Available online at www.sciencedirect.com
ScienceDirect
Journal of Empirical Finance 15 (2008) 436–454
Journal of EMPIRICAL FINANCE
www.elsevier.com/locate/jempfin

Underpricing, ownership dispersion, and aftermarket liquidity of IPO stocks ☆

Steven Xiaofan Zheng [a,*], Mingsheng Li [b]

[a] Department of Accounting and Finance, Asper school of Business, University of Manitoba, Winnipeg, MB, Canada R3T 5V4
[b] Bowling Green State University, Bowling Green, OH 43403, USA

Received 13 December 2005; received in revised form 21 August 2007; accepted 23 August 2007
Available online 4 September 2007

Abstract

Booth and Chua [Booth J., Chua L. Ownership dispersion, costly information, and IPO underpricing. Journal of Financial Economics 1996; 41; 291–310] hypothesize that IPOs are underpriced to promote ownership dispersion, which in turn increases aftermarket liquidity of IPO stocks. We examine a sample of 1179 Nasdaq IPOs and find that underpricing is positively correlated with the number of non-block institutional shareholders after IPO but negatively correlated with the changes in the total number of shareholders. Firms with many non-block institutional shareholders tend to have high liquidity in the secondary market. These results provide support to Booth and Chua's hypothesis. Underpricing also has direct effects on secondary market liquidity after controlling for ownership structure and other factors.

Jel classification: G12; G14
Keywords: Initial public offerings; IPO; Underpricing; Liquidity; Ownership

1. Introduction

The initial public offering (IPO) is an important milestone in the life cycle of a private firm and has significant effects on the firm's ownership structure and the control rights of existing owners. Zingales (1995) suggests that the initial owner has to balance two factors in deciding whether to go public and what fraction of ownership to remain. The initial owner can maximize his proceeds either from the sale of cash flow rights by selling to dispersed shareholders or from the sale of control rights by negotiating directly with a potential buyer. Similarly, Mello and Parsons (1998) point out that it is important for the initial owner to design the sale of new shares with the final ownership structure in mind. These authors show that an optimal strategy is to sell dispersed holdings to small and passive investors at the IPO stage and controlling blocks are sold to active investors subsequent to the IPO.

☆ We thank participants at 2004 Northern Finance Association Conference, and, in particular, Theo J. Vermaelen the editor and two anonymous referees for helpful comments and suggestions. We also thank Jay Ritter for providing underwriter ranking data.
* Corresponding author. Tel.: +1 204 474 7933; fax: +1 204 474 7545.
E-mail address: zhengxs@ms.umanitoba.ca (S.X. Zheng).

0927-5398/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.jempfin.2007.08.001

Several papers highlight the important roles played by underpricing in achieving the desired ownership structure. Among these papers, Booth and Chua (1996) argue that IPOs are intentionally underpriced to help achieve a dispersed post-IPO ownership structure so that the newly issued stocks have a liquid secondary market. However, limited evidence exists about this theory, except the study about Australian IPOs by Pham et al. (2003). Thus, in this paper, we use the IPOs in the U.S. market and examine the following three questions related to Booth and Chua's (1996) hypothesis:

First, how does underpricing affect post-IPO ownership structure? According to Booth and Chua (1996), underpricing leads to a dispersed ownership structure (also see Brennan and Franks, 1997). In sharp contrast, Stoughton and Zechner (1998) suggest that IPO companies use underpricing to create a more concentrated ownership structure. Thus, how underpricing affects ownership structure is an empirical question, and we provide direct evidence in this study.

Second, does dispersed ownership improve aftermarket liquidity for IPO stocks as suggested by Booth and Chua (1996)? If so, which aspect of liquidity does a dispersed ownership affect? Trading volume, spreads, or depths? Although several studies analyze the association between ownership and liquidity of seasoned equity (Kini and Mian, 1995; Heflin and Shaw, 2000), the evidence is not conclusive and the relations for seasoned equity may not apply to IPO stocks because of the special institutional features of IPOs. In the current study, we employ different liquidity measures and provide comprehensive analyses on this issue.

Third, does underpricing have any direct effect on the IPO aftermarket liquidity after controlling for ownership dispersion? According to Booth and Chua (1996), the relation between underpricing and aftermarket liquidity is achieved through a broad ownership. However, underpricing may affect liquidity directly without the central link of a broad ownership. It can be argued that underpricing attracts investor attention and creates a broad base of possible traders, which leads to active trading for the underpriced IPOs. This argument is actually consistent with Habib and Ljungqvist's (2001) evidence that underpricing is a substitute for promotion and marketing expenses. We test this argument empirically in this paper.

Using a sample of 1179 IPOs listed on NASDAQ market from 1993 to 2000, we find the following main results:

For the first question, we find that underpricing is negatively related to the change in the number of shareholders after IPO but positively related to the number of non-block institutional shareholders after IPO. This result implies that hot IPO firms have more non-block institutional shareholders and smaller increases in individual shareholders than other IPO firms. We do not observe any significant relation between underpricing and the change in blockholder ownership after IPO.

For the second question, we find evidence that the number of non-block institutional shareholders is positively related to aftermarket liquidity. The relation is robust and significant especially when liquidity is measured by aftermarket trading volume. However, we do not find any significant relation between the number of shareholders and different liquidity measures. These results, along with the positive relation between underpricing and the number of non-block institutional shareholders, support the hypothesis of Booth and Chua (1996). It seems that underpricing is used to help increase the number of non-block institutional shareholders, which improves the secondary market liquidity. We also find that blockholder ownership is negatively correlated with trading volume and positively correlated with bid-ask spreads. This result indicates that ownership concentration has a negative effect on aftermarket liquidity.

For the third question, we find that IPO underpricing is positively related to trading volume in the secondary market. The result is consistent and robust after controlling for ownership structure variables and firm characteristics. This suggests that underpricing does have some direct effect on market liquidity.

The overall conclusions in our paper are largely consistent with Pham et al. (2003), who conduct a comprehensive study on similar issues using Australian data. However, our paper is different from Pham et al. (2003) in several important ways:

The first difference is related to the IPO pricing mechanisms. U.S. firms use book-building, in which the offer price and the number of shares offered can be altered until the final offer price is determined (see e.g., Lee et al., 1996). In sharp contrast, Australian firms predominantly use fixed pricing, which does not allow for changes in either the offer price or the number of shares offered after the prospectus is filed. Under a fixed pricing system, a substantial amount of private information is not incorporated into offer price (Sherman and Titman, 2002), which leads to more severe adverse selection problems for small investors. So underpricing may be more important and effective in attracting small investors and increasing the shareholder base in Australia. This helps explain why the relations between underpricing and post-IPO ownership structure in Australia are different from those in the US. Specifically, Pham, Kalev and Steen

(2003) find that underpricing is positively related to the breadth of shareholding base and negatively related to blockholder ownership in Australia, while we find a negative relation between underpricing and the number of shareholders and no significant relation between underpricing and blockholder ownership in the U.S. market. Our results suggest that in the U.S. market underpricing seems to improve liquidity through another dimension of ownership structure: the number of non-block institutional shareholders.

The second difference is related to underwriters' roles in the IPO aftermarket. U.S. underwriters have a much broader role than Australian underwriters. U.S. underwriters undertake different actions to stabilize the aftermarket price, but these activities are illegal in Australia (Bayley et al., 2003). In addition, U.S. underwriters discourage and punish investors who sell their allocated shares immediately (flipping) in the aftermarket, while investors in Australia can freely sell their allocated shares. These institutional differences directly affect aftermarket investor composition and liquidity. This helps explain why we find that investor breadth is not significantly related to aftermarket liquidity in the US market, while Pham et al. (2003) find that the overall investor breadth affects market liquidity in the Australian market.

The third difference is in sample and methodology. Pham et al. (2003) employ a small Australian sample (113 IPOs, among which only 4 IPOs are priced by book-building method and the rest of them use fixed pricing) over a short period (1996 to 1999). Our sample is much larger and covers a longer period (1993 to 2000). In addition, Pham et al. (2003) examine aftermarket liquidity in a 25-day window (day 5 to day 30), whereas we investigate aftermarket liquidity in three periods with 60 or more trading days, which cover all the special events in the U.S IPO aftermarket, such as the quiet period (25 days after IPO), price stabilization (normally a month after issuing) and lockup (typically 180 days).

Our paper contributes to the literature in at least three ways. First, using U.S. IPO data, we conduct a comprehensive analysis on the interactions among underpricing, ownership structure, and aftermarket liquidity, which has not been fully explored in the literature. Second, we provide additional evidence to support Booth and Chua's (1996) hypothesis. The positive relations between underpricing, the number of post-IPO non-block institutional shareholders, and aftermarket trading volume have not been documented in the financial literature. Third, we add value to the literature by investigating whether IPO underpricing impacts market liquidity directly as a substitute for promotion and marketing expenses as posited by Habib and Ljunqvist (2001) or only indirectly through the central link of a diversified ownership structure as suggested by Booth and Chua (1996). Overall, our results show interesting interactions among underpricing, ownership structure, and aftermarket liquidity given the different institutional features in the U.S. IPO market.

The rest of the paper is organized as follows: Part 2 discusses the related literature and develops hypotheses; Part 3 describes the sample and data; and Part 4 presents the empirical analysis and discusses the test results; conclusions are offered in Part 5.

2. Literature review and hypothesis

2.1. Underpricing and ownership dispersion

Financial theories suggest that underpricing can be used to affect post-IPO ownership structure (Booth and Chua, 1996; Brennan and Franks, 1997; Stoughton and Zechner, 1998). Specifically, when an IPO is underpriced, investors are more likely to oversubscribe for the offering. So IPO issuers and underwriters can intentionally underprice the issue to solicit oversubscription. With oversubscription, the underwriters can allocate shares to preferred investors and achieve the desired ownership structure for the issuer.

However, different arguments exist about the desired ownership structure that underpricing is used to achieve. Booth and Chua (1996) and Brennan and Franks (1997) argue that small investors are preferred and underpricing is used to help achieve a dispersed ownership. Stoughton and Zechner (1998), however, argue that IPO companies prefer a more concentrated ownership of a few large investors. The motivations for the desired ownership structure are also different. Booth and Chua (1996) suggest that a dispersed ownership helps improve aftermarket liquidity and benefits shareholders; Brennan and Franks (1997) opine that a dispersed ownership reduces the probability of hostile takeovers and benefits the management; whereas Stoughton and Zechner (1998) believe that the large investors in a concentrated ownership structure have incentives to monitor the managers and help maximize firm value.

To test the relation between IPO underpricing and ownership structure, we construct different measures for ownership dispersion/concentration because ownership structure has many dimensions. The first dimension is the

Table 1
Summary of testable implications

Panel A. Possible relations between underpricing and ownership structure

Hypothesis	Ownership dispersion measures		
	Total # of shareholders	Blockholder ownership	# of non-block institutional shareholders
Booth and Chua (1996) and Brennan and Franks (1997)	Positive	Negative	Positive
Stoughton and Zechner (1998)	Negative	Positive	Negative

Panel B. Possible relations between ownership structure and liquidity based on Booth and Chua (1996)

Liquidity Measures	Ownership structure measures		
	Total # of shareholders	Blockholder ownership	# of non-block institutional shareholders
Trading volume	Uncertain	Negative	Positive
Quoted spread	Uncertain	Positive	Negative
Effective spread	Uncertain	Positive	Negative
Quoted depth	Uncertain	Negative	Uncertain

This table summarizes the predictions of different theories about the relation between IPO underpricing, ownership structure, and secondary market liquidity. The ownership structure is measured by three variables: the number of shareholders, blockholder ownership, and the number of non-block institutional shareholders. Blockholder ownership is the total number of shares held by all blockholders as a proportion of total number of shares outstanding, where blockholder refers to any shareholder who holds more than 5% of shares outstanding. Liquidity measures include: (1) Trading volume, the total number of shares traded each day; (2) quoted spreads, the difference between quoted bid and ask prices; (3) effective spreads, calculated as twice the absolute value of the difference between trade price and quoted midpoint; and (4) quoted depths, the total number of shares quoted at bid and ask prices.

number of shareholders.[1] A firm with dispersed ownership structure may have a lot of shareholders, i.e., wide breadth (see, e.g., Pham et al. (2003) for detailed discussions). However, even in a firm with a lot of shareholders, a few large shareholders may hold a large portion of the shares, creating severe inequality of distribution. In this case, the ownership structure is concentrated rather than dispersed. Thus, the number of shareholders alone is not adequate for measuring ownership dispersion/concentration.

Proportional ownership by blockholders (investors who hold more than 5% of a firm's shares) is commonly used to capture the extent of ownership concentration. A firm with dispersed ownership should have low blockholder ownership, but this measure alone is not adequate either. Suppose firm A has twenty-five shareholders and each of them owns 4% of the company. Firm B has 1000 shareholders and each of them holds 0.1% of firm B's shares. The blockholder ownership is zero for both firms. Thus, one may conclude that these two firms have the same extent of ownership dispersion if he considers only blockholder ownership. But obviously, firm B has a more dispersed ownership structure than firm A. Based on above mentioned reasons, we emply both the number of shares and blockholder ownership to measure ownership dispersion/concentration.

The number of non-block institutional shareholders, i.e., the institutional investor who holds less than 5% of the firm's total shares, is another dimension of ownership dispersion. Just like the increase in the number of shareholders, the increase in the number of non-block institutional shareholders tend to make the ownership structure more dispersed. In addition, there is evidence that the existence of institutional shareholders improves market liquidity (see, e.g., Kini and Mian, 1995). If IPO firms intend to improve market liquidity after IPO, non-block institutional investors could be the preferred investors and the desirable ownership structure would have many non-block institutional investors. This dimension of ownership dispersion could be an important factor in the theory of Booth and Chua (1996). Therefore, we include it in our tests about the relation between underpricing and post-IPO ownership structure.

In Panel A of Table 1, we summarize the predictions of different hypotheses about the relation between IPO underpricing and different ownership structure measures. The hypotheses of Booth and Chua (1996) and Brennan and Franks (1997) imply a positive relation between underpricing and the number of shareholders, a negative relation between underpricing and blockholder ownership, and a positive relation between underpricing and the number of non-

[1] New companies have to meet the minimum number of shareholders requirement to get listed in Nasdaq. In February 2007, the minimum requirement is 2200 shareholders for IPOs and 400 shareholders for continued listing.

block institutional shareholders. Stoughton and Zechner's (1998) hypothesis suggests a negative relation between underpricing and the number of shareholders, a positive relation between underpricing and blockholder ownership, and a negative relation between underpricing and the number of non-block institutional shareholders.

Limited empirical evidence exists on the predictions mentioned above. Arugaslan et al. (2004) investigate the relations between institutional ownership, share class structure (single class vs. dual class), and underpricing. They find that institutional ownership is associated with firm size rather than with underpricing or dual class share structure. Field and Sheehan (2004) find no significant relation between underpricing and outside blockholder ownership.

2.2. Ownership dispersion and aftermarket liquidity

Booth and Chua (1996) suggest that the main motivation of achieving a broad initial ownership through underpricing is to increase secondary market liquidity. Given the three dimensions of ownership dispersion discussed in the previous section, this implies that liquidity is positively associated with the number of shareholders and the number of non-block institutional shareholders, but negatively correlated with blockholder ownership.

Note that liquidity is a multi-dimensional concept that includes at least three aspects: trading volume, quoted and effective spreads, and quoted depth. Trading volume measures trading activities. The quoted and effective spreads measure trading cost. Quoted depth measures the availability of shares at the posted quotes. Higher liquidity implies higher trading volume, lower spreads, and/or larger quoted depth.

Booth and Chua (1996) do not specify which aspect(s) of liquidity is affected by which dimension of ownership dispersion. However, Heflin and Shaw (2000) suggest that blockholders are informed traders and that market makers will mitigate losses to informed traders by quoting wider spreads and smaller depths. Therefore, high blockholder ownership is expected to be associated with large spreads and small quoted depth. These actions increase trading costs and discourage liquidity traders from trading. As a result, we expect that blockholder ownership is negatively correlated with trading volume.

When a firm has more shareholders, each shareholder holds fewer shares. So trade size tends to be smaller while the number of trades tends to be larger. Because trading volume is the product of trade size and the number of trades, it is not clear how the increase in the number of shareholders affects total trading volume. With more shareholders, market makers will face lower probability of informed trading. This gives an incentive for market makers to quote small spreads and large depths. However, for very small trades, the cost of executing trades (as a percentage of trade value) is higher.[2] Thus, market makers may also have the incentive to charge larger average spreads on each trade. Small average trade size also reduces the need to quote larger depths. Thus the effects of a larger number of shareholders on spreads and depths are not clear either.

It is reasonable to expect non-block institutional investors to trade more actively than other investors. Thus, a large number of non-block institutional investors should be associated with high trading volume. As documented in the market microstructure literature, high trading volume is usually associated with small spreads. Therefore we expect a negative relation between spreads and the number of non-block institutional shareholders. The relation between quoted depth and the number of non-block institutional shareholders is not clear. These expected relations are summarized in Panel B of Table 1.

In the financial literature, the empirical relation between ownership dispersion and liquidity is inconclusive. Kini and Mian (1995) examine the relation between bid-ask spread and ownership structure variables. They document a positive, but generally insignificant, relation between spread and blockholdings. Conversely, Heflin and Shaw (2000) find that firms with greater blockholder ownership have larger quoted spreads, effective spreads, adverse selection spread components, and smaller quoted depths. Kini and Mian (1995) find a negative relation between institutional ownership and spreads.

Note also that the two studies mentioned above are based on large seasoned firms in exchange markets (mostly New York Stock Exchange), and their findings may not be directly applicable to the Nasdaq IPOs. In addition to the differences between Nasdaq and the NYSE,[3] there are many other institutional features such as underwriters'

[2] The costs associated with using economic resources to route orders, executive orders, clear and settle trades, and maintain an inventory. These costs have economies of scale. See, for example, Stoll (2000).

[3] It is well known that spreads are larger on Nasdaq than on the NYSE and AMEX (see Christie and Schultz, 1994; Huang and Stoll, 1996). In addition, quoted depths are different between Nasdaq and the NYSE (AMEX) (Chan et al., 1995; Barclay et al., 1999). Another difference is that the trading volume between Nasdaq dealers is double-counted, which inflates total trading volume.

stabilization, lockup expiration, and exit of venture capitalists (Field and Hanka, 2001), which exist in IPO market and affect IPO market liquidity but do not exist in seasoned offerings.[4]

2.3. IPO underpricing and aftermarket liquidity

Increasing ownership dispersion may not be the only way through which IPO underpricing affects aftermarket liquidity. Habib and Ljungqvist (2001) argue that IPO underpricing and promotion are alternatives to each other and they find that at the margin, each dollar spent on promotion reduces pre-IPO owners' wealth losses from underpricing by ninety-eight cents. If underpricing is a method of promotion, then it can be argued that underpricing increases the number of potential investors who are interested in trading the IPO stocks. The increase in the number of potential investors would increase trading volume. Thus, IPO underpricing may directly affect aftermarket liquidity through increased trading volume. We call this argument the *investor attention* hypothesis.

It is unclear how underpricing affects the information asymmetry that market makers face. Hence, the investor attention hypothesis above does not have a clear prediction about the relation between IPO underpricing and spreads or quoted depth. Similar to Booth and Chua's (1996) argument, the investor attention hypothesis suggests that aftermarket liquidity is a factor in IPO underpricing decisions. However, it does not rely on the hypothesis that IPO underpricing promotes ownership dispersion. Limited evidence exists on how underpricing affects different liquidity measures, with the exception of Reese (1998), which shows that underpricing is positively related to trading volume in the secondary market.

3. Data and sample selection

The initial sample consists of 3099 IPOs collected from the Securities Data Corporation (SDC) database during the period from 1993 to 2000. The sample period starts at 1993 because the trade and quote data in TAQ database start from 1993. Then we apply the following screening criteria:

(a) The IPO stocks must have return and trading volume data available from the Center for Research in Security Prices (CRSP) database. This reduces the sample to 2912 IPOs.
(b) We exclude ADRs, SBIs (shares of beneficial interest), Units, Americus Trust Components (Primes and Scores), Closed-end funds and REIT's (Real Estate Investment Trusts) based on CRSP description. We also exclude IPOs with offer price below $5. These screens reduce the sample to 2462 IPOs.
(c) We exclude the NYSE and AMEX stocks and keep only IPOs listed on Nasdaq. As mentioned earlier, market microstructure literature shows that the liquidity characteristics of Nasdaq stocks are quite different from those of the NYSE and AMEX stocks. In addition, a high proportion of the IPOs between 1993 and 2000 are listed on Nasdaq, so we feel it is more appropriate to focus on Nasdaq IPOs. Only 180 IPOs are excluded by this step, and the sample is reduced to 2282 IPOs.
(d) We exclude the IPOs that conduct seasoned equity offerings or acquire other companies in the year after IPO because these actions affect their ownership structure and liquidity. This reduces the sample to 2106 IPOs.
(e) To examine the liquidity of the IPO stocks, we require that each IPO stock must have at least sixty trading days of data available from the NYSE TAQ database. Only 1491 IPOs satisfy this requirement.
(f) The IPOs must have lockup requirements and the lockup period is 180 days. We impose these requirements to make sure that the liquidity characteristics of IPOs are comparable with each other because lockup and lockup expiration have significant effects on the IPO aftermarket liquidity.[5] Subsequently, when we divide the post-IPO year into several periods, this requirement reduces the effects that lockup expiration trading may have on our results. There are 1192 IPOs satisfying this requirement.

[4] Ellis et al. (2000) show that lead underwriters engage in stabilization efforts and trade actively until three months after IPO. These activities affect market liquidity. Cao et al. (2004) show that liquidity changes substantially after lockup expiration. So it is important to specifically study the relation between ownership dispersion and liquidity for IPO stocks.

[5] For example, Cao et al. (2004) provide comprehensive analyses regarding microstructure effects of lockup expiration. They find that quoted depth and trading activity improve substantially following lockup expirations. Many others investigate the floating effect on stock price. Field and Hanka (2001) find a substantial negative return when lockup expires.

Table 2
Descriptive statistics of initial public offerings

Year	*N*	Underpricing (%)	Shares offered (thousands)	Market value ($ million)	# of shareholders after IPO	Blockholder ownership after IPO	# of institutional shareholders after IPO
1993	177	14.64	2404	121.65	709	0.56	22
		(8.33)	(2200)	(90.21)	(239)	(0.58)	(18)
1994	137	11.44	2219	94.25	601	0.53	22
		(5.77)	(2000)	(71.53)	(189)	(0.51)	(18)
1995	199	22.66	2657	143.34	706	0.51	19
		(16.67)	(2470)	(105.50)	(190)	(0.50)	(17)
1996	273	18.62	2995	165.29	749	0.56	20
		(12.50)	(2600)	(123.28)	(190)	(0.60)	(18)
1997	166	15.76	3127	136.93	802	0.48	20
		(10.67)	(2900)	(101.35)	(260)	(0.49)	(17)
1998	72	27.30	3145	151.24	862	0.52	20
		(11.79)	(2959)	(118.53)	(259)	(0.50)	(16)
1999	94	61.18	4272	456.39	972	0.59	37
		(40.10)	(4000)	(254.06)	(189)	(0.62)	(33)
2000	61	50.44	5085	557.04	1,755	0.55	24
		(26.56)	(4600)	(284.72)	(229)	(0.60)	(23)
1993–2000	1179	23.04	2997	185.40	795	0.54	22
		(11.76)	(2600)	(113.87)	(213)	(0.55)	(18)

Our sample includes 1179 IPO stocks listed on Nasdaq from 1993 to 2000. The data are collected from the SDC database, CRSP database, 10-K filings, proxy statements, and Form 13F filings. Underpricing is defined as (Closing − Offer)/Offer, where Closing and Offer are the first-day closing price and offer price, respectively. Market value is calculated as the product of the number of shares outstanding and closing price on the first trading day, converted to 1993 dollars. Blockholder ownership is the proportion of shares held by all blockholders, where blockholder refers to any shareholder who holds more than 5% of shares outstanding. Institutional shareholders include only non-block institutional shareholders. Medians are reported in parentheses.

(g) To conduct tests about ownership structure, we require that each IPO has data available for at least one of the following variables: the number of shareholders (from the first 10-K filing after IPO), blockholder ownership (from the first proxy statement after IPO), and the number of non-block institutional shareholders (from the first form 13F after IPO). After examining the filings carefully, we are able to collect ownership structure data for 1179 IPOs, which form the base sample used in this paper.

We calculate quoted spreads, effective spreads, and quoted depth using intraday quotes and trades data from TAQ. The quoted spread is the difference between bid and ask prices. It may overstate the total trading cost because many trades are conducted within the quoted spreads. The effective spread corrects this bias and is calculated as twice the absolute value of the difference between trade price and quoted midpoint. Quoted depth is the total number of shares quoted at bid and ask prices. Note that we should not assign too much importance to Nasdaq quoted depth as a measure of liquidity because the majority of Nasdaq dealer quotes are for 1000 shares.[6]

For the intraday quote data, we exclude observations with: (1) quotes before opening (9:30) or after closing (16:00); (2) bid or ask prices ≤ 0; (3) quoted spread at bid and ask prices $>\$5$ or ≤ 0; (4) the ratio of bid price or ask price to the quoted midpoint >0.5; and (5) non-firm quotes and quotes corresponding to trading halts. For trade data, we eliminate observations with: (1) trades before opening (9:30) or after closing (16:00); (2) trades reported out of time sequence; and (3) cancelled trades. The reason for deleting these observations is that these quotes do not represent the normal quotes or are due to errors.

Table 2 provides summary statistics of the IPO sample. The level of underpricing (first-day initial return), which is calculated as (the first-day closing price − offer price)/offer price, has a mean value of 23.04% for the whole sample, with a median of 11.76%. The level of underpricing for our sample IPOs is higher than that reported in the IPO literature because IPOs in recent years have higher initial returns. For example, Loughran and Ritter (2002) show that

[6] In addition, Johns and Lipson (2001) point out that only one market maker's quoted depth is reported in Nasdaq when multiple market makers quote identical depths at the best quote. This fact also makes quoted depth in Nasdaq less meaningful.

Table 3
Regressions on ownership structure

Independent variables	Dependent variables								
	Change in Log NSH (1)	Change in Log NSH (2)	Change in Log NSH (3)	Change in BHO (4)	Change in BHO (5)	Change in BHO (6)	INST (7)	INST (8)	INST (9)
Underpricing	−0.39**	−0.52**	−0.64**	0.01	0.01	0.01	4.29**	2.98**	2.41**
	(−2.05)	(−2.88)	(−3.27)	(0.24)	(0.38)	(0.38)	(4.07)	(2.88)	(2.06)
Log MV	0.08	0.42**	0.47**	0.04**	0.02	0.03	9.90**	11.74**	12.38
	(0.77)	(3.68)	(3.60)	(2.37)	(0.91)	(1.57)	(19.99)	(20.34)	(18.13)
Float ratio		2.36**	1.77		−0.05	0.03		34.83**	33.75**
		(2.25)	(1.53)		(−0.32)	(0.19)		(6.99)	(5.97)
Primary ratio		−0.04	0.70		−0.02	0.00		−11.13	−8.54
		(−0.04)	(0.56)		(−0.10)	(0.00)		(−2.09)	(−1.40)
Venture-backed		−1.11**	−1.10**		0.12**	0.11**		3.61	3.82**
		(−7.66)	(−6.63)		(5.42)	(4.58)		(4.99)	(4.55)
Top-tier underwriter		−0.18	−0.16		0.01	−0.00		0.27	0.53*
		(−1.08)	(−0.83)		(0.35)	(−0.05)		(1.14)	(1.96)
Adj. R^2	0.004	0.121	0.117	0.007	0.039	0.036	0.405	0.460	0.451
# of observations	664	664	533	911	911	732	1,060	1,060	852

This table reports the results of regressions relating ownership structure measures to underpricing. The base sample includes 1179 IPOs listed on Nasdaq between 1993 and 2000. The data for regressions are collected from the SDC database, CRSP database, IPO prospectuses, 10-K filings, proxy statements, and Form 13F filings. Dependent variables are listed in the 1st row. Log NSH is log of number of shareholders and BHO is the proportion of shares held by blockholders after IPO. Changes in Log NSH and BHO are the changes in these variables after IPO. INST is the number of non-block institutional shareholders after IPO. Independent variables are listed in the 1st column: underpricing is calculated as (1st day closing price / offer price − 1); Log MV is log of market value of equity after IPO; Float ratio is the number of shares offered in IPO as a fraction of total shares outstanding after IPO; Primary ratio is the number of primary shares offered as a fraction of total shares outstanding after IPO; Venture-Backed is a dummy, which equals 1 for IPOs backed by venture capitalists and 0 otherwise. Top-tier underwriter is a dummy variable, which takes the value of 1 if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or above (see Loughran and Ritter (2004)) and 0 otherwise. Regressions (1), (2), (4), (5), (7), and (8) use all observations with relevant data available. Regressions (3), (6), and (9) use only observations from unstablized IPOs (IPOs with initial return >0). *T*-statistics are reported in parentheses. "**" and "*" represent statistical significance at 5% and 10% level respectively.

the average underpricing was 7.4% during 1980–1989, compared to 14.4% and 65% during the periods of 1990–1998 and 1999–2000, respectively.

The number of shares offered is also significantly larger in recent years. The average shares offered are around 4.3 million shares and 5.1 million shares in 1999 and 2000, respectively, compared to about three million shares for the whole sample. The market value (measured by 1993 dollars) of the IPO firms in our sample has a mean of $185.40 million and a median of $113.87 million. The ownership structure also varies over time. Generally, the number of shareholders after IPO increases over time. In most years, the number of non-block institutional shareholders is close to 20 and the proportional blockholder ownership is close to 55%.

4. Empirical results

4.1. Underpricing and ownership

To test the hypotheses about the relation between ownership dispersion and underpricing, we examine how underpricing affects the three dimensions of ownership dispersion: the total number of shareholders, blockholder ownership, and the number of non-block institutional shareholders. We conduct both univariate analyses and multivariate regressions. Since the results based on univariate analyses are consistent with the regression results, we do not report the univariate results for brevity.[7]

To capture the effect of underpricing on the number of shareholders, we regress the change in number of shareholders after IPO on underpricing and several control variables. The change in the number of shareholders is measured as the difference between post-IPO number of shareholders and pre-IPO number of shareholders. To reduce

[7] The univariate results are available from the authors upon request.

the effect of extreme numbers, we take log transformations. Therefore, the change in log number of shareholders (Log NSH) is calculated as Log (post-IPO number of shareholders) − Log (pre-IPO number of shareholders). We hand-collect the pre-IPO ownership data from IPO prospectuses. Only 664 IPOs have both pre- and post-IPO number of shareholders data available.

The results of the regressions based on changes in Log NSH are reported in Table 3. In regression (1), we include only Log market value of equity after IPO (Log MV) to control for firm size. The coefficient on underpricing is negative and significantly different from zero at the 0.05 level. The negative coefficient indicates that IPOs with severe underpricing experience small increases in the number of shareholders after IPO. This result is inconsistent with the ownership dispersion hypothesis of Booth and Chua (1996) and Brennan and Franks (1997), but consistent with the ownership concentration hypothesis of Stoughton and Zechner (1998).

In regression (2), we incorporate more variables that control for offering characteristics at the IPO. These variables include float ratio, primary ratio, venture-backed dummy, and top-tier underwriter dummy. Float ratio is the number of shares offered in IPO as a fraction of total number of shares outstanding after IPO. Primary ratio is the number of primary shares offered as a fraction of total number of shares outstanding after IPO. Venture-Backed is a dummy variable that equals 1 for IPOs backed by venture capitalists and 0 otherwise. Top-tier underwriter (a dummy variable) takes the value of 1 if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or above (see Loughran and Ritter, 2004) and 0 otherwise. The float ratio and primary ratio are included because all the hypotheses depend on the allocation of shares offered in IPO. We include the venture-backed dummy variable because the exit by venture capitalists from the IPO companies affects the post-IPO ownership structure. The reputation of the underwriter affects the composition of investors interested in the offering and thus can affect the post-IPO ownership structure. Hence, we include the Top-Tier Underwriter dummy as another control variable.[8] After including all these control variables, the coefficient on underpricing is still negative and significantly different from zero.

Note that it is very common for underwriters to engage in stabilization activities immediately after IPO (see Aggarwal, 2000). The stabilization activities affect IPO aftermarket price and possibly initial returns. Thus, it is inappropriate to assume that there is only one process that generates IPO initial returns. Asquith et al. (1998) provide empirical evidence suggesting that the cross-sectional distribution of initial return is modeled better as a mixture of two distributions. Following Asquith et al., we separate the sample into stabilized and unstabilized IPOs. Stabilized (unstabilized) IPOs are those with initial returns ≤ 0 (>0).[9] Regression (3) is estimated for unstabilized IPOs only.[10] The coefficient on underpricing is negative and significantly different from zero, similar to those in regressions (1) and (2).

To capture the effect of underpricing on blockholding, we regress the change in proportional blockholder ownership (BHO) on underpricing. Change in BHO is calculated as BHO after IPO minus BHO before IPO. The data for BHO before IPO are hand-collected from IPO prospectuses. In regression (4) (Table 3), only underpricing and market value of equity (Log MV) are included as independent variables. The coefficient on underpricing is positive, but not significant. When we include all other control variables (float ratio, primary ratio, venture-backed dummy, and top-tier underwriter dummy) in regression (5), the coefficient on underpricing is similar to that in regression (4). We also estimate the regression for the unstabilized IPOs in regression (6), and the results are essentially unchanged. The weak relation between underpricing and blockholding ownership is consistent with the finding of Field and Sheehan (2004), but it does not support either the prediction of Booth and Chua (1996) and Brennan and Franks (1997) or the prediction of Stoughton and Zechner (1998).

To find out whether underpricing has any impact on the number of non-block institutional shareholders, we regress the number of non-block institutional shareholders after IPO (INST) on underpricing. Note that we do not calculate the change in the number of non-block institutional shareholders. The reason for this is that IPO firms report only principal shareholders in their prospectuses. In most prospectuses, principal shareholders include blockholders, executive officers, and directors. An institutional shareholder is reported only if it is a blockholder. Thus, we cannot get the pre-IPO non-block institutional ownership data from IPO prospectuses.

[8] The data for underwriters' ranks are collected from Professor Jay Ritter's website at http://bear.cba.ufl.edu/ritter.

[9] We thank the anonymous referee for this suggestion.

[10] We do not report the regression results for stabilized IPOs for two concerns. First, among the IPOs with available data, only about 190 IPOs are stabilized. Second, a large portion of the stabilized IPOs has zero initial return, which further reduces the reliability of any regression result due to the small sample size.

The results of the regressions on INST are reported as regressions (7), (8) and (9) in Table 3. In regression (7), we include only underpricing and Log MV as independent variables. In regression (8) and (9) we include other control variables. Note that regression (9) is only for unstabilized IPOs. In all these regressions, the coefficients on underpricing are positive and significant at the 0.05 level, suggesting that underpricing is positively related to the number of non-block institutional shareholders after IPO. This result is consistent with the theory of Booth and Chua (1996).

Our sample period includes the technology bubble period (1999 and 2000), during which the level of underpricing is much higher than in other years. To find out whether our results are driven by the bubble period, we exclude IPOs in 1999 and 2000 from our sample and re-estimate all the regressions in Table 3. The results are qualitatively similar.[11]

So our tests about the impact of underpricing on ownership dispersion suggest an interesting pattern: underpricing is negatively correlated with the changes in the total number of shareholders but positively correlated with the number of non-block institutional shareholders after IPO. A possible interpretation is that hot IPOs are intentionally allocated to non-block institutional investors. Is this consistent with Booth and Chua (1996)? It depends on how the total number of shareholders and the number of non-block institutional shareholders affect liquidity in the secondary market. If liquidity is positively related to the total number of shareholders, then the results above are not consistent with Booth and Chua (1996). If liquidity is positively related to the number of non-block institutional shareholders, then the results are consistent with Booth and Chua (1996).

4.2. Ownership dispersion and aftermarket liquidity

In this section, we investigate how different ownership structure measures relate to secondary market liquidity for IPO firms. We use both univariate analyses and multivariate regressions. For brevity, we report only the multivariate regression results.

To carry out the test, we first divide the one-year aftermarket test window into three periods to reflect the changes in aftermarket liquidity. The literature shows that both underwriter stabilization and lockup expiration affect aftermarket liquidity. Underwriter stabilization typically lasts for three months (Ellis et al., 2000) while lockup expiration is 180 calendar days for IPOs in our sample. To capture these aftermarket events, we designate Period 1 as from trading day 6 to trading day 60. The end of Period 1 corresponds to the end of stabilization activities. Period 2 ranges from trading day 61 to trading day 120, which is between the end of stabilization and lockup expiration. Period 3 covers trading days from 141 to 240 and corresponds to the period following lockup expiration. We drop the first five trading days after the IPO because trading volume is extremely high in these days. We also exclude the twenty trading days (trading days from 121 to 140) around lockup expiration to avoid the effect of lockup expiration trading on our test results. We examine the relation between ownership dispersion and liquidity in each of the three periods. The twenty trading days around lockup expiration are discussed in our robustness tests.

We calculate the following liquidity measures for each IPO in each of the three periods: Log trading volume (Log V), Log Quoted Spread, Log Effective Spread, Log Quoted Depth, and a comprehensive liquidity index (Liquidity Index). The liquidity index is based on Butler et al. (2005) and computed by using the ranks of spreads, depths, and trading volume. Specifically, we first calculate the following fractional ranks for each IPO in our sample: relative trading volume rank (ranging from zero for the IPO with the lowest relative trading volume to 1 for the IPO with the higher relative trading volume);[12] percentage quoted spread rank (ranging from zero for the IPO with the largest percentage quoted spread to 1 for the IPO with the smallest percentage quoted spread); percentage effective spread rank (ranging from zero for the IPO with the largest percentage effective spread to 1 for the IPO with the smallest percentage effective spread); and quoted depth rank (ranging from zero for the IPO with the lowest quoted depth to 1 for the IPO with the highest quoted depth). Relative trading volume is calculated as trading volume divided by the number of shares outstanding; Percentage quoted (effective) spread is calculated as quoted (effective) spread divided by closing price. The simple average of the four ranks for each IPO is used as the comprehensive liquidity index. A high index is associated with high liquidity.

[11] The results are available from authors upon request.

[12] For example, suppose there are three observations and their values are 2, 7, 8, respectively. Then the fractional ranks of the three observations are 0, 0.5, 1, respectively.

Table 4
Ownership structure and aftermarket liquidity

Independent variables	Dependent variables				
	Log V	Log quoted spread	Log effective spread	Log depth	Liquidity index
Panel A. Regressions for Period 1					
Log NSH	−0.01	0.00	0.00	0.01	0.00
	(−0.72)	(0.21)	(0.58)	(0.59)	(−0.23)
BHO	−0.08	0.08**	0.08**	−0.08	−0.04**
	(−1.23)	(2.02)	(2.00)	(−1.20)	(−2.38)
INST	0.18	−0.07	−0.11	0.26*	0.08*
	(1.23)	(−0.77)	(−1.34)	(1.82)	(1.95)
σ^2	96.74**	10.26**	15.80**	−33.32**	1.15
	(15.34)	(2.35)	(3.88)	(−4.83)	(0.64)
Log MV	0.88**	−0.18**	−0.17**	−0.18**	0.16**
	(20.38)	(−5.66)	(−5.73)	(−3.47)	(12.85)
Log P	−0.45**	0.75**	0.79**	0.02	0.02
	(−7.96)	(20.75)	(23.35)	(0.31)	(1.02)
Float ratio	2.19**	−0.25**	−0.28**	−0.27	0.36**
	(13.10)	(−2.24)	(−2.66)	(−1.55)	(7.65)
Log V		−0.24**	−0.21**	0.06**	
		(−11.68)	(−11.18)	(1.97)	
Venture-backed	0.06	0.02	0.01	0.02	0.01
	(1.59)	(1.14)	(0.73)	(0.46)	(0.93)
Top-tier underwriter	0.03	0.03	0.01	−0.11**	−0.01
	(0.80)	(1.11)	(0.60)	(−2.97)	(−0.52)
Adj. R^2	0.656	0.469	0.505	0.093	0.461
Panel B. Regressions for Period 2					
Log NSH	0.00	−0.01	0.00	0.01	0.00
	(−0.16)	(−0.88)	(−0.66)	(1.09)	(1.09)
BHO	−0.17*	0.11**	0.09**	−0.01	−0.04**
	(−1.94)	(2.58)	(2.33)	(−0.29)	(−2.31)
INST	0.56**	−0.12	−0.17*	0.17	0.13**
	(2.71)	(−1.23)	(−1.90)	(1.40)	(3.09)
σ^2	95.32**	9.68**	15.27**	−16.45**	5.12**
	(11.18)	(2.28)	(3.86)	(−3.13)	(2.81)
Log MV	0.94**	−0.21**	−0.19**	−0.15**	0.14**
	(16.11)	(−6.89)	(−6.52)	(−3.88)	(11.22)
Log P	−0.46**	0.77**	0.79**	−0.05	0.01
	(−6.77)	(23.36)	(25.76)	(−1.22)	(0.48)
Float ratio	1.97**	−0.39**	−0.37**	0.06	0.36**
	(8.38)	(−3.41)	(−3.49)	(0.43)	(7.17)
Log V		−0.21**	−0.20**	0.00	
		(−13.51)	(−13.41)	(−0.12)	
Venture-backed	0.10**	0.03	0.02	0.00	0.01
	(2.09)	(1.33)	(1.14)	(−0.03)	(0.57)
Top-tier underwriter	0.03	0.07**	0.05**	−0.02	−0.01
	(0.67)	(2.76)	(2.18)	(−0.61)	(−1.02)
Adj. R^2	0.542	0.557	0.591	0.137	0.437
Panel C. Regressions for Period 3					
Log NSH	0.00	−0.01	0.00	0.00	0.00
	(−0.07)	(−0.70)	(−0.59)	(0.03)	(0.83)
BHO	−0.22**	−0.01	0.01	−0.04	−0.02
	(−2.33)	(−0.11)	(0.15)	(−1.08)	(−1.09)
INST	1.33**	0.09	0.09	−0.28**	0.04
	(6.30)	(0.92)	(0.98)	(−3.55)	(1.10)
σ^2	64.60**	0.82	5.28	−8.43**	4.80**
	(9.06)	(0.23)	(1.63)	(−3.10)	(3.54)

Table 4 (*continued*)

Independent variables	Dependent variables				
	Log V	Log quoted spread	Log effective spread	Log depth	Liquidity index
Panel C. Regressions for Period 3					
Log MV	1.00**	−0.32**	−0.30**	−0.04	0.18**
	(15.13)	(−9.19)	(−9.22)	(−1.42)	(14.17)
Log P	−0.64**	0.84**	0.82**	−0.07**	−0.04**
	(−9.53)	(25.12)	(26.73)	(−2.82)	(−3.08)
Float ratio	1.38**	−0.53**	−0.56**	0.10	0.31**
	(4.90)	(−3.99)	(−4.47)	(1.00)	(5.72)
Log V		−0.16**	−0.16**	0.02	
		(−10.05)	(−10.27)	(1.50)	
Venture-backed	0.35**	−0.02	−0.03	0.01	0.05**
	(6.79)	(−0.92)	(−1.34)	(0.54)	(4.90)
Top-tier underwriter	0.04	0.03	0.01	0.05**	0.01
	(0.73)	(1.22)	(0.54)	(2.39)	(1.05)
Adj. R^2	0.586	0.648	0.671	0.134	0.534

This table reports the results of regressions relating IPO aftermarket liquidity measures to ownership dispersion measures. The data for the regressions are collected from the SDC database, CRSP database, TAQ database, 10-K filings, proxy statements, and Form 13F filings. Dependent variables are listed in the 1st row. Log V is log of daily trading volume in number of shares; Liquidity index is calculated as the average of the fractional ranks of relative trading volume, percentage spread, percentage effective spread, and quoted depth. Independent variables are listed in the 1st column. Log NSH is log of number of shareholders after IPO; BHO is proportion of blockholder ownership after IPO; INST is the number of non-block institutional shareholders after IPO; Log MV is log of market value of equity; Log P is log of share price; Float ratio is the number of shares offered in IPO as a fraction of total shares outstanding after IPO; Venture-Backed is a dummy, which equals 1 for IPOs backed by venture capitalists and 0 otherwise. Top-tier underwriter is a dummy variable, which takes the value of 1 if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or above (see Loughran and Ritter, 2004) and 0 otherwise. Period 1 spans from trading day 6 to trading day 60. Period 2 ranges from trading day 61 to trading day 120. Period 3 covers trading days from 141 to 240. The regressions in Periods 1 and 2 include 1058 IPOs listed on Nasdaq between 1993 and 2000. In Period 3, the number of observations drops to 973. We take the averages of daily values in each period before taking the logarithm. The number of observations in the regressions for Periods 1, 2 and 3 are 896, 891, and 820 respectively. T-statistics are reported in parentheses. "**" and "*" represent statistical significance at 5% and 10% level respectively.

We regress the liquidity measures in each period on the following ownership structure variables: Log of number of shareholders after IPO (Log NSH), proportional blockholder ownership after IPO (BHO), and the number of non-block institutional shareholders (INST). We also include in the regression other control variables that are shown to have direct effects on liquidity in the microstructure literature (see e.g., Stoll, 2000). These independent variables include: σ^2 (variance of daily return in the corresponding test period), Log of market value of equity (Log MV), and Log of share price (Log P). Log V is also included in spreads and depth regressions because trade volume is an important factor affecting spreads and depths (see e.g., Easley et al., 1996). Other independent variables that control for offering characteristics in the IPO process include Float ratio, Venture-backed dummy, and Top-Tier Underwriter dummy. These variables are defined in the previous section.

To reduce the potential errors associated with daily data, we follow Stoll (2000) and average the daily values of liquidity variables, price, and the number of shares outstanding in each of the three periods for each IPO. Then, we calculate the logarithm of the averages to get the relevant dependent and independent variables. In Period 1, there are 896 IPOs in our sample with data available for all variables. In Periods 2 and 3, the sample size decreases to 891 and 820, respectively. The regression results are reported in Table 4.

Panels A, B, and C of Table 4 report the relation between ownership dispersion and liquidity in Periods 1, 2, and 3, respectively. The relation between INST and trading volume is the strongest one. In both Period 2 and Period 3, the coefficients of INST are positive and significant at the 5% level in the trading volume (Log V) regressions. These results suggest that a large number of non-block institutional ownership is associated with high trading volume. In addition, in Period 1, the coefficients of INST are positive and significant at 10% level in the Log Depth and Liquidity Index regressions. In Period 2, the coefficients of INST are positive and significant at the 5% level in the liquidity index regression and negative and significant at the 10% level in the effective spread (Log Effective Spread) regression. All these results indicate that a large number of non-block institutional shareholders is associated with high liquidity. The only result that contradicts this interpretation is the negative coefficient of INST in the Log Depth regression in Period

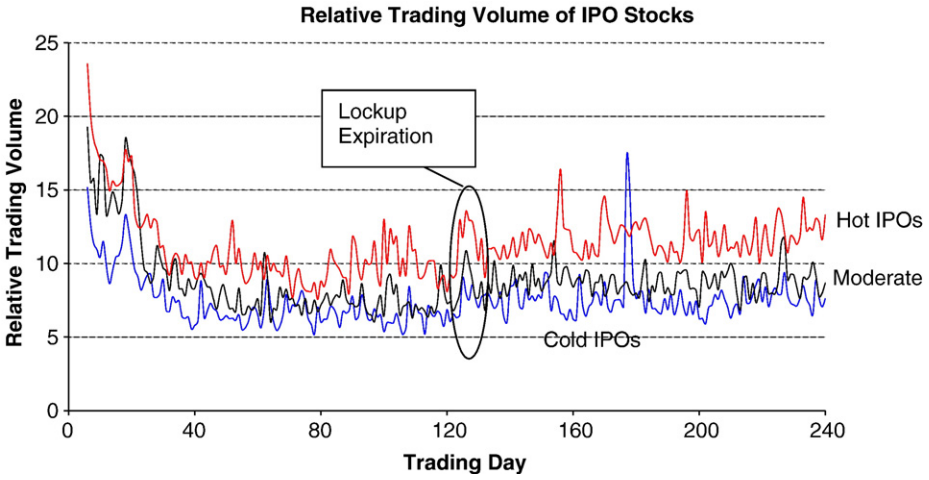

Fig. 1. Trading volume for IPO stocks in the year after offering. This figure shows the average trading volume scaled by the number of shares outstanding for cold, moderate, and hot IPOs over the 240 trading days after IPO. The sample includes 1084 Nasdaq IPO stocks issued between 1993 and 2000. For each calendar year, we divide the IPOs into 3 groups (cold, moderate and hot) based on their level of underpricing. The three groups have approximately the same number of observations. Then we pool the cold IPOs in each year to form the cold IPO sub-sample. Using the same method we form the moderate and hot IPO sub-samples. The cold IPO sub-sample includes 361 IPOs. The moderate IPO sub-sample includes 362 IPOs. The hot IPO sub-sample includes 361 IPOs. For each IPO, relative trading volume is calculated as (trading volume)/(shares outstanding). Then the averages for each of the 3 sub-samples are calculated for each trading day.

3. However, as we mentioned in Section 3, quoted depth in Nasdaq is not a reliable liquidity measure. Considering the evidence in Table 3 that IPO underpricing is positively related to the number of non-block institutional shareholders, we believe that these results support Booth and Chua (1996)'s theory that underpricing improves liquidity through ownership structure.

Consistent with our expectation, the coefficients of blockholder ownership (BHO) are positive and significant at the 5% level in the spreads (Log Quoted Spread and Log Effective Spread) regressions in Periods 1 and 2. In addition, the coefficients of BHO are negative and significant in the liquidity index regression in the two periods. BHO also has negative and significant coefficients in the trading volume regressions in Periods 2 and 3. These results are consistent with the argument that high ownership dispersion leads to high liquidity. The coefficients of Log NSH (the number of shareholders) are insignificant in all regressions in all periods, suggesting that increasing the overall number of shareholders is not a good way to improve liquidity for IPO stocks.[13]

In summary, the test results in Table 4 support the idea that ownership dispersion improves the aftermarket liquidity. Specifically, both the number of non-block institutional shareholders and proportional blockholder ownership have significant effects on various liquidity measures in each of the three periods after IPO. However, the number of shareholders after IPO does not have much effect on market liquidity once we control for other factors. The overall results are consistent with Booth and Chua (1996).

4.3. Underpricing and liquidity

Now, we turn to the third question: does underpricing have any direct effect on liquidity? Although Booth and Chua (1996) suggest that underpricing affects aftermarket liquidity by promoting ownership dispersion, it is possible that underpricing may directly affect liquidity by attracting investors' attention as we discussed in the investor attention hypothesis in part 2.3.

As a coarse test, we divide the IPO sample into three sub-samples (hot, moderate, and cold) based on underpricing. The hot sub-sample includes IPOs with the largest underpricing and the cold sub-sample includes IPOs with the smallest underpricing. Then, we calculate and compare the average daily liquidity measures for the three sub-samples

[13] The results above are based on the whole sample from 1993 to 2000. To eliminate any possible effects of the technology bubble, we exclude the IPOs after 1999 and re-estimate all the regressions in Table 4. The unreported results, available from authors, are similar to those reported in Table 4.

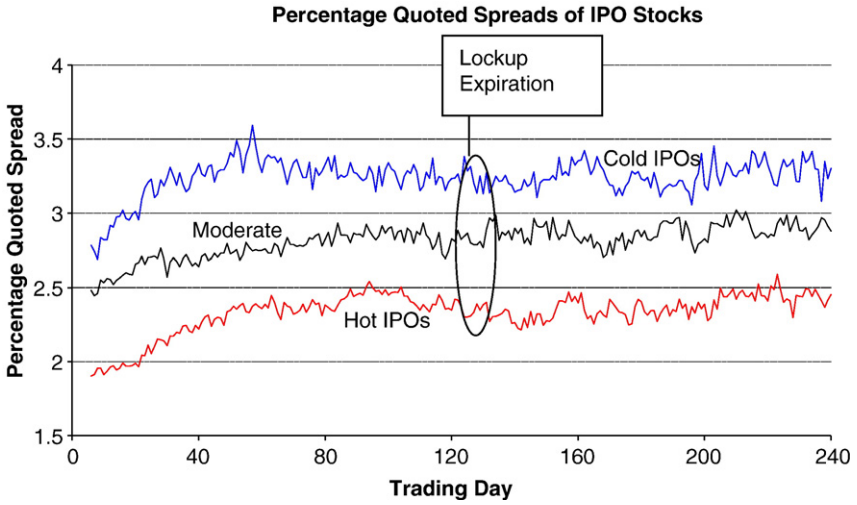

Fig. 2. Quoted spreads for IPO stocks in the year after offering. This figure shows the average percentage quoted spreads for cold, moderate, and hot IPOs over the 240 trading days (about 12 months) after IPO. Percentage quoted spread is calculated as quoted spread over closing price. The sample includes 1084 Nasdaq IPO stocks issued between 1993 and 2000. For each calendar year, we divide the IPOs into 3 groups (cold, moderate and hot) based on their level of underpricing. The three groups have approximately the same number of observations. We pool the cold IPOs in each year to form the cold IPO sub-sample. Using the same method we form the moderate and hot IPO sub-samples. The cold IPO sub-sample includes 361 IPOs. The moderate IPO sub-sample includes 362 IPOs. The hot IPO sub-sample includes 361 IPOs. The averages of percentage quoted spreads for each of the 3 sub-samples are calculated for each trading day.

from trading day 6 to trading day 240. Again we exclude the first five trading days due to the extremely large trading volume. To make sure that the average liquidity measures in different trading days are comparable with each another, we include only the IPOs with liquidity data available for all the 235 trading days. There are 1084 IPO observations in this test. The number of hot, moderate, and cold IPOs is 361, 362, and 361, respectively.

Fig. 1 shows the average trading volume adjusted by the number of shares outstanding for the three sub-samples. Hot IPOs have the highest trading volume for most of the 235 trading days. Cold IPOs have the lowest trading volume. This is consistent with the evidence reported in Reese (1998) and supports the investor attention hypothesis.

Fig. 2 illustrates the percentage quoted spreads for hot, moderate, and cold IPOs. The cold IPOs have the largest percentage quoted spreads and hot IPOs have the smallest during the 235 trading days. Although not reported in the figure, effective spreads show the same pattern across the three sub-samples. This indicates that underpricing is positively correlated with aftermarket liquidity. Fig. 3 shows the average quoted depth for the three sub-samples. Generally, quoted depths increase over time. However, hot IPOs have the lowest average quoted depth, while cold IPOs have the highest.

To further investigate how underpricing affects aftermarket liquidity, we run multivariate regressions. The dependent variables are the five liquidity measures discussed in part 4.2 of this section: Log V, Log Quoted Spread, Log Effective Spread, Log Depth, and Liquidity Index. The independent variables include underpricing, ownership structure measures, and other control variables used in Table 4.[14] Again we run regressions in the three periods (as discussed in Part 4.2) separately. The regression results are reported in Table 5.

Panel A of Table 5 reports the regression in Period 1. The coefficient of underpricing is positive and significant in Log V regression after controlling for ownership structure, firm size, and offering characters, but it is insignificant in all other regressions. This suggests that underpricing affects liquidity only through trading volume. The coefficients of the ownership structure variables are very similar to those in Panel A of Table 4.

Panels B and C report the regression results in Periods 2 and 3. The coefficients of underpricing are positively correlated with trading volume (Log *V*) in both Periods 2 and 3, and insignificant in other regressions (except the Log

[14] Hahn and Ligon (2004) run a regression for underpricing using price as an independent variable, then use the residual from the regression as independent variable to test the relation between spreads and underpricing. We also tried this method and find that it does not change the results if average aftermarket price is used to estimate residual initial return.

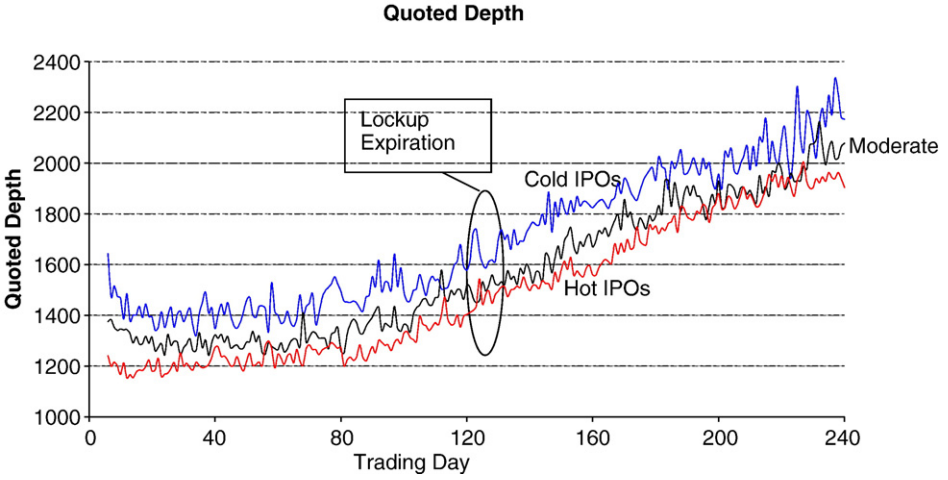

Fig. 3. Quoted depths for IPO stocks in the year after offering. This figure shows the average quoted depths for cold, moderate, and hot IPOs over the 240 trading days (about 12 months) after IPO. The sample includes 1084 Nasdaq IPO stocks issued between 1993 and 2000. For each calendar year, we divide the IPOs into 3 groups (cold, moderate and hot) based on their level of underpricing. The three groups have approximately the same number of observations. We pool the cold IPOs each year to form the cold IPO sub-sample. Using the same method we form the moderate and hot IPO sub-samples. The cold IPO sub-sample includes 361 IPOs. The moderate IPO sub-sample includes 362 IPOs. The hot IPO sub-sample includes 361 IPOs. The averages of quoted depths for each of the 3 sub-samples are calculated for each trading day.

Depth regression in Period 3). These results are generally consistent with those in Period 1. In both period 2 and period 3, the coefficients of ownership structure variables are similar to those in regressions without underpricing (as reported in Panels B and C of Table 4).

In summary, after controlling for ownership structure and other variables, underpricing is positively related to trading volume. This result is consistent and robust across the three periods after IPO. We do not find any consistent relation between underpricing and other liquidity measures. The evidence suggests that underpricing has some direct positive effect on the aftermarket liquidity and supports the investor attention hypothesis. We also notice that the relation between ownership structure variables and liquidity variables are not affected by the inclusion of underpricing in the regressions.

4.4. Robustness tests

Our tests cover a eight year period (1993–2000). Two main events occurred on Nasdaq during our test period, and these events had significant effects on liquidity. Order Handling Rule (OHR) was implanted on a phased-in basis beginning on January 20, 1997, and ending on October 13, 1997. The tick-size reduction became effective on June 2, 1997. The minimum quote size changed from $1/8 to $1/16 for stocks selling at prices equal to or greater than $10.

To capture the effects of these events, we divide our IPO sample into two sub-samples: pre-OHR/16th and post-OHR/16th. Since we use a one-year test window after offerings, the pre-OHR/16th sub-sample includes the IPOs coming to the market before January 20, 1996, i.e., one year before OHR began to be phased in. The total number of IPOs in the pre-OHR/16th sub-sample is 513. The post-OHR/16th sub-sample consists of 270 IPOs coming to the market after October 13, 1997, the last phase of OHR. We eliminate the IPOs coming to the market between January 20, 1996, and October 12, 1997, because the one-year test window for these stocks spans over either OHR or tick-size reduction.

We repeat the regression tests involving liquidity using both of the two sub-samples above. Although not reported in this paper, the results are similar to the results using the whole sample. In particular, we confirm the positive relation between the number of non-block institutional shareholders and trading volume and the positive relation between underpricing and trading volume in the two sub-samples.

We also re-estimate the regressions after replacing the Top-Tier Underwriter dummy with more underwriter ranking dummies (one dummy for each rank). But we find no significant difference in the results. Since we dropped twenty trading days around lockup expiration (trading day 121–140) in our earlier tests, we re-estimate all the liquidity regressions for the twenty trading days and find that the results are similar to those in Period 3.

Table 5
Underpricing and IPO aftermarket liquidity

Independent variables	Dependent variables				
	Log V	Log quoted spread	Log effective spread	Log depth	Liquidity index
Panel A. Regressions for Period 1					
Underpricing	0.16**	−0.01	0.00	−0.04	0.00
	(3.04)	(−0.20)	(0.13)	(−0.74)	(0.09)
Log NSH	−0.01	0.00	0.00	0.01	0.00
	(−0.65)	(0.20)	(0.58)	(0.58)	(−0.23)
BHO	−0.08	0.08**	0.08**	−0.08	−0.04**
	(−1.21)	(2.01)	(2.00)	(−1.21)	(−2.37)
INST	0.17	−0.07	−0.11	0.26*	0.08*
	(1.19)	(−0.77)	(−1.34)	(1.83)	(1.94)
σ^2	90.49**	10.47**	15.67**	−32.06**	1.10
	(13.70)	(2.32)	(3.73)	(−4.51)	(0.58)
Log MV	0.88**	−0.18**	−0.17**	−0.18**	0.16**
	(20.40)	(−5.66)	(−5.72)	(−3.50)	(12.84)
Log P	−0.52**	0.76**	0.79**	0.04	0.02
	(−8.55)	(19.13)	(21.39)	(0.58)	(0.91)
Float ratio	2.21**	−0.25**	−0.28**	−0.29	0.36**
	(13.29)	(−2.25)	(−2.64)	(−1.60)	(7.64)
Log V		−0.24**	−0.21**	0.07**	
		(−11.60)	(−11.13)	(2.04)	
Venture-backed	0.06	0.02	0.01	0.02	0.01
	(1.65)	(1.14)	(0.73)	(0.45)	(0.93)
Top-tier underwriter	0.04	0.03	0.01	−0.11**	−0.01
	(0.95)	(1.10)	(0.61)	(−3.00)	(−0.52)
Adj. R^2	0.659	0.469	0.504	0.093	0.460
Panel B. Regressions for Period 2					
Underpricing	0.32**	−0.01	0.02	−0.05	0.01
	(4.95)	(−0.26)	(0.67)	(−1.31)	(0.89)
Log NSH	0.00	−0.01	0.00	0.01	0.00
	(−0.09)	(−0.88)	(−0.65)	(1.07)	(1.10)
BHO	−0.19**	0.11**	0.09**	−0.01	−0.04**
	(−2.16)	(2.61)	(2.29)	(−0.23)	(−2.33)
INST	0.47**	−0.12	−0.18*	0.17	0.13**
	(2.44)	(−1.21)	(−1.96)	(1.49)	(2.99)
σ^2	85.98**	9.85**	14.86**	−15.38**	4.76**
	(9.97)	(2.29)	(3.71)	(−2.89)	(2.55)
Log MV	0.92**	−0.21**	−0.19**	−0.15**	0.14**
	(15.89)	(−6.89)	(−6.51)	(−3.89)	(11.12)
Log P	−0.53**	0.77**	0.78**	−0.04	0.00
	(−7.67)	(22.83)	(24.97)	(−0.90)	(0.31)
Float ratio	2.00**	−0.39**	−0.37**	0.05	0.36**
	(8.61)	(−3.42)	(−3.43)	(0.34)	(7.19)
Log V		−0.21**	−0.20**	0.00	
		(−13.28)	(−13.34)	(0.10)	
Venture-backed	0.10**	0.03	0.02	0.00	0.01
	(2.12)	(1.32)	(1.15)	(−0.05)	(0.57)
Top-tier underwriter	0.04	0.07**	0.05**	−0.02	−0.01
	(0.83)	(2.75)	(2.20)	(−0.66)	(−0.99)
Adj. R^2	0.554	0.557	0.590	0.138	0.437
Panel C. Regressions for Period 3					
Underpricing	0.31**	−0.03	−0.01	−0.06**	0.02
	(4.83)	(−0.91)	(−0.34)	(−2.31)	(1.31)
Log NSH	0.00	−0.01	0.00	0.00	0.00
	(−0.10)	(−0.70)	(−0.58)	(0.05)	(0.82)

(continued on next page)

Table 5 (*continued*)

Independent variables	Dependent variables				
	Log V	Log quoted spread	Log effective spread	Log depth	Liquidity index
Panel C. Regressions for Period 3					
BHO	−0.25**	0.00	0.01	−0.03	−0.02
	(−2.65)	(−0.05)	(0.17)	(−0.91)	(−1.17)
INST	1.09**	0.11	0.10	−0.24**	0.03
	(5.12)	(1.07)	(1.03)	(−3.05)	(0.78)
σ^2	59.27**	1.14	5.39	−7.80**	4.52**
	(8.33)	(0.32)	(1.65)	(−2.86)	(3.29)
Log MV	0.99**	−0.32**	−0.30**	−0.04	0.18**
	(15.16)	(−9.22)	(−9.22)	(−1.53)	(14.12)
Log P	−0.64**	0.84**	0.82**	−0.07**	−0.04**
	(−9.64)	(25.13)	(26.71)	(−2.72)	(−3.07)
Float ratio	1.53**	−0.55**	−0.56**	0.07	0.31**
	(5.45)	(−4.08)	(−4.47)	(0.68)	(5.83)
Log V		−0.16**	−0.15**	0.02*	
		(−9.76)	(−10.06)	(1.87)	
Venture-backed	0.35**	−0.02	−0.03	0.01	0.05**
	(7.03)	(−0.98)	(−1.36)	(0.38)	(4.94)
Top-tier underwriter	0.04	0.03	0.01	0.05**	0.01
	(0.72)	(1.22)	(0.54)	(2.39)	(1.05)
Adj. R^2	0.597	0.648	0.670	0.138	0.535

This table reports the results of regressions relating IPO aftermarket liquidity measures to underpricing. The data for regressions are collected from the SDC database, CRSP database, TAQ database, 10-K filings, proxy statements, and Form 13F filings. Dependent variables are listed in the 1st row. Log V is log of daily trading volume in number of shares; Liquidity index is calculated as the average of the fractional ranks of relative trading volume, percentage spread, percentage effective spread, and quoted depth. Independent variables are listed in the 1st column. Underpricing is calculated as (1st day closing price/offer price−1). Log NSH is log of number of shareholders after IPO; BHO is proportion of blockholder ownership after IPO; INST is the number of non-block institutional shareholders; σ^2 represents the variance of daily return; Log MV is log of market value of equity; Log P is log of share price; Log Float is log of number of shares offered in IPO; Venture-Backed is a dummy variable that equals 1 for IPOs backed by venture capitalists and 0 otherwise. Top-tier underwriter is a dummy that takes the value of 1 if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or more (Loughran and Ritter, 2004). Period 1 spans from trading day 6 to trading day 60. Period 2 ranges from trading day 61 to trading day 120. Period 3 covers trading days from 141 to 240. We take the averages of daily values in each period before taking the logarithm. The number of observations in the regressions for Periods 1, 2 and 3 are 896, 891, and 820 respectively. T-statistics are reported in parentheses. "**" and "*" represent statistical significance at 5% and 10% level respectively.

The data for the ownership structure after IPO come from different time points in the one-year window after offerings. For example, some IPOs have proxy statements issued in less than six months after offerings while others have proxy statements issued at a later date. Thus, these data are noisy to some extent. To find out whether this mismatching of time period affects our results, we re-estimate the liquidity measures for each IPO stock for the 60, 120, and 240 trading days after proxy statement dates and re-run the regressions. The results are qualitatively similar. Generally, the aftermarket liquidity is positively related to the number of non-block institutional investors and negatively related to blockholder ownership. In addition, we do not find any significant relation between the number of shareholders and the liquidity measures. We also run regressions using liquidity measures estimated for the 60, 120, and 240 trading days after 10-K dates and Form 13F dates and the results do not change significantly.

In our study, the number of observations varies considerably across tests because different tests require different data items and not all firms have all the required data. A possible concern is that the results may be affected by the variation in sample firms. To address this concern, we form a sub-sample which includes only firms with the required data items in all tests and re-run all the tests using this sub-sample. The results are qualitatively similar. Overall, we feel the robustness tests confirm the major results reported in Tables 3, 4, and 5.

5. Conclusions

In this paper, we examine the relations between underpricing, ownership dispersion and secondary market liquidity of newly issued stocks in the U.S. market. We find that underpricing is negatively related to changes in the total number

of shareholders but positively related to the number of non-block institutional shareholders after IPO. A possible interpretation is that underpricing is intentionally used to attract non-block institutional investors. In addition, we find that the number of shareholders after IPO is not correlated with the different market liquidity measures, but the number of non-block institutional shareholders is positively associated with market liquidity. The positive correlations between underpricing, the number of non-blockholding institutional investors, and after market liquidity is consistent with Booth and Chua's (1996) theory. We also find that underpricing has a direct effect on market liquidity. This effect is mainly captured by trading volume. The result provides partial support to the hypothesis that underpricing attracts the attention of investors and increases the number of potential traders.

One may be tempted to interpret the negative relation between underpricing and the change in the total number of shareholders as support for Stoughton and Zechner's (1998) hypothesis. However, consistent with Field and Sheehan (2004), we do not find any significant relation between underpricing and the change in blockholder ownership. Given that Stoughton and Zechner's (1998) hypothesis focuses on shareholder control, we do not think that the negative relation between underpricing and the change in the number of shareholders provides strong support for Stoughton and Zechner's (1998) hypothesis.

Although our paper uses only Nasdaq IPO stocks, there is no reason to believe that our results won't hold for NYSE and Amex IPOs. There is evidence that ownership dispersion is positively associated with market liquidity in NYSE and Amex (Heflin and Shaw, 2000). Thus, NYSE and Amex IPO firms also have the incentive to improve ownership dispersion. These IPO firms go through the same underwriting process, so underpricing can also be used to help achieve a dispersed ownership. Therefore we expect similar results for NYSE and Amex IPOs.

References

Aggarwal, R., 2000. Stabilization activities by underwriters after initial public offerings. Journal of Finance 55, 1075–1103.

Arugaslan, O., Cook, D., Keischnick, R., 2004. Monitoring as a motivation for IPO underpricing. Journal of Finance 59, 2403–2420.

Asquith, D., Jones, J., Kieschnick, R., 1998. Evidence on price stabilization and underpricing in early IPO returns. Journal of Finance 53, 1759–1773.

Barclay, M., Christie, W., Harris, J., Kandel, E., Schultz, P., 1999. Effects of market reform on the trading costs and depths of NASDAQ stocks. Journal of Finance 54, 1–34.

Bayley, L., Lee, P., Walter, T., 2003. IPO flipping in Australia: cross-sectional explanations. Working paper. University of New South Wales.

Booth, J., Chua, L., 1996. Ownership dispersion, costly information, and IPO underpricing. Journal of Financial Economics 41, 291–310.

Brennan, J., Franks, J., 1997. Underpricing, ownership and control in initial public offerings of equity securities in the UK. Journal of Financial Economics 45, 391–413.

Butler, W., Grullon, G., Weston, J., 2005. Stock market liquidity and the cost of issuing equity. Journal of Financial and Quantitative Analysis 40, 335–348.

Cao, C., Field, L., Hanka, G., 2004. Does insider trading impair market liquidity? Evidence from IPO lockup expirations. Journal of Financial and Quantitative Analysis 39, 25–46.

Carter, R., Manaster, S., 1990. Initial public offerings and underwriter reputation. Journal of Finance 45, 1045–1068.

Chan, K., Chirstie, W., Schultz, P., 1995. Market structure and the intraday pattern of bid-ask spreads for NASDAQ securities. Journal of Business 68, 35–60.

Christie, W., Schultz, P., 1994. Why do Nasdaq market makers avoid odd-eighth quotes? Journal of Finance 49, 1813–1840.

Easley, D., Kiefer, N., O'Hara, M., Paperman, J., 1996. Liquidity, information, and infrequently traded stocks. Journal of Finance 51, 1405–1436.

Ellis, K., Michaely, R., O'Hara, M., 2000. When the underwriter is the market maker: an examination of trading in the IPO aftermarket. Journal of Finance 55, 1039–1074.

Field, L., Hanka, G., 2001. The expiration of IPO share lockups. Journal of Finance 56, 471–500.

Field, L., Sheehan, D., 2004. IPO underpricing and outside blockholding. Journal of Corporate Finance 10, 263–280.

Habib, M., Ljungqvist, A., 2001. Underpricing and entrepreneurial wealth losses in IPOs: theory and evidence. Review of Financial Studies 14, 433–458.

Hahn, T., Ligon, J., 2004. Liquidity and initial public offering underpricing. Working Paper, FMA 2004 meetings.

Heflin, F., Shaw, K., 2000. Blockholder ownership and market liquidity. Journal of Financial and Quantitative Analysis 35, 621–633.

Huang, R., Stoll, H., 1996. Dealer versus auction markets: a paired comparison of execution costs on Nasdaq and the NYSE. Journal of Financial Economics 41, 313–357.

Johns, C., Lipson, M., 2001. Sixteenths: direct evidence on institutional execution costs. Journal of Financial Economics 59, 253–278.

Kini, O., Mian, S., 1995. Bid-ask spread and ownership structure. Journal of Financial Research 18, 401–414.

Lee, P., Taylor, S., Walter, T., 1996. Australian IPO pricing in the short and long run. Journal of Banking and Finance 20, 1189–1210.

Loughran, T., Ritter, J., 2002. Why don't issuers get upset about leaving money on the table in IPOs? Review of Financial Studies 15, 413–443.

Loughran, T., Ritter, J., 2004. Why has IPO underpricing changed over time? Financial Management 33, 5–37.

Mello, A., Parsons, J., 1998. Going public and the ownership structure of the firm. Journal of Financial Economics 49, 79–109.

Pham, P., Kalev, P., Steen, A., 2003. Underpricing, stock allocation, ownership structure and post-listing liquidity of newly listed firms. Journal of Banking and Finance 27, 919–947.

Reese, W., 1998. IPO underpricing, trading volume and investor interest. Working paper.
Sherman, A., Titman, S., 2002. Building the IPO order book: underpricing and participation limits with costly information. Journal of Financial Economics 65, 3–29.
Stoll, H., 2000. Friction. Journal of Finance 55, 1479–1514.
Stoughton, N., Zechner, J., 1998. IPO-mechanisms, monitoring and ownership structure. Journal of Financial Economics 49, 45–77.
Zingales, L., 1995. Insider ownership and the decision to go public. Review of Economic Studies 62, 425–448.