ELSEVIER

Journal of Financial Economics 65 (2002) 309–335

JOURNAL OF Financial ECONOMICS

www.elsevier.com/locate/econbase

Litigation risk and IPO underpricing ☆

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Received 9 October 2000; received in revised form 17 September 2001

Abstract

We examine the relation between risk and IPO underpricing and test two aspects of the litigation-risk hypothesis: (1) firms with higher litigation risk underprice their IPOs by a greater amount as a form of insurance (insurance effect) and (2) higher underpricing lowers expected litigation costs (deterrence effect). To adjust for the endogeneity bias in previous studies, we use a simultaneous equation framework. Evidence provides support for both aspects of the litigation-risk hypothesis. © 2002 Elsevier Science Ltd. All rights reserved.

JEL classification: G24; G32; K22; K40

Keywords: Initial public offering; IPO underpricing; Securities litigation; Endogeneity

1. Introduction

Firms conducting Initial Public Offerings (IPOs) typically earn a return of approximately 15% on their first day of trading. While the magnitude of this initial return varies over time and as a function of firm characteristics, it shows no signs of dissipating. The persistent and systematic underpricing of IPO issues is puzzling, and this apparent violation of market efficiency has received considerable attention from researchers. There currently exist three main theories for these high initial returns: signaling, information asymmetry, and litigation risk (Ibbotson et al., 1994). A

☆We thank Laura Field, Jarrad Harford, Jon Lewellen, Harold Mulherin, Micah Officer, Ken Schwartz, Bill Schwert (the editor), Jay Shanken, Ross Watts, Pete Wilson, Jerry Zimmerman, two anonymous referees, and workshop participants at Boston College and the University of Rochester.

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PII: S0304-405X(02)00144-7

substantial body of literature empirically tests the first two potential explanations, and evidence indicates that information asymmetry is an important determinant of IPO initial returns. However, much of the magnitude of and variation in initial returns remains unexplained. Interestingly, litigation risk, the third potential explanation for underpricing, has received relatively little attention in the empirical literature. The idea that IPO firms and underwriters intentionally underprice their shares to insure against future liability is intuitively appealing, yet the existing evidence on this is at best mixed and inconclusive.

Skeptics of the litigation-risk hypothesis (e.g., Alexander, 1993) often point to the high costs of underpricing relative to the average lawsuit settlement costs and the low historical lawsuit frequency (around 6% for our sample) as anecdotal evidence against this hypothesis. However, this 'back-of-the-envelope' reasoning ignores many important factors. First, it is possible that the lawsuit frequency and settlement payments are low precisely because most firms have used underpricing as a form of insurance. Further, as discussed in more detail below, this argument omits many of the costs associated with lawsuits.

For a firm planning to go public, the potential costs of litigation are substantial. One of the most highly publicized costs of litigation is the settlement payment, which averages $3.3 million in our sample and represents 11% of the total proceeds raised. Notably, some of the cases settle for considerably larger amounts. For example, in four cases the settlement amount exceeds 35% of proceeds raised, and in one case the settlement amount is nearly 50% of proceeds. Further, these settlement amounts are only one portion of the total costs associated with a lawsuit. There are other, potentially more important, costs of litigation that are often overlooked because they are not directly observable. Examples of such costs include reputation costs to both the IPO firm and its managers, legal fees, and the opportunity cost of management time dedicated to the lawsuit. As discussed later, several companies in our sample cite such costs in their decisions to settle their lawsuits.

Because litigation is costly, managers have incentives to insure against such costs. One way to effectively insure against these costs is to lower the probability of being sued. For this reason, all firms and their underwriters conduct due diligence prior to the IPO, i.e., they investigate all aspects of the firm's business, finances, management, and projections and discuss their findings in the IPO prospectus. However, it is not feasible to foresee every possible future event, and there are obvious limits to what can be incorporated into a prospectus. A second way to lower the probability of being sued is to decrease the potential damages that plaintiffs can recover. Alexander (1993) emphasizes that the amount of the expected settlement reward is a major determinant of the probability of being sued. For this reason, underpricing is a particularly attractive form of insurance. Unlike other forms of insurance that firms can purchase, underpricing lowers the potential damages that plaintiffs can recover, and thus reduces plaintiffs' incentives to bring a lawsuit against the firm.

To understand why underpricing potentially lowers the probability of being sued, we briefly discuss some specifics of the securities laws. The Securities Acts of 1933 and 1934 give investors the right to bring a lawsuit against an IPO firm for material untruths or omissions in the prospectus and provide guidelines for the calculation of

associated damages. Almost all IPO-related lawsuits against the issuer are brought under Sections 11 and 12 of the Securities Act of 1933 and Section 10(b) of the Securities Act of 1934. Under Section 11, damages for direct purchasers in the IPO are based on the difference between the *offer price* and either the sale price or the security's price at the time of the lawsuit, depending on whether or not the share was sold. Persons who bought the stock in the aftermarket are eligible to receive damages under Section 11 if they can show reliance on the prospectus. For these aftermarket purchasers, damages are based on the lower of the *offer price* and the price at which the security was bought. Thus, for all suits brought under Section 11, damages are directly related to the offer price. A firm that underprices its IPO by a greater amount has a lower offer price, meaning that it has lower potential damages and a decreased probability of being sued. Sections 12 and 10(b) similarly apply to both direct and aftermarket purchasers. However, damages under both these sections are based on the investor's purchase price rather than the offer price. Because there is no direct link between the offer price and subsequent damages in these cases, the litigation-risk hypothesis is more applicable to Section 11 lawsuits.

Based on the institutional facts of the securities laws, Ibbotson (1975) and Tinic (1988) hypothesize that underpricing represents a form of insurance against future litigation. The issuer and the underwriter agree to set the offer price below the expected market value of the securities because this decreases the probability of future litigation as well as the amount of damages in the event of a lawsuit. Consistent with this, Tinic (1988) finds that the initial returns of a sample of IPOs prior to the Securities Act of 1933 are significantly lower than those of a sample of firms that went public after this Act was implemented. Drake and Vetsuypens (1993) note that these results can be misleading because they do not control for the time variation in initial returns unrelated to litigation risk. Using a cross-sectional framework, they find that the initial returns of firms that are ultimately sued are no different than those of non-sued firms. Drake and Vetsuypens interpret these results as inconsistent with the litigation-risk hypothesis, since sued firms do not appear to be overpriced. However, their analysis suffers from the following endogeneity problem. Under the litigation-risk hypothesis, initial returns can be related to the probability of a lawsuit along two dimensions. First, firms with higher litigation risk should underprice their IPOs by a greater amount as insurance against litigation. This implies that initial returns are an increasing function of litigation risk. Second, firms that buy more insurance against litigation, i.e., underprice more, expect to be sued less often. This implies that litigation is a decreasing function of initial returns. Because the probability of being sued is itself an endogenous variable that could depend on underpricing, a comparison of initial returns across sued and non-sued firms is problematic.

The objective of this paper is to examine the relation between underpricing and litigation risk in more depth. Specifically, we want to simultaneously address two distinct but related questions: (1) whether litigation risk affects IPO issuers' incentives to underprice their issues, and (2) whether underpricing lowers the expected litigation costs by reducing lawsuit probabilities.

This study contributes to the literature in several ways. First, we address the shortcomings of earlier studies by using a cross-sectional, simultaneous-equation approach. This research design provides a better specified test of the litigation-risk hypothesis and enables us to draw inferences on the validity of the hypothesis with more confidence. Second, we are able to directly examine both dimensions of the litigation-risk hypothesis, i.e., the extent to which issuers underprice their IPOs as a form of insurance against future litigation (the insurance effect) as well as whether underpricing is effective in reducing expected litigation costs (the deterrence effect).

Results show that the relation between the probability of a lawsuit (more specifically, a Section 11 lawsuit) and initial returns lends support to both the insurance and the deterrence aspects of the litigation-risk hypothesis. First, firms with higher legal exposure tend to underprice their offerings by a significantly greater amount, suggesting that firms use underpricing as a form of insurance against future litigation. As discussed in more detail later, the OLS regression produces the opposite result, thus highlighting the importance of controlling for endogeneity in this context. Second, consistent with the effectiveness of underpricing as a form of insurance, we find evidence that underpricing decreases the expected litigation costs by reducing lawsuit probability.

Section 2 discusses the related literature in more detail. Section 3 describes the data selection process and provides some descriptive statistics. Section 4 details the simultaneous-equation methodology used in this study. Section 5 presents evidence on the relation between IPO underpricing and litigation risk. Conclusions are offered in Section 6.

2. Related literature

This paper contributes to both the considerable literature on the determinants of underpricing and to the growing evidence on the importance of litigation risk. We first broadly review the main evidence on underpricing, as this motivates many of our controls in the empirical analysis. We then go into more detail regarding the papers that have focussed on the relation between IPO initial returns and litigation risk. Finally, we briefly review evidence from the economics and accounting literature regarding the determinants and implications of securities litigation.

The IPO literature offers three main theories on the determinants of underpricing. First, Allen and Faulhaber (1989), Grinblatt and Hwang (1989), and Welch (1989) posit that high quality firms underprice their issues to signal their quality to the market. Greater underpricing enables them to raise more capital in the future at more favorable rates. Jegadeesh et al. (1993), Garfinkel (1993), Michaely and Shaw (1994), and Spiess and Pettway (1997), among others, find relatively little support for the signaling story.

Second, Beatty and Ritter (1986), Benveniste and Spindt (1989), Rock (1986), and Baron (1982) hypothesize that underpricing results from information asymmetry between the various parties involved in the IPO. Issues that are characterized by greater uncertainty are underpriced more to compensate for the higher costs of

learning about these firms' true values. Many papers, including Beatty and Ritter (1986), Megginson and Weiss (1991), Michaely and Shaw (1994), Koh and Walter (1989), and Hanley (1993), find empirical support for the importance of information asymmetry as a determinant of underpricing.

Third, Ibbotson (1975) and Tinic (1988) posit that firms intentionally underprice their shares as a form of insurance against future liability. Tinic models expected legal liabilities as:

$$\mathrm{E}[L_t] = f(P_0/P_t)g(P_0 - P_t), \tag{1}$$

where L_t equals the dollar cost of legal liabilities, P_0 is the offer price, and P_t is the post-offer price of the stock at $t = 1, 2, \ldots, T$. The probability of being sued, f, is an increasing function of P_0/P_t. Damages, g, are an increasing function of the difference between P_0 and P_t. Hughes and Thakor (1992) extend Tinic's analysis in a game-theoretic setting and specify the conditions required for equilibrium underpricing. Hensler (1995) formalizes Tinic's model using a utility-maximization single-period model. Both models similarly predict a positive relation between litigation risk and underpricing.

Tinic (1988) tests the litigation-risk hypothesis by comparing the underpricing of IPOs prior to and subsequent to the 1933 Securities Act, which substantially increased the legal exposure of IPO issues. He compares initial returns in the 1923–1930 period to those in the 1966–1971 period. Average underpricing was significantly higher in the later period. He concludes that the 1933 Securities Act increased expected litigation costs and therefore resulted in more underpricing.

However, Tinic's finding of higher initial returns in the 1966–1971 period, compared to the 1921–1930 period, may be driven by factors other than litigation risk. Ibbotson et al. (1988) show that initial returns fluctuate substantially over time. Further, Drake and Vetsuypens (1993) point out that average initial returns between 1972 and 1977 (the five years immediately following the Tinic sample period) were actually lower than those in the 1921–1930 period.

Drake and Vetsuypens (1993) address some of these issues in a cross-sectional analysis. They compare 93 IPO firms that were sued with a sample of matched non-sued IPO firms, where firms are matched on year, underwriter rank, and offer size. They find that the average initial returns of the sued firms are greater than those of non-sued IPO firms. They also compare IPOs with positive initial returns to those with initial returns less than or equal to zero. They find that a greater portion of IPOs in the first category is sued. They conclude that sued firms are not overpriced and interpret the result as inconsistent with the litigation-risk hypothesis. However, as discussed earlier, this analysis suffers from an endogeneity problem, which makes the results difficult to interpret.

Keloharju (1993) examines the underpricing of IPOs in Finland, where there is negligible litigation risk. He finds a mean initial return of 8.7%, despite essentially zero potential legal liabilities associated with the IPO. This suggests that expected litigation costs cannot explain all of initial returns, but it provides little information on their relative importance in the U.S. As Keloharju notes, mean initial returns are significantly higher in the U.S., and it is possible that the difference reflects litigation risk.

While our analysis applies specifically to Section 11 lawsuits, the evidence complements previous findings on the determinants and impacts of other types of securities litigation in the U.S. For example, Jones and Weingram (1996) investigate the determinants of securities lawsuits filed under Section 10(b), and they find that variables that enter into shareholder damage formulas, including the proportion of shares traded, firm market capitalization, and the share price declines, all contribute to litigation exposure. Our results are broadly consistent with these findings. In addition, we document the incremental effect of underpricing on expected Section 11 litigation exposure.

Alexander (1991) examines 17 computer-related IPOs in 1983. She finds that securities lawsuits were more likely filed when the dollar amount of the ex post stock price decline was sufficient to support the fixed cost of bringing a case. She also finds little variation among the settlements as a fraction of shareholder losses. Since it is unlikely that all these cases are equally strong, her analysis raises doubts on the role of merits in these suits. Further, Dunbar et al. (1995) find that available assets are a better predictor of settlements than potential merits. These findings suggest that companies are susceptible to frivolous lawsuits, which by definition are hard to avoid through due diligence prior to the IPO. We therefore conjecture that companies might resort to using underpricing as a form of insurance, thus decreasing potential damages and lowering the probability of a lawsuit.

Our study also provides additional evidence on the effects of securities litigation on economic agents. Skinner (1994) finds that the threat of litigation potentially alters firms' disclosure behavior, and Krishnan and Krishnan (1997) and Shu (2000) find that this same threat causes auditors to stay away from risky clients. We extend this line of research by documenting another effect of litigation risk, i.e., it leads IPO firms to lower their offer price as one form of insurance against future litigation.

3. Data

Data on IPOs between 1988 and 1995 are obtained from the Securities Data Company (SDC). Closed-end funds, unit offerings, REITs, financial firms, reverse LBOs, ADRs, and spinoffs are excluded. We also require firms to have initial return data. Initial return is defined as the percentage difference between the offer price and the first closing price. The final sample consists of 1,841 IPOs.

We search the *Securities Class Action Alert* newsletters between 1990 and 1997 for all lawsuits filed against these 1,841 IPO firms under the Securities Acts of 1933 and 1934.[1] We further searched the *Securities Class Action Clearinghouse* website for cases that were filed after 1997. Both in the newsletters and on the website cases are

[1] Data availability constraints prevent us from collecting lawsuit information for 1988 and 1989. However, detailed information on the majority of the lawsuits is reported in *Securities Class Action Alert* two or more years after the IPO. Also, *Securities Class Action Alert* does not include lawsuits filed in state courts. The possibility that some sued firms are classified as non-sued biases against finding our predicted results.

listed by company name, making it relatively easy to ascertain which of these 1,841 IPO firms were sued. Our lawsuit sample consists of all firms that had an IPO between 1988 and 1995, meet the above criteria (e.g., not ADRs, spinoffs, etc.), and were sued for violations relating to the IPO. We find that 106 (5.8%) of the 1,841 IPOs were sued.

For reasons discussed earlier, our main analysis focuses on Section 11 lawsuits. We thus searched company annual reports, 10Ks, 10Qs, Lexis, court dockets, and the Gilardi and Company web site to determine which of these 106 lawsuits were brought under Section 11. The SEC filings were obtained from EDGAR or Nexis. Court dockets were obtained from Pacer, a web-based service that enables one to search court dockets online (http://pacer.psc.uscourts.gov). In addition, Gilardi and Company is a class action administration company, and their web site contains details on some of the cases (http://www.gilardi.com/index.html). Finally, Investors Research Bureau, Inc., publisher of *Securities Class Action Alert*, provided information on the cases that we were unable to find in these other sources. We are able to find the relevant information for 101 of the 106 total lawsuits. We find that 84 out of these 101 lawsuits were brought under Section 11, and these 84 firms represent our primary sample.

3.1. Characteristics of IPO lawsuits

Table 1 shows the distribution of non-sued IPOs, total sued IPOs, and IPOs sued under Section 11 across years and industries. IPO volume was highest in 1995 with 431 IPOs, and lowest in 1990 with 91 IPOs. Only 2% of the IPOs in 1988 were ultimately sued under Section 11, vs. over 6% of the 1991 IPOs. While both the total number of IPOs and the number of lawsuits against IPO firms vary over the sample period, there does not appear to be any systematic relation between the two. The most Section 11 lawsuits, 32, were against firms in the communications, computers, and electronics industry. However, this industry also had the largest number of IPOs. On a percentage basis, about 5.5% of IPO firms in this industry were ultimately sued under Section 11. However, between 5% and 9% of firms in the apparel industry, the recreation industry, and the utility industry were also sued under Section 11.

Table 2 describes the lawsuits filed against the sample firms in more detail. Panel A provides information on the length of time between the IPO and the filing of the lawsuit. The securities laws limit the time between the IPO and the filing to three years. We find that 56 of the 84 Section 11 lawsuits are filed within one year of the IPO, 25 in the second year after the IPO, and only 3 in the third year. In comparison, the non-Section 11 lawsuits are relatively equally divided between the first, second, and third years after the IPO. It appears that Section 11 lawsuits tend to be filed sooner after the IPO. Consistent with this, the median number of days between the IPO and the filing of the lawsuit is 251 days for Section 11 lawsuits, compared to 502 days for non-Section 11 lawsuits.

Panel B of Table 2 describes the outcome of the Section 11 lawsuits. Sixty of the 84 suits were settled, 18 were dismissed or withdrawn, and 3 were still pending as of

Table 1
Distribution of sample firms across years and industries
The sample consists of IPOs between 1988 and 1995 that are in the Securities Data Company (SDC) database. Closed-end funds, unit offerings, REITs, financial firms, reverse LBOs, ADRs, and spinoffs are excluded. Firms must also have data on initial return. The final sample consists of 1,841 IPOs. Sued firms represent those IPOs that are listed in the *Securities Class Action Alert* newsletter or database as having been sued under the Securities Acts of 1933 or 1934. Panel A classifies the total number of IPOs and the number of IPOs that were sued by year. Panel B classifies the firms by industry, where industries are defined by SIC code.

Panel A: Distribution across years

Year	No. of IPOs	No. of IPOs that were sued	No. of IPOs sued under Section 11	% IPOs sued under Section 11
1988	102	2	2	1.96
1989	109	4	3	2.75
1990	91	6	4	4.40
1991	223	14	14	6.28
1992	273	21	14	5.13
1993	390	27	23	5.90
1994	222	11	9	4.05
1995	431	21	15	3.48
Total	1,841	106	84	4.56

Panel B: Distribution across industries

Industry	SIC codes	No. of IPOs	No. of IPOs sued	No. of IPOs sued under Section 11	% IPOs sued under Section 11
Agriculture and mining	100–1299, 1400–1499	9	0	0	0.0
Apparel	2200–2399, 3100–3199	33	2	2	6.1
Communications, computers, and electronics	3570–3579, 3600–3699, 4800–4899, 7370–7379	580	44	32	5.5
Construction	1500–1799	23	2	2	8.7
Finance	6000–6499, 6700–6799	23	1	1	4.3
Food	2000–2099	24	0	0	0.0
Health	8000–8099	89	6	3	3.4
Manufacturing	2400–2499, 2600–2699, 2800–2899, 3000–3099, 3200–3569, 3580–3599, 3900–3999	294	12	10	3.4
Oil and Gas	1300–1399, 2900–2999, 4600–4699, 4920–4929	37	1	0	0.0
Printing and publishing	2700–2799	19	0	0	0.0
Recreation	7000–7099, 7800–7999	64	6	6	9.4
Science	3800–3899, 8710–8719, 8730–8739	139	7	6	4.3

Table 1 (*continued*)

Panel B: Distribution across industries

Industry	SIC codes	No. of IPOs	No. of IPOs sued	No. of IPOs sued under Section 11	% IPOs sued under Section 11
Services	6500–6599, 7200–7369, 7380–7399, 7600–7699, 8100–8399, 8720–8729, 8740–8749	89	5	3	3.4
Trade	5000–5999	289	16	15	5.2
Transportation	3700–3799, 4000–4299, 4400–4599, 4700–4799, 7510–7549	80	3	3	3.8
Utilities	4910–4919, 4930–4979	18	1	1	5.6
Other		31	0	0	0.0
Total		1,841	106	84	4.6

March 2001. We are unable to determine how the remaining 3 lawsuits were resolved.

Panel C of Table 2 provides details on the settlement costs of these Section 11 lawsuits. As mentioned earlier, the average settlement amount across all cases equals \$3.1 million. To gauge the magnitude of these costs relative to the size of the offering, we divide settlement costs by proceeds raised for each firm and average this ratio across all firms sued under Section 11. We find that, on average, settlement costs equal approximately 10% of proceeds raised. However, as shown in the table, these costs vary widely, from a minimum of \$0 for dismissed cases to a maximum of \$15 million, or 46% of proceeds raised. As noted in Panel B, 18 of the lawsuits are dismissed. Excluding these dismissed cases, average settlement costs equal \$4 million, or 13% of proceeds raised.

In addition to paying substantial settlements, firms also incur a variety of other costs. While we are unable to obtain quantifiable evidence on the total magnitude of these costs, evidence suggests they are quite substantial. As shown in Panel D, firms facing Section 11 charges undergo a lengthy defense process. Both the mean and median time lags between the filing of a lawsuit and its resolution are approximately 27 months. Retaining a legal team and having managerial resources diverted to litigation-related matters over such a lengthy period is likely to be quite costly. In fact, several companies in the sample, including Meadowbrook Rehabilitation and US wireless, cited the costs of defending the litigation and the 'desire to minimize disruption of company operations and management resources' as the main reasons for a settlement in their annual reports.[2]

[2] These costs are analogous to the indirect costs in the context of bankruptcy (see, e.g., Weiss, 1990; Warner, 1977).

Table 2
Nature and resolution of lawsuits
Using the *Securities Class Action Alert* newsletter and database, company SEC filings, the Gilardi and Co. class action administration web site [http://www.gilardi.com/index.html], and court dockets, we determine which of the sued firms were sued under Section 11 of the Securities Act of 1933. Panel A categorizes the lawsuits by length of time between the IPO offer date and the date on which the lawsuit was filed. For each of the Section 11 lawsuits, we search the same sources to determine how the lawsuit was resolved. For those cases that settled, we again use these same sources to determine the amount of the settlement. The outcomes are reported in Panel B. Panel C reports the settlement amounts (in millions) across the 56 cases for which we were able to obtain data on the amount of the settlement fund. For each of these cases, we also calculate the settlement as a percentage of proceeds raised, and this percentage is likewise averaged over these 56 cases. Finally, Panel D presents statistics on the number of months between the filing of the lawsuit and the final settlement. For cases that we do not have the actual date on which the lawsuit was filed, we use the last day of the class period. Final settlement dates are obtained from firm SEC filings (e.g., annual reports, 10Ks, and 10Qs). We are able obtain this information for 34 firms.

Panel A: Distribution of lawsuits aligned by IPO offer date

	No. of lawsuits filed in years 1, 2, and 3 after IPO			Median no. of days between IPO and filing of lawsuit
	Year 1	Year 2	Year 3	
All IPO-related lawsuits	64	33	9	292
Section 11 lawsuits	56	25	3	251
Non-Section 11 lawsuits	6	7	6	502

Panel B: Outcome of Section 11 lawsuits

	No. of cases
Dismissed/withdrawn	18
Seffled	60
Still pending	3
Could not determine	3
Total	84

Panel C: Settlement amount of Section 11 lawsuits

	Mean	Quartile 1	Median	Quartile 3	Maximum
All cases					
Settlement (millions)	3.1	0.3	2.4	4.3	15.0
Settlement/proceeds	10.1%	1.8%	8.0%	14.3%	46.2%
Excluding dismissed cases					
Settlement (millions)	4.0	1.6	3.3	6.0	15.0
Settlement/proceeds	13.3%	5.1%	10.0%	17.3%	46.2%

Panel D: Time to resolution for a sub-sample of Section 11 lawsuits

	Mean	Quartile 1	Median	Quartile 3	Maximum
Time to resolution (months)	27.6	19.8	26.1	35.3	64.9

3.2. Descriptive statistics on sued vs. non-sued firms

Table 3 provides descriptive statistics on the sued and non-sued firms. Because the litigation-risk hypothesis applies specifically to Section 11 lawsuits, through the remainder of the paper sued firms refers only to Section 11 lawsuits, while non-sued firms refers to firms that were not sued for violations relating to the IPO (i.e., not sued under Sections 10b, 11, or 12) during the sample period.[3] Note the univariate comparisons are only descriptive in nature and our main inferences are based on multiple regressions performed in Section 5.

Initial return, measured as the percentage difference between the first day closing price and the offer price, equals 13.22% for sued firms and 14.51% for non-sued firms. These numbers are similar to the 15.3% average returns obtained by Ibbotson et al. (1994). Consistent with the findings of Drake and Vetsuypens (1993), there is no significant difference between the initial returns of sued and non-sued firms. However, the endogeneity problem discussed earlier makes this comparison inappropriate. Regression results in Section 5 illustrate the importance of controlling for endogeneity.

Sued firms are significantly larger in terms of proceeds raised and market capitalization after the IPO. Market capitalization is measured as the number of shares outstanding after the IPO times the first closing price. All size measures are expressed in millions of 1983 dollars to control for inflation over time. The positive relation between a firm's size and its legal exposure has been well documented in the legal literature, and is referred to as the 'deep pocket' theory. Because of the fixed costs associated with filing a lawsuit, plaintiffs initiate a lawsuit only if they perceive the recoverable damages to be sufficiently large. Alexander (1991) finds that of the seventeen IPOs in the computer industry in 1983, the six largest offerings were all sued. While smaller firms probably are riskier, the benefits of suing larger firms are greater because of their 'deep pockets'. The benefits of suing a small firm may not justify the costs.

Sued firms also have significantly higher ranked underwriters than non-sued firms. Underwriter rank is measured using the Carter et al. (1998) measures, with higher ranks representing higher quality.[4] Higher ranked underwriters may be related to lawsuit probability along two different dimensions. First, more reputed underwriters are more likely to have 'deep pockets'. Since Section 11 of the Securities Act of 1933 mandates several and joint liabilities for the parties involved in the IPO, all defendants of a lawsuit are jointly responsible for the damage payments. In the case that the IPO firm does not have sufficient funds to meet all the damage payments, the plaintiffs can recover the rest from the other parties, including the underwriter. The finding that the 'deep pocket' of an underwriter is related to the occurrence of a lawsuit is consistent with Bohn and Choi (1996). Second, firms may choose more

[3] All suits brought under multiple sections are considered Section 11 suits as long as one of the sections is Section 11. Approximately 80% of the cases brought under Section 11 were also brought under Section 10(b).

[4] Underwriters not covered by Carter et al. are assigned a rank of zero.

Table 3
Characteristics of sued vs. non-sued firms
The sample consists of IPOs between 1988 and 1995, excluding closed-end funds, unit offerings, REITs, financial firms, reverse LBOs, ADRs, and spinoffs. Firms must also have data on initial return. There are 84 IPO firms sued under Section 11 of the 1933 Securities Act and 1739 non-sued IPO firms. Some of the variables are based on fewer observations because of missing data. Initial return is the percentage change between the offer price and the closing price on the first day of trading. Market capitalization equals the closing price on the first day of trading times the number of shares outstanding. Proceeds raised (in the domestic market) and market capitalization are in millions of 1983 dollars. Underwriter rank equals the Carter et al. (1998) ranks, with higher ranks representing higher quality underwriters. One-year stock return is the compounded percentage return during the first year after the IPO. Standard deviation equals the annualized standard deviation of daily returns during the first year after the IPO in percentage terms. Turnover equals $[1 - \Pi_t\ (1-\text{volume traded}_t/\text{total shares}_t)]$, computed for the year after the IPO. One-year stock return, standard deviation, and turnover are measured over one year starting at day 22. Firms are labeled as technology firms or venture capital backed IPOs according to the SDC classifications. If the firm reports five or more years of earnings in its prospectus (as reported by SDC), it is classified as $\geqslant 5$ years old. Data on exchange listing (NYSE, Amex, or Nasdaq) are obtained from CRSP. Frac. secondary offering equals the number of shares sold by pre-issue shareholders in the IPO, divided by the total number of shares in the offering. Price update equals the percentage change between the midpoint of the filing range and the offer price.

	Sued IPO firms			Non-sued IPO firms			Wilcoxon test
	Mean	Median	Std.err.	Mean	Median	Std.err	
Initial return	13.22%	[6.70]	(2.25)	14.51%	[7.95]	(0.52)	−0.75
Proceeds raised	26.72	[21.43]	(2.01)	20.84	[14.18]	(0.68)	5.21***
Market cap. after IPO	118.79	[80.48]	(12.28)	91.40	[49.50]	(3.66)	4.82***
Underwriter rank	7.03	[8.75]	(0.35)	5.23	[7.38]	(0.09)	3.62***
% firms backed by venture capitalist	58.33%			43.61%			
1 year stock return	−48.33%	[−50.00]	(3.43)	16.12%	[1.27]	(1.98)	−9.17***
Std. Dev. (annualized)	89.09%	[80.88]	(3.36)	69.12%	[65.09]	(0.69)	6.32***
Turnover	0.56	[0.56]	(0.02)	0.50	[0.49]	(0.01)	2.21**
% technology firms	46.43%			48.65%			
% firms 5 years old	32.14%			31.82%			
% firms on NYSE/AMEX	8.33%			8.41%			
Frac. secondary offering	17.14%	[10.11]	(2.20)	11.02%	[0.00]	(0.41)	3.31***
Price update	4.81%	[5.97]	(1.96)	0.55%	[0.00]	(0.47)	2.44**

**Significant at 5% level,
***Significant at 1%, using Wilcoxon tests.

reputed underwriters to minimize the risk of IPOs and thus lower the possibility of being sued. Beatty and Ritter (1986) show that good underwriters produce more accurate forecasts of IPO offer prices and minimize uncertainty surrounding the offering. The finding that sued firms have significantly higher ranked underwriters lends more support to the deep pockets story.

The 'deep pocket' argument made above in the context of underwriters can also be extended to the venture capitalist backing an IPO. The practice of several and joint liabilities implies that shareholders can potentially recover damages from a venture capitalist. This likewise increases the perceived benefits from a lawsuit, hence

increasing plaintiffs' incentives to initiate a lawsuit. Consistent with this conjecture, almost 60% of sued firms were backed by a venture capitalist, compared to only 44% of non-sued firms.

Alexander (1991) reports that every firm in the computer industry that went public in 1983 and whose total value of the offering declined over $20 million during the several years subsequent to the IPO was sued. Consistent with such prior evidence, we find that sued firms experienced lower ex post mean and median one-year stock returns (−48% and −50% respectively, compared to 16% and 1% for non-sued firms). One-year stock return is measured as the compounded return, measured over one year beginning one month after the IPO.

A stylized fact is that a class-action lawsuit tends to be precipitated by a steep drop in stock price. Because there is a higher probability of a substantial stock price decrease (or increase) if stock volatility is higher, more volatile stocks are exposed to higher litigation risks. Thus, we compare the standard deviation of daily returns in percentage terms, measured over a one-year period beginning one month after the IPO, across sued and non-sued firms. Consistent with our conjecture, sued firms have significantly higher standard deviation of stock returns (the median annualized standard deviation is 89% for sued firms, compared to 69% for non-sued firms).

Stock turnover, measured as the proportion of shares traded at least once during a given period, is also related to plaintiffs' incentives to initiate lawsuits. This is because shareholder damages are generally increasing in the number of shares traded at the allegedly misleading prices. Turnover is defined as $[1-\Pi_{t=22}^{387}(1-\text{volume traded}_t/\text{total shares}_t)]$, computed for the one-year period starting from one month after the IPO.[5] Not surprisingly, sued firms have significantly higher turnover.[6]

Firms in high-tech industries derive more of their values from growth options than from tangible assets. Growth options are harder to value and subject to more uncertainties, suggesting that firms whose value is largely based on growth options may be subject to higher litigation risk. The Alexander (1991) study of IPOs in the computer industry is a good example of the litigation risks associated with high

[5] The turnover measure is a direct input in estimating damaged shares under the proportional trading model. During our sample period, this model was widely accepted by the courts as the appropriate way to calculate damages in class action lawsuits. Consistent with prior studies, we adjust for the Nasdaq volume definition by dividing Nasdaq volume by a factor of two.

[6] The Supreme Court's 1995 decision in the Gustafson case (93-404) potentially affects the impact of turnover on litigation risk in more recent Section 11 lawsuits. This decision limited the scope of Section 12 of the Securities Act of 1933 to include only initial purchasers of securities in public offerings, and it left open the possibility that the scope of Section 11 should be similarly limited. If the scope was so limited, then turnover would not be positively related to lawsuit probability, as only those investors who bought at the initial offering would be eligible to receive damages. However, for several reasons, this decision is unlikely to affect the firms in our sample. First, our IPO sample ends in 1995, meaning that most of the cases were brought before the Gustafson decision. Further, the Gustafson case specifically concerns Section 12, while we are interested only in Section 11 suits. As far as we were able to determine, it does not seem that Section 11 lawsuits have been similarly limited. This is supported by the lengths of the class periods of the Section 11 cases brought *after* the decision (especially those filed solely on the basis of Section 11). If only initial buyers were included in the class, then the class period would by definition consist of one day (the IPO date). However, all of the class periods are at least several months long, thus leading us to believe that the scope of the Section 11 cases has not been strictly limited.

growth and high-risk industries. The SDC classification system is used to define firms as high-tech. Interestingly, the descriptive statistics reveal little difference across the two samples in terms of membership in high-tech industries. Forty-six percent of sued firms are in the technology industry, compared to 49% of non-sued firms.

We also compare the exchange listing and age of sued vs. non-sued firms. Specifically, we compare the fraction of each group of firms that are listed on NYSE/AMEX and the fraction that report at least five years of earnings in the IPO prospectus (as reported by SDC). To the extent that firms listing on Nasdaq and younger firms are riskier and/or harder to value, we might expect more of these firms to be sued. However, we find little difference between the two groups in terms of exchange listings and age. Across both groups of firms, roughly 8% are listed on NYSE or AMEX, and about 32% are five or more years old.

The signaling hypotheses of Leland and Pyle (1977) and Grinblatt and Hwang (1989) predict that insiders of high-quality firms signal firm quality by retaining a greater portion of the firm, i.e., by selling fewer shares than insiders of low-quality firms. Because we do not have data on insider sales, we use shares sold by pre-issue shareholders as a proxy for insider sales. Consistent with the signaling theory, pre-issue shareholders of firms that are ultimately sued sell significantly more shares in the IPO than pre-issue shareholders of non-sued firms. The mean (median) fraction of secondary shares (i.e., shares sold by pre-issue shareholders) over total shares equals 17% (10%) for sued firms compared to 11% (0%) for non-sued firms.

Finally, we examine the price update of the two groups, where price update is defined as the percentage difference between the expected offer price (the midpoint of the range of prices stated in the prospectus) and the offer price. We find that sued firms have significantly higher price updates than non-sued firms. The average price update is 4.48% for sued firms and 0.55% for non-sued firms. It seems that firms that engage in more aggressive pricing, as measured by this price update, are more likely to be sued. In contrast, firms that are more conservative in setting the final offer price are less likely to experience future securities litigation.

4. Methods

As argued earlier, a firm about to make an IPO faces a trade-off in its pricing decisions. A higher offer price (i.e., lower underpricing) increases proceeds from the IPO, but it also raises the expected litigation costs. Individual IPO firms select the amounts of underpricing to maximize their net benefits (proceeds minus expected litigation costs), and the resulting underpricing levels reflect this trade-off. Two predictions emerge concerning the cross-sectional relations between IPO underpricing and inherent litigation risks. First, firms with higher litigation risk purchase more insurance, that is, they underprice their shares by a greater amount (the insurance effect). Second, firms who choose higher levels of insurance incur lower expected litigation costs in the form of reduced probabilities of lawsuits (the deterrence effect). This interrelation between underpricing and litigation risk is

captured by the following equations:

$$\text{Insurance effect:} \quad \text{initial return} = \gamma_1 \text{ litigation risk} + \theta_1 X + \beta_1 X_1 + \varepsilon_1, \tag{2}$$

$$\text{Deterrence effect:} \quad \text{litigation risk} = \gamma_2 \text{ initial return} + \theta_2 X + \beta_2 X_2 + \varepsilon_2, \tag{3}$$

where Initial Return is the amount of underpricing for IPO firm i (primary variable of interest); Litigation Risk is the probability of litigation for firm i (primary variable interest); X is a vector of exogenous IPO characteristics that are common to both equations, i.e., they are related both to initial return and to litigation risk (control variables); X_1 is a vector of exogenous IPO characteristics that are uniquely related to the amount of underpricing, but not to litigation risk (identifying variables); X_2 is a vector of exogenous IPO variables that are directly related to the probability of an IPO lawsuit but not to initial return (identifying variables).

The objective of the system of equations is to model an IPO firm's trade-off between lower underpricing and higher litigation risk at the time of the IPO. Consequently, all of the above explanatory variables must be measurable at the time of the IPO.

Eq. (2) addresses whether and how expected litigation risk affects a firm's underpricing. Note that, because of the potential interdependencies discussed earlier, it is not appropriate to substitute a dummy variable denoting ex post occurrence of litigation for litigation risk and estimate this equation with OLS. The occurrence of litigation is not exogenous. Rather, it depends in part on the amount of underpricing. For example, from Eq. (2), a firm that chooses to overprice its IPO will have an especially low error term, ε_1, and it is also likely to have a high probability of being sued. Therefore, the error term and litigation risk are not independent. This violates a fundamental assumption of OLS and will yield inappropriate inferences.

Eq. (3) examines whether underpricing is effective in reducing expected litigation risk. For similar reasons, it is not appropriate to estimate this equation by a regular probit model. For example, firms faced with higher litigation risk might underprice their shares more at the time of IPO, leading to an endogeneity bias, as discussed above. To account for the interdependency between the amount of underpricing and the litigation risk, we treat Eqs. (2) and (3) as simultaneous equations.

To estimate this system of equations, it is necessary to identify both Eqs. (2) and (3). Thus, X_1 needs to contain at least one variable not in X_2, and vice versa. We first describe the two variables that help identify the two equations and then discuss the control variables.[7] To identify Eq. (3), X_1 includes prior market-wide returns, a variable that conceptually explains initial returns but not the occurrence of litigation. Specifically, we choose the compounded market returns in the 15 days prior to the IPO as the identifying variable. Loughran and Ritter (2002) show that this variable is significantly positively related to the initial return. Loughran and Ritter interpret

[7] We note that even though having an identifying variable in both equations is conceptually appealing, identification can be achieved even without an identifying variable in X_2 because the predicted lawsuit probability is a non-linear combination of the variables in in the first-stage regression (see Comment and Schwert, 1995, p. 27).

their findings as indicating that underwriters do not entirely incorporate public information that becomes available during the registration period into the offer price. Consequently, this public information (as proxied by the market return) contributes to the initial return. Lowry and Schwert (2002) further examine this relation, and they find that the significance of market returns stems from private information learned during the filing period, but not incorporated into the offer price. In either case, it does not seem plausible that market returns prior to the IPO should affect the litigation risk of the firm several months or years later. Consequently, this variable is not included in the deterrence equation.

To identify Eq. (2), X_2 includes the stock turnover of matched firms. As discussed earlier, firms with higher turnover are subject to greater litigation risk. However, the turnover of the IPO firms is not measurable until after the IPO and may not be in management's information set at the time of the offering. Therefore, we use the turnover of a matched sample of firms prior to the IPO. Specifically, we select all firms from the same three-digit SIC code that have market capitalization within 80–120% of the IPO firm, where the market capitalization of both the IPO firm and the control firms is measured at the close of the IPO firm's first trading day. We then calculate the turnover of these matched firms over the one year prior to the IPO. To the extent that similar firms have similar turnover, this measure should capture managers' estimate of their firm's turnover once they are publicly traded.[8] It is therefore conjectured to be related to litigation risk. However, it is hard to imagine why the stock turnover of similar firms prior to the IPO should directly affect the initial return.

There are a number of control variables (X) that are common to both equations. We first discuss the effects of these control variables in the context of Eq. (3). Because many of the variables were described earlier when comparing sued vs. non-sued firms, they are only briefly summarized here. As discussed earlier, the 'deep pocket' theory suggests that an IPO firm's litigation risk is positively related to its size (measured as market capitalization), underwriter ranking and the backing of venture capitalists. The higher uncertainty surrounding younger firms, firms in high-tech industries, and firms listed on Nasdaq is also likely to increase these firms' legal exposure. Because we do not have data on age, we construct a dummy equal to one if the firm reports five or more years of pre-IPO earnings data in its prospectus (according to SDC), and zero otherwise. In addition, the presence of insider sales in the offering potentially increases a firm's legal exposure since this makes it easier for the plaintiffs to establish a motive in the lawsuit. We only have data on sales by pre-issue shareholders. This might be a noisy proxy for insider sales since pre-issue shareholders potentially include outsiders without a direct connection to the company as well as company insiders. We therefore construct a cruder measure to denote the presence of insider sales. We note that if there are no sales by pre-issue shareholders, then by definition there are no sales by insiders. On the other hand,

[8] The correlation between the turnover for the matched sample and the ex post turnover of the IPO firm is 0.21 (p-value <0.0001), suggesting the proxy captures a significant portion of the company's turnover pattern.

non-zero sales by pre-issue shareholders potentially include non-zero insider sales. Thus, we include a dummy variable, equal to one if pre-issue shareholders sold shares in the offering, zero otherwise. Finally, as seen in the descriptive statistics, a higher percentage of firms that update the offer price upward from the expected offer price are sued, perhaps because these firms are more aggressive in setting in setting the final offer price.

As discussed in Section 3, a firm's litigation risk is also increasing in the volatility of the stock. One way to obtain the expected volatility is to use the standard deviation of prior stock returns. However, this is not feasible for IPO firms. Another alternative is to use the standard deviation of post-IPO returns. However, this is not observable prior to the IPO and may not be in the managers' information set at the time of the offering. To address this problem, we take advantage of the matched sample approach described earlier. Specifically, for each IPO firm we select all firms from the same three-digit SIC code that have market capitalization within 80–120% of the IPO firm, and we calculate the standard deviation of these matched firms' returns over the one year prior to the IPO. This should provide an estimate of the IPO firm's future volatility based on information available at the offering.[9]

Control variables in the context of Eq. (2) are motivated by information asymmetry, signaling and other factors that potentially affect initial returns. Regarding the effects of information asymmetry, Ritter (1984), Carter and Manaster (1990), and Michaely and Shaw (1994) note that there exists less uncertainty surrounding issues whose values are certified by higher quality players. Underwriters and venture capitalists are repeat players in the new issues market, and they have valuable reputations to protect. As such, they have incentives to accurately portray information regarding the value of the IPO firms. Therefore, underwriter rank and venture capitalist backing should proxy for information asymmetry. Firms in high-tech industries are subject to higher information asymmetry since they have more growth options and thus are harder to value. Carter and Manaster (1990) and Megginson and Weiss (1991) note that more information is readily available about older firms, and they find a negative relation between initial returns and age. Finally, firms with more volatile stocks are characterized by higher information asymmetry.

To control for the effects of signaling, we include the insider sales dummy variable. Insiders of higher quality firms should sell fewer shares, and IPOs of these firms should be more underpriced.

Other variables can also affect IPO underpricing. For example, market capitalization of the IPO firms can be related to initial returns in several ways. First, information tends to be more readily available about larger firms. Thus, the information asymmetry hypothesis predicts a negative relation between firm size and initial returns. However, other things held constant, Michaely and Shaw (1994) point

[9] Anecdotal evidence suggests many firms use similar approaches in practice. For example, many pre-IPO or IPO firms calculate the value of outstanding options using the volatility of comparable firms in the Black-Scholes model. This approach seems sensible since the standard deviation of the matched firms is likely correlated with the firm's real standard deviation (this correlation in our sample is 0.37and highly significant with a p-value <0.001).

out that larger issues can be harder to sell, suggesting that an underwriter may underprice them by a larger amount.[10]

Finally, Benveniste and Spindt (1989) show that the price update will also tend to be related to underpricing. They model initial returns as consisting of some new information and some information known by underwriters prior to the offering. Prior to going public, a company must file a prospectus containing the range of prices within which it expects the IPO offer price to be. During the registration period, the company and the underwriter market the issue to institutional investors. They rely on these investors to reveal their true valuation of each IPO. Benveniste and Spindt conjecture that underwriters must give investors incentives to reveal their valuation. Therefore, underwriters only partially update the final offer price from the expected offer price (the midpoint of the range of prices stated in the prospectus). Consistent with this theory, Hanley (1993) finds a strong positive relation between the price update and initial returns.

The estimation of the simultaneous equation system is slightly complicated by the fact that the dependent variable in the first equation, initial return, is continuous, while that in the second equation, litigation risk, is observed only as a dichotomous variable. In this case, we cannot fully recover the parameters in Eqs. (2) and (3) (Maddala, 1983, p. 244). The estimable structural equations are

$$\text{Insurance effect:} \quad \text{initial return} = \gamma_1\sigma_2\,\text{litigation risk}^{**} + \theta_1 X + \beta_1 X_1 + \varepsilon_1, \quad (4)$$

$$\text{Deterrence effect:} \quad \text{litigation risk}^{**} = \frac{\gamma_2}{\sigma_2}\,\text{initial return} + \frac{\theta_2}{\sigma_2} X + \frac{\beta_2}{\sigma_2} X_2 + \frac{\varepsilon_2}{\sigma_2}, \quad (5)$$

where $\sigma_2^2 = Var(\varepsilon_2)$. The estimation method consists of two stages. In the first stage, we regress initial return and litigation risk on all the exogenous variables in the system (including all variables in X, X_1, and X_2), using OLS and probit, respectively. In the second stage, we substitute the predicted values from the first-stage estimation as explanatory variables in Eqs. (4) and (5), and then estimate Eq. (4) by OLS and Eq. (5) by probit.[11] While we are not able to separately estimate γ_1 and γ_2, we can at least test whether the two coefficients are *statistically* different from zero, and thus shed light on the statistical significance of the insurance and deterrence effects.

5. Empirical results

This section addresses the cross-sectional relation between underpricing and the probability of litigation related to the IPO. Section 5.1 discusses the regression results without controlling for the endogeneity between initial underpricing and litigation risk. Section 5.2 examines the insurance and the deterrence effects using a

[10] We use market capitalization after the IPO instead of proceeds raised because of the mechanical relation between proceeds and initial returns.

[11] The regression coefficients from the second-stage regression are consistent, but the standard errors are underestimated since the explanatory variables include two generated regressors. We adjust the standard errors using the methodology in Maddala (1983, p. 245).

simultaneous-equation framework. Finally, Section 5.3 conducts various sensitivity analyses.

In constructing our main tests, we conjecture that the timing of the lawsuit might be important for detecting the relation between underpricing and litigation risk. Specifically, managers are likely to forecast lawsuits closer to an IPO with greater accuracy. In contrast, a lawsuit that occurs long after an IPO is more likely prompted by random stock price fluctuations not in the managers' information set at the time of IPO, and this greater noise might mask the relation between underpricing and litigation risk. Thus, we can enhance the power of our tests by focusing on litigation risk within a relatively short horizon. Therefore, our main tests are based on Section 11 lawsuits that were filed within two years of the IPO. In the sensitivity analysis, we also summarize the estimation results for other time intervals.

5.1. Regression results without controlling for simultaneity

To provide a benchmark for our simultaneous-equation approach, we first present the regression results without controlling for the simultaneity. The first column of Table 4 tests the insurance effect of the litigation-risk hypothesis. We estimate an OLS regression of initial returns on a lawsuit dummy, equal to one if the firm was sued and zero otherwise, plus the control variables described in the previous section. This OLS regression is similar in spirit to the analysis of Drake and Vetsuypens (1993) and ignores the endogeneity of lawsuit probability. This specification suggests that initial returns are a decreasing function of litigation risk, implying that firms with higher litigation risk underprice their IPOs less. Similar to the findings in Drake and Vetsuypens, this result contradicts the insurance effect. However, as discussed earlier, the OLS coefficient may be biased because litigation risk is an endogenous variable.

Similarly, Column 2 of Table 4 tests the deterrence effect by including initial return as one of the explanatory variables without adjusting for the potential endogeneity. The simple probit regression produces a negative and significant coefficient on initial return, consistent with the deterrence effect. However, we hesitate to draw any inferences here since the coefficient is potentially affected by the endogeneity bias. Instead, we focus our discussion on the next section. The importance of controlling for the endogeneity between initial return and litigation risk is highlighted by the simultaneous-equation results shown in the next section.

5.2. Regression results using simultaneous equations

To properly account for the endogeneity of initial returns and litigation risk, Table 5 re-estimates Eqs. (4) and (5) using a simultaneous-equation approach. Columns 1 and 3 show the first-stage regressions where the dependent variable, lawsuit occurrence or initial returns, is regressed on all of the exogenous variables (i.e., the control variables X and the identifying variables X_1 and X_2) in the system of equations (2) and (3). Columns 2 and 4 show the second-stage regressions of the insurance and deterrence effects. The explanatory variables in the two equations are

Table 4
Regression results without controlling for simultaneity
These regressions are based on 1,154 IPOs between 1988 and 1995. Observations consist of IPO firms that were sued under Section 11 within two years of the IPO and also IPO firms that were not sued. Insider sales dummy equals one if any shares in the IPO were sold by pre-issue shareholders, zero otherwise. We use the average standard deviation and average stock turnover of a matched sample over the one year prior to the IPO to proxy for the IPO firm's standard deviation and stock turnover. The matched sample consists of firms in the same three-digit SIC code with market capitalization within 80–120% of the IPO firm's market value at the close of the first day of trading. Turnover equals [$1 - \Pi_t$ (1−volume traded$_t$/ total shares$_t$)] over the one year prior to the IPO. Price update equals the percentage change between the midpoint of the file range and the offer price. Prior market return equals the compounded value-weighted market return over the 15 trading days prior to the IPO. All other variables are defined in Table 3. Standard errors are reported in parentheses.

Variable	Insurance effect, dep. = IR	Deterrence effect, dep. = suit
Intercept	21.501***	−1.968***
	(2.614)	(0.411)
Lawsuit	*−4.453**	
	(2.781)	
IR		*−0.007**
		(0.004)
Market cap.	4.574***	0.139
	(0.856)	(0.117)
UW rank	−0.546***	0.009
	(0.185)	(0.023)
Dummy: age ⩾ 5 years	−3.147***	−0.195
	(1.268)	(0.152)
Tech. dummy	0.472	−0.192
	(1.282)	(0.156)
Dummy: insider sales	0.416	0.169
	(1.298)	(0.152)
Dummy: VC backed	−0.431	0.295*
	(1.298)	(0.157)
Dummy: NYSE–AMEX	−11.002***	−0.203
	(2.573)	(0.311)
Std. dev. (match sample)	16.205	−3.634
	(55.387)	(8.286)
Turnover (match sample)		0.881*
		(0.491)
Price update	0.462***	0.007*
	(0.032)	(0.004)
Prior market returns	89.263***	
	(27.830)	
(Pseudo) adj-R^2	0.251	0.078

*Significant at 10% level,
***Significant at 1%, using two-tailed tests.

similar to those in Table 4, except that the lawsuit and initial return variables are now substituted by the two instruments, equal to the fitted values from the two first-stage regressions.

Table 5
Simultaneous equations results
These regressions test the insurance and deterrence effects using the simultaneous-equation approach, where initial return (IR) and lawsuit probability are treated as the endogenous variables. Observations (1,154 firms) consist of IPO firms that were sued under Section 11 within two years of the IPO and also IPO firms that were not sued. Please refer to Tables 3 and 4 for variable definitions. Columns 1 and 2 are the first- and second-stage regressions of the insurance effect. The first stage is a probit regression. The lawsuit instrument in Column 2 equals the fitted value from the first-stage regression. Columns 3 and 4 are the first- and second-stage regressions of the deterrence effect. The first stage is an OLS, and the second stage is a probit regression. The IR instrument equals the fitted value from the first-stage regression. Standard errors are reported in parentheses.

	Insurance effect		Deterrence effect	
Variable	First-stage dep. = suit	Second-stage dep. = IR	First-stage dep. = IR	Second-stage dep. = suit
Intercept	−2.039***	40.652***	17.277***	−1.168
	(0.409)	(8.522)	(3.102)	(0.781)
Lawsuit instrument		*11.462***		
		(4.803)		
IR instrument				*−0.051*
				(0.037)
Market cap.	0.121	2.200*	3.585***	0.302*
	(0.118)	(1.286)	(0.935)	(0.183)
UW rank	0.012	−0.672***	−0.537***	−0.015
	(0.024)	(0.191)	(0.184)	(0.032)
Dummy: age ⩾ 5 years	−0.193	−0.840	−3.049**	−0.347*
	(0.152)	(1.573)	(1.265)	(0.194)
Tech. dummy	−0.195	2.432*	0.196	−0.185
	(0.156)	(1.504)	(1.288)	(0.157)
Dummy: insider sales	0.182	−1.961	0.119	0.188
	(0.152)	(1.615)	(1.299)	(0.152)
Dummy: VC backed	0.290*	−3.755**	−0.434	0.268*
	(0.158)	(1.868)	(1.296)	(0.159)
Dummy: NYSE–AMEX	−0.154	−8.810***	−10.578***	−0.688
	(0.313)	(2.720)	(2.574)	(0.510)
Std. dev. (match sample)	−3.463	34.783	−4.908	−3.710
	(8.307)	(55.880)	(55.986)	(8.304)
Turnover (match sample)	0.843*		9.662**	1.330**
	(0.494)		(4.048)	(0.615)
Price update	0.004	0.414***	0.458***	0.027
	(0.004)	(0.037)	(0.032)	(0.018)
Prior market returns	−4.605	144.079***	91.300***	
	(3.407)	(35.568)	(27.770)	
(Pseudo) adj-R^2	0.074	0.253	0.253	0.074

*Significant at 10% level,
**Significant at 5%,
***Significant at 1%, using two-tailed tests.

Inferences on both the insurance and deterrence effects and also on the control variables are based on the second-stage regressions. Looking at the second-stage results of the insurance effect, the coefficient on the lawsuit instrument in Column 2 is significantly positive. This finding supports the insurance effect, i.e., firms subject to higher litigation risk underprice their IPOs by a greater amount. The coefficient is 11.462, with a standard error of 4.803, and significant at the 1% level using two-tailed tests. This is in sharp contrast to the OLS result that suggests the opposite. Endogeneity seems to drive the apparent negative relation between the probability of being sued and initial returns obtained in Table 4.[12]

Most of the inferences on the control variables in Column 2 are similar to the findings in prior literature. Consistent with the information asymmetry hypothesis, initial returns are significantly negatively related to underwriter rank and to venture capital backing. Further, the coefficient on NYSE/AMEX is significantly negative, suggesting that shares listed on NYSE/AMEX are less risky and incur less underpricing. The coefficient on the age dummy is also negative, although insignificant at conventional levels. Finally, the significantly positive coefficient on the technology dummy is also consistent with the importance of information asymmetry as a determinant of underpricing. Consistent with the signaling hypothesis, the coefficient on the dummy variable for insider selling is negative, but it is not significant at conventional levels. As predicted by the partial updating hypothesis, we find that the price update is significantly positively related to initial return. Finally, consistent with the findings of Loughran and Ritter (2000), initial return is significantly positively related to market returns over the 15 trading days prior to the IPO.

To test the deterrence effect, we focus on the initial return instrument in the second-stage regression shown in Column 4. Consistent with the deterrence effect, the initial return instrument is still negative, but the significance level is attenuated compared to the simple probit. The coefficient (standard error) is -0.051 (0.037), not significant at conventional levels using more conservative two-tailed tests. Notably, a one-tailed test (since we have a prediction on the sign) has a p-value of 0.08. It is somewhat surprising that the deterrence effect is not more significant, particularly in light of the strong significance of the insurance effect. This is examined in more detail in the next section.

Most of the coefficients on the control variables in Column 4 are consistent with the inferences in Table 2. The coefficients on issuer market capitalization and the venture capital dummy are positive and significant, implying that large firms and firms backed by venture capitalists are more likely to experience securities litigation. This supports the importance of 'deep pockets' in securities litigation suggested by prior studies.

[12] As can be seen in Eqs. (4) and (5), we cannot recover the original parameters γ_1 and γ_2. Consequently, even though we can *statistically* test whether the original parameters are significantly different from zero, we cannot interpret the economic significance of the original equations since we only have estimates for $\gamma_1\sigma_2$ and γ_2/σ_2.

As discussed earlier, existing literature shows that turnover is an important determinant of securities litigation. As expected, the coefficient on the stock turnover of matched sample firms is positive and significant.

Regression results also indicate that firms that have been around longer ($\geqslant 5$ years old) are less likely to be sued, probably due to their lower information asymmetry. Somewhat surprisingly, the coefficient on insider sales is not significant, although the sign of the coefficient is positive. This is perhaps because pre-issue shareholders is a noisy proxy for insider sales, as discussed earlier. Finally, price update is positively related to litigation risk, but it is not significant at conventional levels.

In summary, results provide strong support for the insurance effect, that firms with higher litigation risk underprice their IPOs by a greater amount. We also find some support for the deterrence effect, that greater underpricing lowers a firm's litigation risk. However, the coefficient on the deterrence effect is only marginally significant.

5.3. Sensitivity analysis

To examine the robustness of our results, this section conducts various sensitivity tests and reports the results in Table 6. First, we re-estimate the simultaneous equations, varying the time horizons over which sued firms are included in the sample. Specifically, our main tests are based on lawsuit observations within two years of the IPO. Here we experiment with different cut-off dates. The resulting coefficients (γ_1 and γ_2) are reported in Column 1. For example, the coefficients reported in the first (second) row are obtained after discarding lawsuits that occurred more than a year (a year and a half) after the IPO. The third row contains the 2-year benchmark results (copied from Tables 4 and 5), and the fourth row reports the full sample results. As can be seen from the estimates of γ_1, the insurance effect is consistently strong across all windows. However, the estimates of the deterrence effect, γ_2, are more sensitive to the varying windows. The results for the 1-, 1.5- and 2-year windows yield similar inferences. Although not significant using two-tailed tests, all of the above estimates of γ_2 are negative and significant at the 10% level using the less conservative one-tailed tests. The significance is attenuated when the full (3-year) sample is used. These results are consistent with our earlier conjecture that the shorter window generates more powerful tests.

Next, we repeat the varying-window exercise, excluding lawsuits that were dismissed or withdrawn. The fact that a lawsuit is dismissed or withdrawn indicates that the case was especially weak. Recall that all of these lawsuits are for violations relating to the IPO. While a drop in the stock price most likely precipitated these lawsuits, either the judge or the plaintiffs themselves evidently concluded that the event(s) leading to the lawsuit could not have been directly linked to the IPO. In some sense, the fact that the lawsuit is dismissed or withdrawn indicates that it should never have been brought. For these reasons, dismissed/withdrawn lawsuits might attenuate the relation between underpricing and litigation risk. We therefore reestimate the simultaneous equations by excluding these cases. As suspected, the magnitude of the coefficients on both the insurance and the deterrence effects goes

Table 6
Sensitivity analysis
This table performs a sensitivity analysis for the strengths of the insurance and the deterrence effects over various time horizons. In the test of the insurance effect, we rerun the simultaneous equations with the focus on γ_1 in the first equation, $\text{IR} = \gamma_1 \text{ litig. risk}^{**} + \theta_1 X + \beta_1 X_1 + \varepsilon_1$, limiting the time windows of the lawsuits. In Row 1 (Row 2), a lawsuit observation is used only if the suit occurs within 1 year (1.5 years) of the IPO. In Row 3, a lawsuit observation is used only if the suit occurs within 2 years (it replicates the result in Table 4). Row 4 is based on all Section 11 lawsuits. In the test of the deterrence effect, we focus on the coefficient γ_2^* in the second equation, $\text{litig.risk}^{**} = \gamma_2^* \text{ IR} + \theta_2^* X + \beta_2^* X_2 + \varepsilon_2^*$. We report the estimated coefficients for γ_2 similarly.

	Coefficient (γ_1 or γ_2) (std. err.)	
	All observations	Excluding dismissals
Insurance effect (γ_1): $\text{IR} = \gamma_1 \text{ litig. risk } ^{**} + \theta_1 X + \beta_1 X_1 + \varepsilon_1$		
Sub-sample: lawsuits within 1 year	16.614***	25.220***
	6.980	10.479
Sub-sample: lawsuits within 1.5 years	13.485***	19.469***
	5.704	8.325
Sub-sample: lawsuits within 2 years	11.462***	14.294***
	4.803	6.046
Full sample: lawsuits within 3 years	13.450***	18.456***
	5.676	7.861
Deterrence effect (γ_2): $\text{litig. risk}^{**} = \gamma_2^* \text{ IR} + \theta_2^* X + \beta_2^* X_2 + \varepsilon_2^*$		
Sub-sample: lawsuits within 1 year	−0.054	−0.091**
	0.043	0.046
Sub-sample: lawsuits within 1.5 years	−0.051	−0.072**
	0.038	0.040
Sub-sample: lawsuits within 2 years	−0.051	−0.074**
	0.037	0.039
Full Sample: lawsuits within 3 years	−0.032	−0.050
	0.037	0.039

**Significant at 5% level,
***Significant at 1%, using two-tailed tests.

up substantially. In the insurance equation, the coefficients for all four windows increase uniformly and maintain the strong significance levels. Notably, both the magnitude and the significance of the coefficients in the deterrence equation are increased. The results for the 1-, 1.5- and 2-year windows are now significant at the 5% level, using two-tailed tests. The full (3-year) sample result is still not significant at conventional levels using a two-tailed test, but it is now significant at the 10% level using a one-tailed test.

Although not reported in the tables, we also perform other sensitivity analyses to test the robustness of both the insurance effect and the deterrence effect. To mitigate the effects of underwriter price support (Ruud, 1993), we define the initial return as the percentage change between the offer price and the closing prices on the eleventh and on the twenty-first trading day (two weeks and one month after the IPO,

respectively). We also rerun both regressions excluding IPOs with offer prices less than $5. Since tiny firms are generally not worth suing, their inclusion potentially introduces noise and thus decreases the power of our tests. Results are qualitatively similar across all of these specifications.

6. Conclusion

Potential litigation costs are quite significant for firms that have recently gone public. Attorney fees, the costs of management time allocated to the lawsuit, reputation costs, and settlement costs represent an enormous potential liability for a young firm. Unlike most forms of insurance, IPO underpricing is a viable form of insurance against all of these costs because it lowers plaintiffs' potential recoverable damages, and thus lowers the probability of being sued. This paper investigates the extent to which firms underprice their IPOs as a form of insurance and whether underpricing is effective in deterring litigation.

Our examination of the relation between underpricing and litigation risk emphasizes the importance of controlling for endogeneity. For example, results from OLS regressions contradict the insurance effect component of the litigation risk hypothesis. However, this finding is overturned once we jointly model initial returns and litigation risk in a simultaneous equations system. Specifically, we find that firms with higher litigation risk underprice their IPOs by significantly greater amounts. Further, consistent with the deterrence effect of underpricing, there is evidence that firms that engage in more underpricing significantly lower their litigation risks, especially for lawsuits occurring closer to the IPO dates. After controlling for the endogeneity of initial returns and lawsuit probability, we find support for both the insurance and deterrence aspects of the litigation-risk hypothesis.

The simultaneous-equation framework used in this study is potentially useful for other settings. Many corporate finance events are similarly endogenous in nature, and researchers' ability to account for such endogeneity in future studies potentially affects the conclusions that are drawn.

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