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Are IPOs really overpriced?

Steven X. Zheng *

Asper School of Business, University of Manitoba, Winnipeg, MB, Canada R3T 5V4

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Abstract

Purnanandam and Swaminathan [Purnanandam, A., Swaminathan, B. 2004. Are IPOs really underpriced? Review of Financial Studies, 17, 811–848.] find that IPOs are overvalued at the offer price relative to value metrics based on industry peer price multiples. I discuss some possible problems in their valuation methodology and find that IPOs are not overvalued after steps are taken to address the problems. More importantly, when I examine the long-run performance of IPO firms and their industry peers, I find that IPOs do not underperform their industry peers in the 5 years after IPO. This casts doubt to the argument that IPOs are overvalued.

JEL classification: G12; G1
Keywords: IPO; Valuation; Long-run performance

1. Introduction

It has been well documented that initial public offering (IPO) stocks have average initial return over 10% (see, for example, Ibbotson, 1975; Loughran and Ritter, 2004). This has been traditionally interpreted as evidence that IPOs are underpriced relative to their fair value. However, the recent IPO valuation results in Purnanandam and Swaminathan (2004) suggest that IPOs are significantly overpriced relative to comparable firms by between 14% and 50% depending on the peer matching criteria. Given the initial return on the offering day, their findings imply that the aftermarket overvalues the IPO firms by an even higher extent. This is consistent with the suggestion that IPO stocks have poor long-run performance (see, for example, Ritter, 1991; Loughran and Ritter, 1995). To provide support to the valuation results, Purnanandam and

* 181 Freedman Crescent, Winnipeg, MB, Canada R3T 5V4. Tel.: +1 204 474 7933; fax: +1 204 474 7545.
E-mail address: zhengxs@ms.umanitoba.ca.

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Swaminathan (2004) show that, among other things, the "overvalued" IPOs underperform the "undervalued" IPOs in the five years after IPO.

However, there are concerns about Purnanandam and Swaminathan (2004)'s valuation results. As discussed in section 2.1 of Purnanandam and Swaminathan (2004), "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." Because most IPO firms are expected to have high growth rates, the omission of expected growth may significantly affect the valuation results. Actually, after Purnanandam and Swaminathan (2004) control for expected growth when choosing industry peers, the "overvaluation" drops significantly.

Another possible concern is about how to scale prices of IPO firms and matching firms. Purnanandam and Swaminathan (2004) calculate price multiples including price/sales, price/EBITDA (Earnings Before Interest, Taxes and Depreciation and Amortization) and price/earnings ratios and compare the price multiples of IPO companies with those of matching companies. They use sales, EBITDA, and earnings in the fiscal year prior to IPO to do the calculation. This creates a potential problem. Most IPO firms raise a lot of capital and are expected to increase their sales, EBITDA, and earnings substantially after IPO. Because the price of a firm reflects expected future cash flows to the firm, the prices of IPO firms reflect the expected increase. In contrast, most of the matching firms do not raise capital and are not expected to have the same increase in future cash flows. Their prices reflect this lower expectation. So, given the same accounting data in the year prior to IPO, the price of an IPO firm should be higher than the price of its matching firm simply because the IPO firm is expected to have higher future cash flows after IPO. Thus the IPO firms will have higher price multiples and appear overpriced if the price multiples are based on accounting data prior to IPO, although in fact they may be fairly valued. So Purnanandam and Swaminathan (2004)'s method may overstate the IPO price multiples and IPO valuation. In addition, the price multiples used in Purnanandam and Swaminathan (2004) are not adjusted for cash holdings and leverage. This may also bring biases to their valuation measures. These problems should be addressed together with the omission of expected growth.

More importantly, we should find out whether IPO long-run performance is consistent with the valuation results. Because it is inevitable that some IPOs are overvalued and some other IPOs are undervalued, Purnanandam and Swaminathan (2004)'s evidence that some IPOs underperform other IPOs does not necessarily lead to the conclusion that IPOs are overvalued in general. Their valuation measures suggest that IPOs are overpriced when compared with seasoned industry peers. To test this suggestion, a better approach is to compare IPO long-run performance with that of industry peers. If IPOs underperform their industry peers, then the argument that IPOs are overvalued will receive more support. If not, then probably the 'overvaluation' results are driven by the omission of growth expectation and the improper use of accounting data.

I modify Purnanandam and Swaminathan (2004)'s method to address the first two concerns above. I exclude the new primary shares and adjust for cash holdings and leverage when calculating the IPO firm price multiples so that they are consistent with the accounting variables. I control for expected growth when selecting matching firms. After these adjustments, I find that the IPO firms in my sample are not overpriced anymore.

I compare the long-run performance of IPO firms with the matching firms. Valuation results using Purnanandam and Swaminathan (2004)'s method suggest that IPO firms should underperform the peer firms matched by sales and profitability. However, I find that IPO firms do not underperform these matching firms. This does not support the argument that IPOs are overpriced. When I compare the long-run performance of IPO firms with the peer firms matched by sales and growth, I find that IPOs do not underperform the growth-matching firms. So, the

long-run performance results support the valuation results from the modified method I use. Overall, the results in this paper are more consistent with the traditional view that IPOs are underpriced at offer price and fairly priced at 1st day aftermarket price when compared with seasoned firms.

The rest of the paper is organized as follows: Section 2 discusses the possible biases in Purnanandam and Swaminathan (2004)'s valuation method; Section 3 presents the data and methodology; Section 4 discusses the valuation results using modified valuation method; Section 5 examines the long-run performance of IPO firms and matching firms; Section 6 concludes this paper.

2. IPO valuation: possible biases

Purnanandam and Swaminathan (2004) calculate price-to-value (P/V) ratios to measure the valuation of IPO firms. The P/V ratios are computed by dividing the IPO offer price multiple by the comparable firm's market multiple. Purnanandam and Swaminathan (2004) calculate the IPO offer price multiples as follows:

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

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

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

In the equations, CRSP shares outstanding are after IPO. They include the new primary shares issued in IPO. The comparable firm's market multiples are calculated as follows:

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

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

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

Here the market price is for the trading day before the IPO date. Then the P/V ratios are calculated as:

$$\left(\frac{P}{V}\right)_{\text{Sales}} = \frac{(P/S)^{PS}_{\text{IPO}}}{(P/S)_{\text{Match}}}$$

$$\left(\frac{P}{V}\right)_{\text{EBITDA}} = \frac{(P/\text{EBITDA})^{PS}_{\text{IPO}}}{(P/\text{EBITDA})_{\text{Match}}}$$

$$\left(\frac{P}{V}\right)_{\text{Earnings}} = \frac{(P/E)^{PS}_{\text{IPO}}}{(P/E)_{\text{Match}}}$$

In this valuation method, there are three areas where biases are possible. These areas are the inclusion of new primary shares, cash holdings, and capital structure.

2.1. New primary shares

Purnanandam and Swaminathan (2004)'s method of calculation assumes that the accounting variables in the prior year can be used to scale the price of the IPO firm after offering. This assumption is plausible if there are no new primary shares in the offering. But when there are new primary shares in the offering, this assumption may introduce an upward bias into the P/V ratios. To illustrate this bias, let's apply Purnanandam and Swaminathan (2004)'s method to an IPO example:

Suppose company A will go public. Currently A has 2000 shares outstanding and it does not plan to issue any new primary shares. Its sales in the prior fiscal year was $200,000. Suppose a comparable seasoned company, company B, has P/S ratio of 0.1. Then the intrinsic value of company A should be $20,000 because its P/S ratio should also be 0.1. If each share of company A is priced at $10, it will be fairly priced. At this price, the P/V ratio of company A will be 1. The P/V ratio correctly reflects its valuation.

Now, suppose company A decides to take a zero-NPV project, which requires initial investment of $10,000. To finance the initial investment, company A changes its IPO plan to offer new primary shares to raise the $10,000. The offer price of the primary shares should also be $10 to reflect the project's zero-NPV. So, 1000 new primary shares, along with any secondary shares company A planned to offer, will be offered at a price of $10 per share. This price is still fair. However, the problem is, after the IPO, company A will have 3000 shares outstanding. If we use Purnanandam and Swaminathan (2004)'s method to calculate P/S ratio, company A's P/S ratio will become 0.15, and its P/V ratio will become 1.5. It will be 'overpriced' by 50%!

We can also apply Purnanandam and Swaminathan (2004)'s method to seasoned companies. Suppose a fairly valued company issues seasoned equity at fair price, Purnanandam and Swaminathan (2004)'s method will use the post-offering firm value, which includes new primary shares, and will show that the company becomes overpriced after offering. If the same company repurchases shares at fair price, Purnanandam and Swaminathan (2004)'s method will use the post-repurchase firm value, which will show that the company becomes undervalued after repurchase.

Obviously, the results above are caused by a bias in the calculation. If we include new primary shares when calculating P/S ratio in IPO valuation, as Purnanandam and Swaminathan (2004) do, we should consider the fact that the new equity raised in the IPO will bring higher sales and the total value of the IPO firm reflects the expected increase in cash flows. The matching company will not have the same increase in cash flows because it has not raised any new capital. So the total value of the IPO firm should be higher than that of the matching firm. In this case, using sales in the prior fiscal year may overstate the P/S ratio of the IPO firms but not overstate the P/S ratio of the matching firm. This introduces an upward bias into the P/V ratios. For P/V ratios based on

EBITDA and earnings, the same logic applies. So it is a common practice among practitioners to use projected earnings, EBITDA, and sales to calculate the price multiples.

However, using projected earnings, EBITDA, and sales may not be an easy solution in academic studies. There are two problems. First, the projected values cannot be easily determined. Second, even if we have the projected values, it can be argued that they should be used to scale future price, not IPO offer price. We may have to compound the offer price by an expected return, which is difficult to estimate, to get a proper measure of price multiples. We will also have to assume that the price multiples remain stable over time. So, in the process of addressing the 'overpricing' bias, we may introduce more biases.

The discussions above show that the price multiple approach to IPO valuation may be more tricky than what we initially expect, especially when new primary shares are included. So I try another method: excluding the new primary shares from the calculation of price multiples. In other words, I use the pre-money valuation, not the post-money valuation,[1] to calculate the price multiples. The pre-money valuation gives us the price of (assets in place + growth opportunities) and it is plausible to scale it by pre-IPO accounting data. For company A in our example, if we exclude the new primary shares from the price of company A, then it is still plausible to use sales in the prior fiscal year to calculate P/S ratio. And the P/V ratio will still be one, showing that A is fairly priced. Thus we can avoid the "overpricing" bias and the problems related to using projected accounting data.

2.2. Cash holding

The discussions above also have implications about another possible bias in Purnanandam and Swaminathan (2004)'s valuation method. The IPO firms and matching firms may have different cash holdings. These cash holdings affect the market values of the firms. However, if these cash holdings are not used for daily operations of the firms, then they do not affect the sales, EBITDA, or earnings of the firms. In this case using the accounting performance measures to scale the market value of the firms will again bring bias to the valuation measure. Just imagine two firms that are identical except for the amount of cash holdings. If we calculate the P/S ratio of the two firms, the firm with higher amount of cash holdings should have higher P/S ratio. But this does not imply that this firm is overvalued. To measure the valuation of the two firms correctly, we should subtract cash holdings from the market value of the two firms before calculating the price multiples.

2.3. Capital structure

Another problem with Purnanandam and Swaminathan (2004)'s valuation method is about leverage. The IPO firms and matching firms may have very different amounts of debt. Given the same sales and EBITDA, when a firm uses more debt and less equity in its capital structure, it will have a lower market value of equity. And its P/S ratio and P/EBITDA ratio will be lower. Purnanandam and Swaminathan (2004)'s valuation method will suggest that the firm has become undervalued. But obviously this is not true. The correct way to do the calculation in this case is to find the enterprise value to sales ratio and enterprise value to EBITDA ratio. The enterprise value should include both the value of debt and the market value of equity.

[1] This terminology is commonly used by venture capitalists and other practitioners. The pre-money valuation is the price per share multiplied by the number of shares outstanding before any new shares are issued as part of equity financing (such as an IPO). The post-money valuation uses the post-issue number of shares outstanding.

Table 1
Description of the IPO sample

Panel A: descriptive IPO statistics (number of issues=2493)

Variable	Mean	25%	Median	75%
Offer price in $	11.45	8.00	11.00	14.00
Net proceeds, $ Millions	26.11	10.01	19.50	33.60
First day initial return (%)	12.16	0.83	5.98	18.06

Panel B: characteristics of IPO firms and matching firms (number of issues=2493)

Characteristics	IPO firms				Matching firms based on sales and EBITDA profit margin			
	Mean	25%	Median	75%	Mean	25%	Median	75%
Net sales, $ Millions	65.36	13.92	29.65	65.10	74.58	16.32	33.57	72.03
EBITDA, $ Millions	8.33	1.75	3.86	8.63	9.93	1.99	4.60	9.97
Net income, $ Millions	2.67	0.57	1.48	3.31	3.63	0.67	1.69	3.92

Panel C: characteristics of IPO firms and growth-matching firms (number of issues=1404)

Characteristics	IPO firms				Matching firms based on sales and expected growth			
	Mean	25%	Median	75%	Mean	25%	Median	75%
Net sales, $ Millions	83.88	20.35	40.06	84.01	105.21	26.89	53.76	111.70
EBITDA, $ Millions	10.65	2.46	5.32	10.77	17.12	3.94	7.96	17.18
Net income, $ Millions	3.18	0.80	1.84	4.07	6.71	1.44	3.45	6.99
IBES growth rate	26.49	20.00	25.00	31.71	25.80	19.50	23.75	30.00

This table reports descriptive statistics on the sample of IPOs from 1980 to 1997. The relevant data are retrieved from the Securities Data Corporation (SDC) database, Center for Research in Security Prices (CRSP) database, Compustat database and IBES database. EBITDA represents earnings before interest, taxes, depreciation, and amortization.

In this section I have identified three possible area of bias in Purnanandam and Swaminathan (2004)'s valuation method. Later I will use a modified method to correct for these possible biases.

3. Data and valuation methodology

3.1. Sample selection

To make the results comparable with those in Purnanandam and Swaminathan (2004), I select a comparable sample. As in Purnanandam and Swaminathan (2004), the initial sample of IPOs from 1980 to 1997 is collected from the Securities Data Corporation (SDC) database and updated using Jay Ritter's corrections (http://bear.cba.ufl.edu/ritter/SDCCOR.PDF). To select a final sample, I use similar criteria as those used in Purnanandam and Swaminathan (2004):

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).
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.
g) The IPO should have only one class of shares. This criterion is not mentioned in Purnanandam and Swaminathan (2004). But it is applied in this paper because CRSP shares outstanding, which does not cover multiple share classes, is used to calculate the IPO market value.

There are 2493 IPOs from 1980 to 1997 in my final sample that satisfy these criteria. Table 1 provides summary statistics on my IPO sample and matching firms. The median offer price and median net proceeds are $11 and $19.50 million respectively. Both are a little bit lower than but very close to the statistics reported in Purnanandam and Swaminathan (2004). The mean and median of first day return are 12.16% and 5.98% respectively. They are consistent with the literature. The median sales, median EBITDA and median net income of the IPOs in my sample are $29.65 million, $3.86 million and $1.48 million respectively. These statistics are again lower than but close to those reported in Purnanandam and Swaminathan (2004).

3.2. Choosing matching firms in the same industry

I use two methods to choose matching firms. The first method selects industry peer matching firms with comparable sales and EBITDA profit margin. I call it the comparable firm multiple method. It follows the same procedure as the one used in Purnanandam and Swaminathan (2004). As described in their study, "…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. 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…" The only difference is, I also eliminate firms that issued seasoned shares between the end of the prior fiscal year and the IPO date when I choose matching firms. The reason is, if a matching firm issues primary shares between the end of the prior fiscal year and the IPO date, then using the sales, EBITDA and earnings in the prior fiscal year to calculate price multiples may overstate the valuation of matching firms. Most firms in the IPO sample get unique matching firms in the cohort year, just like in Purnanandam and Swaminathan (2004). The characteristics of matching firms are reported in Panel B of Table 1. They are similar to those of the IPO firms but have slightly higher value, as in Purnanandam and Swaminathan (2004).

As indicated in Kim and Ritter (1999), valuing IPOs using comparable firm multiples is of only limited use if historical numbers rather than forecasts are used. To capture the effect of expected growth on valuation, the second method I use selects matching firm based on industry, sales, and ex post consensus analyst growth forecasts. I call it the growth-matching method. The procedure is similar to the first matching procedure except that ex post consensus analyst growth forecasts replace EBITDA profit margins. Analyst growth forecasts of earnings per share are

collected from the IBES analyst forecast database and the average of growth forecasts in the year after the IPO is used as the ex post consensus analyst growth forecast. This reduces the sample size to 1404 IPO firms because many IPO firms do not have ex post analyst growth forecasts available in the year after the IPO. However, this sample size is close to the sample size of 1530 and 1652 in Purnanandam and Swaminathan (2004) when they consider growth in selecting matching firms[2].

The characteristics of the 1404 IPOs and the corresponding matching firms are reported in Panel C of Table 1. The median sales, median EBITDA and median net income of these 1404 IPOs are higher than those of the whole final sample, suggesting that analysts tend to follow larger IPO firms. Like the first matching procedure, matching on industry, sales, and ex post consensus analyst growth forecasts also produce matching firms with slightly higher but close statistics. The only exception is expected growth rate: the earnings of IPO firms are expected to grow at a slightly higher rate.

3.3. IPO valuation using price multiples

As discussed earlier, I use a modified method to calculate the P/V ratios of the IPO firms to measure IPO valuation. Specifically, I exclude new primary shares from the calculation of IPO offer price multiples. For both IPO firms and matching firms, I exclude cash and short-term investments (Compustat data item 1) when calculating the price multiples. For P/S and $P/$EBITDA ratios, I add total debt (Compustat data item 9 plus 34) to the price of equity. This modified method can be expressed by formulas below:

$$\left(\frac{P}{S}\right)^{M}_{\text{IPO}} = \frac{\text{Offer Price} \times (\text{CRSP Shares Outstanding} - \text{New Primary Shares}) - \text{Cash} + \text{Total Debt}}{\text{Prior Fiscal Year Sales}}$$

$$\left(\frac{P}{\text{EBITDA}}\right)^{M}_{\text{IPO}} = \frac{\text{Offer Price} \times (\text{CRSP Shares Outstanding} - \text{New Primary Shares}) - \text{Cash} + \text{Total Debt}}{\text{Prior Fiscal Year EBITDA}}$$

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

$$\left(\frac{P}{S}\right)^{M}_{\text{Match}} = \frac{\text{Market Price} \times \text{CRSP Shares Outstanding} - \text{Cash} + \text{Total Debt}}{\text{Prior Fiscal Year Sales}}$$

$$\left(\frac{P}{\text{EBITDA}}\right)^{M}_{\text{Match}} = \frac{\text{Market Price} \times \text{CRSP Shares Outstanding} - \text{Cash} + \text{Total Debt}}{\text{Prior Fiscal Year EBITDA}}$$

[2] Purnanandam and Swaminathan (2004) use analyst growth forecasts made in the two years after IPO when they select their samples. Obviously adding another year does not increase the sample size much. In addition, I believe that growth forecasts made in the year after IPO are more relevant.

Table 2
IPO valuation based on comparable firm multiples

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	75%	Wilcoxon *p*-value	No. of issues	25%	Median	75%	Wilcoxon *p*-value	No. of issues	25%	Median	75%	Wilcoxon *p*-value
Panel A. Purnanandam and Swaminathan (2004) *method*															
Overall	2493	0.81	1.62	3.28	0.01	2493	0.83	1.61	3.49	0.01	2023	0.84	1.60	3.27	0.01
Panel B. Modified method															
1980	27	0.58	1.40	2.60	0.37	27	0.56	1.50	2.19	0.14	24	0.55	1.29	3.07	0.36
1981	91	0.81	1.52	4.44	0.00	91	0.86	1.60	3.94	0.00	85	0.85	1.63	5.69	0.00
1982	27	0.55	1.51	2.85	0.61	27	0.73	1.48	2.87	0.16	22	0.72	1.59	2.32	0.14
1983	207	0.74	1.69	3.27	0.00	207	0.80	1.50	3.17	0.00	187	0.92	1.73	3.14	0.00
1984	90	0.67	1.36	3.08	0.00	90	0.67	1.26	2.24	0.01	83	0.70	1.24	2.46	0.00
1985	81	0.61	1.10	1.77	0.40	81	0.70	1.23	1.72	0.02	77	0.66	1.09	1.91	0.15
1986	204	0.63	0.98	2.23	0.83	204	0.63	1.04	1.88	0.38	182	0.63	1.21	2.37	0.01
1987	134	0.56	1.07	1.69	0.65	134	0.60	1.13	1.87	0.29	119	0.61	1.16	2.42	0.08
1988	49	0.68	1.27	2.73	0.16	49	0.79	1.18	2.55	0.16	41	0.47	1.08	4.23	0.24
1989	44	0.67	0.97	1.59	0.98	44	0.66	1.11	1.95	0.48	35	0.62	0.87	2.00	0.66
1990	57	0.65	1.58	3.97	0.03	57	0.91	1.74	3.01	0.00	43	0.78	2.17	3.67	0.01
1991	140	0.56	1.27	2.00	0.18	140	0.57	1.21	2.13	0.39	103	0.50	1.28	2.70	0.04
1992	187	0.65	1.25	2.42	0.02	187	0.68	1.26	2.78	0.00	139	0.49	1.26	2.68	0.01
1993	258	0.72	1.32	2.56	0.00	258	0.74	1.37	2.75	0.00	198	0.56	1.27	2.65	0.00
1994	196	0.66	1.22	2.29	0.01	196	0.68	1.19	2.14	0.01	152	0.49	0.86	2.20	0.78
1995	214	0.73	1.45	2.65	0.00	214	0.73	1.48	2.60	0.00	170	0.59	1.35	2.94	0.00
1996	288	0.70	1.30	2.35	0.00	288	0.71	1.43	2.50	0.00	209	0.58	1.39	3.34	0.01
1997	199	0.68	1.29	2.34	0.00	199	0.73	1.30	2.69	0.00	154	0.53	1.14	2.72	0.01
Overall	2493	0.68	1.29	2.44	0.00	2493	0.71	1.30	2.48	0.00	2023	0.60	1.30	2.75	0.00

This table reports distribution of offer-price-to-value (*P*/*V*) ratios for IPOs from 1980 to 1997. The data are from Security Data Corporation (SDC) database, Center for Research in Security Prices (CRSP) database, and Compustat database. Each IPO is matched with an industry peer, which 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. EBITDA represents earnings before interest, taxes, depreciation, and amortization. *P*/*V* ratios are computed as the ratio of the offer-price-to-sales, offer-price-to-EBITDA, or offer-price-to-earnings divided by the corresponding market-price-to-sales, market-price-to-EBITDA, or market-price-to-earnings of the comparable firm. In Panel B, the price multiples are based on a modified method which adjust for issuing proceeds, cash holdings and leverage. Wilcoxon *p*-value is based on Wilcoxon rank sum test on the hypothesis that the price multiples of the IPO firm follow the same distribution as those of the matching firms.

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

For all the multiples above, all fiscal year data end at least three months prior to the IPO offer date. Earnings refer to net income before extraordinary items (Compustat data item 123). CRSP Shares Outstanding refers to the shares outstanding at the end of the offer day. The P/V ratios are calculated as the ratios of the modified IPO price multiples over the modified matching firm price multiples.

4. IPO valuation results

4.1. Comparable firm multiple method

First I calculate the P/V ratios using IPO multiples based on the method in Purnanandam and Swaminathan (2004). Matching firms used in the calculations here are based on industry, sales and EBITDA. The results are reported in Panel A of Table 2. They are quite consistent with the results in Purnanandam and Swaminathan (2004). The median P/V ratios for the whole sample is around 1.6, regardless of the price multiple. This is even higher than Purnanandam and Swaminathan (2004)'s median, which is about 1.5. Wilcoxson rank sum tests show that the price multiples of the IPO firms are significantly higher than the corresponding price multiples of matching firms[3]. Although not reported in Table 2, additional tests confirm that the IPO firms have higher price multiples every year from 1980 to 1997.

The results change significantly when the modified method is used to calculate the price multiples. The last row of Panel B in Table 2 shows that the median P/V ratios drop by about 0.3 to around than 1.3. Wilcoxon tests show that, for the whole sample, the price multiples of the IPO firms are still significantly higher than those of matching firms. However, in eight of the 18 sample years, at least two of the price multiples of the IPO firms are not significantly higher than those of matching firms. Obviously, after the upward biases discussed in Section 2 are avoided, the 'overpricing' results become less robust.

Not surprisingly, the modified method reduces the value of the P/V ratios but does not change the rankings of P/V ratios much. Although not reported, the P/V ratios based on the modified method are highly correlated with Purnanandam and Swaminathan (2004)'s P/V ratios, with Spearman correlation coefficients above 0.87 within all three categories (P/S, P/EBITDA, and P/E multiples).

4.2. Growth-matching method

As mentioned earlier, P/V ratios based on the comparable firm multiple method neglects growth expectation, which plays an important role in IPO valuation. So I repeat the P/V ratio calculations based on the modified method using growth-matching firms. The results are reported in Panel A of Table 3. Like in Purnanandam and Swaminathan (2004), the P/V ratios decline after growth forecast is taken into account. The difference is, in Purnanandam and Swaminathan (2004), the median IPO firms are still 'overpriced' by about 14% relative to matching firms. But

[3] Purnanandam and Swaminathan (2004) conduct Wilcoxson tests about the hypothesis that the median P/V ratio is equal to 1. But, due to Jensen's inequality, the null hypothesis would not be that the P/V ratio is one. So I test the null hypothesis that the price multiples of IPO firms follow the same distribution as those of matching firms.

Table 3
IPO valuation based on industry, sales and growth

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	75%	Wilcoxon *p*-value	No. of issues	25%	Median	75%	Wilcoxon *p*-value	No. of issues	25%	Median	75%	Wilcoxon *p*-value
Panel A. P/V ratios based on offer price															
1981	5	1.69	2.69	4.86	0.13	5	0.75	1.36	2.44	0.44	5	0.89	1.86	2.48	0.31
1982	9	0.70	0.92	1.80	0.99	9	0.57	1.01	1.26	0.99	7	0.81	1.20	1.27	0.69
1983	68	0.66	1.29	2.32	0.00	68	0.47	0.90	1.84	0.63	67	0.67	1.10	2.71	0.11
1984	24	0.34	0.59	1.03	0.09	24	0.41	0.95	1.81	0.96	20	0.56	0.93	1.81	0.99
1985	27	0.57	1.25	2.49	0.66	27	0.75	1.42	2.70	0.05	25	1.07	1.37	3.39	0.01
1986	87	0.62	1.13	1.88	0.54	87	0.37	0.85	1.38	0.01	73	0.61	0.99	1.60	0.67
1987	45	0.57	1.34	2.43	0.34	45	0.64	1.34	1.94	0.31	37	0.64	1.28	2.00	0.16
1988	28	0.48	1.19	2.53	0.81	28	0.79	1.46	3.38	0.14	26	0.68	1.18	4.83	0.19
1989	31	0.42	0.72	1.55	0.40	31	0.55	1.03	2.32	0.59	27	0.59	1.02	2.02	0.51
1990	36	0.41	0.93	1.67	0.72	36	0.73	1.07	1.71	0.64	31	0.83	1.39	2.76	0.07
1991	93	0.37	0.64	1.40	0.00	93	0.54	1.00	1.54	0.66	82	0.57	0.99	1.85	0.60
1992	142	0.50	0.83	1.64	0.20	142	0.59	1.00	1.73	0.88	110	0.49	0.94	1.84	0.92
1993	169	0.42	0.79	1.73	0.06	169	0.57	0.97	1.47	0.48	134	0.45	0.95	1.47	0.12
1994	129	0.40	0.88	1.62	0.05	129	0.63	0.97	1.85	0.76	95	0.54	0.87	1.69	0.35
1995	162	0.44	0.85	1.50	0.03	162	0.43	0.90	1.93	0.32	122	0.43	0.94	2.04	0.55
1996	207	0.29	0.66	1.84	0.00	207	0.38	0.91	1.86	0.09	159	0.40	0.93	1.92	0.36
1997	142	0.47	0.83	1.45	0.02	142	0.75	1.16	1.83	0.01	113	0.54	1.06	2.23	0.60
Overall	1404	0.43	0.87	1.73	0.01	1404	0.54	0.99	1.75	0.85	1133	0.55	1.01	1.94	0.61
Panel B. P/V ratios based on 1st day market price															
Overall	1404	0.47	0.95	1.94	0.39	1404	0.57	1.10	1.98	0.01	1133	0.59	1.15	2.19	0.01

This table reports distribution of offer-price-to-value (*P/V*) ratios for IPOs from 1980 to 1997. The data are from Security Data Corporation (SDC) database, Center for Research in Security Prices (CRSP) database, I/B/E/S and Compustat database. Each IPO is matched with an industry peer, which is a comparable publicly traded firm in the same Fama and French (1997) industry as the IPO firm and has the closest sales and growth forecast. *P/V* ratios are computed as the ratio of the price-to-sales, price-to-EBITDA, or price-to-earnings divided by the corresponding market-price-to-sales, market-price-to-EBITDA, or market-price-to-earnings of the comparable firm. The price multiples are based on a modified method which adjust for issuing proceeds, cash holdings and leverage. In Panel A, the price multiples of the IPO firms are based on offer price. In Panel B, the price multiples of the IPO firms are based on first-day market price. Wilcoxon *p*-value is based on Wilcoxon rank sum test on the hypothesis that the price multiples of the IPO firm follow the same distribution as those of the matching firms.

Table 4
Spearman correlation among *P*/*V* ratios

	P/*V* (sales)3	*P*/*V* (EBIT)3	*P*/*V* (earnings)3
P/*V* (sales)1	0.31	0.36	0.20
P/*V* (sales)2	0.35	0.36	0.19
P/*V* (sales)3	1.00	0.62	0.28
P/*V* (EBIT)1	0.25	0.40	0.18
P/*V* (EBIT)2	0.30	0.41	0.16
P/*V* (EBIT)3	0.55	1.00	0.47
P/*V* (earnings)1	0.19	0.25	0.36
P/*V* (earnings)2	0.25	0.29	0.35
P/*V* (earnings)3	0.33	0.65	1.00

This table reports the Spearman correlation coefficient between *P*/*V* ratios based on different methods. *P*/*V* (sales) is the *P*/*V* ratio calculated as the ratio of the offer-price-to-sales multiple divided by the corresponding market-price-to-sales multiple of the matching firm. *P*/*V* (EBIT) and *P*/*V* (earnings) are calculated using price-to-EBITDA and price-to-earnings multiples. *P*/*V* (sales)1, *P*/*V* (EBIT)1, and *P*/*V* (earnings)1 mean that the matching firms are chosen based on industry, sales and EBITDA profit margin (EBITDA/sales) and the price multiples are calculated using Purnanandam and Swaminathan (2004) method. *P*/*V* (sales)2, *P*/*V* (EBIT)2, and *P*/*V* (earnings)2 mean that the matching firms are chosen based on industry, sales and EBITDA profit margin (EBITDA/sales) and the price multiples are calculated after adjusting for offering proceeds, cash and short term investment, and leverage. *P*/*V* (sales)3, *P*/*V* (EBIT)3, and *P*/*V* (earnings)3 mean that the matching firms are chosen based on industry, sales and earnings growth forecast and the price multiples are adjusted for offering proceeds, cash and short term investment, and leverage. All correlations are significant at 1% or higher level.

in Table 3, after we exclude the new primary shares, the median *P*/*V* ratios range from 0.87 to 1.01. The IPO firms are no longer overpriced! If we look at the results year by year, we will find that the price multiples of the IPO firms are not consistently higher than those of matching firms at 5% significance level in any of the 18 sample years. Actually, for the entire sample, the modified *P*/*S* multiples of the IPO firms are significantly lower than those of matching firms, suggesting that the IPO firms are underpriced. This is consistent with the traditional view that IPO firms are underpriced relative to their fair value.

The results above bring an interesting question: if IPOs are underpriced, does the aftermarket price IPOs at their fair value? To answer this question, I replace the offer price in the IPO price multiples by the closing price on the offer date. The market price and CRSP shares outstanding in matching firm price multiples are also replaced by values on the offer date. Then the price multiples and *P*/*V* ratios are recalculated. The results are reported in Panel B of Table 3.

Panel B shows that different price multiples lead to different results: The median *P*/*V* ratio based on *P*/*S* multiples is 0.95; The median *P*/*V* ratio based on *P*/EBITDA multiple is 1.10; The median *P*/*V* ratio based on *P*/*E* multiple is 1.15. According to Wilconxon tests, the *P*/*S* multiples of the IPO firms are not significantly different from those of matching firms while the *P*/EBITDA and *P*/*E* multiples of the IPO firms are significantly higher. Considering the fact that the median growth rate of IPO firms is still more than 1% higher than that of growth matching firms, it seems that the aftermarket valuation of the IPO firms is close to the valuation of their growth-matching firms.

When the growth-matching method is used, both the value and the ranking of *P*/*V* ratios change a lot. But, as shown in Table 4, the *P*/*V* ratios calculated using growth-matching firms are still significantly correlated with *P*/*V* ratios based on the comparable firm multiple method. The Spearman correlation coefficients between *P*/*V* ratios based on growth-matching method and those based on comparable firm multiples (either Purnanandam and Swaminathan, 2004 method or the modified method) range from 0.19 to 0.41. So, it is possible for the *P*/*V* ratios by Purnanandam and

Table 5
Long-run returns of IPO and comparable firm multiples matching firms

Portfolio	Mth 1–6	Mth 7–12	Year 2	Year 3	Year 4	Year 5	Year 1–5 buy and hold
Equal-weighted average returns (%)							
IPO BHR	9.17	3.33	11.58	12.89	13.38	9.45	63.91
IPO AR	2.99	−4.62	−7.31	−5.27	−2.11	−1.50	−28.15
Matching BHR	4.45	5.26	15.71	13.78	15.04	13.09	62.63
Matching AR	−1.73	−2.69	−3.18	−4.38	−0.45	2.14	−29.43
IPO-matching	4.72	−1.93	−4.13	−0.89	−1.66	−3.64	1.28
Empirical *p*-value	0.01	0.07	0.01	0.36	0.29	0.06	0.48
Value-weighted average returns (%)							
IPO BHR	10.75	5.12	15.38	10.81	14.76	−1.84	73.58
IPO AR	3.79	−3.19	−3.02	−7.09	2.05	−8.20	−16.59
Matching BHR	5.72	5.33	10.69	9.10	7.85	7.15	68.41
Matching AR	−1.24	−2.98	−7.71	−8.8	−4.86	0.79	−21.76
IPO-matching	5.03	−0.21	4.69	1.71	6.91	−8.99	5.17
Empirical *p*-value	0.01	0.47	0.09	0.28	0.22	0.06	0.32
# of observations	2493	2492	2466	2293	2082	1878	2493

This table presents buy-and-hold returns (BHR) and market adjusted abnormal returns (AR) of IPO and matching firms over the first 6 months (Mth 1–6), months 7 to 12 (Mth 7–12), the second (Year 2), third (Year 3), fourth (Year 4), or fifth (Year 5) year after the offer date. The returns of the NYSE/AMEX/NASDAQ value-weighted return are used as market return. (IPO-matching) is the difference between the returns of IPOs and the returns of matching firms. The empirical *p*-values are based on observed significance levels of (IPO-Matching) from a randomization procedure. The null hypothesis is that (IPO-matching) has a mean of zero.

Swaminathan (2004) to pick up some of the cross-sectional differences in IPO valuation but exaggerate the overall valuation for the whole IPO sample.

Although not reported in this paper, I also calculate P/V ratios based on matching by industry, sales, EBITDA profit margin and analyst forecast. The P/V ratios calculated using the modified method are close to 1 and again the IPO firms are not overpriced relative to matching firms.

Purnanandam and Swaminathan (2004) raise some concerns about the validity of the growth-matching method. The most important one is: growth-matching may pick the wrong matching firm. Rajan and Servaes (1997) find that the analyst growth expectations may be excessively optimistic for IPO firms and IPOs with higher analyst growth expectations underperform IPOs with low analyst growth expectations in the long run. Michaely and Womack (1999) find similar results. Thus, it is likely that IPOs with high analyst growth expectations tend to be overvalued. For the matching firms, Chan, Karceski and Lakonishok (2003) find that IBES growth forecasts are overly optimistic and La Porta (1996) finds that stocks with high growth expectations earn lower returns in the future. So, Purnanandam and Swaminathan (2004) argue that the comparable firm multiple method is better because growth-matching may pick matching firms that also tend to be overvalued and reduce the power of the P/V ratios to find mispricing.

The best way to address Purnanandam and Swaminathan (2004)'s concern is to examine the long-run performance of IPO firms and the different groups of matching firms. If IPO firms are really overpriced, as shown by the comparable firm multiples method, then IPO firms should underperform the comparable firm multiple matching firms in the long run. If IPO firms are not overpriced, as shown by the growth-matching method, then IPO firms should not underperform their matching firms in the long run. So I examine the long-run performance of both the IPO firms and the different groups of matching firms in the next section.

5. IPO long-run performance

5.1. Buy-and-hold returns of IPO and comparable firm multiple matching firms

I start by calculating the buy-and-hold returns earned by the IPO firms and the comparable firm multiple matching firms. To distinguish the market adjusted returns from the raw buy-and-hold returns (BHR), I denote the market adjusted buy-and-hold return as abnormal return (AR). As in Purnanandam and Swaminathan (2004), I calculate the buy-and-hold returns over the 5 years after the IPO and the returns each year. The Year 1 returns are broken up into two six-month periods because lockup periods usually end after six months and the literature documents significant price change around lockup expiration (see, for example, Field and Hanka, 2001; Bradley et al., 2001; Brav and Gompers, 2003). Equal-weighted average returns and value-weighted average returns are calculated. For the 5-year period and the first six-month period, which actually starts from the 2nd trading day after the IPO, the market values of the firms at the close of the first trading day are used as the weights to calculate value-weighted average returns. For other periods, the market values of the firms at the close of the last trading day in the previous period are used as the weights. For example, the market values of firms at the close of the first 6 months are used as the weight to calculate the value-weighted buy-and-hold returns in the 2nd 6-month period. Following Ritter (1991) and others, if an IPO firm is delisted from CRSP during the five-year period, the returns of both the IPO firm and its matching firm are calculated up to the delisting day and the portfolios are rebalanced the next day. If a matching firm is delisted, it is replaced on a point-forward basis with another matching firm. Thus the number of observations is different in different holding periods. CRSP NYSE/AMEX/NASDAQ value-weighted return is used as the market return.

Kothari and Warner (1997), Lyon et al. (1997) and others indicate that parametric tests about long-horizon return performance are severely misspecified. So following Purnanandam and Swaminathan (2004), I use a randomization procedure to calculate empirical p-values. For each pair of IPO and matching firm, I randomly assign the returns of the IPO and the matching firm to the two firms. There is a 50% chance that the IPO firm may keep its own return and another 50% chance that it may be assigned the return of the matching firm. The situation is the same for the matching firm. Thus I get a pseudo-sample of annual returns for both the IPO firms and the matching firms. Then I compute the market-adjusted returns and non-parametric t-statistics for differences in means. This procedure preserves the skewness, time-series autocorrelation and clustering properties of the original sample. I repeat this procedure 20,000 times to generate a small-sample distribution for the t-statistics[4] under the null hypothesis of equality of means. Then the empirical p-values can be derived to measure the statistical significance of the differences in returns between the IPO firms and matching firms.

Table 5 presents the results of BHR for the IPO firms and the comparable firm multiple matching firms. Consistent with the literature and the results in Purnanandam and Swaminathan (2004), it seems that the IPO firms underperform the market no matter which measurement we use. If we use equal-weighted average return, the IPO firms underperform the market by almost 28% in the 5-year period after offering. In addition, the IPO firms underperform the market in all the 5 years after the IPO except the first 6 months. If we use value-weighted average return, the underperformance is reduced but the IPO firms still underperform the market in 4 of the 5 years (excluding the first 6 months) and the 5-year underperformance is 16.59%. However, the matching firms also underperform the market. When we use equal-weighted return, the matching

[4] I also examined the small sample distribution of the differences in means and derived the corresponding p-value for the differences. The results are similar.

Table 6
Long-run returns of IPO and growth-matching firms

Portfolio	Mth 1–6	Mth 7–12	Year 2	Year 3	Year 4	Year 5	Year 1–5 buy and hold
Equal-weighted average return (%)							
IPO BHR	16.81	6.39	13.11	13.59	14.24	11.44	93.27
Matching BHR	8.04	5.35	12.06	9.37	20.92	13.51	59.98
IPO-Matching	8.77	1.04	1.05	4.22	−6.68	−2.07	33.29
Empirical *p*-value	0.01	0.23	0.34	0.08	0.03	0.24	0.01
Value-weighted average return (%)							
IPO BHR	14.65	6.92	16.61	12.74	15.01	−2.51	89.45
Matching BHR	6.14	3.83	8.22	13.47	13.59	6.31	65.68
IPO-matching	8.51	3.09	8.39	−0.73	1.42	−8.82	23.77
Empirical *p*-value	0.01	0.11	0.01	0.46	0.43	0.09	0.06
# of observations	1404	1396	1378	1311	1189	1078	1404

This table presents the buy-and-hold returns (BHR) of IPO and growth-matching firms over the first 6 months (Mth 1–6), months 7 to 12 (Mth 7–12), the second, (Year 2), third (Year 3), fourth (Year 4), or fifth (Year 5) year after the offer date. The returns of the NYSE/AMEX/NASDAQ value-weighted return are used as market return. (IPO-matching) is the difference between the returns of IPOs and the returns of matching firms. The empirical *p*-values are based on observed significance levels of (IPO-Matching) from a randomization procedure. The null hypothesis is that (IPO-matching) has a mean of zero.

firms underperform the market by 29.43% in the 5-year period. When we use value-weighted return, the matching firms underperform the market by 21.76%.

As a result, when we look at the difference in BHR between the IPO firms and matching firms[5], it is doubtful whether the IPO firms underperform the matching firms at all. For equal-weighted returns, the IPO firms and matching firms have similar performance over the five-year period and the difference is not significant. For value-weighted returns, the IPO firms outperform matching firms by more than 5% over the five-year period although this difference is not significant. If we look at the annual returns[6], matching firms do not consistently and significantly outperform the IPO firms in any one of the 5 years. The results are consistent with those in Brav et al. (2000) and do not support the argument that IPO firms are overvalued relative to comparable firm multiple matching firms.

5.2. Buy-and-hold returns of IPO and growth-matching firms

The buy-and-hold returns earned by the IPO firms and the growth-matching firms are reported in Table 6. If we look at equal-weighted returns, we will notice that the IPO firms significantly underperform the growth-matching firms only in Year 4. In Year 5, the IPO firms underperform the growth-matching firms by 2.07%. But this underperformance is not statistically significant. In all the other years, the IPO firms perform better than growth-matching firms. Over the 5-year holding period, the IPO firms outperform matching firms by 33.29%. If value-weighted returns are used, then the IPO firms do not significantly underperform in any of the 5 years. Over the five-year period, the

[5] The difference in BHR is equal to the difference in AR because the same market returns are used to calculate ARs for IPO firms and matching firms.

[6] The differences in annual returns cannot be used to calculate the difference in 5-year BHR. The number of observations changes over time. In addition, when equal-weighted buy-and-hold returns are calculated for each year, the portfolios are rebalanced. Thus the portfolios measured by annual BHRs are different from the portfolio measured by 5-year BHR.

IPO firms outperform matching firms by 23.77%. It seems that firms with high expected growth based on IBES earnings forecasts have much lower returns if they are seasoned rather than if they are IPOs. This does not support the argument that IPO firms are overvalued.

Instead, the results seem to support the *P*/*S* based valuation results in Panel B of Table 3, which shows that the market priced based *P*/*S* multiples of the IPO firms are significantly lower than those of matching firms. So, does this imply that IPO firms are undervalued relative to growth-matching firms? Not necessarily. In Table 6 the IPO firms are required to have analyst growth forecasts available in the first year after IPO. If we compare the returns of the IPO firms in Table 6 with those in Table 5, we will notice that the IPO firms with growth forecasts have much higher returns in the first year than other IPO firms, whether we look at equal-weighted average or value-weighted average. So it seems analysts tend to follow IPOs with better performance in the first year. In years 2, 3, 4, and 5, this performance difference largely disappears. If we compare the annual returns of the IPO firms with those of growth-matching firms, we will find that the IPO firms have similar performance as growth-matching firms in the 4-year period from year 2 to year 5[7]. So, probably the higher five-year BHR of the IPO firms relative to growth-matching firms is driven by the ex post selection bias associated with the IBES forecasts requirement.

5.3. Size and book-to-market adjusted returns

The risk characteristics of IPO firms and the matching firms may be different from each other. Thus subtracting the BHRs of IPOs from those of matching firms may not be a proper method. The market returns do not provide accurate risk adjustment either. As shown in Fama and French (1992), size (market value of equity, ME) and book-to-market ratio (BE/ME) are two important characteristics we should control for. Thus I calculate the size and book-to-market adjusted returns for both the IPO firms and the matching firms.

Each IPO firm or matching firm is assigned to one of 25 benchmark portfolios formed on ME and BE/ME. The benchmark portfolios, which are constructed at the end of each June, are the intersections of 5 portfolios formed on ME and 5 portfolios formed on BE/ME (Fama and French, 1993). The size breakpoints for year t are the NYSE market equity quintiles at the end of June of t. BE/ME for June of year t is the book equity for the last fiscal year end in $t-1$ divided by ME for December of $t-1$. The BE/ME breakpoints are NYSE quintiles. Benchmark buy-and-hold returns are calculated based on the value-weighted monthly returns of the benchmark portfolios. Following Brav et al. (2000), for both the IPO firms and the matching firms, the initial market value of equity is calculated at the end of the first month after the offering. Also following Brav et al. (2000), their initial book value of equity is the first book value after the IPO as long as it is within 18 months of the offering month[8]. The book value is calculated using Compustat data based on the method in Fama and French (1993) and Davis, Fama, and French (2000). The IPO and matching firms are first assigned to appropriate benchmark portfolios based on their initial ME and BE/ME. Later, at the end of each June, when the benchmark portfolios are re-constructed, the IPO and matching firms are re-assigned to the benchmark portfolios based on updated ME and BE/ME[9]. Buy-and-hold returns are calculated for the IPO and matching firms based on their

[7] Although not reported, the average BHR of IPO firms over the 4-year period (year 2–5) is not significantly different from that of growth-matching firms.

[8] As discussed in Brav et al. (2000), reducing this 18-month period decreases the number of IPO firms but does not change the results.

[9] I also calculate the size and book-to-market adjusted return based on the initial assignment only (without re-assign the IPO and matching firms every June). The results are similar.

Table 7
The distribution of IPOs and comparable firm multiples matching firms by book-to-market and size

Book-to-market quintiles	Size quintile					
	Smallest (%)	Quintile 2 (%)	Quintile 3 (%)	Quintile 4 (%)	Largest (%)	Total (%)
Panel A. IPO firms						
Low	41.6	15.1	2.9	0.8	0.1	60.5
2	22.2	3.6	0.4	0.0	0.0	26.2
3	7.4	0.7	0.2	0.0	0.0	8.3
4	3.1	0.3	0.0	0.0	0.0	3.4
High	1.4	0.2	0.0	0.0	0.0	1.6
Total	75.7	19.8	3.5	0.9	0.1	100.0
Panel B. Comparable firm multiple matching firms						
Low	28.3	6.9	2.3	1.0	0.1	38.5
2	17.1	2.6	0.3	0.1	0.1	20.2
3	14.0	1.7	0.2	0.2	0.0	16.1
4	12.6	0.8	0.1	0.0	0.0	13.5
High	11.5	0.3	0.0	0.0	0.0	11.8
Total	83.5	12.2	2.9	1.3	0.2	100.0

Each IPO or matching firm is assigned to one of 25 size and book-to-market portfolios formed according to Fama and French (1993). The portfolios, which are constructed at the end of each June, are the intersections of 5 portfolios formed on size (market equity, ME) and 5 portfolios formed on the ratio of book equity to market equity (BE/ME). This table reports the proportion of IPO or matching firms in each of the 25 benchmark portfolios.

Table 8
Size and book-to-market adjusted long-run returns of IPO and comparable firm multiples matching firms

Portfolio	Mth 1–6	Mth 7–12	Year 2	Year 3	Year 4	Year 5	Year 1–5 buy and hold
Equal-weighted average returns (%)							
IPO BHR	8.27	2.88	11.84	14.02	12.49	10.50	62.74
IPO AR	6.52	0.74	−0.12	1.62	−0.42	−1.25	11.97
Matching BHR	5.18	5.16	16.25	13.42	14.37	14.25	63.39
Matching AR	0.96	0.64	1.06	−0.48	−0.01	1.63	−5.02
IPO-matching	5.56	0.10	−1.18	2.10	−0.41	−2.88	16.99
Empirical *p*-value	0.01	0.47	0.25	0.16	0.45	0.15	0.06
Value-weighted average returns (%)							
IPO BHR	9.36	4.62	14.66	10.46	16.4	−1.84	69.97
IPO AR	7.35	2.63	4.63	−0.67	7.43	−5.29	19.57
Matching BHR	6.23	3.95	11.41	8.99	7.96	10.68	64.42
Matching AR	1.84	0.59	−0.18	−3.79	−3.41	2.15	−0.74
IPO-matching	5.51	2.04	4.81	3.12	10.84	−7.44	20.31
Empirical *p*-value	0.01	0.19	0.07	0.27	0.13	0.09	0.07
# of observations	2475	2473	2437	2255	2040	1822	2475

This table presents size and book to market adjusted buy-and-hold returns of IPO and matching firms over the first 6 months (Mth 1–6), months 7 to 12 (Mth 7–12), the second, (Year 2), third (Year 3), fourth (Year 4), or fifth (Year 5) year after the offer date. Each IPO or matching firm is assigned to a size and book to market portfolio formed based on Fama and French (1993). The differences between IPO returns and the portfolio returns are denoted abnormal returns (AR). The abnormal returns for matching firms are calculated in a similar manner. (IPO-matching) is the difference between the abnormal returns of IPOs and the abnormal returns of matching firms. The empirical *p*-values are based on observed significance levels of (IPO-matching) from a randomization procedure. Note that the *p*-values are referring to the difference in abnormal returns, not the difference in raw returns. The null hypothesis is that (IPO-Matching) has a mean of zero.

Table 9
The distribution of IPOs and sales and growth-matching firms by book-to-market and size

Book-to-market quintiles	Size quintiles					
	Smallest (%)	Quintile 2 (%)	Quintile 3 (%)	Quintile 4 (%)	Largest (%)	Total (%)
Panel A. IPO firms						
Low	31.9	20.4	3.8	1.1	0.1	57.4
2	21.5	5.1	0.6	0.1	0.0	27.3
3	8.3	1.1	0.0	0.1	0.0	9.6
4	3.5	0.4	0.0	0.0	0.0	4.0
High	1.6	0.1	0.0	0.0	0.0	1.7
Total	66.9	27.2	4.5	1.3	0.1	100.0
Panel B. Growth-matching firms						
Low	27.2	24.0	8.3	2.5	0.6	62.6
2	9.7	3.1	0.5	0.1	0.0	13.4
3	6.5	1.2	0.4	0.2	0.0	8.4
4	5.2	0.6	0.1	0.0	0.0	5.9
High	9.1	0.5	0.1	0.0	0.0	9.7
Total	57.8	29.3	9.5	2.8	0.6	100.0

Each IPO or growth-matching firm is assigned to one of 25 size and book-to-market portfolios formed according to Fama and French (1993). The portfolios, which are constructed at the end of each June, are the intersections of 5 portfolios formed on size (market equity, ME) and 5 portfolios formed on the ratio of book equity to market equity (BE/ME). This table reports the proportion of IPO or matching firms in each of the 25 benchmark portfolios.

monthly returns. So the buy-and-hold returns actually start from the month after the IPO month. Abnormal returns are calculated as the difference between the IPO/matching firm buy-and-hold returns and benchmark portfolio returns. In the process above, if an IPO has negative book value, then it is excluded from our analysis. If a matching firm has negative book value, then it is replaced by another matching firm. The distributions of the IPOs and the comparable firm multiple matching firms by initial ME and BE/ME are reported in Table 7.

Consistent with Brav et al. (2000), the IPOs are heavily weighted in the small, low book-to-market portfolios. More than 40% of the IPO firms are in the smallest, lowest book-to-market portfolio, the (1,1) portfolio. More than 75% of the IPO firms are among the smallest firms and more than 60% of the IPO firms are among the firms with the lowest BE/ME.

Comparable firm multiple matching firms show some differences in their distributions. They also tend to be among the smallest firms (83.5%). However, only 28.3% of the matching firms are in the (1,1) portfolio and more than 60% of the matching firms are not in the portfolios with the lowest BE/ME. One can interpret this as further evidence that IPOs are overvalued, if he believes the conclusion in Purnanandam and Swaminathan (2004). Or, based on Fama and French (1993), one can interpret this as evidence that the IPO firms and the comparable firm multiple matching firms have different risk characteristics.

Table 8 reports the BHRs and the abnormal returns (AR) of the IPO firms and the comparable firm multiple matching firms. Consistent with Brav et al. (2000), the IPOs do not underperform the size and book-to-market benchmark portfolios over the 5-year horizon[10], whether we use equal-weighted return or value-weighted return. If we look at annual returns, the IPOs do not significantly underperform the benchmark portfolios in any of the 5 years. This is inconsistent

[10] Ritter and Welch (2002) argues that differences in sample periods and sample selection criteria account for some of the differences in the long-run abnormal returns between studies.

Table 10
Fama–French three-factor regressions for IPOs and comparable firm multiple matching firms

Portfolio	1–6 months of seasoning					7–60 months of seasoning				
	a	b	s	h	Adj. *R*	*a*	b	s	h	Adj. *R*
Panel A: equal-weighted average monthly returns, matching by comparable firm multiples										
IPO	0.57 (2.45)	1.19 (19.95)	1.35 (14.77)	−0.44 (−4.36)	0.833	−0.07 (−0.36)	1.08 (21.23)	1.01 (16.08)	−0.08 (−1.07)	0.814
Matching	0.23 (0.92)	0.81 (12.80)	0.94 (9.72)	−0.22 (−2.12)	0.665	−0.06 (−0.35)	0.99 (22.81)	0.89 (17.04)	0.22 (3.54)	0.802
IPO-matching	0.33 (1.08)	0.38 (4.72)	0.41 (3.31)	−0.21 (−1.57)	0.224	−0.01 (−0.08)	0.10 (2.57)	0.11 (2.09)	−0.33 (−5.04)	0.257
Panel B: value-weighted average monthly returns, matching by comparable firm multiples										
IPO	0.77 (2.59)	1.18 (15.47)	1.28 (10.88)	−0.54 (−4.23)	0.754	0.01 (0.04)	1.23 (21.33)	0.76 (10.64)	−0.55 (−6.45)	0.828
Matching	0.16 (0.61)	0.97 (13.83)	0.70 (6.51)	−0.48 (−4.10)	0.679	−0.19 (−1.04)	1.06 (21.28)	0.74 (11.63)	−0.11 (−1.53)	0.787
IPO-matching	0.60 (1.58)	0.21 (2.22)	0.58 (3.91)	−0.06 (−0.37)	0.107	0.20 (0.87)	0.16 (2.51)	0.04 (0.49)	−0.44 (−4.83)	0.201

This table reports the results of Fama and French (1993) three-factor regressions involving both equal-weighted and value-weighted monthly calendar time returns of both IPOs and comparable firm multiple matching firms. There are 2493 IPO firms in the sample. The IPOs and matching firms stay in their respective portfolios for (a) a period of 6 months starting the month after they go public (1–6 months of seasoning) or (b) for a period of 54 months starting 6 months after they go public (7–60 months of seasoning). For 1–6 months of seasoning regressions the time period is from March 1980 to May 1998. For 7–60 months of seasoning regressions the time period is from September 1980 to November 2002. The regression model is given below:

$$r_{pt}r_{ft} = a_p + b_p(R_{mt}-R_{ft}) + s_p\mathrm{SMB}_t + h_p\mathrm{HML}_t + u_t$$

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 monthly return on small firms minus the return on large firms, and HML is the monthly 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 percentage and b_p, s_p and h_p are factor loadings.

with the suggestion that IPOs are overvalued. More importantly, when we compare the abnormal return of the IPO stocks (IPO AR) with that of comparable firm multiple matching firms (Matching AR), the IPO firms do not underperform the matching firms over the 5-year period. Actually, the IPO firms seem to perform better by between 17% and 20%, although the difference is statistically insignificant. So using size and book-to-market benchmark does change the abnormal returns to some extent. If we look at the annual abnormal returns, consistent with the results in Table 5, there is no significant difference between those of the IPO firms and those of comparable firm multiple matching firms, except in the first 6 months, during which the IPO firms outperform the matching firms. The results are again inconsistent with the comparable firm multiple valuation results, which suggest that IPOs are overvalued relative to the comparable firm multiple matching firms.

Given the fact that the IPOs and comparable firm multiple matching firms have different distributions in terms of initial ME and BE/ME, it will be interesting to find out whether matching by growth expectation achieves a better distribution. The distributions of the IPO firms and the growth-matching firms by initial ME and BE/ME are reported in Table 9.

Table 9 shows that the distribution of the IPO firms is close to the distribution of the growth-matching firms. 31.9% of the IPO firms are in the (1,1) portfolio; 66.9% are among the smallest firms and 57.4% are among the lowest BE/ME firms. For growth-matching firms, the corresponding numbers are 27.2%, 57.8% and 62.6%. This improves from the distributions of comparable firm multiple matching firms in Table 7 and may suggest a better match between the risk characteristics of the IPO firms and those of growth-matching firms.

Although not reported in the paper, the results for the size and book-to-market adjusted abnormal returns for the IPO firms and growth-matching firms are similar to the results in Table 6. They are generally consistent with the idea that IPO firms are fairly valued relative to growth-matching firms after the ex post selection bias related to IBES forecast requirement is excluded.

5.4. Fama–French three-factor model

Another approach to measure long-run performance is to examine the performance of calendar time portfolios. Thus I use Fama and French (1993) three-factor model of monthly returns to compare the performance of the IPOs with that of comparable firm multiple matching firms.

Following Purnanandam and Swaminathan (2004), I construct calendar-time portfolios for the IPOs. One portfolio contains the IPOs held for 6 months starting from the beginning of the first calendar month after the IPO (1–6 months of seasoning). The other portfolio contains the IPOs held for 54 months starting from the seventh month after the offer date (7–60 months of seasoning). Similar calendar-time portfolios are also constructed for the matching firms. To further compare the IPO firms with their matching firms, a zero-investment portfolio of (IPO–Matching) is also constructed. Both equal-weighted average returns and value-weighted average returns (weighted by the market value at the beginning of each month) are calculated across all stocks in each portfolio for each calendar month. Fama and French (1993) three-factor model is estimated using the monthly returns of the 3 portfolios.

Panels A and B of Table 10 present the results of the three-factor model regressions for the IPOs and comparable firm multiple matching firms. For the six-month holding period, consistent with Purnanandam and Swaminathan (2004) and our earlier results in Tables 5 and 8, the IPO firms have positive and significant abnormal return. The magnitude of the abnormal return is between 0.57% and 0.77% per month. This translates into between 3% and 4% per 6 month, lower than the results in Table 8 but close to the results in Table 5. However, for both equal-weighted and value-weighted

Table 11
Fama–French three-factor regressions for IPOs and growth-matching firms

Portfolio	1–6 months of seasoning					7–60 months of seasoning				
	a	b	s	h	Adj. R	a	b	s	h	Adj. R
Panel A: equal-weighted average monthly returns, matching by industry, sales and growth										
IPO	1.89 (5.46)	1.33 (14.76)	1.31 (9.35)	−0.70 (−4.43)	0.745	−0.04 (−0.19)	1.20 (23.39)	0.92 (14.18)	−0.02 (−0.30)	0.823
Matching	0.18 (0.62)	1.19 (15.62)	1.08 (9.10)	−0.53 (−3.97)	0.750	−0.11 (−0.52)	1.14 (19.99)	0.99 (13.79)	−0.01 (−0.14)	0.782
IPO-Matching	1.71 (3.77)	0.14 (1.19)	0.23 (1.26)	−0.17 (−0.82)	0.021	0.07 (0.31)	0.07 (1.16)	−0.08 (−0.92)	−0.00 (−0.03)	0.002
Panel B: value-weighted average monthly returns, matching by industry, sales and growth										
IPO	1.74 (4.08)	1.33 (11.96)	1.32 (7.66)	−0.67 (−3.45)	0.655	0.15 (0.59)	1.32 (20.41)	0.65 (7.98)	−0.55 (−5.65)	0.804
Matching	0.06 (0.16)	1.12 (12.17)	0.77 (5.36)	−0.81 (−5.03)	0.662	−0.18 (−0.92)	1.14 (21.62)	0.63 (9.73)	−0.22 (−3.11)	0.806
IPO-Matching	1.68 (3.23)	0.21 (1.55)	0.56 (2.65)	0.14 (0.58)	0.036	0.33 (1.21)	0.21 (2.87)	0.01 (0.14)	−0.33 (−2.81)	0.124

This table reports the results of Fama and French (1993) three-factor regressions involving both equal-weighted and value-weighted monthly calendar time returns of both IPOs and growth-matching firms. There are 1404 IPO firms in the sample. The IPOs and matching firms stay in their respective portfolios for (a) a period of 6 months starting the month after they go public (1–6 months of seasoning) or (b) for a period of 54 months starting 6 months after they go public (7–60 months of seasoning). For 1–6 months of seasoning regressions the time period is from May 1981 to May 1998. For 7–60 months of seasoning the time period is from November 1981 to November 2002. The regression model is given below:

$$r_{pt}-r_{ft} = a_p + b_p(R_{mt}-R_{ft}) + s_p\mathrm{SMB}_t + h_p\mathrm{HML}_t + u_t$$

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 monthly return on small firms minus the return on large firms, and HML is the monthly 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 percentage and b_p, s_p and h_p are factor loadings.

returns, the regression intercept (risk-adjusted abnormal return) of the (IPO-Matching) zero-investment portfolio is not significant, suggesting that the IPO firms do not outperform comparable firm multiple matching firms in the six-month holding period. This is different from the results in Tables 5 and 8[11]. In the long run (7–60 months of seasoning), it seems that the IPO firms do not underperform whether we use equal-weighted returns or value-weighted returns. In both cases the comparable firm multiple matching firms do not underperform either. More importantly, the regression intercept of the (IPO-Matching) zero-investment portfolio is insignificant in both Panels A and Panel B, suggesting that the IPO firms do not underperform the comparable firm multiple matching firms. Thus, the three-factor regression results are consistent with the buy-and-hold return results in Tables 5 and 8, suggesting that the IPO firms are fairly valued relative to comparable firm multiple matching firms. As a robustness check, I also estimate the Fama and French (1993) model for daily returns. The results (not reported in this paper) are similar and do not show any underperformance by the IPO firms relative to their matching firms[12].

We also estimate Fama and French (1993) three-factor regressions for the IPO firms and the growth-matching firms. The results are reported in Table 11. For the six-month holding period, both equal-weighted and value-weighted returns lead to positive and significant intercepts for the IPO portfolio and the (IPO-Matching) portfolio. They are consistent with the buy-and-hold return results in Table 6. The magnitude of abnormal return for the (IPO-Matching) portfolio is about 1.7% per month. This translates into about 10% for the first 6 months and is actually slightly higher than the abnormal return reported in Table 6. In the long run, both equal-weighted returns and value-weighted returns produce insignificant intercepts for the IPO portfolio and the (IPO-Matching) portfolio. These results are consistent with the results in Table 6 and support the valuation results of the growth-matching method, which suggests that IPO firms are not overvalued in the aftermarket relative to growth-matching firms.

6. Conclusions

Purnanandam and Swaminathan (2004) find that IPOs are overvalued at the offer price relative to matching firms selected by comparable firm multiples. This paper shows that the valuation results are sensitive to two issues: the control for growth expectation and whether new primary shares are included when calculating price multiples. After I use alternative methods to address the two issues, the IPO firms are not overvalued any more. More importantly, tests about long-run performance consistently show that IPOs do not underperform the matching firms, whether we control for growth expectation or not. Overall, the results in this paper are consistent with the traditional view that IPOs are underpriced at offer price and fairly valued in the aftermarket relative to comparable seasoned firms.

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[11] As discussed in Loughran and Ritter (2000), calendar time portfolio approach weight each time period equally and have lower power detecting time-varying abnormal returns.

[12] Loughran and Ritter (2000) point out that traditional Fama–French multifactor regressions have intercepts that are biased towards zero because the factors are partly composed of recent IPOs. The results in this paper do not have significant change after recent IPO are purged from the factors.

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