Is the IPO pricing process efficient? ☆

Michelle Lowry[a],*, G. William Schwert[b,c]

[a] Smeal College of Business, Pennsylvania State University, University Park, PA 16802, USA
[b] University of Rochester, Rochester, NY 14627, USA
[c] National Bureau of Economic Research, USA

Abstract

This paper investigates underwriters' treatment of public information throughout the IPO pricing process. Two key findings emerge. First, public information is not fully incorporated into the initial price range. While the economic magnitude of the bias is small, it is puzzling because it is not clear who benefits from it. Further, it indicates that the filing range midpoint is not an unbiased predictor of the offer price, as prior literature has assumed. Second, while public information is similarly not fully incorporated into the final offer price, the small economic significance of this relation indicates that the IPO pricing process is *almost* efficient.
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1. Introduction

The pricing of initial public offerings (IPOs) is one of the more puzzling phenomena in finance. It seems that underwriters do not fully incorporate all

available information into the offer price. As a result, there exist significant relations between the initial return and information known by underwriters before the IPO. Prior literature has shown that some of these relations are consistent with efficient markets. For example, the finding that firms whose value is more uncertain tend to have higher initial returns is consistent with underwriters compensating investors for the higher costs of learning about such firms. Also, the finding that private information learned during the filing period is only partially incorporated into the offer price is consistent with underwriters rewarding institutional investors for the information they provide during the filing period about the value of the IPO firm (Benveniste and Spindt, 1989).

However, the extent to which public information is incorporated into the pricing of an IPO is a matter of recent debate. Loughran and Ritter's (2002a) findings suggest that public information is only partially incorporated into the offer price, even though Benveniste and Spindt (1989) would not predict this. In fact, this partial incorporation of public information seems to suggest that the IPO pricing process is not efficient. The objective of this paper is to examine underwriters' treatment of public information throughout the entire IPO pricing process, and thereby shed light on the extent to which the IPO price-setting process is efficient.

Benveniste and Spindt's (1989) partial updating hypothesis contains predictions on the effects of private versus public information in the pricing process. They posit that informed investors provide underwriters with private information about the value of the IPO firm during the filing period. Underwriters compensate these investors for the private information they provide by only partially incorporating it into the offer price, thus allowing the informed investors to earn especially high returns on the first day the IPO firm trades. Consistent with this theory, Ljungqvist and Wilhelm (2002) find that institutions that reveal more valuable information during the registration period are rewarded with higher allocations when such information is positive. Also, Hanley (1993) and Cornelli and Goldreich (2001) show that this private information learned during the registration period is only partially incorporated into the offer price.

In contrast, it is difficult to conjecture why the incomplete incorporation of *public* information into the offer price would be consistent with efficient markets. By definition, such information is available to all market participants, including the underwriter and the issuing firm. Thus, the underwriter does not need to compensate any one group of investors for providing this information. In fact, by not fully incorporating public information, the underwriter seems to "freely" reward all buyers of the IPO at the expense of the issuer. Yet Loughran and Ritter's (2002a) findings suggest that underwriters do just that.

This paper examines the effects of public information in the pricing of IPOs in more detail. The process of pricing an IPO begins at the time the issue is filed, and therefore we begin our analysis at that point. To file an IPO, the company must register with the Securities and Exchange Commission (SEC) a preliminary prospectus containing basic information on the company and the proposed offering. Either in this preliminary prospectus or in an amended prospectus, the company provides a range of prices within which it expects to take the issue to market. We

examine underwriters' treatment of public information beginning at the time the preliminary price range is set, and continuing through the determination of the final offer price.

This analysis has the potential to shed light on two issues. First, is public information fully incorporated into the initial price range? Prior literature (e.g., Hanley, 1993; Loughran and Ritter, 2002a; Bradley and Jordan, 2002) has used the midpoint of this price range as an unbiased predictor of the ultimate offer price. Our empirical tests provide the first evidence on the validity of this assumption. Second, is public information fully incorporated into the final offer price? The answer to this question is directly linked to the efficiency (or inefficiency) of the IPO pricing process.

We begin by investigating the statistical significance of the relations between public information and various IPO pricing measures. However, we also assess the *economic* significance of these relations because small but precisely measured mispricing would not imply that the IPO price-setting process is inefficient.

To examine underwriters' treatment of various information in the price-setting process, we first focus on the percentage difference between the midpoint of the preliminary price range and the final offer price, i.e., the price update. We find significant relations between the price update and certain firm- and offer-specific characteristics. It seems that firm- and offer-specific characteristics can explain the price update in much the same way that they explain the initial return. While the ability of such variables to explain the initial return has been generally interpreted as supporting the information asymmetry hypothesis, it is difficult to reconcile their ability to explain the price update with the same theory. In addition, we find that the price update is significantly positively related to broad market returns leading up to the filing.

Evidently, underwriters do not fully account for publicly available information when they set the preliminary price range. The statistical significance of these relations suggests that the midpoint of the price range is a biased predictor of the offer price, which is contrary to the assumptions in the prior literature. How substantial is the bias? We find that public information can predict about 3% of the variation in the price update. This 3% number can be considered either high or low. On the one hand, it is similar in magnitude to the predictability of initial returns, based on firm- and offer-specific characteristics. While the predictability of initial returns has received considerable attention in both the theoretical and empirical literature, price updates have not. On the other hand, the economic significance of these relations is relatively low, meaning that underwriters do in fact incorporate *most* public information into the preliminary price range. Finally, while the finding that underwriters tend to omit available information is certainly surprising, we note that one cannot trade at these prices. Consequently, while the preliminary price range may represent a biased estimate of true firm value, there is no opportunity to profit from this bias.

The second portion of the paper focuses on the relation between initial returns and public information learned during the filing period. Consistent with Loughran and Ritter (2002a), we find a statistically significant relation between initial returns

and market returns before the offering, indicating that public information is not fully incorporated into the offer price. However, unlike Loughran and Ritter, we find the economic significance of this relation to be quite low. An 11% change in market returns during the filing period (approximately one standard deviation) is associated with a 1.6% change in initial returns (approximately a 0.08 standard deviation change). For comparison, we examine the effects of a one standard deviation change in the price update measure, which equals about 18%. We find that this is associated with an 8% change in initial returns (approximately a 0.40 standard deviation change). Thus, relatively little of the variation in initial returns is driven by public information that is not incorporated into the offer price, and a far greater amount is driven by private information. The low economic significance of market returns during the filing period suggests that almost all public information is incorporated into the offer price.

In summary, our findings show that while underwriters omit some public information when they set both the initial price range and the final offer price, the vast majority of public information is in fact fully incorporated. It appears that the IPO pricing process is *almost* efficient. Section 2 discusses the data that we use to examine the price updates and initial returns. Sections 3 and 4 investigate the predictability of the price update and the initial return, respectively. In Section 5 we conduct robustness tests. Section 6 summarizes the results of the paper.

2. Data

To examine the biases in the pricing of IPOs, we obtain data from the Securities Data Co. (SDC) on all firms that went public between 1985 and 1999. We exclude unit IPOs, closed end funds, real estate investment trusts (REITs), American Depository Receipts (ADRs), and issues with an offer price less than $5. An examination of these data indicates that the IPOs in 1998 and 1999 had substantially different behavior than the IPOs in the earlier years. Our main analysis therefore focuses on data from 1985 to 1997, although we also perform all of our tests over the 1985–1999 period, and the results are robust to using this longer sample period. These issues are discussed in detail in Section 5.

Section 2.1 defines our IPO pricing measures as well as the explanatory variables that we use in our empirical tests. Section 2.2 investigates the issue of sample selection, which potentially affects our empirical analysis.

2.1. SDC data on individual IPOs

The pricing of an IPO can be thought of as occurring in three stages, as illustrated in Fig. 1. First, the firm and its underwriters agree on a range of prices within which they expect to set the offer price. This price range is listed in a prospectus that is filed with the SEC. Data on the original registration dates are available on SDC, but the initial pricing information is not always included in the original registration statement. Often, the first pricing information is provided in an amended prospectus

[Price Update, ΔP] [Initial Return, IR]

Preliminary Price   Offer Price Is Set   Post-IPO Price is observed
Range Is Set   and IPO Occurs   in the Secondary Market

Fig. 1. Timeline for the IPO pricing process.

that is filed between the registration date and the offering date, and SDC does not contain the dates of these amended statements. We are able to determine the exact timing of the first available pricing information for a subset of offerings in 1996–1997 using data from the SEC Electronic Data Gathering, Analysis, and Retrieval system (EDGAR), and we use these more detailed data in some of our tests.

The second stage of the pricing process typically occurs after the market closes on the day before the offering, when the company and its underwriters set the final offer price. This is the price at which the issue is offered to the public. Finally, when the issue starts trading we observe the market's assessment of the value of the firm.

For each IPO, the price update (ΔP) equals the percentage change between the midpoint of the initial price range and the offer price. The initial return (IR) equals the percentage change between the offer price and the first closing price. To determine the first closing price of a particular issue, we use the first closing price from the Center for Research in Securities Prices (CRSP) if price data are available within 14 calendar days of the offer date. If CRSP data are not available, we try to obtain the closing price on the first day of trading from SDC. If that is not available, the close on the second day or otherwise the end of the first week of trading (both from SDC) is used.

As discussed earlier, our analysis of the effects of public information on the pricing of IPOs begins at the time the initial price range is set. We first examine the relation between the firm-level price update and both firm- and deal-specific characteristics and various measures of market returns. This analysis reveals whether or not investment bankers incorporate all available information into the initial price range. In addition, it also sheds light on the extent to which public information that becomes available during the filing period is incorporated into the offer price. Section 4 of the paper investigates this second point in more depth. Specifically, Section 4 focuses on the relation between initial returns and market returns during the registration period, after controlling for the same firm- and deal-specific characteristics.

The firm- and deal-specific characteristics consist of information available in the preliminary prospectus. For each firm, we identify the lead underwriter from SDC and assign an underwriter rank (RANK) based on Loughran and Ritter's (2002b) classification, which is similar to that of Carter and Manaster (1990). Underwriters are ranked from 0 to 9, with higher numbers representing higher quality. Using the SDC classification system, we also assign each firm a technology dummy (TECH), equal to one if the firm is in a technology industry and zero otherwise. To capture the effects of firm size, we collect data on total assets before the offering (TA) and proceeds filed (PRO) from SDC. Proceeds filed equals the midpoint of the initial

price range multiplied by the number of shares filed. To adjust for inflation, TA and proceeds are converted to 1983 dollars using the Consumer Price Index (CPI), and they are then transformed using logarithms to reduce skewness. We include three dummies, NYSE, NMS, and AMEX, where each dummy equals one if the IPO was listed on that market and zero otherwise. Finally, we also include a venture capital dummy (VENT) and a carve-out dummy (CARVE) that respectively equal one if the IPO was backed by a venture capitalist or was a carve-out, and zero otherwise.

In addition to looking at the relation between firm-level information and the price update, we also examine the effects of marketwide public information. Specifically, we examine the effects of three measures of "market returns" (MKT): (1) the CRSP equally weighted index of NYSE, AMEX, and Nasdaq stocks, (2) returns on a portfolio of all firms that went public during the prior year, and (3) returns on a portfolio of technology or non-technology firms that went public during the prior year, matched with the given IPO depending on whether that firm was in a technology or non-technology industry. Each of these variables is measured over the period between the filing date and the offer date.

To investigate the possibility that positive and negative information learned during the registration period affect the offer price differently, we define two asymmetry measures. First, ΔP^+ equals ΔP when the price update is positive, and zero otherwise. Similarly, MKT^+ equals MKT when the market returns during the registration period are positive, and zero otherwise. Thus, in our cross-sectional regression models, the coefficients on these variables measure the differences between the effects of positive versus negative information, if any.

2.2. Sample selection bias

The goal of this analysis is to explain the IPO pricing process. How are IPO prices updated between the initial prospectus and the final IPO, and how does the aftermarket price of the stock relate to the IPO offer price? The tests control for the characteristics of the IPO firms and of the transactions. The regression models, however, require full data on the explanatory variables. The data sources (SDC and CRSP) do not have complete information on all of the variables for many firms.

Table 1 shows a comparison of means between the sample of 3,878 firms with full data available for all of the variables listed above (referred to as the regression sample) in Column 1 and the means of these variables for the observations that are omitted from the regression sample because they have data missing for at least one other variable (referred to as the incomplete data sample) in Column 2. This shows the nature of the sample selection bias associated with the regression tests in Tables 2–4. Column 3 of Table 1 shows *t*-statistics that test whether the means of the regression sample and the incomplete data sample are equal, based on hetero-skedasticity-consistent standard errors, and Column 4 shows the number of observations in the incomplete data sample.

We find that the characteristics of the regression sample firms differ significantly from the missing-data firms along several dimensions. For example, the initial return is significantly larger for the regression sample by almost 2%, on average (*t*-statistic

Table 1

Sample selection bias based on availability of SDC and CRSP data, 1985–1997

Column (1) shows the means for the variables used to estimate regression models in subsequent tables. IR is the initial return to IPO investors using SDC data from 1985 to 1997, calculated as the percent difference between the IPO price and the secondary market price, for IPOs whose price was \$5 or more. ΔP is the price update between the middle of the range of prices in the initial registration statement and the offer price. RANK is the underwriter rank, from Loughran and Ritter (2002b), using methods similar to Carter and Manaster (1990) [http://bear.cba.ufl.edu/ritter/rank.htm]. TECH equals one if the firm is in a high-tech industry (biotech, computer equipment, electronics, communications, and general technology, as defined by SDC), and zero otherwise. TA equals the logarithm of real total assets before the IPO. PRO is the logarithm of proceeds filed in the initial IPO prospectus. NYSE equals one if the IPO firm will be listed on the New York Stock Exchange, and zero otherwise. NMS equals one if the IPO firm will be listed on the Nasdaq National Market System, and zero otherwise. AMEX equals one if the IPO firm will be listed on the American Stock Exchange, and zero otherwise. RME is the return to the CRSP equal-weighted portfolio of NYSE, AMEX, and Nasdaq stocks for the period between the filing date and the offering date for the IPO. TECHRET and NONRET are the returns between the filing date and the offering date to the equal-weighted portfolios of firms that have had IPOs within the last year, but not within the last month. VENT equals one if the IPO firm had venture capital backing, and zero otherwise. CARVE equals one if the IPO firm is a carve-out from another company, and zero otherwise. The means in Column 1 are based on the common regression sample of 3,878 firms with complete data. Columns 2 and 3 show means for the cases where data are missing for some other variable so they are not included in the regression analysis, with a t-statistic testing whether the difference is reliably different from zero using White's (1980) heteroskedasticity-consistent standard errors. Column 4 shows the size of the incomplete data sample, i.e., the number of observations with data for this variable but where data for at least one other variable are missing. Column 5 shows the proportion of observations for each year from 1985 to 1997 for the cases in the regression sample. Column 6 shows the proportion of observations for each year from 1985 to 1997 where data are missing for some other variable so they are not included in the regression analysis, with a t-statistic testing whether the difference from the regression sample is reliably different from zero.

Variable	(1) Regression sample (N=3,878) Mean	(2) Incomplete data sample Mean	(3) t-Statistic for difference	(4) Incomplete data sample Size, N	Year	(5) Regression sample (N=3,878) Percent	(6) Incomplete data sample (N=968) Percent	(7) t-Statistic for difference
IR	12.317	10.474	2.92	895	1985	0.051	0.058	−1.33
ΔP	−1.359	−0.950	−0.67	945	1986	0.107	0.123	−1.66
RANK	7.155	7.119	0.46	964	1987	0.077	0.087	−1.52
TECH	0.365	0.340	1.49	968	1988	0.028	0.031	−0.38
TA	16.965	16.599	1.57	143	1989	0.026	0.029	−0.44
PRO	16.714	16.801	−2.12	868	1990	0.025	0.025	−0.01
NYSE	0.120	0.152	−2.54	968	1991	0.063	0.045	2.45
NMS	0.540	0.475	3.64	968	1992	0.081	0.099	−1.55
AMEX	0.042	0.029	2.13	968	1993	0.100	0.143	−3.35

Table 1. (*Continued*)

Variable	(1) Regression sample (N = 3,878) Mean	(2) Incomplete data sample Mean	(3) t-Statistic for difference	(4) Incomplete data sample Size, N	Year	(5) Regression sample (N = 3,878) Percent	(6) Incomplete data sample (N = 968) Percent	(7) t-Statistic for difference
VENT	0.355	0.314	2.41	968	1994	0.079	0.105	−2.31
CARVE	0.123	0.128	−0.43	968	1995	0.093	0.101	−0.59
RME	6.319	5.851	1.33	943	1996	0.157	0.098	5.45
TECHRET	4.800	4.412	0.82	943	1997	0.113	0.056	6.54
NONRET	3.561	3.175	1.15	943				

of 2.92). Firms in the regression sample are more likely to issue on either the National Market System (NMS) or the AMEX (*t*-statistics of 3.64 and 2.13, respectively) and therefore less likely to issue on the NYSE (*t*-statistic of −2.54). In addition, firms in the regression sample have significantly lower proceeds filed and are significantly more likely to be venture backed (*t*-statistics of −2.12 and 2.41, respectively).

Columns 5 and 6 of Table 1 show the percentage of IPOs that occur in each year from 1985 through 1997 for each sample, and Column 7 shows the heteroskedasticity-consistent *t*-statistics for the differences between the proportions in each sample by year. We find that the missing data are spread throughout the sample period. While a relatively small portion of the incomplete data sample falls in the early 1990s, these years also had few IPOs. In fact, a comparison of the number of firms with missing data and total IPO volume each year shows that for nearly every year between 1985 and 1995, between 20% and 25% of the IPOs are missing data for at least one variable. Data in 1996 and 1997 are more complete.

The most important message from Table 1 is that the firms with missing or incomplete data are not random. Thus, at a minimum, we must be cautious in interpreting our regression results because they might not be representative of the firms with incomplete data.

3. Predictability of price updates

The pricing of an IPO begins at the time the IPO is filed, and thus we begin our analysis of the pricing process at this point. The preliminary price range should provide some information about how underwriters expect to price the offering. In fact, much prior literature has used the midpoint of this initial range as an estimate of the expected offer price. The use of this midpoint price as an unbiased predictor of the final offer price assumes that underwriters incorporate all available information in setting the preliminary price range. However, anecdotal evidence suggests that this might not be the case. For example, according to some people, investment bankers deliberately set the price range low during the 1990s, with the hope of generating momentum and thereby increasing demand for the offering. Yet many investment banks deny that this is the case, and Loughran and Ritter (2002a) also provide some evidence against this story. In addition, Daniel (2002) shows that initial returns are significantly related to market returns up to three months before the offering. He notes that this finding, combined with the fact that registration periods average approximately two months, suggests that price updates are predictable. The objective of this section is to investigate whether or not the midpoint of the price range actually represents an unbiased estimate of the final offer price.

The first thing to note about the price update is that it is negative on average (−1.359% in Table 1) and a simple *t*-test for whether this is reliably different from zero equals −4.79. Thus, the IPO price is about 1.4% below the midpoint of the initial filing range, on average. This simple test provides some evidence inconsistent with the momentum-generating strategy mentioned above.

Sections 3.1 and 3.2 examine the extent to which underwriters incorporate available information about the company at the time they set the initial filing range. In addition, we also provide some evidence on how underwriters treat information that becomes available during the filing period. Specifically, we examine the effects of firm- and deal-specific characteristics, marketwide information that becomes available before the setting of the price range, and also marketwide information that becomes available during the filing period.

3.1. The initial release of the preliminary price range

To investigate underwriters' treatment of marketwide information, we would ideally like to examine market returns immediately before the first release of the price range. Unfortunately, the SDC database does not contain this date, and we are unable to obtain this date for all issues. However, for 554 of the firms that went public in 1996 and 1997, we are able to use the EDGAR database to determine the date of the first prospectus that included the initial filing range of prices.[1] In about 60% of the cases, the initial prospectus included the initial price range, while for the remaining 40% of cases the first pricing information was released later in an amended prospectus. Across all cases, the average number of trading days between the release of the first price range and the IPO was 44 days, or about 75% of the entire registration period.

Table 2 shows regressions of the price update for these 554 firms on three different measures of market returns. In the first row of each panel, market returns are measured between the release of the initial price range, which is obtained from EDGAR, and the setting of the offer price, which is assumed to be one day before the IPO (MKT^{EDGAR}). For comparison, we also regress the price update of these same 554 firms on market returns between the initial filing date and the setting of the offer price, where the initial filing date is obtained from SDC (MKT^{SDC}). As discussed above, this period is the same for approximately 60% of the cases, while for the other 40% it is longer.

Because MKT^{EDGAR} represents public information learned between the setting of the initial price range and the final offer price, we expect MKT^{EDGAR} to be more strongly related to the price update than is MKT^{SDC}. MKT^{SDC} includes returns between the filing of the first prospectus and the release of the first pricing information (in an amended prospectus). This information was available before the setting of the initial price range and should therefore not be related to the price update if underwriters fully incorporate all information when they set the price range.

Looking first at Panel A where market returns represent returns on the CRSP equal-weighted index, we see that the coefficient on MKT^{SDC} is somewhat larger and slightly more significant that MKT^{EDGAR}. In a multiple regression that includes

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[1] Because EDGAR only goes back to 1996, we are unable to determine the date of the first prospectus that contained pricing information for earlier IPOs. Also, EDGAR is missing information for some 1996 and 1997 IPOs.

Table 2

Relation of price updates to public information: market returns during the registration period, SDC and EDGAR filing dates, 1996–1997

Regression models for the percentage change between middle of the range of prices in the initial registration statement and the offer price, ΔP, using SDC and EDGAR data from 1996 to 1997:

$$\Delta P_i = \alpha + \beta_{SDC} MKT_i^{SDC} + \beta_{EDGAR} MKT_i^{EDGAR} + \varepsilon_i.$$

MKT^{SDC} is the return to a "market" portfolio between the initial filing date from SDC and the offering date for the IPO. MKT^{EDGAR} is the return to a "market" portfolio between the first announcement date for the initial price range from EDGAR (which is often after the initial filing date of the IPO) and the offering date for the IPO.

Three different measures of market returns are used: (a) the CRSP equal-weighted portfolio of NYSE, AMEX, and Nasdaq-listed stocks; (b) an equal-weighted portfolio of all stocks that have had an IPO within the last year, but not within the last month; and (c) an equal-weighted portfolio of all technology or non-technology stocks that have had an IPO within the last year, but not within the last month, matched with the IPO firm in question as to whether the firm is a technology stock.

The sample includes the 539 firms for which the exact date of the filing containing the initial price range could be determined from EDGAR during 1996–1997. The t-statistics use White's (1980) heteroskedasticity-consistent standard errors. R^2 is the coefficient of determination, adjusted for degrees of freedom.

	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
A. CRSP EW market return			
MKT_{EDGAR}	0.349		−0.350
	(2.63)		(−1.51)
MKT_{SDC}		0.532	0.765
		(4.52)	(3.86)
R^2	0.057	0.016	0.062
B. All recent IPOs			
MKT_{EDGAR}	0.524		0.043
	(6.29)		(0.27)
MKT_{SDC}		0.528	0.498
		(7.34)	(3.64)
R^2	0.104	0.074	0.102
C. Recent matched technology or non-technology IPOs			
MKT_{EDGAR}	0.501		0.010
	(5.73)		(0.06)
MKT_{SDC}		0.524	0.516
		(6.83)	(3.46)
R^2	0.107	0.073	0.106

both MKT^{SDC} and MKT^{EDGAR} (the last column of Panel A), MKT^{SDC} is again more significant. These results suggest that returns before the setting of the initial price range are related to the price update. It seems that underwriters do not fully incorporate available public information at the time they set the price range.

Panels B and C contain similar analyses, substituting other measures of market returns, calculated over the same periods described above. Panel B uses an equal-weighted average of returns on all firms that have gone public within the past year, although we omit the returns for firms that have had an IPO within the last month to avoid the potential effects of underwriter price support. Panel C uses an equal-weighted average of returns on technology firms that have gone public within the past year for the technology IPOs in our sample, and an equal-weighted average of returns on non-technology firms that have gone public within the past year for the non-technology IPOs. Firms that have gone public within the last month are again omitted. We find that the coefficients on MKT^{EDGAR} and MKT^{SDC} are approximately equal, but MKT^{SDC} is more significant than MKT^{EDGAR}. This again suggests that returns before the setting of the initial price range are significantly related to the price update. This inference is examined in more depth in subsequent tables.

3.2. Underwriters' treatment of public information before and during the filing period

Table 3 directly examines the effects of market returns before the setting of the initial price range. Because we don't have the exact date on which the initial price range was released for all firms, we examine market returns before the filing date. In addition, Table 3 also investigates the effects of firm- and deal-specific characteristics and the effects of market returns between the filing date and the offer date. Specifically, we estimate the following regression:

$$\Delta P_i = \alpha + \beta_1 \, RANK_i + \beta_2 \, TECH_i + \beta_3 \, TA_i + \beta_4 \, PRO_i + \beta_5 \, NYSE_i$$
$$+ \beta_6 \, NMS_i + \beta_7 \, AMEX_i + \beta_8 \, VENT_i + \beta_9 \, CARVE_i$$
$$+ \beta_{10} \, MKT_i + \beta_{11} \, MKT_i^+ + \sum_{k=1}^{8} \beta_{k+11} \, WK_{ki} + \varepsilon_i. \tag{1}$$

All of the firm- and deal-specific characteristics were defined in Section 2. MKT represents the equal-weighted returns on a portfolio of either technology firms or non-technology firms that have had an IPO within the last year but not within the last month, between the initial filing date and the offer date. The portfolio of recent IPO firms is matched to the IPO in question according to the SDC technology classification. WK_k represents equal-weighted returns to recent IPO firms for the kth week immediately before the filing date, where each week represents five trading days. For example, WK_1 represents returns over the five trading days before the filing date, and WK_2 represents returns over the 6th–10th trading days before the filing date. This variable is similarly measured across recent technology and non-technology IPOs and matched to each observation.

Column 1 shows a regression of the price update on the firm- and deal-specific characteristics, MKT, and WK1 through WK8. We find that many of the predetermined variables predict the IPO price update. For example, IPOs underwritten by highly ranked investment bankers are likely to have higher price updates (*t*-statistic of 6.20 in Column 2). This suggests that banks that are more

Table 3
Firm and deal characteristics and market conditions that predict price updates between the initial filing and the IPO, 1985–1997

Regression models for the percentage change between the middle of the range of prices in the initial registration statement and the offer price, ΔP, using SDC data from 1985 to 1997, for IPOs whose price was \$5 or more. RANK is the underwriter rank, from Loughran and Ritter (2002b), using methods similar to Carter and Manaster (1990) [http://bear.cba.ufl.edu/ritter/rank.htm]. TECH equals one if the firm is in a high-tech industry (biotech, computer equipment, electronics, communications, and general technology, as defined by SDC), and zero otherwise. TA equals the logarithm of real total assets before the IPO. PRO is the logarithm of proceeds filed in the preliminary IPO prospectus. NYSE equals one if the IPO firm will be listed on the New York Stock Exchange, and zero otherwise. NMS equals one if the IPO firm will be listed on the Nasdaq National Market System, and zero otherwise. AMEX equals one if the IPO firm will be listed on the American Stock Exchange, and zero otherwise. VENT equals one if the IPO firm had venture capital backing, and zero otherwise. CARVE equals one if the IPO firm is a carve-out from another company, and zero otherwise. MKT is the return to an equal-weighted portfolio of either technology firms or non-technology firms that have had IPOs within the last year, but not within the last month, between the initial filing date and the IPO date. The portfolio of recent IPO firms is matched to the IPO in question according to the SDC technology classification. MKT^+ is the return to recent IPO firms and equals MKT when MKT is positive, and zero otherwise. WK1 through WK8 are the equal-weighted returns to recent IPO firms for the eight weeks (trading days 1–5, 6–10, …, and 36–40) immediately before the filing date. The t-statistics and F-tests use White's (1980) heteroskedasticity-consistent standard errors. R^2 is the coefficient of determination, adjusted for degrees of freedom. $S(u)$ is the standard error of the regression. The sample size is 3,878 observations. Fama-MacBeth estimates are an average of the year-by-year regression coefficients; the t-statistics are based on the standard deviation of the time series of coefficient estimates; and the R^2 is the average of the individual regression R^2s.

					Fama-MacBeth	
	(1) Coefficient	(2) t-Statistic	(3) Coefficient	(4) t-Statistic	(5) Coefficient	(6) t-Statistic
Constant	20.474	3.51	21.454	3.69	30.809	3.05
RANK	1.008	6.20	0.898	5.54	0.917	3.33
TECH	2.775	4.21	3.435	5.19	2.113	2.86
TA	−0.263	−1.35	−0.326	−1.68	−0.286	−1.05
PRO	−1.709	−3.95	−1.558	−3.61	−2.029	−3.68
NYSE	3.275	3.23	3.733	3.69	1.125	1.05
NMS	0.726	1.24	1.226	2.08	−2.403	−3.10
AMEX	−3.926	−2.68	−3.502	−2.42	−7.747	−3.72
VENT	−0.277	−0.43	−0.211	−0.33	−0.935	−1.43
CARVE	−0.145	−0.18	−0.085	−0.11	0.179	0.31
MKT	0.408	10.81	0.973	11.51	0.703	3.72
MKT^+			−0.754	−6.55	−0.497	−2.06
WK1	0.413	3.12	0.362	2.77	0.239	1.48
WK2	0.363	2.78	0.340	2.64	0.454	2.51
WK3	0.215	1.51	0.194	1.39	0.103	0.62
WK4	0.147	1.19	0.158	1.28	0.348	2.28
WK5	0.219	1.79	0.256	2.11	0.143	0.98
WK6	0.249	2.23	0.302	2.69	0.180	1.51
WK7	0.077	0.68	0.128	1.12	0.032	0.32
WK8	0.043	0.36	0.072	0.59	0.121	1.09
F-test: WK1 = ⋯ = WK4 = 0 (p-value)	8.30	(0.000)	7.22	(0.000)		

Table 3. (*Continued*)

	(1) Coefficient	(2) t-Statistic	(3) Coefficient	(4) t-Statistic	Fama-MacBeth (5) Coefficient	(6) t-Statistic
F-test: WK5 = ··· = WK8 = 0 (p-value)	2.94	(0.019)	4.62	(0.001)		
R^2		0.092		0.108	0.112	
$S(u)$		16.836		16.688		

reputable are more conservative in setting the initial price range. In other words, highly ranked banks lowball the initial price range, on average. Technology firms also tend to have higher price updates (t-statistic of 4.21). This suggests that investment banks set the filing range of riskier firms lower, to protect themselves in the event that the firm ends up being worth less than they had forecast. Anecdotal evidence suggests that the market perceives an offer price less than the filing range to be a very negative signal about the expected success of the IPO. It thus seems reasonable that investment bankers would strive to avoid such a scenario. The negative relation between proceeds filed and the price update is also consistent with this intuition. To the extent that smaller offerings tend to be made by riskier companies, one would expect investment banks to be more conservative in setting the price range of such issues.

The exchange on which the firm lists is also significantly related to the price update. Firms that list on the NYSE tend to have higher price updates, while firms that list on the AMEX tend to have smaller price updates. To the extent that firms listing on the NYSE tend to be less risky than those listing on the NMS and the over-the-counter market, the positive coefficient on NYSE is inconsistent with the intuition that riskier firms would have higher price updates.

The effects of market returns both before and after the offering are particularly interesting. A variety of information is likely to be revealed between the time the initial price range is set and when the final offer price is decided. Some of this information, such as the general state of the overall economy, will be reflected in market returns. Thus, we would expect the price update to be related to market returns during the filing period. Consistent with this intuition, Loughran and Ritter (2002a) find that the price update is significantly related to the CRSP value-weighted return during the 15 days before the offering. We examine this relation in more depth to better understand how public information that becomes available before the IPO affects the final offer price. For example, we examine the effects of market returns both during the filing period and before the initial registration date. We note that there is no obvious reason that the price update should be related to market returns before the initial registration date. In fact, this would indicate that underwriters did not fully incorporate available public information into the price range.

Consistent with the results in Table 2, market returns during the filing period are significantly positively related to the price update (*t*-statistic of 10.81). However, market returns before the filing are also significantly positively related to the price update. An *F*-test that the coefficients on WK1 through WK4 equal zero is rejected at the 0.001 level, and a similar test for WK5 through WK8 has a *p*-value of 0.019. This result suggests that underwriters do not fully incorporate all available information when they set the initial price range.

Why do the underwriter and issuing firm disregard so much publicly available information? One potential explanation is that in some cases the parties implicitly agree on the initial price range before it is publicly released in the preliminary prospectus. Our results are broadly consistent with a scenario in which the parties agree to the price range one to two months before the filing. Notably, this is the approximate time of the "bake-off," the process by which the issuing firm chooses an underwriter. The choice of underwriter is based on a variety of factors, one of which is the proposed price range. Our results suggest that the price range that is agreed to at that point is not always updated before being released in the prospectus. Perhaps the issuer implicitly agrees to register the offering in that range, i.e., there is an understanding between the underwriter and the issuing firm that the price range will not be adjusted for future market movements.

Interestingly, just as the coefficients on WK1 through WK8 indicate that public information released before the filing is not always fully incorporated into the filing range, the coefficient on MKT seems to suggest that public information released between the filing and the offering is not always fully incorporated into the ultimate offer price. Viewing the coefficient on MKT as an average β of the IPO firms and assuming that IPO firms are more risky than an average firm, one would expect this coefficient estimate to be greater than one. However, we obtain an estimate of 0.4. It seems that the offer price is adjusted less than one-for-one with overall movements in market values in the months before the IPO. In contrast, Ibbotson (1975), Clarkson and Thompson (1990), and Chan and Lakonishok (1992) find that the β of IPOs shortly after going public is greater than two, and Ritter and Welch (2000) obtain a β estimate of approximately 1.7. If IPO firms have similar risk levels before the actual offer, then the low β estimates in Tables 2 and 3 suggest that the price update represents only a partial adjustment to the public information reflected in market returns. Such a finding would be inconsistent with Benveniste and Spindt's (1989) model, as originally noted by Loughran and Ritter (2002a).

An alternative interpretation of the low β estimates is that they reflect the lack of trading in these pre-IPO stocks. Gintschel (2000) shows that returns to NYSE, AMEX, and Nasdaq stocks during nontrading periods, which are measured from quote revisions, are much less sensitive to market returns than returns based on trading prices. Since the price update is essentially a quote revision, Gintschel's evidence is directly applicable. Whether the low sensitivity of market maker and investment bankers' quotes to market movements is rational or not remains an interesting question. We reexamine the relation between public information learned during the filing period and the offer price in the next section.

Column 3 of Table 3 investigates the relation between market returns during the filing period and the price update in more depth. Specifically, Column 3 allows for an asymmetric reaction of price updates to market returns. It is possible that underwriters treat positive information learned during the filing period differently than they treat negative information. Thus, we include both MKT and MKT^+, where MKT^+ equals MKT when MKT is positive and zero otherwise.

In Column 3, the coefficient on MKT is 0.973 (*t*-statistic of 11.51), implying that a market return of -10% results in a price update of -9.7%. In contrast, the coefficient on MKT^+ is -0.754 (*t*-statistic of -6.55), implying that a market return of $+10\%$ results in a price update of only $+2.2\%$ $(0.973-0.754)$. As expected, negative information learned during the filing period results in a significantly lower offer price; bad systematic news appears to cause both the market prices of public firms and the offer prices of firms in registration to fall by an equivalent amount. This large adjustment of price updates to negative information most likely reflects the fact that neither the issuing firm nor the underwriter wants the IPO to be overpriced and therefore unattractive to investors.

In contrast, the finding that offer prices are revised very little when market prices increase is puzzling. Presumably the increase in market prices reflects positive information that would cause the value of the IPO firm to increase by a similar or perhaps even greater amount (if IPO firms have a higher-than-average β).

Why do the underwriter and issuing firm agree to incorporate such a small portion of this positive information into the offer price? Edelen and Kadlec (2002) note that we only observe a final offer price for firms that actually go public. They argue that firms are more likely to withdraw their offerings following negative market returns. They estimate a probit model for offer withdrawal, then use the estimated probability to help explain the price update using the method of Heckman (1979). Not surprisingly, the relation between negative market returns and the price update is weaker, presumably because much of the effect of negative market returns is encompassed in the probability of withdrawal. However, it remains puzzling that offer prices are revised relatively little when market returns are positive.

Finally, the last column of Table 3 examines the robustness of these results. The regressions in Columns 1 and 3 pool IPO price updates across the 1985–1997 period, but to the extent that there are known cycles in the IPO market (see, for example, Ibbotson et al., 1988, 1994; Lowry and Schwert, 2002), it is likely that the regression errors for firms with IPOs close together in time are correlated. One simple way to check the severity of this problem is to use a bootstrap estimator similar to Fama and MacBeth (1973). Column 5 in Table 3 shows the average of the estimates of the coefficients in Column 3 when they are estimated year-by-year from 1985 to 1997. Each *t*-statistic in Column 6 is based on the standard deviation of the time series of estimates. The Fama-MacBeth estimates and tests in Columns 5 and 6 generally support the pooled regression estimates. The estimate of the NMS-listing variable changes sign, suggesting that this effect is not stable across the sample, but this is the only substantial difference between the pooled and Fama-MacBeth results.

3.3. Discussion

The objective of this paper is to examine the efficiency of the IPO pricing process. As discussed earlier, any conclusion in this regard must consider both statistical and economic significance. The regressions in Table 3 show that many variables that are known before the filing are significantly related to the price update in statistical terms. There are systematic patterns in price updates that are significantly related to firm- and deal-specific characteristics and to market returns before the filing. These statistical relations are of interest for at least two reasons.

First, the literature on IPO pricing has often used variables such as those in Table 2 to explain initial returns as a test of theories about asymmetric information. To assess the predictability of the price update on just these "asymmetric information variables," we estimate the regression in Column 3, omitting MKT and MKT^+. This regression of the price update solely on variables that are known at the time of the filing produces an adjusted R-squared of 3.3%. Notably, this is similar in magnitude to a regression of initial returns on the same explanatory variables. While the relation between initial returns and firm- and offer-specific characteristics has been generally interpreted as supportive of information asymmetry hypotheses, it is not clear how these theories would predict any particular pattern in price updates.

Second, many papers have used the price update that occurs between the filing date and the offer date as a measure of learning during the filing period. Such analysis implicitly assumes that the midpoint of the filing range is an unbiased predictor of the final offer price, so that the price update is unpredictable based on information that is available at the time that the initial price range is set. The regressions in Table 3 show that this assumption is not entirely accurate.

How large is the bias imposed by using the midpoint of the price range as a predictor of the final offer price? The answer to this question is related to the economic significance of these relations. To assess economic significance, we allow each explanatory variable to vary by one standard deviation and calculate the consequent effect on the price update. Underwriter reputation (RANK), the industrial sector of the issuing firm (TECH), and the size of the issue (PRO) have the largest effect on the size of the price update. A one standard deviation change in each of these variables is associated with approximately a 0.1 standard deviation change in the price update, i.e., approximately 1.8%. While the total effect on the price update also depends on the correlations among the independent variables, this simple calculation suggests that the economic significance of these relations is relatively low. In other words, most of the variability in the price update is unrelated to the variables in the regression model.

In summary, Table 3 indicates that investment bankers do not incorporate all available information into the initial price range. This is surprising because we do not know of any reason that either the company or the investment bank would benefit by ignoring certain information. However, as discussed earlier, any inferences about the efficiency of the IPO pricing process must consider the economic as

well as the statistical significance of these relations. It is reassuring that the economic significance of these relations is relatively low, meaning that underwriters do seem to incorporate the vast majority of available information. In other words, there does not seem to exist any economically meaningful bias in the initial filing range.

4. Predictability of initial returns

Tables 2 and 3 showed that the price update is predictably related to information in the preliminary prospectus and to market returns before the filing. The process of updating the price of the issuing firm's stock takes another large step when the IPO occurs. This section investigates the extent to which public information learned during the registration period is incorporated into the offer price. If such information is entirely incorporated into the final offer price, then it should have no power to explain initial returns. Benveniste and Spindt's (1989) model provides a rational explanation for why private information should be only partially incorporated into the offer price. However, Loughran and Ritter (2002a) propose a prospect theory explanation, which predicts that both public and private information will be only partially incorporated into the offer price, and they find evidence consistent with this theory. Notably, their findings are inconsistent with Benveniste and Spindt's model.

4.1. The adjustment of IPO prices to public and private information

When the IPO firm and its underwriters go on the road show before the offering, they presumably have two main objectives. They wish to market the issue to potential investors, and they seek to obtain more information on the true value of the firm. To the extent that this new information is incorporated into the offer price, it contributes to a more accurate pricing of the new issue. Note that if such information were entirely incorporated into the offer price, then it would not be related to the initial return. Table 4 examines the extent to which two measures of information learned during the registration period, market returns and the price update, are reliably related to the initial return.

Column 1 of Table 4 includes all of the firm- and offer-specific variables from Table 3, plus two measures of the information that becomes available during the registration period, MKT and ΔP. Assuming that underwriters employ both public and private information learned during the registration period to arrive at the ultimate offer price, the price update (ΔP) should incorporate both types of information. In contrast, MKT should only reflect public information. Because we include both of these variables in one regression, to the extent that MKT captures the effects of public information on the initial return, the coefficient of ΔP should isolate the effects of private information.

As shown in Table 4, we find that both information measures are significantly positive (*t*-statistics of 4.31 and 18.71 for MKT and ΔP, respectively). Consistent

Table 4

Effects of information learned during the registration period on initial returns to IPO investors, 1985–1997

Regression models for the percentage change between IPO price and the secondary market trading price, IR, using SDC data from 1985 to 1997. RANK is the underwriter rank, from Loughran and Ritter (2002b), using methods similar to Carter and Manaster (1990) [http://bear.cba.ufl.edu/ritter/rank.htm]. TECH equals one if the firm is in a high-tech industry (biotech, computer equipment, electronics, communications, and general technology, as defined by SDC), and zero otherwise. TA equals the logarithm of real total assets before the IPO. PRO is the logarithm of proceeds filed in the initial IPO prospectus. NYSE equals one if the IPO firm will be listed on the New York Stock Exchange, and zero otherwise. NMS equals one if the IPO firm will be listed on the Nasdaq National Market System, and zero otherwise. AMEX equals one if the IPO firm will be listed on the American Stock Exchange, and zero otherwise. VENT equals one if the IPO firm had venture capital backing, and zero otherwise. CARVE equals one if the IPO firm is a carve-out from another company, and zero otherwise. MKT is the return to an equal-weighted portfolio of either technology firms or non-technology firms that have had IPOs within the last year, but not within the last month, between the initial filing date and the IPO date. The portfolio of recent IPO firms is matched to the IPO in question according to the SDC technology classification. MKT^+ is the return to recent IPO firms and equals MKT when MKT is positive, and zero otherwise. ΔP is the price update between the middle of the range of prices in the initial registration statement and the offer price. ΔP^+ is the price update when ΔP is positive, and zero otherwise. The t-statistics use White's (1980) heteroskedasticity-consistent standard errors. R^2 is the coefficient of determination, adjusted for degrees of freedom. $S(u)$ is the standard error of the regression. The sample size is 3,878 observations. Fama-MacBeth estimates are an average of the year-by-year regression coefficients and the t-statistics are based on the standard deviation of the time series of coefficient estimates.

| | | | | | Fama-MacBeth | |
	(1) Coefficient	(2) t-Statistic	(3) Coefficient	(4) t-Statistic	(5) Coefficient	(6) t-Statistic
Constant	32.114	4.29	33.275	4.45	73.101	2.26
RANK	−0.244	−1.31	−0.407	−2.19	0.220	0.38
TECH	1.686	2.26	1.255	1.69	−0.321	−0.38
TA	−1.048	−5.41	−0.946	−4.93	0.172	0.18
PRO	−0.101	−0.18	−0.317	−0.58	−3.894	−1.26
NYSE	0.757	0.54	0.670	0.48	−2.232	−1.16
NMS	1.562	1.69	0.635	0.69	−3.303	−1.71
AMEX	−3.111	−2.00	−3.945	−2.57	−4.347	−2.19
VENT	0.885	1.11	0.326	0.40	0.629	0.74
CARVE	−2.438	−3.88	−2.477	−4.00	−1.519	−2.58
MKT	0.147	4.31	0.132	2.15	0.226	2.76
MKT+			0.019	0.21	0.042	0.31
ΔP	0.463	18.71	0.241	9.06	0.304	6.11
ΔP^+			0.439	5.29	0.244	1.28
R^2	0.207		0.223		0.200	
$S(u)$	18.670		18.488			

with the prior findings of Loughran and Ritter (2002a), this seems to suggest that underwriters only partially incorporate both the public and the private information that they learn during the registration period into the offer price. Consequently, such information contributes significantly to the initial return.

The price update regressions in Section 3 suggest that underwriters incorporate negative information more fully into the offer price than positive information. Moreover, Benveniste and Spindt's partial updating theory suggests that underwriters and issuing firms will share the benefits of positive information learned from informed investors, but they will fully adjust to negative information that is learned.

Column 3 allows for an asymmetric effect in the initial return regressions. Specifically, we add both MKT^+ and ΔP^+ to the regression. We find that the effect of the price update on initial returns is strongly asymmetric. A 10% higher price update corresponds to a 6.8% $(0.241 + 0.439)$ higher initial return, while a 10% lower price update corresponds to a 2.4% lower initial return. Thus, the magnitude of the initial return tends to be lower after negative price updates than after positive price updates. The lower magnitude of initial returns following negative information indicates that negative information is more fully incorporated into the offer price, compared to positive information. In a contemporaneous paper, Bradley and Jordan (2002) obtain similar results. They show that decreases in the file range (in amended prospectuses) have a smaller impact on initial returns than increases in the file range. As with the results in Table 3, investment bankers and issuing firms adjust to negative information more fully than to positive information. This is consistent with underwriters trying to avoid losses on overpriced issues while allowing informed investors to share the gains on underpriced issues.

In contrast, we find no asymmetric effect for MKT. The insignificant coefficient on MKT^+ suggests that both positive and negative public information have a small and similar effect on the initial return.

Columns 5 and 6 in Table 4 show the Fama-MacBeth bootstrap estimates of the regression in Column 3 and the associated *t*-statistics. Most of the estimates and their *t*-statistics are similar to those in Columns 3 and 4, indicating that the relations are stable over time.

In summary, the statistical significance of ΔP and ΔP^+ and of MKT in Table 4 indicates that underwriters do not fully incorporate either private or public information into the offer price. But how much private and public information are they really disregarding? What fraction of the variation in initial returns can be explained by private versus public information learned during the filing period?

4.2. The economic significance of initial return predictability

To shed light on this issue, we estimate the economic impact of market returns and the price update on initial returns. The regressions in Table 4 show that an 11% change in market returns during the filing period (approximately a one standard deviation change) is associated with a 1.6% change in initial returns (approximately a 0.08 standard deviation change). Thus, the economic significance of market returns appears quite low. These statistics are perhaps more meaningful when we compare them to the economic significance of the price update. We thus calculate the effects of a one standard deviation change in the price update, which is about 18%. We find

that this is associated with an 8% change in initial returns (a 0.40 standard deviation change). Thus, private information learned during the filing period has a much greater effect on the initial return than public information. While underwriters seem to systematically omit much positive private information from the offer price, it seems that they incorporate the vast majority of public information.

In summary, while market returns during the filing period are a statistically significant predictor of initial returns, their economic significance is quite low. This low economic significance is consistent with Benveniste and Spindt (1989) and suggests that underwriters fully incorporate most *public* information. In contrast, the high statistical and economic significance of the price update indicates that they only partially incorporate *private* information. This finding is reassuring in the sense that Benveniste and Spindt provide a rational incentive-based explanation for underwriters only partially incorporating private information, but similar theories do not hold for public information.

4.3. Comparisons with prior literature

Our finding that almost all public information learned during the registration period is incorporated into the offer price contrasts with the conclusions of Loughran and Ritter (2002a). We thus briefly discuss the differences in the studies that lead to these opposite conclusions.

Loughran and Ritter estimate simple regressions of the initial return on value-weighted market returns during the 15 days before the IPO, and they find that initial returns are significantly related to these market returns. In our multiple regressions, this effect is much weaker statistically and economically, because we also include the price update in the regression. To the extent that the "private information" that is learned about the IPO firm during the registration period is correlated with the value of firms that are already trading in the market, it is not surprising that the price update and the pre-IPO market return are correlated. As a result, the effect of the price update on the IPO return is strong and the incremental effect of market returns is small. There is nothing in the Benveniste and Spindt (1989) argument that requires that informed investors be compensated only for the idiosyncratic part of their information (i.e., the information that is completely uncorrelated with the values of other marketable securities). Our interpretation is that the coefficient of market returns in Table 4 exactly measures the part of past market returns that is unrelated to the price update (and the private information created during the process of marketing the IPO).

Most of the coefficients on the firm- and deal-specific characteristics are consistent with the findings in the prior literature. For example, underwriter rank is negatively related to initial returns, suggesting that more reputable investment bankers price the issue closer to its true value. Equity carve-outs and firms with more assets are less underpriced, consistent with the idea that bigger and more mature firms tend to be less risky. We also find that firms that go public on AMEX are less underpriced.

5. Robustness checks

To assess the robustness of our results, we examine the effects of limiting our sample period to 1985–1997. We estimate similar tests extending the sample through 1999, but the extreme conditions in the IPO market in 1998–1999 result in some unusual estimates when these additional years are included.

Fig. 2 shows the time series of estimates of a regression of initial returns on firm- and deal-specific characteristics estimated year by year from 1985 to 1999 (similar to the regressions in Table 4, with initial returns as the dependent variable). It is obvious from Fig. 2 that the estimates of many of the coefficients in 1998 and 1999 are extreme outliers compared with the 1985–1997 sample, so including these data could skew the conclusions for the entire sample.

The dispersion of initial returns across different IPOs was much higher in 1998 and 1999, so any type of ordinary least squares (OLS) procedure, such as those used in Tables 2 through 4, would give inordinate weight to the data from the last two years. As one check on this conjecture, we used weighted least squares (WLS) to create Fama-MacBeth estimates for Tables 3 and 4. The weights used for each year are the cross-sectional standard error estimates for the regression coefficients. Using
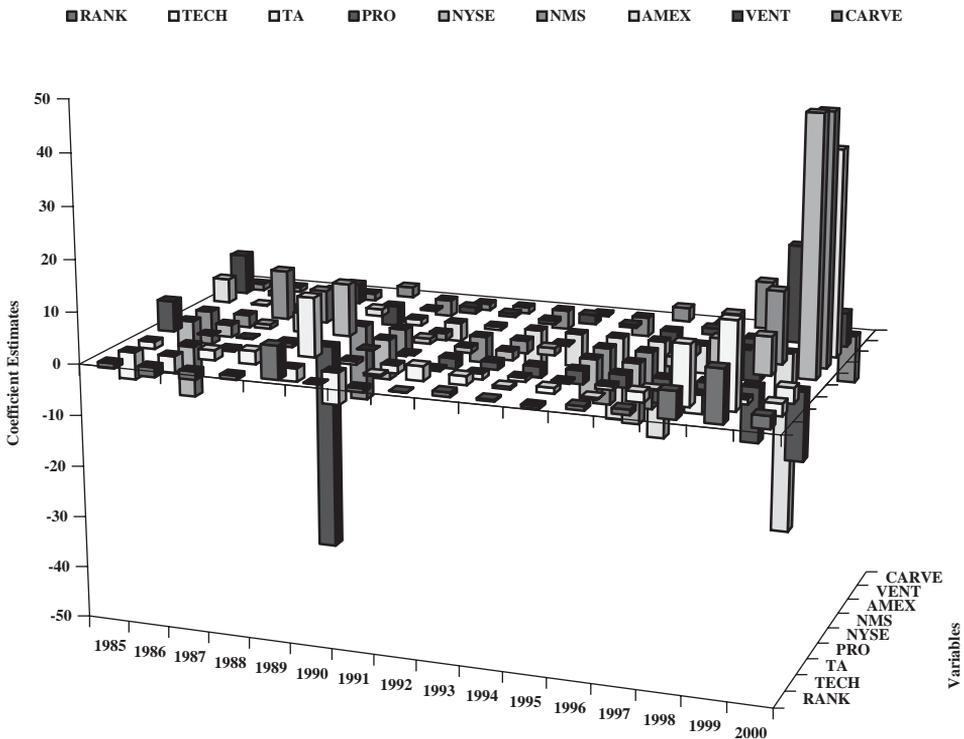

Fig. 2. Time-series plot of year-by-year estimates of the regression of initial returns to IPO investors on firm and deal characteristics (similar to the regressions in Table 4), 1985–2000.

this WLS Fama-MacBeth procedure, the estimates from 1985 to 1999 are similar to the OLS estimates from 1985 to 1997. Thus, after controlling for the hetero-skedasticity of the data, adding 1998 and 1999 does not change the conclusions we draw from the 1985–1997 sample. We choose to report and focus on the results from 1985 to 1997 because it is not necessary to use complicated WLS procedures in our tests. The data are sufficiently stable within this period to use standard least squares procedures.

6. Conclusion

This paper investigates underwriters' treatment of public information throughout the IPO pricing process. Our objective is to determine whether this aspect of the pricing process is efficient. Two key findings emerge.

First, underwriters do not fully incorporate publicly available information into the preliminary price range. Both prior market returns and firm- and deal-specific characteristics are significantly related to the price update. This finding does not necessarily imply a market inefficiency, however. Investors cannot buy shares at the filing prices, so the predictability of the price update does not represent a profit opportunity, nor is it a cost for the issuing firm. Moreover, the economic significance of these relations is relatively low. Little of the variation in the price update can be explained by public information known at the filing. Nevertheless, this finding does have implications for future research. Most of the prior literature has assumed that the midpoint of the preliminary price range is an unbiased predictor of the final offer price. To the best of our knowledge, this is the first paper to provide any evidence on the validity of this assumption.

Second, we find that underwriters similarly disregard some public information when they set the final offer price. But again, the effect of this public information on initial returns is quite small in economic terms. It seems that underwriters incorporate the vast majority of public information into the final offer price, which is generally consistent with the predictions of Benveniste and Spindt (1989). By definition, public information is available to everyone, including the underwriter. Therefore, the underwriter does not need to reward any group of investors for providing this information, such as by enabling them to reap abnormal gains on the IPO firm's first day of trading.

In summary, while there are reliable statistical relations between public information and underwriters' pricing of the issue at various stages, these relations are relatively insignificant in economic terms. Thus, underwriters' treatment of public information appears to be *almost* consistent with an efficient IPO pricing process.

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