the power of these tests to detect abnormal performance (see Loughran and Ritter (2000)).

Panel A of Table 7 presents the regression results for both the six-month holding period and the 54 month holding period. We focus on the intercept of the (Low P/V – High P/V) portfolio which represents the "risk-adjusted" abnormal return earned by the (Low P/V - High P/V portfolio). Based on the three-factor model, at the six-month horizon, 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 54 month horizon, the "risk-adjusted" abnormal return earned by the high P/V portfolio based on the three factor model is a statistically significant –7.6% (-0.63 times 12) per annum. The abnormal return earned by the low P/V portfolio is only -2.8% (-0.23 times 12) per annum and is insignificant. The difference is 4.8% (0.40 times 12) per annum and is statistically significant. The difference increases to about 6.7% (0.56 times 12) when the two-factor model is used to control for risk and it becomes about 7.3% per annum (0.61 times 12) when only the single factor model is used to control for risk. We provide the single factor and two factor results since there is still controversy over whether HML is a risk factor or just a style factor.[20]

The results in Panel A also provide clues as to the style characteristics of the long-run portfolio strategy involving low P/V and high P/V stocks. In the long-run, high P/V IPOs have a small negative loading on the HML factor and the low P/V IPOs have a small positive loading on the HML factor which suggests that the two portfolios have some tendency to behave like *glamour* stocks and *value* stocks respectively. This translates into a significant positive loading on the HML for the Low P/V–High P/V portfolio. This positive loading on HML, however, is not sufficient to explain all of the returns earned by this portfolio. Since it is not clear that HML is necessarily a risk factor, a minimalist interpretation of our finding is that the Low P/V–High P/V portfolio tends to do well when value stocks do well relative to glamour stocks. Finally, there is not much difference in the market and SMB betas across the two portfolios suggesting that the portfolio is fairly well hedged in terms of market and small firm risks.

4.4 Tests based on Buy-and-Hold Abnormal Returns

In this section, we report long-run buy-and-hold abnormal returns (BHAR) for the three IPO portfolios with respect to various benchmarks. Inferences based on long-run returns are not as statistically reliable as those based on average abnormal returns due to the extreme skewness problems associated with long-run returns.[21] As a result, the calendar-time approach considered in the previous section is preferable. Still, for the sake of completeness and to provide a sense of long-term investor experience in trading these portfolios we provide results using buy-and-hold abnormal returns. The buy-and-hold abnormal returns are calculated as in Ritter (1991) and Loughran and Ritter (1995) without rebalancing using daily returns from the beginning of the holding period until the end of the holding period or the *delisting date* whichever is earlier. In addition to computing the traditional buy-and-hold abnormal returns (BHAR), we also compute log buy-and-hold abnormal returns (LBHAR). The log buy-and-hold abnormal return is calculated as the difference between the log buy-and-hold return of the IPO, $\log(1+R_{IPO})$, minus the log buy-and-hold return of the benchmark firm or portfolio, $\log(1+R_{BM})$. As can be seen, this difference is just the log of the wealth relative of the IPO firm with respect to benchmark firm over the holding period. The log wealth relative LBHAR should suffer less from the skewness problems associated with the traditional BHAR and should have better distributional properties.[22]

We compute BHAR and LBHAR using three benchmarks: (a) NYSE/AMEX/NASDAQ value-weighted market index, (b) 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) and (c) size and B/M matched control firms where book value of equity is from the first fiscal year after the IPO date and the market value is based on first-day closing price. The BHAR and LBHAR are computed for a period of 54 months beginning six months after the IPO goes public. We skip the first six months to account for the momentum until the lock-up period expires. If a control firm delists before the end date or the IPO delisting date, we replace it with another control firm with similar characteristics as of the IPO date.

The equal-weighted mean and median BHAR and LBHAR are presented in Panel B of Table 7 for the low, medium, and high P/V IPOs. The table also provides t-statistics for testing for the equality of means and medians. The test for equality of means is a simple two-sample t-test and the test for equality of medians is a Wilcoxson-Mann-Whitney test both computed under the assumption of independence of observations. Statistical inferences are based on empirical critical statistics. The results confirm that low P/V IPOs outperform high P/V IPOs by about 20% to 40% over the 54 month period.[23] All t-statistics of the differences are significant at 5% or 1% level based on empirical critical t-statistics which are quite close to critical t-statistics from the normal distribution. Tests of differences in medians and differences in mean LBHAR are more significant than tests of differences in mean BHAR even though differences in mean BHAR are larger. The results are robust to various benchmarks including size and B/M benchmarks. The returns are also robust over sub-samples. VW market adjusted mean BHAR return differences between low P/V and high P/V portfolios are 43.9% for the IPOs in the 1982-1986 sample period, 38% for the IPOs in the 1987-1991 sample period and 57.6% for the IPOs in the 1992-1997 sample period.

4.5 Robustness Tests

In Table 8, we conduct robustness checks for valuations based on two alternate matching firm criteria. These valuation models choose matching firms based on: (a) industry, sales, profit

margin, and analyst growth and (b) industry, sales and growth. The median IPO valuations for these two cases are 1.33 and 1.14 respectively (see Section 2.1).

Table 8 provides the results from cross-sectional regression tests and calendar-time portfolio tests. Columns 2 and 3 provide the first-day returns regressions slope coefficient (see regression (4)) corresponding to LnPV. Columns 4 to 7 provide slope coefficients on LnPV corresponding to long-run risk adjusted returns (see regression (5)). Columns 8 to 10 provide the factor model intercepts for the Low P/V – High P/V portfolio based on calendar time returns. The results confirm our basic findings: (a) there is a strong positive relationship between P/V ratios and first-day returns, (b) there is a strong negative relationship between P/V ratios and long-run risk-adjusted returns and (c) a portfolio of low P/V IPOs outperforms a portfolio of high P/V IPOs by an average (across both robustness cases) of about 43 basis points per month or 5.2% per annum after controlling for the influences of market, SMB, and HML[24].

We have also computed BHAR and LBHAR statistics (not reported in a table) for the robustness cases in Table 8 and the results indicate that the LBHAR statistics are more significant than BHAR statistics as in Table 8 even though their magnitudes are comparable. We have also examined the robustness of the cross-sectional regression in equation (5) to measures of buy-and-hold risk-adjusted returns; the results in Table 6 are robust to using the log wealth relative (LBHAR) with respect to the size-B/M benchmark of individual IPOs as the dependent variable. In the next section, we analyze ex post operating performance to see how well low, medium, and high P/V IPOs perform in the five years after they go public.

5. IPO Valuations and Ex Post Operating Performance

Table 9 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 cash flow return on assets defined as the ratio of cash flow from operations (CFO) divided by total assets. For the post-1987 period, CFO is directly obtained from the statement of cash flows (item number 308 minus 124) whereas for the earlier period we compute CFO as Operating Income after Depreciation (178) minus accruals as defined in section 3.2. Panel D reports annual

EBITDA profit margin defined as the ratio of EBITDA to sales. Panel E reports the ratio of accruals to total assets. The accruals variable is computed as net income before extraordinary items less cash flow from operations. 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. All accounting numbers are from Compustat annual file and the appropriate data item numbers are reported in Table 9.

The following patterns stand out in Table 9. 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 of high P/V IPOs do not persist for long. By the end of the fifth year, there is no appreciable difference in growth rates across the two portfolios.[25] The industry median-adjusted numbers tell the same story as the raw numbers. The simple message is that IPOs are unable to sustain their initial high sales growth rates over the long run.

Lower sales numbers should not matter much if high P/V IPOs earn higher return on assets (ROA), cash flow return on assets (CFROA) or EBITDA profit margins than low P/V IPOs. The results in Panels B, C, and D show that not only do high P/V IPOs earn lower ROA, CFROA and profit margins than low P/V IPOs in the fiscal year prior to going public but that they do so every year over the next five years. 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 CFROA is 2.51% in Year 1 and 1.49% in Year 5. Similarly, the difference in profit margins is 2.5% in Year 0 and 2.3% in Year 5. 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.

One reason for the quick reversion to mean in the operating performance of the high P/V IPOs may have to do with the lower quality of their earnings. The results in Panel E show that high P/V IPOs have higher accruals than low P/V IPOs in the first couple of years after they go

public. The accruals of both groups of IPOs tend to be higher than that of the industry over the first two years. These abnormal accruals revert to the industry median by the fifth year. The higher accruals of high P/V IPOs indicates lower earnings quality. The lower quality of earnings may be the result of aggressive earnings management on the part of managers to justify the optimistic earnings growth forecasts.

Could high P/V IPOs be potentially less risky than low P/V IPOs? The results in Table 7 showed that the two IPO portfolios differed only in their 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. To explore this possibility, we examine 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 subsequent 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.[26] Overall, the evidence presented in Table 9 and elsewhere in the paper does not seem to 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.

6. Discussion and Conclusions

Our results show that IPOs are overvalued at the offer price, tend to run up in the after market and revert to fair value in the long-run. What do these results imply for the rational theories of IPO pricing? Our first-day results seem inconsistent with the predictions of traditional asymmetric information theories of IPO pricing. These theories would predict that in the cross-section those IPOs that are the most undervalued should earn the largest first-day return as an efficient market bids the price up to its fair value. In contrast, we find that most overvalued IPOs run up the most on the first day. A rational interpretation of our long-run findings is that high P/V IPOs are less risky than low P/V IPOs. While the various measures of risk that we have examined, cash flow volatility, leverage, ex post operating performance, market and SMB betas, etc. indicate that high P/V IPOs are not less risky, we cannot rule out this possibility. If

differences in risk are a source of our findings then identifying and characterizing such risk is an important task for future research.

Our results seem consistent with the mispricing view of IPO underperformance put forth in Ritter (1991) and Loughran and Ritter (1995). They are also consistent with Miller's (1977) argument that investors who buy IPOs initially tend to be those who are the most optimistic about its prospects. How do our results relate to recent behavioral theories? The work that appears to be most directly related to our findings is the one by Daniel, Hirshleifer, and Subrahmanyam (1998). In the DHS model, investors' overconfidence about private information causes initial overreaction, and underreaction to subsequent public news leads to continuing overvaluation, which is ultimately followed by long-run reversals. This pattern is consistent with our finding of initial IPO overvaluation at the offer price and even more overvaluation in the after market followed ultimately by long-run reversals. Our results, however, can also be consistent with the predictions of Barberis, Shleifer, and Vishny (1998), Hong and Stein (1999) and Aggarwal, Krigman, and Womack (2002) if underwriters underprice not with respect to fair value but with respect to the maximum offer price they could have charged given the observed demand in the pre-market. Thus, IPOs could be both overvalued and underpriced at the same time.

Our results point to the need to better understand the role of IPO marketing in IPO pricing. Underwriters aggressively market IPOs through road shows. Such marketing strategies may 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 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.

[1]See Logue (1973), Ibbotson (1975), and Ibbotson, Sindelar, and Ritter (1994).

[2]See the asymmetric information models of Rock (1986), Benveniste and Spindt (1989), Allen and Faulhaber (1989), Welch (1989), Grinblatt and Hwang (1989) and the information momentum model of Aggarwal, Krigman, and Womack (2002).

[3]An earlier paper by Kim and Ritter (1999) examines the valuation of IPOs based on comparable IPO transaction multiples using 190 firms that went public in 1992 and 1993. Their focus however, is on determining the accuracy of these multiples in predicting offer prices and not on relating valuation to ex post returns.

[4]In cross-sectional tests, the long run risk-adjusted return for individual IPOs is estimated as the intercept from the Fama-French three factor regressions based on ex post excess returns.

[5]In portfolio tests, we measure long-run risk-adjusted returns using the Fama and French (1993) three-factor model and buy-and-hold abnormal returns (BHAR) measured with respect to various control portfolios and firms including size and B/M controls. Both the cross-sectional regression tests and the portfolio tests indicate that the relationship between P/V ratios and long-run returns is robust to the book-to-market effect.

[6] See Teoh, Welch, and Wong (1998).

[7] 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.

[8] See also Kim and Ritter (1999) who argue for controlling for differences in growth and profitability.

[9] 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.

[10] Liu, Nissim, and Thomas (2002) find that cash flow and earnings multiples perform the best in terms of relative valuation accuracy. Multiples based on book value of equity and sales are the worst.

[11]The overvaluation results are robust across technology and non-technology IPOs. 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). 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.

[12]We have experimented with both CRSP and Compustat two-digit SIC codes. We have also experimented with the industry definitions in Brav (2000) who augments the industry definitions of Ritter (1991) and Spiess and Affleck-Graves (1995) (only 2/3 d of our sample fits into these industry definitions however). In all these cases, the median overvaluation is between 1.45 and 1.50 for our base case. Our results are also robust to including IPOs with offer prices less than $5; the P/S valuations are also robust to including negative EBITDA firms.

[13]We also find that there are no significant differences in the ex post five-year EBITDA coefficient of variation or standard deviation of EBITDA growth rates between IPOs and their matching firms.

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

[15]Underwriter Quality is based on the ratings assigned to the underwriters by Carter and Manaster (1990) and Carter, Dark and Singh (1998) after the modifications suggested by Loughran and Ritter (2002b). Age and percent held by insiders after the IPO are from the SDC database. The sample size for age is about 170 firms per portfolio while the sample size for percentage held by institutions is about 400 firms per portfolio.

[16] See Fama (1998), Barber and Lyon (1997), Brav (2000), Kothari and Warner (1997), Loughran and Ritter (2000), and, Lyon, Barber, and Tsai (1998).

[17] See Aggarwal, Krigman, and Womack (2002) and Brav and Gompers (2003) on stock price performance and insider selling around lock-up expiration.

[18] The misspecification in long run returns, BHAR (buy and hold abnormal returns) in particular, 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."

[19]In 1983, however, there are often only one or two firms in the three IPO portfolios introducing idiosyncratic risk and adding noise to the estimation. Dropping these months does not change the intercept much but improves the t-stats.

[20]Brav and Gompers (1997) note that the Fama-French three-factor regressions tend to give statistically significant negative intercepts for small firms with low B/M ratios. Therefore, to further examine whether our results are driven by the B/M effect, we have estimated the 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 long-run intercepts are a statistically significant –11.4% (12 times –0.95%) per annum for high P/V IPOs they are an insignificant –4.2% (12 times –0.35%) for low P/V IPOs. If the P/V effect was driven by the B/M effect, then the intercepts should be the same across the three P/V portfolios within the small size-low B/M portfolio. Finally, we have also estimated the long-run FF regressions by adding the returns to a momentum portfolio as an additional style factor and the results are similar to those in Panel A of Table 7. The loading on the momentum factor on the Low P/V – High P/V portfolio return is close to zero and insignificant. The intercept is 0.40% per month (as in the base case) and continues to be significant at the five percent level. The six-month regressions provide similar results.

[21]Lyon, Barber and Tsai (1999) develop complicated techniques to compute t-statistics that are well specified in the presence of skewness while at the same time having enough power to detect abnormal performance. But their techniques deal with computing abnormal returns for a single portfolio and do not apply to the case of computing non-paired differences in buy-and-hold abnormal returns across portfolios. Moreover, even in their univariate case, their tests statistics do not control for the cross-sectional dependence in event returns.

[22] Barber and Lyon (1997), however, argue against using log (continuously compounded) returns because log returns tend to yield negatively biased estimates of long-run abnormal returns. However, since there is no a priori reason that the bias should be different for the low P/V and the high P/V portfolios, the bias is likely to cancel out when computing the difference in returns earned by the two portfolios. This is confirmed by empirical critical t-statistics computed under the null hypothesis from a randomization procedure (see Subsection 4.1 for details) which do not show any negative bias. The advantage is that log returns might provide a simple and easy way to control for the skewness problem. Also as expected, LBHAR exhibits much less skewness in each IPO portfolio and very little dispersion in skewness across portfolios compared to BHAR

[23] The high number for the size controlled matching is partly due to a negative differential of about 18% across the benchmark firms corresponding to the two IPO portfolios which is attributable to pure chance. In general, the differences in medians seem to be more robust.

[24] We have also tried robustness checks using matching criteria based on industry, sales and ROA (return on assets) and industry and size (where size is based on the mid-point of the filing range). Our results are similar for these robustness cases.

[25] The mean sales growth rates exhibit similar patterns. In years 1 through 5 the mean growth rates 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.

[26]We have also examined differences in asset turnover, capital expenditures, and book leverage ratios. Our results suggest that 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 reinvestment rates (estimated by the ratio of capital expenditures and acquisitions to EBITDA) are comparable across the two IPO portfolios although the reinvestment rate of low P/V IPOs is slightly higher. Finally, we find that 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% during the entire five-year period. The actual difference in leverage ratios between the two groups of IPOs ranges between 8% and 12% of total assets. This is unlikely to cause significant differences in financial risk and cost of equity.

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Table 1
Description of the IPO Sample

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

This table reports descriptive statistics on our sample of IPOs from 1980 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.

Table 2
IPO Valuation based on Comparable Firm Multiples

Panel A: IPO Valuations

Year	P/V Ratio Based on P/S Multiple					P/V Ratio Based on P/EBITDA Multiple					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 B: Spearman Correlation among P/V Ratios

	P/V (EBITDA)	P/V (Earnings)
P/V (Sales)	0.85	0.61
P/V (EBITDA)	-------	0.71

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. Panel B presents Spearman pooled cross-sectional-time-series correlations.

Table 3
IPO Valuation, First-Day Returns and IPO Characteristics

IPO Portfolio	Median P/V	Median 1st Day Return	Mean 1st Day Return	Filing-to-Offer Median Return	Filing-to-Offer Mean Return	Median 1st Day Turnover	Median Overallot-ment	Median Sales	Median EBITDA Margin	Analyst Consensus Growth	Median Size	IPO Proceeds	Age	% Held by Insiders	Underwriter Quality	No. of Issues
Low P/V	0.55	3.1%	8.2%	-4.0%	-5.0%	7.5%	10.0%	57.8	13.2%	20.0%	65.7	20.5	9.4	48.3	7.1	734
Medium P/V	1.49	5.0%	10.4%	0.0%	-2.2%	8.3%	10.6%	47.7	13.4%	25.0%	87.8	24.2	10.3	48.2	7.3	733
High P/V	4.50	8.5%	15.6%	0.0%	1.9%	8.8%	14.9%	25.7	10.6%	30.0%	89.0	21.3	7.6	51.0	7.1	728
Low - High		-5.4%	-7.5%	-4.0%	-6.8%	-1.3%	-4.9%	32.0	2.6%	-10.0%	-23.3	-0.7	1.8	-2.7	0.1	
		(-7.90)	(-7.72)	(-7.97)	(-7.80)	(-1.26)	(-3.98)	(10.74)	(6.36)	(-10.75)	(-4.69)	(-0.07)	(1.53)	(-1.93)	(0.51)	
All IPOs	1.49	5.3%	11.4%	0.0%	-1.8%	8.16%	11.73%	42.0	12.32%	25.00%	79.0	21.6	8.6	49.3	7.2	2195

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. *Analyst Consensus Growth* is obtained from the I/B/E/S and represents the long-term growth forecast of the IPO firm available within a year of the offer date. *IPO Proceeds* represent the money raised, after fees and expenses, from the IPO in millions of dollars. *Underwriter Quality* is based on the ratings assigned to the underwriters by Carter and Manaster (1990) and Carter, Dark and Singh (1998) after the modifications suggested by Loughran and Ritter (2002). *Percentage Held by Insiders* represents the percentage of equity share capital held by the insiders of the firm after the IPO. The sample size for age is about 170 firms per portfolio while the sample size for percentage held by insiders is about 400 firms per portfolio. *Sales* and *Size* are in millions of dollars.

Table 4
Cross-sectional Regressions of IPO Valuation and First-day Returns

Independent Variable	Coefficients	
LnPV	2.36	2.35
	(5.49)	(4.98)
LnBM	-5.05	-6.43
	(-2.96)	(-4.13)
LnGrowth	-----	5.53
	-----	(1.89)
Accruals	-0.60	-1.31
	(-0.22)	(-0.48)
LnSales	-1.38	-1.59
	(-4.28)	(-4.17)
EBITDA Margin	0.06	0.07
	(2.06)	(2.27)
NOBS	2057	1686

This table reports the results of the following cross-sectional regression:

$$\begin{aligned} R(1stDay) &= a + b \times LnPV + c \times LnBM + d \times LnGrowth \\ &\quad + e \times Accruals + f \times LnSales \\ &\quad + g \times EBITDA\ \ Margin + u \end{aligned}$$

The first-day return is simply the NYSE/AMEX/Nasdaq value-weighted market adjusted return, LnPV and LnBM are the natural logs of P/V ratio and book-to-market ratio, LnGrowth is the natural log of one plus analyst consensus growth rate over the next five years or one year whichever is available, Accruals is the ratio of accruals to total assets based on the first annual statement after the IPO goes public, and EBITDA Margin is the ratio of EBITDA to Sales for the fiscal year ending at least three months before the IPO goes public. Book value of equity is for the fiscal year after the firm goes public. Thus these variables are not necessarily available as of the IPO date. Analyst growth rates are also available only after the firm goes public. Accounting variables are from Compustat and growth rates are from IBES. Market value is based on *first-day closing price*. The regression is estimated as a pooled time-series, cross-section regression. The numbers in parentheses are White (1980) heteroskedasticity consistent t-statistics.

Table 5
Long-Run VW Market Adjusted Abnormal Returns of IPO Portfolios

Panel A: Median Annual Market Adjusted Abnormal Returns						
Portfolio	Mth 1 - 6	Mth 7 -12	Year 2	Year 3	Year 4	Year 5
Low P/V	-6.58%	-7.99%	-10.77%	-11.53%	-8.08%	-14.39%
Medium P/V	-5.14%	-8.35%	-16.93%	-21.44%	-16.03%	-13.99%
High P/V	-3.72%	-10.65%	-23.76%	-18.38%	-17.84%	-17.89%
Low P/V - High P/V	-2.86%	2.66%	12.99%	6.85%	9.76%	3.50%
	(-1.51)	(1.43)	(4.37)	(1.88)	(2.49)	(1.50)
Empirical p-value	*0.06*	*0.07*	*0.01*	*0.03*	*0.01*	*0.11*
All IPO Firms	-5.13%	-8.97%	-17.15%	-16.43%	-13.65%	-15.82%
Panel B: Mean Annual Market Adjusted Abnormal Returns						
Low P/V	-0.07%	-3.41%	-3.05%	-3.47%	-1.07%	-0.63%
Medium P/V	1.47%	-2.68%	-9.75%	-6.50%	-4.08%	-3.14%
High P/V	5.31%	-5.40%	-13.25%	-7.39%	-5.94%	-4.25%
Low P/V - High P/V	-5.38%	1.99%	10.20%	3.92%	4.87%	3.62%
	(-2.24)	(0.86)	(2.92)	(0.97)	(1.20)	(0.62)
Empirical p-value	*0.01*	*0.19*	*0.01*	*0.15*	*0.10*	*0.45*
All IPO Firms	2.23%	-3.83%	-8.68%	-5.81%	-3.72%	-2.72%

This table presents compounded returns of Low, Medium, and High P/V portfolios of IPOs over the first 6 months (Mth 1 – 6), months 7 to 12 (Mth 7 – 12). Year 2, 3, 4, and 5 refer to compounded returns earned by IPOs over the second, third, fourth, or fifth year after the offer date. The returns are market adjusted abnormal returns computed as the difference between the annual returns of the IPO firm and the annual returns of the NYSE/AMEX/Nasdaq Value-Weighted Market Index. Panel A reports median returns and Panel B reports equal-weighted mean returns. The numbers in parentheses in Panel A are t-statistics based on the Wilcoxson-Mann-Whitney test for differences in medians and the those in Panel B are simple two-sample t-test for difference in means both computed under the assumption of independence in observations. The row titled *empirical p-value* reports observed significance levels from a *randomization* procedure designed to control for clustering, autocorrelation, and skewness of the original sample under the null hypothesis. The *p-values* for *Mth 1-6* are *lower tail* probabilities and the rest are *upper tail* probabilities.

Table 6
Cross-Sectional Regressions of IPO Valuation and Long-run Returns

Independent	Dep = Long-run Risk Adjusted Return			
	Pooled		Fama-MacBeth	
LnPV	-0.38	-0.50	-0.48	-0.55
	(-2.69)	(-3.53)	(-3.32)	(-5.85)
# of Negative Coefficients			12	15
LnBM	-0.35	-0.68	-0.08	-0.51
	(-1.27)	(-1.71)	(-0.30)	(-2.11)
LnGrowth	-----	-1.60	-----	-0.86
	-----	(-2.43)	-----	(-0.57)
Accruals	-0.24	-0.36	-0.09	-0.29
	(-0.33)	(-0.47)	(-0.13)	(-0.56)
LnSales	0.19	-0.07	0.49	-0.24
	(1.96)	(-0.62)	(2.54)	(-2.03)
EBITDA Margin	-0.01	0.00	-0.27	0.26
	(-1.16)	(0.37)	(-1.37)	(0.99)

This table reports the results of the following cross-sectional regression:

$$R^* = a + b \times LnPV + c \times LnBM + d \times LnGrowth + e \times Accruals + f \times LnSales + g \times EBITDA\ \ Margin + u$$

R* is the long-run risk-adjusted return computed as follows. We regress each IPO's monthly excess returns (in excess of one-month T-bill return) starting six months after they go public and ending five years after they go public on Fama-French factors (Mkt, SMB, and HML) for the same period. The risk-adjusted return R* is the intercept from this regression. LnPV and LnBM are the natural logs of P/V ratio and book-to-market ratio, LnGrowth is the natural log of one plus analyst consensus growth rate over the next five years or one year which ever is available, Accruals is the ratio of accruals to total assets based on the first annual statement after the IPO goes public, and EBITDA Margin is the ratio of EBITDA to Sales for the fiscal year ending at least three months before the IPO goes public. Book value of equity is for the fiscal year after the IPO date. Thus these variables are not necessarily available as of the IPO date. Analyst growth rates are also available only after the firm goes public. Accounting variables are from Compustat and growth rates are from IBES. The regression is estimated using (a) pooled time-series, cross-section regression approach and (b) Fama-MacBeth approach based on each annual cohort of IPOs from 1982 to 1997. For the pooled regressions, the numbers in parentheses are White (1980) heteroskedasticity consistent t-statistics. For the Fama-MacBeth approach, the numbers in parentheses are t-stats computed with Newey-West autocorrelation correction with four lags. The aggregate sample size for regressions without growth is 2,057 and for those with growth is 1,686. The sample size is smaller for regressions with growth because not all IPOs have a growth forecast within one year after going public.

Table 7
IPO Valuation and Long-run Risk-Adjusted Returns

Panel A: Fama-French Factor Regressions

	Six-month Returns					Long-run Returns				
IPO Portfolio	a	b	s	h	Adj.R^2	a	b	s	h	Adj.R^2
Low P/V	-0.11	1.22	1.31	0.05	68.9%	-0.38	1.12			62.5%
	(-0.35)	(14.16)	(10.05)	(0.36)		(-1.47)	(18.94)			
						-0.17	1.01	0.77		80.2%
						(-0.92)	(23.22)	(13.85)		
						-0.23	1.06	0.81	0.12	80.5%
						(-1.22)	(21.18)	(13.04)	(1.58)	
High P/V	1.34	1.32	1.26	-0.51	68.2%	-0.99	1.31			59.6%
	(3.42)	(12.85)	(8.11)	(-2.87)		(-3.08)	(17.85)			
						-0.73	1.17	0.95		78.9%
						(-3.14)	(21.83)	(13.99)		
						-0.63	1.12	0.88	-0.18	79.2%
						(-2.67)	(18.15)	(11.52)	(-1.93)	
Low P/V - High P/V	-1.45	-0.09	0.05	0.56	5.0%	0.61	-0.19			6.1%
	(-3.09)	(-0.81)	(0.26)	(2.65)		(2.87)	(-3.85)			
						0.56	-0.16	-0.19		9.6%
						(2.67)	(-3.33)	(-3.06)		
						0.40	-0.06	-0.07	0.30	14.7%
						(1.93)	(-1.14)	(-1.09)	(3.68)	
All IPOs	0.54	1.26	1.32	-0.23	84.0%	-0.42	1.11	0.86	0.06	86.2%
	(2.31)	(20.69)	(14.39)	(-2.20)		(-2.21)	(22.50)	(13.95)	(0.75)	

Panel B: Buy-and-hold Abnormal Returns

Benchmark	Abnormal	Median				Mean BHAR				NOBS
	Return	Low	High	Low - High	t-stat	Low	High	Low - High	t-stat	
VW Market Index	BHAR	-65.9%	-100.8%	34.9%	5.41	-1.1%	-48.2%	47.1%	2.33	2,195
	LBHAR	-48.8%	-88.6%	39.8%	5.38	-70.1%	-107.4%	37.3%	5.26	
Size	BHAR	-12.7%	-43.3%	30.6%	3.98	8.5%	-51.4%	59.9%	2.46	2,195
	LBHAR	-11.7%	-58.3%	46.6%	4.80	-23.8%	-63.0%	39.2%	4.42	
Size-B/M	BHAR	-0.1%	-26.4%	26.4%	3.71	26.3%	-19.4%	45.7%	2.00	2,125
	LBHAR	0.0%	-41.8%	41.8%	4.11	-12.8%	-46.7%	33.9%	3.84	

Panel A 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. The IPOs stay in their respective portfolios for (a) a period of six months starting the month after they go public or (b) for a period of 54 months starting six months after they go public. The 54 month results are provided under the heading *Long-run Returns*. 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 B reports *median* and *(equal-weighted) mean 4½* -year buy-and-hold abnormal returns (BHAR) and log buy-and-hold abnormal (LBHAR) returns earned by IPOs in portfolios formed on the basis of their P/V ratios computed from P/EBITDA multiples. The first six months are skipped to account for the momentum until the lock-up period expires. The BHAR and LBHAR are computed with respect to (a) the CRSP NYSE/AMEX/Nasdaq value weighted index (b) benchmark firms based on first day closing market capitalization and (c) benchmark firms based on market capitalization and B/M ratios. The book value of equity is for the fiscal year after the company goes public. For median BHAR and LBHAR, the numbers in parentheses in column titled (Low – High) are Wilcoxson-Mann-Whitney non-parametric t-statistics for testing differences in medians under the assumption of independence of observations. For mean BHAR and LBHAR, the numbers in column t-stat are simple t-statistics for differences in mean also computed under the assumption of independence of observations. *Critical t-stats* (not reported) are computed from a Monte Carlo simulation. The one-to-one correspondence between P/V ratios and BHARs is randomly shuffled 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 20,000 times and generate the empirical t-distribution. The 90th, 95th, and 99th percentiles from this distribution for an upper tail test are used to test significance.

Table 8
IPO Valuation and Long-run Returns: Robustness Tests

Matching Criteria	First-day Return		Long-run Risk Adjusted Return				1-Factor	2-Factor	3-Factor
	Pooled		Pooled		Fama-MacBeth		Low-High	Low-High	Low-High
	w/o growth	with growth	w/o growth	with growth	w/o growth	with growth	Intercept	Intercept	Intercept
Industry, Sales, EBITDA Margin and Earnings Growth	2.17	2.01	-0.36	-0.34	-0.72	-0.64	0.67	0.62	0.51
NOBS = 1530	(4.96)	(4.59)	(-2.28)	(-2.11)	(-2.60)	(-2.62)	(3.11)	(2.89)	(2.40)
Industry, Sales and Earnings Growth	1.05	0.96	-0.21	-0.18	-0.30	-0.14	0.44	0.37	0.34
NOBS = 1652	(2.68)	(2.45)	(-1.82)	(-1.61)	(-1.76)	(-2.48)	(2.33)	(2.03)	(1.79)

This table presents results on the cross-sectional relationship between P/V ratios and long-run returns for P/EBITDA valuations based on alternate matching firm selection procedures. *Industry, Sales, EBITDA Margin and Earnings Growth* chooses comparable firms in the same Fama-French industry with roughly the same sales, EBITDA margin and IBES consensus growth estimates for the next year (obtained from earnings forecasts over the next two years). *Industry, Sales and Earnings Growth* chooses comparable firms based on industry, sales, and consensus analyst growth rate forecasts for the next five years (if five-year growth rate is not available we take the one year growth rate imputed from forecasts over the next two years). Note that analyst forecasts are available only after the firm goes public and is not, therefore, available for valuation prior to the IPO date. Columns 4 to 9 provide the slope coefficients corresponding to LnPV from cross-sectional regressions of first-day or long-run returns on firm characteristics such as growth, accruals, sales, book-to-market ratio and profit margins. The last three columns provide the intercepts from 1-factor (Mkt), 2-factor (Mkt, SMB), and the Fama-French three factor (Mkt, SMB, HML) regressions for the Low P/V – High P/V portfolio.

Table 9
IPO Valuation and Operating Performance

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 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 : EBITDA 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 : Cash Flow Return on Assets												
Low P/V	----	9.59%	7.93%	8.48%	8.23%	8.53%	----	2.52%	1.03%	1.85%	1.62%	2.21%
Medium P/V	----	9.65%	7.15%	7.90%	7.19%	8.21%	----	2.65%	0.73%	1.25%	0.76%	1.14%
High P/V	----	7.08%	4.72%	7.07%	7.52%	7.04%	----	0.86%	-1.22%	0.95%	1.37%	0.32%
Low P/V - High P/V	----	2.51%	3.21%	1.41%	0.71%	1.49%	----	1.66%	2.25%	0.90%	0.25%	1.89%
		(2.79)	(3.71)	(1.52)	(1.12)	(1.98)		(2.45)	(3.60)	(1.06)	(0.98)	(2.16)
Panel D : 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 E : Accruals/Total Assets												
Low P/V	----	-1.01%	-1.11%	-3.08%	-4.16%	-4.33%	----	3.17%	2.46%	0.64%	0.21%	0.14%
Medium P/V	----	0.65%	-0.69%	-2.88%	-3.43%	-4.50%	----	4.88%	3.24%	1.33%	0.73%	0.07%
High P/V	----	1.14%	0.83%	-2.93%	-5.43%	-5.61%	----	5.78%	5.31%	1.30%	-0.63%	-0.79%
Low P/V - High P/V	----	-2.15%	-1.94%	-0.15%	1.27%	1.28%	----	-2.61%	-2.85%	-0.66%	0.84%	0.93%
		(-3.43)	(-2.93)	(-1.16)	(1.78)	(0.72)		(-3.73)	(-3.54)	(-0.65)	(-1.17)	(2.16)

This table reports *median* sales growth rates, profitability measures, and other measures of operating performance for low, medium, and high P/V IPOs. *Return on Assets* is EBITDA/Total Assets, and *EBITDA Profit Margin* is EBITDA/Sales. *Cash Flow Return on Assets* is Cash Flow from Operations (CFO) divided by total assets, *Accruals* is Net Income minus Cash Flow from operations scaled by the total assets. The relevant Compustat item numbers are: Sales (12), EBITDA (13) and Total Assets (6). Accrual is constructed from the statement of cash flows for fiscal years after 1987 and from the balance sheet data for the earlier period. From the statement of cash flows, accrual is defined as Income Before Extraordinary Items (123) minus Cash Flows from Operations (308 minus 124). From the balance sheet, we construct accruals as Change in Current Assets (change in 4) minus Change in Cash (change in 1) minus change in Current Liabilities (change in 5) plus Change in Debt Included in Current Liabilities (change in 34) plus Change in Income Tax Payable (change in 71) minus Depreciation and Amortization (14). CFO is directly obtained from the statement of cash flow after 1987 (item 308 minus 124). For the earlier period, we obtain CFO as Operating Income after Depreciation (178) minus accruals. The numbers in parentheses are Wilcoxon-Mann-Whitney test statistic for difference in median between Low P/V and High P/V portfolios. Industry adjusted numbers are computed as the difference between the raw medians and industry (based on Fama-French industries) medians for the corresponding year.

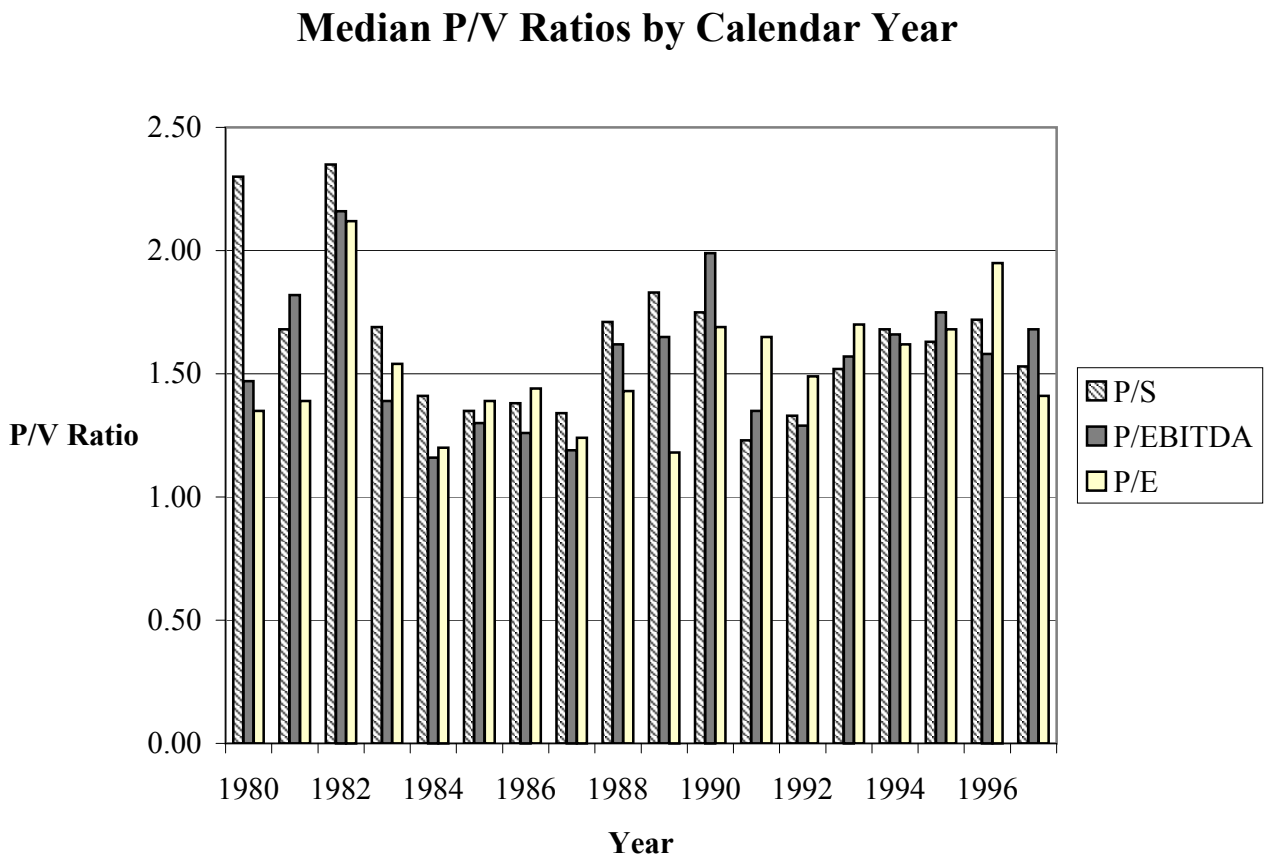

Figure 1: **Median P/V Ratios of Calendar Year Cohorts of IPOs**. The table graphs median P/V ratio for annual cohorts of IPOS based on P/S, P/EBITDA and P/E multiples. P refers to the offer price and V is the intrinsic value based on comparable firm multiples.

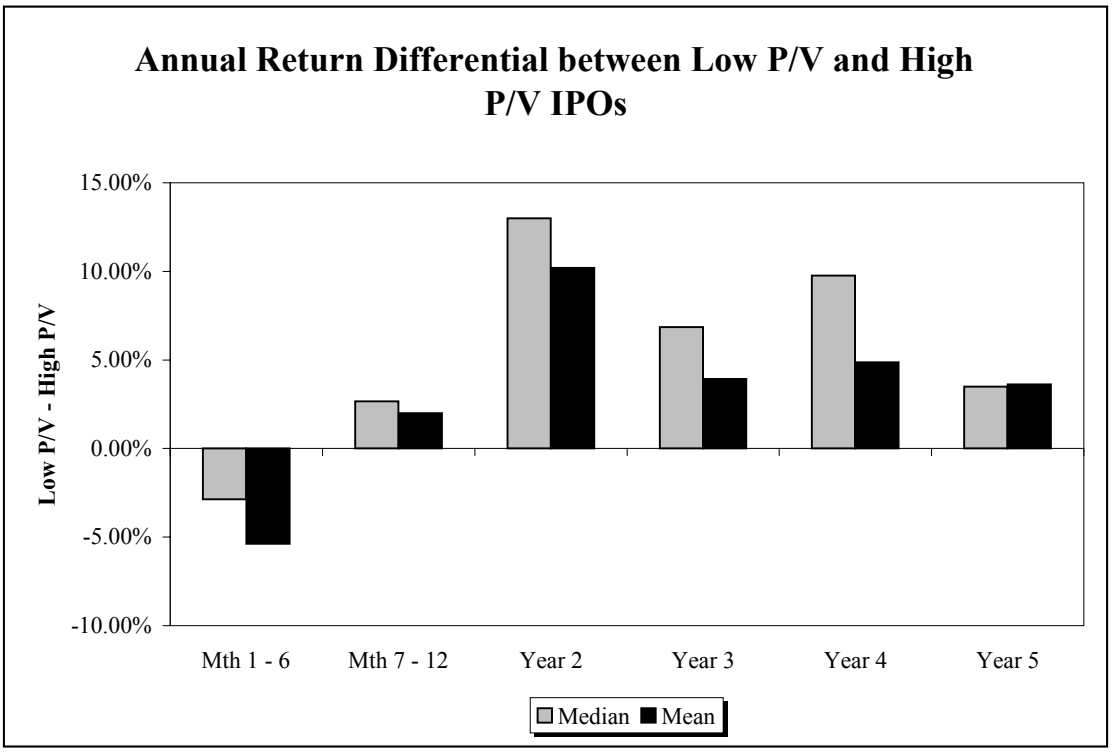

Figure 2: Annual abnormal return differential between Low P/V and High P/V IPOs. This figure plots the annual abnormal return differential between Low P/V and High P/V IPOs. The abnormal returns are computed with respect to the NYSE/AMEX/Nasdaq Value-Weighted Market Index. Mth 1 – 6 refers to the compounded returns over the first six months after the IPO (starting from the close of the first day), Mth 7 – 12 refers to the next six months. 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.