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The option to withdraw IPOs during the premarket: empirical analysis[☆]

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Abstract

American IPOs are priced after a process of bookbuilding, during which issuers can withdraw at any time. We hypothesize that the option to withdraw reduces underpricing by strengthening the issuers' bargaining power with respect to investors. Empirical analysis reveals that underpricing is lower when investor perception of an IPO's likelihood of withdrawal is higher. Withdrawing issuers are neither smaller nor less profitable than issuers completing their IPOs, and engage underwriters that are as reputable as those managing completed offerings. Withdrawal is correlated with leverage, intended use of proceeds, expected issue size, venture backing, revenues, NASDAQ returns, and IPO activity. © 2001 Published by Elsevier Science S.A.

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1. Introduction

Initial public offerings (IPOs) in the U.S. are typically priced following a process of price discovery known as bookbuilding in which the underwriter conducts road shows and solicits indications of interest from investors. The initial prospectus filed by an issuer with the SEC includes only a suggestive offer price range, while the final price varies within as well as outside that range depending on investor feedback during the price discovery process (Ritter, 1987; Hanley, 1993). Benveniste and Spindt (1989) model the process and argue that IPOs should be deliberately underpriced to reward investors for accurately revealing information pertinent to pricing an issue. To the extent that underpricing is an incentive payment for investors, the issuing firm's *option* to withdraw its issue during the price discovery process should have an impact on the level of this payment. Busaba (1999) presents a theoretical analysis of this option and its added value to the bookbuilding selling mechanism. This paper investigates empirically how the issuing firm's ability to withdraw affects the realized outcome of an IPO.

When a firm engages an investment banker for the purpose of going public, it does not commit to issuing shares at whatever price later proposed by the banker. Rather, the firm's commitment is *conditioned* on the proposed offer price and, hence, can be delayed until after the conclusion of the price discovery process. If the firm accepts the proposed price, that price formally becomes the offer price which the banker guarantees, and selling starts typically the next day. But if the firm perceives the proposed price as low, it has the option to cancel its offering and walk away.

The existence of the option to walk away in bookbuilding leads to better offer pricing (Busaba, 1999). This is because investors realize that putting an untruthful negative spin on the firm's prospects and value during the premarket could push the firm to wrongly withdraw, ruining for them a potentially valuable investment opportunity.[1] The result is that issuers whom investors believe are more likely to withdraw can secure investor cooperation with lower promised underpricing. Simply put, these issuers underprice by less if and when they go public.

We test the association between the ex ante expected probability of withdrawal and realized underpricing in two stages. First, we model a rational investor's ex ante derivation of the expected probability of withdrawal for a sample of IPOs. We do that by imputing the probability from a probit model of the decision to withdraw, which we estimate using variables that are observed by investors before and at the time they make subscription decisions. We then

[1] Another source of value for the option to withdraw lies in the fact that the firm can presumably condition its business strategy, including the possibility of ceasing potentially unprofitable projects, on information learned in the process of going public (Benveniste et al., 2001).

examine whether the imputed probability has power in explaining the variation of initial returns both in and out of sample.

Consistent with our hypothesis and the bookbuilding theory, we find a significant negative correlation between the probability of withdrawal and underpricing, especially when premarket demand would have been strong. This result and further analysis suggest that not controlling for the withdrawal probability presents a missing-variable problem for cross-sectional studies of IPO underpricing. We find, for example, that the commonly reported negative correlation between issue size and underpricing vanishes when the predicted probability of withdrawal is included as an explanatory variable of underpricing.

Further, our paper provides a rather detailed empirical picture of firms that withdraw their offerings. Our sample of withdrawn offerings includes 113 that were filed with the SEC during the 1990–1992 period. We identify these firms using the Securities Data Company's (SDC) database and then gather the related prospectuses. As a result, we are able to analyze the decision to withdraw on the basis of the rich financial and ownership information provided in these prospectuses. Interestingly, we find that withdrawn offerings during the sample period are filed by firms that are as large and as profitable (or unprofitable) as firms that complete their IPOs. The probit analysis reveals financial and control attributes of issuing firms that are significantly associated with the likelihood of IPO withdrawal.

Our results have implications for parties involved in the primary equity markets. The established link between an IPO's ex ante probability of withdrawal and the IPO's underpricing suggests that issuing firms potentially have some control over the amount of money they leave on the table when they go public. Issuers can reduce this amount if they take actions ex ante, like securing an alternative source of financing, that signal a stronger willingness to withdraw in the face of weak investor demand. Our results may interest IPO investors as well, since these investors spend resources to become informed and expect to be compensated through allocations of underpriced shares. Their decision to participate in an IPO, therefore, can potentially be conditioned on the IPO's perceived likelihood of withdrawal and the extent of the discount in case the offer is completed.

Our analysis provides insight into an issue that has recently gained attention on Wall Street. A *Wall Street Journal* article suggests that insider selling in an IPO conveys adverse information to the market, and quotes a money manager as saying that "IPOs with insider selling imply that there are people in the management who believe they would be better served by owning a house [financed by stock profits] than owning their own stock" (September 1, 1999, p. C1). The article also states that underwriters "may have difficulty convincing investors to buy an IPO where there is insider selling" (September 1, 1999, p. C1). Our analysis of the factors associated with IPO withdrawal, however, finds no evidence in support of this argument. We find no significant correlation between the percentage of secondary shares in an IPO (shares sold by insiders) and the likelihood that the IPO is withdrawn.

The next section presents evidence on the incidence of IPO withdrawal. Section 3 develops the main hypothesis, which is that the issuer's ability to withdraw reduces underpricing. Section 4 presents the empirical analysis and results, and Section 5 discusses the implications for related literature. Section 6 summarizes the paper.

2. The incidence of IPO withdrawal

Accounts of firms postponing or withdrawing their equity offerings are common in the public press. The case of Kwik Goal's withdrawn IPO epitomizes the option to withdraw in rejection of a low *would-be* offer price. The president of the company, Vincent Caruso,

> … got all the way to the day before the IPO when he decided to walk … 'The underwriter came to us the night before and said they could only get $3 per share instead of the $6 we filed for … I said there was simply no way I was going to sell 55 percent of my company for $3 million …' While underwriters set an initial target price, feedback from potential investors may cause that price to go up or down before the IPO is actually launched … So although he had spent over $200,000 in legal, accounting, and printing fees in preparation for the IPO, Caruso left the investment bankers standing at the altar. (*Nations Business*, June 1996, pp. 57–59)

The withdrawal of initial public offerings is not specific to a particular period of time (although clustering during weak markets is possible), to particular industries, or to issues of particular sizes. A search of the SDC's data set of firm-commitment new common equity issues filed with the SEC by American industrial firms during the 11 year period 1984–1994 reveals that around 14% of these issues are later withdrawn. A total of 2,510 issues that are not unit offerings, REITs, ADRs, closed-end funds, conversion of mutuals, or multiple-class, and not offerings of financials (SIC code 6000–6999), or legal, educational, social, and other services firms (SIC code > 8100) were filed during that period, out of which 2,150 were completed and 360 withdrawn. (These numbers include only issues whose filing date, primary SIC code, number of shares filed, and offer price filing range are available in SDC.)

The annual breakdown of withdrawn versus completed issues is presented in Panel A of Table 1. The percentage of issues withdrawn (out of total filed) ranges from a minimum of 5.8% (1985) to a maximum of 22.8% (1990), with the earlier years having slightly higher percentages on average – 15.2% for 1984–1988 vs. 13.7% for 1989–1994. (The designation of the subperiods is arbitrary.) The breakdown of the sample of withdrawn and completed IPOs by industry

Table 1
Distribution of completed and withdrawn firm-commitment initial public offerings filed with the SEC from 1984 to 1994. The sample is obtained from the New Issues Database of Securities Data Corporation (SDC). Unit offerings, ADRs, offerings of foreign corporations (F-1 filings), REITs, and mutual funds are excluded from the sample. Filings of financial institutions (SIC code 6000–6999) and service companies (sic code > 8100) are also excluded.

Year filed	Withdrawn Issues	Percentage Withdrawn	Completed Issues	Percentage Completed	Total issues Filed
Panel A: Distribution of completed and withdrawn IPOs by year filed with the SEC					
1984	37	19.6%	152	80.4%	189
1985	10	5.8	163	94.2	173
1986	40	11.4	311	88.6	351
1987	54	22.5	186	77.5	240
1988	20	18.7	87	81.3	107
Subtotal	161	15.2%	899	84.8%	1,060
1989	9	10.2%	79	89.8%	88
1990	28	22.8	95	77.2	123
1991	24	9.9	219	90.1	243
1992	73	21.5	267	78.5	340
1993	29	7.5	359	92.5	388
1994	36	13.4	232	86.6	268
Subtotal	199	13.7%	1251	86.3%	1,450
Total	360	14.3%	2,150	85.7%	2,510

Industry	Two-digit SIC codes	Withdrawn IPOs	Percent With-drawn	Com-pleted IPOs	Percent com-pleted	Total filed
Panel B: Distribution of completed and withdrawn IPOs by industry classification (two-digit SIC code)						
Crops, natural resource extraction	01–05, 10–14	13	25.5%	38	74.5%	51
Construction	15–17	8	18.2	36	81.8	44
Other manufacturing	20–27, 29–34, 37, 39	58	15.1	327	84.9	385
Chemicals and allied products	28	28	16.8	139	83.2	167
Industrial machinery	35	26	12.9	175	87.1	201
Electronic and electric equipment	36	31	13.0	208	87.0	239
Instruments and related products	38	31	16.7	155	83.3	186
Transportation	40–49	33	16.3	170	83.7	203
Wholesale	50, 51	25	15.5	136	84.5	161
Retail	52–59	33	11.1	263	88.9	296
Services	70–80	72	12.5	502	87.5	574
Unclassified	—	2	66.7	1	33.3	3
Total		360		2,150		2,510

classification is presented in Panel B of Table 1. For most industry categories, the percentage of withdrawn IPOs ranges from 11% to 19%. The average *expected* offer size of the 199 withdrawn IPOs filed in the period 1989–1994 is \$32.1 million and the median is \$23.7 million, compared to \$24.5 million and \$21.1 million, respectively, for the completed issues filed during the same period. For the earlier five years, 1984–1988, the numbers are \$22.3 million (mean) and \$9.7 million (median) vs. \$16.40 million and \$11.2 million. (Expected issue size is computed as the number of shares filed multiplied by the midpoint of the offer price range specified in the initial prospectus.)

We now turn to the discussion of the issuing firm's option to withdraw and its impact on underpricing. The discussion is carried out within the bookbuilding framework.

3. The hypothesis

Consider a firm that is attempting to go public but does not know how much investors are willing to pay for its shares. It engages an investment banker, who on its behalf attempts to solicit investor valuations, or interest, prior to pricing the offering. Soliciting this information poses a challenge, however, since investors have an incentive to understate their interest in hopes of buying shares at a depressed offer price. Benveniste and Spindt (1989) model the bookbuilding process and derive the incentive-compatible price/allocation rule that maximizes the expected proceeds from the offering (see also Benveniste and Wilhelm, 1990; Benveniste and Busaba, 1997; Benveniste et al., 1996). According to this rule, allocation priority is given to investors who report strong interest, and to reward these investors, the offering is underpriced when aggregate demand is strong. The promised discount is on average equal to the (minimized, but still positive) gain expected from understating interest.

Consider in this framework the issuer's ability to withdraw. If investors believe that the issuer is likely to withdraw in rejection of a low offer price when demand is weak, they will have less of an incentive to downplay their interest, since doing so only increases the chances that the issue is actually withdrawn. The higher the ex ante probability of withdrawal, the less investors expect to benefit from "cheating", and the smaller will be the underpricing that secures their truthfulness. Our hypothesis, then, is:

> Observed underpricing should be lower for IPOs that investors believe ex ante to have a higher likelihood of withdrawal.[2]

[2] The formal proof of this result appears in Busaba (1999).

Testing this hypothesis requires first that we model how investors estimate the probability of withdrawal for an IPO. Since the issuer's "reservation" value is usually private, as was the case, for example, in Kwik Goal's IPO, investors estimate the probability indirectly using information about previous offerings and offering firms. (The reservation value is not typically mentioned in the prospectus; it would not be credible even if it were.) Comparing the characteristics of firms that pull their IPOs to those of firms that do not, investors build a statistical model of the decision to pull and use that model to predict ex ante the withdrawal probability of an IPO under consideration. We build a binary probit model in lieu of this statistical model and use it to impute the ex ante withdrawal probability for a sample of completed IPOs. The explanatory variables in the probit model are observed by investors ex ante, like attributes of the issuing firm and its offering and the state of the stock market during the marketing process. We then test whether underpricing in the sample is negatively correlated with the imputed probability.

It is helpful, for the empirical analysis that follows, to clarify the relation between underpricing and investors' estimate of the withdrawal probability. While underpricing occurs mostly in states of high demand, as the bookbuilding theory predicts and empirical studies (e.g., Hanley, 1993) show, withdrawal is a possibility only if demand is weak. Underpricing, therefore, does not cause, or increase the likelihood of, withdrawal; it is merely a way to allocate the *surplus*, that is, the value based on investor feedback minus the issuer's reservation value, between the issuer and investors. (Economic efficiency requires that the offering be completed whenever investors' valuation exceeds the issuer's reservation value, regardless of the mechanism used to market the IPO.) As such, the expected withdrawal probability is an *exogenous* determinant of the level of underpricing. Further, there is no "self-selection" based on the degree of underpricing; i.e., it is not the case that issuers with low underpricing go public while those to be more severely underpriced select to withdraw.

Note also that investors' share of the surplus under the bookbuilding mechanism is dependent on their perception of the issuer's willingness to withdraw. Therefore, errors that investors (and ourselves) make in estimating this likelihood affect only underpricing, as we hypothesize, but have no bearing on whether the issue is actually completed or not. And since underpricing does not cause withdrawal, these errors do not cause selection bias.

4. Empirical analysis

4.1. Data

Our data cover withdrawn and completed IPOs of U.S. industrials filed with the SEC during the three-year subperiod 1990–1992. As we outline in Section 2, the sample excludes unit and multiple-class offerings, as well as offerings of REITs, ADRs, closed-end mutual funds, and foreign corporations (F-1 filings). It also excludes offerings of financial (SIC code 6000–6999) and legal, education, social, professional, and personal services firms (SIC code > 8100), and offerings that represent conversions of mutual companies.

The main factor that dictates the sample period is the limited availability of data on withdrawn IPOs. Such issues are identified from the Issues in Registration section of the New Issues Database of the Securities Data Company and then verified with the Disclosure Access System, which duplicates SEC filings. Relevant information about these issues that can be found in the SDC data set is restricted, however, to SEC filing details (e.g., number of shares offered, offer price range, filing date, lead underwriter, and issue withdrawal/postponement date). We manually construct other information relating to the issuers' financial position and structure, comparable to what the SDC database contains for completed IPOs, from the preliminary prospectuses. We obtain from the Disclosure Access System the S-1 registration documents of 113 withdrawn issues. The sample of contemporaneous completed IPOs consists of 581 issues of which 423 have data available on all the variables we consider in our analysis.

The data are supplemented by the updated Carter and Manaster rankings of underwriters, obtained from Carter et al. (1998). When no ranking information is available (mostly for small regional investment banks with limited underwriting experience), a rank of zero is assigned. Further, returns on the NASDAQ composite index, computed from closing levels of the index as reported in the Center for Research in Security Pices tapes, are added to the data to control for market movements during the time between filing and issuing/withdrawal of the sample issues. We use the NASDAQ composite index as a market benchmark since the overwhelming majority of IPOs trade there first, and since IPO firms tend to be smaller on average than firms traded on major exchanges.

4.2. The decision to withdraw

To study the decision to withdraw an IPO, we estimate a probit model in which the dependent variable takes the value of one if the IPO is withdrawn and zero otherwise. The explanatory variables are proxies for factors that we argue have an influence on the decision to withdraw.

The decision to withdraw hinges on the position of the issuer's reservation value *relative* to possible investor valuations. Presumably, such a relative position is determined by factors affecting the issuer's reservation value as well as factors affecting investors valuations of the issue. For example, consider two issues for which the market value of a share is uniformly distributed between \$15 and \$20. However, issuer A has a reservation value of \$16 while issuer B's reservation value is \$17. Issuer B, with the higher reservation value, has a higher probability of withdrawal. Alternatively, consider issuer C whose reservation value is equal to B's ($17) but whose market value per share ranges from $16 to $21. Issuer B, with the lower range of market values, is more likely to withdraw. We consider separately factors affecting each dimension.

4.2.1. Factors affecting the issuer's reservation value

We identify three factors that potentially affect the issuer's reservation value. First, issuers with access to alternative sources of financing, all else equal, are likely to have a higher reservation value for equity shares. As such, we predict that issuers with wider access to debt, evidenced by a higher debt ratio, are more likely to withdraw. (A higher debt ratio could in some cases signal the exhaustion of debt capacity, in which case it would be associated with a lower likelihood of withdrawal.) Debt ratio, DEBT, is defined as the ratio of total debt (short- and long-term as well as subordinated) to total assets. Selling equity for the purpose of refinancing existing debt is another, natural indicator of the presence of an "alternative" financing vehicle. After all, if the proceeds are to refinance debt, firms are less likely to be pressured to sell equity under immediate needs of capital for expansion. We use a dummy variable, USEP, that is equal to one if the primary use of proceeds stated in the prospectus is to pay back debt. We argue that the likelihood of withdrawal is higher when USEP equals one.

The minimum acceptable offer price is also affected by the issuer's risk aversion. If going public is motivated by the owners' decision to diversify their wealth, we expect these (poorly diversified) owners to be willing to sell shares at prices below the level at which diversified investors value the shares. We use the percentage of the offering that constitutes secondary shares, SECONDARY, or shares sold by the original shareholders, to proxy for the issuer's risk aversion, and predict that this proxy will be negatively correlated with the probability of withdrawal.

One might argue that larger, more established firms tend to have a higher percentage of secondary shares in their offerings. Because these firms are also easier to value by investors, one might observe a negative correlation between the variable SECONDARY and the probability of withdrawal. However, we believe that asset size and revenues are better measures of firm size and maturity than is SECONDARY. Therefore, in a multivariate analysis that includes all three attributes, whatever marginal effect SECONDARY might have will be a reflection of its proxying for other factors, presumably the issuer's risk aversion.

Last, an issuer's willingness to withdraw is determined, at least in part, by the cost of withdrawal. The ramifications of pulling an IPO could be bad publicity, affecting the way "stakeholders" – suppliers, clients, and possibly employees – deal with the company. Consistent with this view, Guo (1998) finds the survival rate of firms that withdraw to be lower than that of firms that complete their issues. The cost of withdrawal can be especially high for firms manufacturing specialized or unique products (SIC codes between 3400 and 4000), whose workers and suppliers may have job-specific skills and whose customers may not find alternative servicing for the unique products (Titman and Wessels, 1988). To control for this effect, we follow Titman and Wessels and use the dummy variable INDUSTRY to represent firms with such SIC codes. Once such firms attempt an IPO, they will be more reluctant to withdraw, suggesting a negative correlation between the dummy and the probability of withdrawal.

4.2.2. Factors affecting investor valuation

A wide range of factors shapes investors' interest in an IPO and their willingness to bid for shares. Streams of cash flows and earnings are easier to value than are growth options. In this respect, issuers with higher revenues and current profits are less likely to withdraw their IPOs due to investor mispricing. Issuers with more assets in place are also easier to value and are hence less likely to withdraw their IPOs. Revenues are measured by log(REV), the natural logarithm of revenues for the most recent 12 month financial period preceding the offering, and profitability by ROA, the return on assets for the same financial period. Asset size is measured by log(AST), the natural logarithm of total assets at the end of the most recent financial period.

Expected issue size as well as total market capitalization after the IPO potentially affect investor valuation, due to liquidity and risk considerations. Investors bid higher in the premarket for stocks that are expected to be more liquid in the aftermarket. As measures of liquidity, we use the *expected* offering size and the *expected* market capitalization after the IPO. Expected offer size is the product of the midpoint of the offer price range, MID, and the number of shares initially filed with the SEC, SHFILED, and expected market capitalization is MID times the total number of shares to be outstanding upon the IPO, SHTOTAL. As to risk considerations, larger issues involve less risk since they are more likely to attract institutional investors, who produce and bring valuable information to the table. We therefore predict that issuers with larger offerings and market capitalization are less likely to withdraw as they are likely to receive favorable valuations from investors.

Seguin and Smoller (1997) report that a lower IPO price is associated with a higher future mortality rate for the issuing firm. Hence, it is possible that investors are less willing to bid for low-priced IPOs, effectively raising the chances that these issues are pulled. To account for the Seguin-Smoller effect while controlling for offer size and market capitalization, we include in the probit model Log(MID), Log(SHFILED), and Log(SHTOTAL) as separate variables, rather than the restrictive Log(MID$*$SHFILED) and Log(MID$*$SHTOTAL).

Agency theory suggests that ownership retention by selling shareholders can be a signal of the quality of the issuing firm (e.g., Jensen and Meckling, 1976; Leland and Pyle, 1977). Perhaps, an evidence of the significance of this effect is the "lockup" rule that commits insiders not to liquidate their holdings (or parts thereof) typically for 180 days after the IPO. A larger retention ratio brings the valuation of outside investors closer to what insiders expect to sell for, and hence reduces the likelihood that the IPO is withdrawn. We include in the probit analysis the retention ratio, RETAIN, and predict that it will have a negative impact on the probability of withdrawal. RETAIN is computed as the ratio of shares that continue to be held by the selling shareholders after the IPO to total shares then outstanding. (To avoid confusion, we note that RETAIN $\neq$ $1 -$ SECONDARY, the percentage of primary shares in the issue.)

As mentioned in the introduction, the *Wall Street Journal* suggests that it is insider selling at the IPO stage that sends a negative signal to the market, making it more difficult to generate investor demand (September 1, 1999, p. C1). If so, we should observe a positive correlation between the probability of withdrawal and the percentage of secondary shares in the offering, SECONDARY. (This effect is opposite to the correlation predicted in Section 4.2.1 where SECONDARY is used to proxy for the degree of the issuer's risk aversion.)

Barry et al. (1990) suggest that backing by venture capital provides certification of value for firms attempting an IPO. Smith (1986), Booth and Smith (1986), and Carter and Manaster (1990) suggest a certification role for underwriters. We predict that issuers backed by venture capital and those underwritten by reputable bankers are likely to receive a favorable response from investors, and hence are less likely to withdraw. A dummy variable, VENTURE, indicates venture-backed IPOs, and the updated Carter and Manaster ranking, RANK, measures underwriter reputation.

The withdrawal of IPOs is often attributed to weak or "shaky" markets, in which investors lose interest in new equity issues. Investors understand the impact of market movements during the premarket on the firm's decision to go ahead and factor these movements into their bidding behavior. An investor who still has interest in an issue in a weak market would recognize that understating that interest would further increase the odds that the issue is withdrawn, and therefore, the incentive to misrepresent that interest is reduced.

To control for market movements, we use the variable RET30, which measures the returns of the NASDAQ composite index over the 30 trading days immediately following the filing of an IPO with the SEC. Because the bulk of the marketing effort takes place in the few weeks after filing, market movements during that period arguably have a critical impact on the fate of an offering. If it takes less than 30 trading days to cancel or complete an IPO, the NASDAQ return over the period between filing and issuing or withdrawal is computed and transformed into a 30-day equivalent. For a robustness check, we compute another variable, RETF, as the average 30-day NASDAQ return over the period between filing and either issuing or withdrawal. (If the withdrawal date is not specified in the SDC database, we assume it is 270 days after filing, which is the time period the SEC allows before automatically declaring the offering abandoned; see Lerner, 1994.) Investors, who report only nonbinding indications of interest during the premarket, presumably continue to update their bids during the length of the process. Standardizing the return period (to 30 days in this case) is a way to circumvent the potential endogeneity of the length of the premarket, as it could take longer to pre-sell an issue when investor interest is weak.

Last, Dunbar (1998) reports a negative correlation between the likelihood that a filed IPO is completed and the number of issues filed in the same month along with that IPO. Issues coming to market in a flurry during a short period of time have to share the limited funds provided by budget-constrained IPO investors. Because the general willingness (and ability) of investors to pay for a certain IPO weakens in such markets, issuers will more likely end up withdrawing. We include in the probit specification, for every sample IPO, the number of IPOs filed during the same month, Num_IPOs.

Table 2 provides a summary of the variables used to predict the withdrawal probability along with the hypothesized effect of each variable on this probability. Table 3 shows summary statistics of the variables computed separately for the completed and withdrawn sample IPOs. Both the average debt ratio and the percentage of issuers specifying paying debt as the primary use of proceeds are significantly higher for withdrawn issues. Statistical significance is assessed by computing a t-statistic for the difference in the means of the two subsamples and also by the nonparametric Wilcoxon rank sum test. The percentage of secondary shares in an IPO, and of firms with SIC codes in the 3400–4000 range, are not different, on average, across the withdrawn and completed issue subsamples. As to factors affecting investor valuation, asset size and revenues appear to be higher (but not statistically) for withdrawn IPOs, while the Wilcoxon rank test suggests that ROA is higher for completed IPOs. Table 3 also shows that withdrawn IPOs in our sample are less often backed by venture money, are associated on average with lower NASDAQ returns for the first 30 trading days after filing, include a larger number of shares, and are expected to generate higher proceeds than their completed counterparts.[3] Further, the Wilcoxon rank test indicates a lower average retention ratio by shareholders of withdrawn IPOs. While the updated Carter and Manaster underwriter ranking is not

[3] Withdrawn issues are on average larger than completed ones also over the longer 11-year period used in Table 1, consistent with what we find here in the three-year sample. We reported in Section 2 the mean and median expected offering size (MID*SHFILED) over two subperiods for both types of issues. Further analysis reveals that, during the six-year subperiod surrounding our sample period, 1989–1994, the mean and median expected offer size are higher for withdrawn IPOs in every year but 1993 in which both measures are slightly higher for completed IPOs ($24.96 and $21.68 million vs. $23.81 and $20.80 million, respectively). During the earlier subperiod, 1984–1988, the average expected size of withdrawn issues is higher in three of the five years and the median in two.

Table 2
Definition and predicted effect of variables used in the probit analysis of the decision to withdraw.

Variable	Description	Predicted effect on probability of withdrawal
Factors affecting the issuer's reservation value		
DEBT	debt ratio.	+
USEP	dummy variable indicating debt payment as the primary use of proceeds.	+
SECONDARY	the proportion of offering shares sold by existing shareholders.	−
INDUSTRY	dummy variable indicating firms with SIC codes between 3400 and 4000.	−
Factors affecting investors' valuation		
AST	assets in millions before the offering.	−
REV	annual revenue in millions before the offering.	−
ROA	return on assets.	−
SHTOTAL	the expected total shares (in millions) outstanding after the offering.	−
SHFILED	offering shares in millions filed with SEC.	−
MID	the midpoint of the offer range.	−
RETAIN	the portion of total shares retained by the original shareholders.	−
VENTURE	dummy variable indicating backing by venture capital.	−
RANK	the updated Carter and Manaster ranking by Cater et al. (1998).	−
RETF	NASDAQ average 30-day return over the filing-issuing/withdrawal period.	−
RET30	NASDAQ return over the 30-day period after filing.	−
Num_IPOs	the number of IPOs filed in a certain month.	+
SECONDARY	(described above) to capture the negative signal of insider selling.	+

different on average across the two subsamples, withdrawn offerings tend to be associated with periods (months) of higher IPO filing activity.

Earlier literature suggests that withdrawal is an extremely unfavorable event. Lerner (1994, p. 312) states: “A firm that withdraws its IPO may later find it difficult to access the public marketplace. Even if the stated reason for the withdrawal is poor market condition, the firm may be lumped with other businesses whose offerings did not sell because of questionable accounting practices or gross overpricing”. For the three-year sample, only one withdrawn firm is reported in the Nexis News wire to be questioned by SEC for problematic accounting practices. In addition, the numbers presented in Table 3 provide

Table 3
Descriptive statistics on the full sample and subsamples of completed and withdrawn initial public offerings filed with SEC during the three-year period 1990–92

Unit offerings, REITs, ADRs, F-1 filings, filings of mutual funds, and filings of financial firms are excluded from our sample. Excluding offerings with missing observations, the final sample includes 536 offerings, of which 423 are completed and 113 withdrawn. Univariate test statistics for the difference in characteristics between completed and withdrawn IPOs are also presented. The t-statistics are calculated to test the null: mean (withdrawn) – mean (completed) = 0, with the assumption that the two subsamples are randomly and independently selected and the sampled population is approximately normal. The nonparametric Wilcoxon statistic is to test whether the completed and withdrawn issues have identical distributions, with the assumption that the two samples are random and independent. Statistics with significance at the 5% and 1% levels are denoted with * and **, respectively. The variables MID*SHTOTAL and MID*SHFILED, representing *expected* post-offering market capitalization and *expected* offering size, respectively, are reported for the reader's convenience. (AST, REV, SHTOTAL, and SHFILED are in millions.)

Summary statistics and univariate test of key variables

	Full sample		Completed issues		Withdrawn issues		T-statistics	Wilcoxon rank sum test
Variable	Mean	Median	Mean	Median	Mean	Median		
Factors affecting the issuer's reservation value								
DEBT	0.28	0.19	0.23	0.14	0.46	0.41	7.21**	6.31**
USEP	0.42	0	0.38	0	0.59	1	4.21**	4.15**
SECONDARY	0.13	0	0.13	0	0.13	0	0.14	−0.23
INDUSTRY	0.28	0	0.29	0	0.23	0	−1.28	− 1.28
Factors affecting investors' valuation								
AST	53.12	22.75	49.60	23.30	66.31	21.22	1.61	0.20
REV	77.99	35.12	71.71	35.50	101.53	34.13	1.84	− 0.36
ROA	− 0.04	0.05	− 0.04	0.06	− 0.07	0.03	− 0.65	− 2.21*
SHTOTAL	7.48	6.58	7.5	6.55	7.40	6.60	− 0.20	− 0.13
SHFILED	2.40	2.00	2.31	2.00	2.76	2.10	2.71**	1.06
MID	10.85	11.00	10.8	11.00	11.06	11.00	0.69	0.67
MID*SHTOTAL	87.73	75	87.16	74.81	89.83	77.63	0.35	0.21
MID* SHFILED	28.38	24	26.48	24	35.48	24.20	2.98**	1.08
RETAIN	0.65	0.68	0.65	0.68	0.62	0.66	− 1.48	− 2.44*
VENTURE	0.46	0	0.51	1	0.26	0	− 4.87**	− 4.77**
RANK	7.04	8.75	7.03	8.75	7.09	8.75	0.19	− 0.25
RETF	0.007	0.0065	0.0072	0.0064	0.0061	0.0066	− 0.45	0.14
RET30	0.0067	0.0055	0.0088	0.0070	− 0.0009	0.0012	− 2.38*	− 2.14*
Num_IPOs	28.44	25	27.59	23	31.65	27	2.36*	1.6
Sample size	536		423		113			

strong evidence against the notion that the majority of withdrawn offerings are of unknown, small companies or companies with questionable accounting practices. In fact, Guo (1998) studies a sample of 111 withdrawn IPOs and finds that as many as 19 of them successfully went back to market.

While summary statistics allow only for suggestive inference, we leave the task of explaining the decision to withdraw to the probit analysis.

4.2.3. The probit analysis

The probit withdrawal decision model is specified as follows:

$$\begin{aligned}\text{Prob}(y=1) = \Phi(&\alpha_0 + \alpha_1\,\text{DEBT} + \alpha_2\,\text{USEP} + \alpha_3\,\text{SECONDARY}\\ &+ \alpha_4\,\text{INDUSTRY} + \alpha_5\,\text{Log(REV)} + \alpha_6\,\text{ROA}\\ &+ \alpha_7\,\text{Log(AST)} + \alpha_8\,\text{Log(SHTOTAL)} + \alpha_9\,\text{Log(SHFILED)}\\ &+ \alpha_{10}\,\text{Log(MID)} + \alpha_{11}\,\text{RETAIN}\\ &+ \alpha_{12}\,\text{VENTURE} + \alpha_{13}\,\text{RANK} + \alpha_{14}\,\text{RETF}\\ &+ \alpha_{15}\,\text{RET30} + \alpha_{16}\,\text{Num\_IPOs}),\end{aligned}$$

where y is a binary variable that takes the value of one for withdrawn IPOs and zero for completed issues, and Φ is the cumulative standard normal function.

The estimation results are presented in Table 4. Model 1 in the table reports the estimated coefficients and the significance level of all the independent variables identified above. Both the debt ratio and the intention to use IPO proceeds primarily to pay debt have positive and highly significant coefficients, consistent with the argument that issuers with access to alternative sources of financing – in this case, debt – have higher reservation values. The percentage of secondary shares in the offering, as a proxy for the issuer's risk aversion (or alternatively, for the negative signal of insider selling), does not appear to have a significant impact on the decision to pull an IPO. The industry dummy, controlling for the cost of withdrawal, is not significant either.

As to the factors affecting investor valuation, both the revenue variable and the dummy indicating venture backing are significantly correlated with the decision to withdraw. The coefficient on Log(REV) is negative, in line with the argument that revenues can be valued with less uncertainty. The coefficient on the venture dummy is also negative, consistent with the hypothesized certification role that venture capitalists play. The coefficients of neither ROA nor Log(AST) are significant at conventional levels. The expected issue size and market capitalization after the offering do not appear to have a significant effect on the withdrawal decision, with the coefficients of Log(MID) and

Table 4
Probit analysis of the decision to withdraw an IPO, based on a three-year (1990–92) sample of 536 issues filed with the SEC, of which 423 are completed and 113 withdrawn

The dependent variable is one for withdrawn offerings and zero for completed offerings. The MLE estimates of the coefficients are presented in the table, with the p-value (of a χ^2 Wald test) of whether an individual coefficient is different from zero in parenthesis. The χ^2 and p-value of a likelihood ratio test for the hypothesis that all slope coefficients are zero is also reported. A likelihood-ratio index = 1 − (model log likelihood ÷ log likelihood for a zero-slopes model), is reported as one measure of goodness of fit. Partial derivatives of the predicted probability of withdrawal with respect to the independent variables are shown in the last column. The derivatives are evaluated at USEP = 0, VENTURE = 0, and the means of the other variables.

Independent variable	Model 1	Model 2	Model 3	Model 4	Partial derivatives
Intercept	− 1.64 (0.04)	− 1.48 (0.00)	− 1.38 (0.00)	− 1.09 (0.00)	
DEBT	0.83 (0.00)	0.84 (0.00)	0.73 (0.00)	0.73 (0.00)	0.198
USEP	0.58 (0.02)	0.61 (0.01)	0.50 (0.00)	0.51 (0.00)	0.139
SECONDARY	0.57 (0.31)	0.54 (0.27)			
INDUSTRY	− 0.07 (0.76)				
Log (AST)	− 0.17 (0.28)	− 0.16 (0.15)			
Log (REV)	− 0.20 (0.04)	− 0.20 (0.03)	− 0.20 (0.00)	− 0.18 (0.00)	− 0.049
ROA	0.26 (0.34)	0.25 (0.31)			
log (SHTOTAL)	− 0.53 (0.50)				
log (SHFILED)	1.05 (0.21)	0.48 (0.03)	0.39 (0.02)	0.43 (0.01)	0.117
log (MID)	0.27 (0.43)	0.36 (0.21)	0.19 (0.35)		
RETAIN	1.32 (0.50)				
VENTURE	− 0.70 (0.01)	− 0.66 (0.00)	− 0.68 (0.00)	− 0.63 (0.00)	− 0.173
RANK	0.03 (0.63)				

Table 4 (*continud*)

Independent variable	Model 1	Model 2	Model 3	Model 4	Partial derivatives
RETF	1.05 (0.85)				
RET30	− 4.38 (0.19)	− 3.96 (0.11)	− 4.15 (0.04)	− 4.15 (0.03)	− 1.132
Num_IPOs	0.01 (0.13)	0.01 (0.09)	0.01 (0.02)	0.01 (0.01)	0.003
Model χ^2 (p-value)	99.92 (0.000)	96.83 (0.000)	89.71 (0.000)	88.68 (0.000)	
Likelihood-ratio index	18.10%	17.54%	16.25%	16.06%	

Log(SHFILED) having opposite signs to those predicted. The Carter and Manaster underwriter ranking, RANK, also seems to have no significant impact on the decision to withdraw. The NASDAQ return variables and the share retention by original owners, RETAIN, fail to assume significant coefficients. And last, the number of contemporaneous filings assumes a marginally significant positive coefficient in line with the argument that it is difficult to market an IPO when many other issuers are tapping the market.

The lack of significance of the Carter and Manaster underwriter ranking is inconsistent with the findings of Dunbar (1998). In a study of the choice of the underwriting contract, Dunbar estimates a probit model to predict the success of firm-commitment IPOs and finds one measure of underwriter reputation (that is based on market share) to be significant. However, our probit model controls for many attributes (like debt ratio, use of proceeds, revenues, and venture backing) that Dunbar does not control for. His model includes, besides the measure of underwriter reputation, only file size (comparable to SHFILED∗MID), file price (comparable to MID), and the number of contemporaneous filings (Num_IPOs). He does not use a logarithmic transformation of SHFILED∗MID and MID, but RANK remains insignificant in our model when MID and SHFILED replace Log(MID) and Log(SHFILED). Also, when we estimate a model that is comparable to his (except for how we measure underwriter ranking), we still find RANK to be insignificant. This suggests that the difference between Dunbar's findings and ours is due to the differences in the reputation variable, the sample period, and/or sample construction.

To reduce the potential effect of multicollinearity, we eliminate from the probit analysis, individually and in groups, "redundant" variables that do not show up with significant coefficients in Model 1. The result is a sequence of specifications of which Models 2–4 are examples. Model 4, the most parsimonious, draws a clearer picture of the variables closely correlated with an IPO's probability of withdrawal. This probability seems to increase for issuers with higher debt ratios and for those whose primary use of proceeds is debt repayment, and to decrease for companies with higher revenues. Issuers that are expected to sell a larger number of shares are more likely to withdraw, contrary to the prediction that investor reception is stronger for larger, more liquid offerings. The result has a plausible interpretation, however, as overoptimistic issuers, with reservation values that are high relative to market valuation, tend to file for an offer size that is likely to exceed investor appetites. This interpretation is corroborated by the fact that Log(MID) assumes a positive and marginally significant (10% level) coefficient when the variable replaces Num_IPOs in Model 4. Overoptimistic issuers, who rush to the public market in numbers, also tend to file for an offer price range that is commensurate with their sentiment.

The model further shows that venture backing is associated with a lower incidence of withdrawal. A stronger NASDAQ during the 30 trading days after filing seems also to reduce the probability of withdrawal, confirming the conventional wisdom that IPO withdrawal is more pronounced in weak markets. Last, the model suggests that withdrawal becomes more likely when many issues are being marketed contemporaneously.

The economic significance of the variables in the probit model is given by the variables' partial effect on the predicted probability of withdrawal. Column 5 of Table 4 shows the partial effects computed based on probit Model 4 for an issuer with no venture backing (i.e., VENTURE = 0), no intention to pay back debt with the IPO proceeds (i.e., USEP = 0), and "sample-mean" levels for the other variables. (The partial effect of variable j that has a coefficient α_j is $\phi(\boldsymbol{x}'\boldsymbol{\alpha}) \cdot \alpha_j$, where $\phi(\cdot)$ is the standard normal density function, $\boldsymbol{x}'$ is a vector of values of the independent variables, and $\boldsymbol{\alpha}$ is the vector of coefficients.) The predicted withdrawal probability for such an issuer is 19.186%. The probability increases by 0.2 percentage points if the debt ratio increases by one percentage point, and decreases by 1.13 points in response to an increase of one percentage point in the NASDAQ index during the 30 days after filing. Declaring debt payment as the main use of the proceeds increases the probability by almost 14 percentage points, while venture backing reduces it by 17.3 points. A company with both dummies equal to one but otherwise similar is predicted to withdraw with a probability of 16%, very close to what would be predicted using the partial derivatives. Because the partial effects change with the level of the variables, the numbers in Table 4 should be interpreted with caution.

We use probit Model 4 to estimate the ex ante probability of withdrawal, WPROB, of the completed IPOs in the sample. (Using any of the other specifications does not alter the results of the analysis that follows.) The estimate, which is the predicted Prob($Y = 1$) from the probit model, is then used to explain the variation in underpricing across the sample. The main hypothesis we test is whether observed underpricing decreases as the expected withdrawal probability increases. We test the hypothesis also out of sample.

4.3. The underpricing model

The variation in underpricing across the 1990–1992 subsample of completed IPOs is explained by estimating a linear regression model. The dependent variable is measured as the percentage difference between the offer price and the price at the close of the third day after the IPO. A three-day return is used in order to minimize the number of missing observations, since not all IPOs start public trading on the date of the final prospectus. The final sample includes 416 IPOs with available observations. Our results, however, are invariant to whether one-day or two-day returns are used instead.

4.3.1. The main specification

The hypothesized dichotomous nature of underpricing (zero when demand is weak and positive when demand is strong) is an artifact of the existing book-building models, including the one underlying our hypothesis, in which an investor's indication of interest is also dichotomous. In a more general framework, revealed investor interest falls on a continuum, in which case the optimal pricing/allocation schedule will require that underpricing be a monotone-increasing function of aggregate demand. Hence, deliberate underpricing can occur in all demand states, albeit to different degrees, and the hypothesized effect of the ex ante probability of withdrawal, WPROB, on underpricing can possibly be uniform across "almost" all states. In such a framework, WPROB should be included as a stand-alone variable in the underpricing regression. (The next subsection considers alternative specifications in which the effect of WPROB is conditioned on the state of investor demand.)

Along with WPROB, several control variables are added to the right-hand side of the regression equation. The choice of these variables is guided by the literature, our contentions, and the need to ensure that whatever effect WPROB might have is not simply a reflection of the effect of the variables used in the calculation of WPROB. Several studies find that underpricing goes down with the dollar size of an IPO (e.g., Ritter, 1987; Chalk and Peavy, 1987). We use the logarithm of the *expected* proceeds from the offering, Log(PROCEED), to control for this effect. (Expected proceeds is computed as the midpoint of the offer price range multiplied by the number of shares filed.)

Underwriter ranking is found to be negatively correlated with IPO initial returns (Carter and Manaster, 1990). Venture capital backing is also found to reduce underpricing (Barry et al., 1990). To control for these effects, we include in the regression equation the updated Carter and Manster ranking, RANK, and a dummy, VENTURE, indicating venture backing. If insider selling in an IPO conveys negative information, as discussed earlier, a deeper discount might be needed to entice investors to participate in the IPO. We use the percentage of secondary shares, SECONDARY, to control for this effect.

The degree of underpricing within the bookbuilding framework is tied to the extent of ex ante uncertainty surrounding the value of the offered shares (Benveniste and Busaba, 1997). This is because investor information becomes more valuable as this uncertainty increases. Since issuers with established revenue streams can be valued with less uncertainty, less underpricing will be needed to sell their IPOs. The logarithm of revenues, Log(REV), is used to control for this effect. A measure of ex ante uncertainty that is sometimes used in the literature (e.g, Hanley, 1993; Carter and Manaster, 1990) is expected proceeds, with the uncertainty being higher for smaller offerings. The variable is already included, in a logarithmic form, in our regression specification. James and Wier (1990) argue that debt can be a certification of the quality of the issuer. In this respect, debt reduces valuation uncertainty and leads to lower underpricing. We include the debt ratio, DEBT, in the regression specification.

The bookbuilding theory underlying our hypothesis calls for underpricing to occur when premarket demand is strong, and in the general framework outlined above, to be increasing in this demand. To control for the state of demand, we include in our regression the variable ADJUST that measures the percentage difference between the number of shares actually sold and the number of shares initially filed with the SEC. The theoretical justification for the use of this variable is from Benveniste and Busaba (1997), who find the optimal demand-contingent offer size (that maximizes per-share proceeds) to be increasing in premarket demand. Both Hanley (1993) and Ritter (1987) provide evidence suggesting that significant offer size adjustments take place before the final prospectus is filed. We anticipate a positive correlation between the extent of pre-offer size adjustments and the observed level of underpricing.

The regression estimation results are presented in Table 5. The first column shows the estimation results for a benchmark specification that excludes the predicted probability of withdrawal. In our sample of IPOs, the variation in initial returns seems to be significantly negatively correlated with Log(PROCEED), consistent with previous studies. As hypothesized, issuers with larger revenues, Log(REV), seem to leave *less* money on the table for investors while issuers whose offerings include a larger proportion of secondary shares, SECONDARY, tend to leave *more* money on average.

Also, underpricing seems to be strongly positively correlated with the percentage adjustment in offer size, ADJUST, in line with the prediction of Benveniste and Busaba (1997). Issues led by higher-ranked underwriters are associated with deeper discounts, although the effect is weak. While inconsistent with previous studies, this finding is consistent with Beatty and Welch (1996) who show that the effect of underwriter ranking on underpricing has flipped sign in the 1990 s from what it used to be in the 1980 s. Last, neither venture backing nor DEBT appears to be significantly related to the initial returns of our sample IPOs.

Table 5
Ordinary least-squares regressions of IPO initial returns.

The main sample includes 416 completed IPOs filed during the period 1990–1992. The out-of-sample regressions, designated as '93–94', use 403 IPOs from 1993 and 1994. The initial return is the percentage difference between the closing price three days after the IPO and the offer price. WPROB is based on Model 4 in Table 4. PROCEED = MID*SHFILED, is the *expected* proceeds from the offering. The t-statistics are in parenthesis and p-values in square brackets. P-ADJUST is the percentage price adjustment and OVER_MID is an indicator variable for offerings priced above the midpoint of the offering range. Cells with "—" indicate insignificant variables; empty cells indicate variables not part of the original specification.

Independent variables	Main specifications				Alternative specifications			
	Model 1	Model 2	Model 3	93–94	Model 4	Model 5	93–94 (4')	93–94 (5')
Intercept	0.245 (6.44) [0.000]	0.276 (6.88) [0.000]	0.255 (7.34) [0.000]	0.194 (7.81) [0.000]	0.197 (10.48) [0.000]	0.204 (9.23) [0.000]	0.210 (9.52) [0.000]	0.212 (9.74) [0.000]
Log (PROCEED)	− 0.039 (− 2.21) [0.027]	− 0.020 (− 1.04) [0.300]	—	—	—	—	—	—
RANK	0.006 (1.27) [0.206]	0.005 (1.10) [0.274]	—	—	—	—	—	—
VENTURE	0.001 (0.04) [0.966]	− 0.040 (− 1.49) [0.136]	− 0.039 (− 1.77) [0.078]	—	—	—	—	—
SECONDARY	0.103 (2.11) [0.035]	0.099 (2.04) [0.042]	0.094 (1.95) [0.051]	0.075 (1.60) [0.111]	—	—	—	—
Log (REV)	− 0.014 (− 2.08) [0.039]	− 0.022 (− 2.96) [0.003]	− 0.023 (− 3.87) [0.000]	− 0.019 (− 3.33) [0.001]	− 0.015 (− 3.06) [0.002]	− 0.017 (− 3.43) [0.001]	− 0.017 (− 3.50) [0.000]	− 0.018 (− 3.71) [0.000]

Table 5 (*continued*)

Independent variables	Main specifications				Alternative specifications			
	Model 1	Model 2	Model 3	93–94	Model 4	Model 5	93–94 (4')	93–94 (5')
DEBT	− 0.019 (− 0.58) [0.561]	0.039 (0.93) [0.352]	—	—	—	—	—	—
ADJUST	0.122 (2.70) [0.007]	0.104 (2.30) [0.022]	0.111 (2.49) [0.013]	0.229 (4.22) [0.000]				
WPROB		− 0.263 (− 2.31) [0.021]	10.235 (12.89) [0.004]	10.156 (− 2.39) [0.017]	—	− 0.107 (− 1.71) [0.088]	− 0.123 (− 2.10) [0.037]	− 0.129 (− 2.23) [0.026]
P_ADJUST					0.430 (8.80) [0.000]	0.522 (7.68) [0.000]	0.450 (10.78) [0.000]	0.623 (9.53) [0.000]
WPROB*OVER_MID					− 0.185 (− 2.24) [0.026]		—	
WPROB*P_ADJUST						− 0.919 (− 2.969) [0.003]		− 1.052 (− 3.42) [0.001]
Adjusted R^2	4.72%	5.72%	5.81%	8.44%	17.50%	18.50%	25.22%	27.17%

The second column in Table 5 shows the estimation results when the predicted withdrawal probability (WPROB) is included among the explanatory variables. Whether our hypothesis holds in the data depends on the sign and significance of the coefficient of WPROB. The estimated coefficient on the variable comes out to be negative, as hypothesized, and significant at less than the 3% level. The result strengthens, with WPROB becoming highly significant, when we consider more parsimonious regression specifications (e.g., Model 3). An increase of ten percentage points in the predicted probability of withdrawal (which has a standard deviation of 12.9%) is associated with a reduction of 2.35 percentage points in underpricing based on Model 3, and 2.63 percentage points based on Model 2. It appears, therefore, that an issuer with a stronger perceived willingness to pull is able to sell shares at a lower discount.

Including WPROB as an independent variable in the regression specifications generates results that qualify the conclusions of previous cross-sectional studies of IPO underpricing. First, Log(PROCEED) loses its explanatory power, with its significance level weakening from 2.7% in Model 1 to 30% in Model 2. This can be explained by the fact that Log(PROCEED), or essentially Log(MID) + Log(SHFILED), is *positively* associated with WPROB, as shown by the significant coefficient of Log(SHFILED) in the probit estimation in Table 4. When WPROB is missing from the underpricing regression, its significant negative effect on underpricing is captured partly by Log(PROCEED).

Second, the coefficient of the venture dummy flips sign (from positive to negative) and gains statistical significance. (This result *is* consistent with previous studies.) This is not surprising either, since VENTURE is highly *negatively* correlated with the withdrawal probability, and as a result, its coefficient in Model 1 could have confounded two opposite effects, a *direct* negative one and an *indirect* positive one that reflects VENTURE's impact on the withdrawal probability. Last, the change of sign (from negative to positive) of the coefficient of DEBT can also be explained on similar grounds, suggesting that the previously observed negative effect of debt on underpricing might simply be a manifestation of the positive effect of debt on the ex ante probability of withdrawal.

Since WPROB is an imputed variable, we correct the understated standard errors in the regression specifications using the Murphy and Topel (1985) procedure. The correction turns out to be not significant and none of our conclusions change.

4.3.2. Alternative variable specifications

We now examine whether the support for our hypothesis is robust to the specification of the underpricing regression equation. First, we replace the offer size adjustment, ADJUST, with Hanley's (1993) price-adjustment measure as a proxy for premarket demand. The price-adjustment variable, P_ADJUST, is constructed as the percentage difference between the offer price and the midpoint of the offer price range specified in the preliminary prospectus. Where the offer price is finally set relative to the offer price range presumably depends on the strength of investor response during the premarket. Hanley finds the variable to be positively correlated with underpricing. We too find a strong positive correlation (see Models 4 and 5 in Table 5).

Second, as noted earlier, the bookbuilding theory predicts that underpricing occurs mainly when premarket demand is strong. Presumably, therefore, the impact of WPROB should be more pronounced in such demand states.[4] But whether the reduction in underpricing is uniform across these states or increasing in demand is not specified in the theory underlying our hypothesis, which establishes that observed underpricing should be less *on average* as WPROB increases. (The bookbuilding theory does not specify how underpricing should be spread across strong demand states; only that the *average* across these states should equal a certain sum.) How to condition the impact of WPROB is therefore an empirical question and, as such, we try several alternatives. The first assumes that the impact of WPROB is uniform across all strong demand states. Two dummy variables are used to identify IPOs with strong premarket demand. Offerings priced above the upper bound of the offer price range are indicated by the dummy variable OVER_HI, and those priced above the midpoint of the range by OVER_MID. The two dummies are multiplied by WPROB to create two alternative conditional variables, WPROB*OVER_HI and WPROB*OVER_MID, that are added to the regression specification.

Since underpricing is empirically found to be increasing in premarket demand, the second way to control for the conditional impact of WPROB assumes that the reduction in underpricing due to WPROB is also increasing in demand. We therefore create two interactive variables, WPROB times the percentage price adjustment, WPROB*P_ADJUST, and WPROB times the dollar price adjustment, WPROB*(offer price − MID).

We estimate various versions of the alternative regressions and the results turn out to be qualitatively similar. As in the main specification regressions, Log(PROCEED), RANK, and DEBT are insignificant. Further, replacing size adjustment with price adjustment as a measure of premarket demand strips SECONDARY and VENTURE of their explanatory power. To save space, Table 5 reports under the heading "Alternative Specifications" only parsimonious specifications that exclude the insignificant variables. (None of the regression results change when we apply the Murphy–Topel adjustment to the standard errors.)

The price-adjustment variable shows up in all estimated regressions, as predicted and consistent with Hanley (1993), with a highly significant positive coefficient. Model 4 shows that the negative impact of the withdrawal

[4] We thank the referee for suggesting this alternative specification.

probability on underpricing is *only* pronounced for offerings that are priced above the midpoint of their filing range, consistent with the stricter interpretation of the bookbuilding theory. The coefficient of WPROB*OVER_MID is significant at less than the 3% level, while the stand-alone WPROB is insignificant. Also, WPROB*OVER_HI (excluded from Model 4) is insignificant in all specifications, suggesting that IPOs priced above the high end of the offer price range are no different from those priced above MID in terms of the impact of WPROB.

Model 5 summarizes the specifications in which WPROB is conditioned on the percentage price adjustment. In these specifications, the conditional variable shows up with a highly significant (at 0.3% in Model 5) negative coefficient, consistent with our hypothesis. Remarkably, though, WPROB by itself assumes a negative coefficient that is significant at the 9% level, mildly consistent with the more general bookbuilding framework in which underpricing occurs, and the impact of WPROB is felt, in most demand states. Model 5 strongly suggests, nevertheless, that the impact of WPROB strengthens with the state of demand.

Conditioning the impact of WPROB on the dollar size of the price adjustment yields qualitatively similar results. In an unreported regression that is comparable to Model 5, the significance of WPROB improves to less than 7% while the conditional variable attains significance at less than the 3% level. We also try conditioning WPROB on size adjustment, ADJUST, in a regression specification that is otherwise comparable to Model 3 of the main specification in which ADJUST controls for demand. The conditional variable, WPROB*ADJUST, fails to assume significance while WPROB maintains its highly significant negative coefficient. (In fact, the estimation results of Model 3 are literally unaltered by the inclusion of the conditional variable.) It appears, therefore, that the empirical support for our hypothesis is robust to how the predicted withdrawal probability is controlled for. A higher ex ante predicted probability of withdrawal seems to reduce underpricing if the offering is successful, and the impact is more pronounced when premarket demand is strong.

4.3.3. Out-of-sample test of the hypothesis

Last, we test our hypothesis using a sample of 403 completed offerings from the years 1993 and 1994. Testing the hypothesis out of sample is in fact a direct test of the way we model investor behavior. If, as we argue before, investors use information on past offerings to predict the probability of withdrawal for current offerings, then the probit model estimated over the 1990–1992 period should explain fairly well investors' predictions of the outcome of offerings completed in the subsequent period. In line with this argument, we run the underpricing regression on the 1993–1994 IPOs, using withdrawal probabilities imputed from probit Model 4 of Table 4. Various versions of the main and alternative specifications are estimated and the results are qualitatively identical across all versions. Table 5 reports under the "93–94," "93–94(4')," and "93–94(5')" headings the more parsimonious regressions that are comparable to the in-sample Models 3, 4, and 5, respectively. Consistent with our prediction and with the in-sample results, WPROB shows up in the main specification with a negative coefficient that is significant at less than the 2% level. In the alternative model specification that parallels Model 4, WPROB, not its conditional counterparts, assumes a negative and significant coefficient. In the specification that parallels Model 5, both WPROB and WPROB*P_ADJUST show up with significant negative coefficients, with the conditional variable being more significant. As in the case of the in-sample regressions, conditioning on the dollar price adjustment yields comparable results (not reported in the table), but with the significance of WPROB slightly improved and that of the conditional variable slightly reduced. (The results of all the regressions are invariant to the Murphy–Topel adjustment.) In sum, our hypothesis is supported out of sample, consistent with our conjecture of how investors approach an offering under consideration.

5. Relation to other work

Because our hypothesis is derived in the bookbuilding framework, our evidence supports the argument that underpricing is an incentive payment that ensures information *revelation*. It is precisely because underpricing is required to induce investors to truthfully report strong interest that a stronger willingness to withdraw on the part of the issuer reduces underpricing. The evidence is inconsistent with the alternative view that underpricing is compensation for information *production*, as in Booth and Chua (1996). Booth and Chua argue that issuers seek a broad distribution of offerings in an effort to enhance the liquidity of their stock in the aftermarket. Securing the participation of a large number of investors requires that offerings be underpriced enough to compensate these investors for the cost of producing information. If issue withdrawal were allowed into the Booth and Chua framework, required underpricing would be *higher* the higher the ex ante probability of withdrawal of an offering, since investors are compensated *only if* and *when* the offering is completed. This prediction is in sharp contrast to our hypothesis and the evidence we provide.

Our evidence is not consistent either with the implications of "prospect theory" as interpreted by Loughran and Ritter (1999). Loughran and Ritter argue that "when unexpectedly strong demand becomes apparent during the pre-selling period, issuing firms acquiesce in leaving more money on the table" (p. 4). Original shareholders "anchor" on the midpoint of the offer price range, and consider as a gain any amount by which the final offer price exceeds this midpoint. Further, because these shareholders typically retain significant ownership in the firms they take public, a price runup in the aftermarket increases the value of their ownership by more than the money left on the table for the new shareholders. Original shareholders tolerate underpricing as long it is accompanied with the "good news" that their firm-related wealth has increased. Underwriters, assumed by Loughran and Ritter to benefit from underpricing IPOs, can get away with more underpricing if it is accompanied by a larger (positive) offer price adjustment. Like the bookbuilding theory, this line of argument leads to the prediction that observed underpricing should be higher the higher the offer price is set above the midpoint of the offer price range. However, the two theories have different implications regarding the relation between issue withdrawal and underpricing.

Consider in Loughran and Ritter's framework the case when an issuer has a minimum acceptable offer price below which the offering is canceled. This reservation price does not have to coincide with the midpoint of the initial price range, since it is common for offerings to be priced below this midpoint. (Loughran and Ritter report that 27.3% of their 1990–1998 sample IPOs are priced even below *the lower bound* of the price range.) To such an issuer, there are two levels of "good news": the completion of the offering which happens when investors pay at least the issuer's reservation price, and second, the unexpected appreciation of the issuer's retained ownership when investors pay much more than the midpoint of the price range.

Loughran and Ritter's argument would suggest that issuers who ex ante have a lower probability of getting what they want (and hence a higher ex ante probability of withdrawal in our framework) will underprice by more if they successfully go public. Further, underpricing of these issues will be even higher the higher the final offer price is set above the midpoint of the filing range. Our evidence indicates to the contrary that underpricing is lower when the ex ante probability of withdrawal, WPROB, is higher, and is especially lower when a high WPROB is accompanied by a higher price adjustment, however the adjustment is controlled for (see Models 4 and 5 of Table 5).

Last, our analysis of IPO withdrawal sheds a different light on the literature on "earnings management" before offerings (see Teoh et al., 1998a, b; Rangan, 1998). These studies indicate that issuers boost their share prices by using discretionary accruals to increase reported earnings prior to offerings. Examining 1,649 firms that went public in the period 1980–1992, Teoh et al. (1998b) report that the most "aggressive" quartile of earnings managers *underperform* the most "conservative" quartile in the three post-IPO years. If investors cannot see through earnings management, as conjectured in these studies, an IPO issuer can increase the likelihood of obtaining the desired price by simply inflating reported earnings. Our evidence is not consistent with this prediction, however, since we find that a higher ROA does not increase the probability of an IPO's success.

6. Summary and conclusion

An issuing firm that is discontent with investor reception of its IPO can withdraw at any time during the marketing process. Around 14% of IPOs filed with the SEC by American industrial firms during the 1984–1994 period are withdrawn. The percentage ranges from 5.8% to 22.8% annually during the period. Withdrawn offerings are not smaller than their successful counterparts; they are made by firms that are neither smaller nor less profitable than the firms making successful issues; and they are marketed by underwriters that are as reputable as the ones underwriting successful IPOs.

Analyzing the option to withdraw within the bookbuilding framework shows that the option strengthens the bargaining power of the issuing firm, effectively giving it some control over how much money it leaves on the table to secure investor cooperation. The statistical analysis supports this hypothesis, revealing a significant negative correlation between observed underpricing and the issuer's ex ante probability of withdrawal. The correlation is more pronounced when premarket demand would have been strong, in line with the bookbuilding theory's result that underpricing is concentrated in high-demand states. These results suggest that the predicted withdrawal probability is an important variable that is *missing* from earlier cross-sectional studies of IPO underpricing.

To estimate the ex ante probability of withdrawal, we study the decision to withdraw using data from the preliminary prospectuses filed by the firms withdrawing their offerings. We estimate a probit model and the results indicate that larger issues, issues made by firms with higher leverage, and those made for the purpose of paying back debt are more likely to be withdrawn. On the other hand, venture-backed issuers and issuers with larger revenues are less likely to withdraw. The likelihood is lower in strong equity markets but higher when many issues are filed together.

Our results have implications for theories of IPO underpricing and for the literature on earnings management before offerings. The negative correlation between the withdrawal probability and underpricing favors the view that underpricing is a payment for information *revelation*, as proposed in the bookbuilding literature, over the view that it is for information *production* (as in Booth and Chua, 1996). The correlation is also inconsistent with the implication of Loughran and Ritter (1999) who argue that underpricing is desired by underwriters and tolerated by issuers when it is accompanied by "good news". Last, the lack of correlation between the likelihood of withdrawal and ROA does not support the view that issuers can "fool" investors into overpaying by manipulating earnings.

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