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# Warrants, ownership concentration, and market liquidity

Paul Brockman

*Department of Finance, Lehigh University, Bethlehem, Pennsylvania, USA, and*

Brett C. Olsen

*Department of Finance, University of Northern Iowa, Cedar Falls, Iowa, USA*

## Abstract

**Purpose** – Firms issuing equity securities for capital must recognize that this issuance may alter the ownership concentration of the firm. Through this change in ownership structure, the market liquidity of the firm's stock may also change, which has implications for the cost of equity capital and firm value. This paper aims to examine a specific security, the common stock purchase warrant, within this context. It also aims to posit that the decision to issue warrants has important implications for the firm's subsequent ownership structure and market liquidity.

**Design/methodology/approach** – The paper's unique dataset of warrant-issuing firms tracks the warrants from their issue through to their exercise. Based on the study of SEOs by Kothare, the ownership concentration and market liquidity of the underlying stock prior to and following warrant exercises are measured. The paper examines the causal relations between warrant exercises and ownership changes, and between ownership changes and market liquidity.

**Findings** – The paper shows that firms experience a statistically and economically significant decrease in ownership concentration following warrant exercises. Examining the liquidity effects of this change in ownership, it shows that market liquidity increases significantly after the exercise of warrants, consistent with the literature. The decrease in concentration following warrant exercises is experienced exclusively by firm insiders. The paper also finds that outsiders increase their holdings in firms with a high concentration of inside holdings and in firms with a low concentration of outside holdings prior to warrant exercises; that is, they use warrant offerings to increase their influence in the firm.

**Originality/value** – This study is the first to the authors' knowledge that investigates warrants through their entire life span, and the first to examine the effects of warrant exercises on the performance and market liquidity of the firm. The results contribute to securities issuance, ownership, and liquidity literatures.

**Keywords** Warrants, Option exercises, Ownership concentration, Liquidity, Shareholders

**Paper type** Research paper



## 1. Introduction

When managers decide to issue shares of stock they also take into consideration the effect that these new shares will have on the trading of the firm's stock. A more diffuse shareholder base leads to greater stock market liquidity because there is more potential

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shareholder participation in the market. Conversely, a more concentrated shareholder base results in lower liquidity because of the reduced number of potential traders. Kothare (1997) shows in her study of rights offerings vs public underwritten offerings (SEOs) that the method of equity issuance affects the liquidity of the issuing firm's stock through its effect on the firm's ownership concentration. In addition to rights offerings and SEOs, there are other methods of raising capital available to firm managers. This study examines a widely used fundraising instrument, common stock purchase warrants, and its effects on the market liquidity of the firm's underlying stock caused by subsequent changes in ownership concentration.

Firms offer warrants through various methods as part of public offerings and private placements, as well as part of stock and debt offerings. Depending on the method of issuance, warrants can alter the ownership structure of the firm during the exercise process. When managers consider adding warrants to an equity or debt offering, they also weigh the potential consequences that a change in ownership structure could have on the firm's underlying liquidity.

In this study, we examine market liquidity effects of warrant exercises for firms issuing warrants with stock from 1994 to 2004. We use a hand-collected dataset to identify firms that issue warrants as part of public equity offerings, including initial public offerings (IPOs). We study the period before and after warrant exercises to understand the change in ownership concentration. We then examine the resulting change in the market liquidity of the issuing firm's stock. Our main objective is to investigate the relation between a firm's ownership structure and the market liquidity of the firm's stock around warrant exercises.

Our empirical results show that ownership structure is significantly less concentrated after warrant exercises. The composition of ownership changes significantly as well, with a decrease in ownership concentration among inside equity holders, i.e. managers and directors who own shares of the firm. In contrast, outside owners (those holding 5 percent or more of the firm's outstanding equity) significantly increase their holdings in firms with high levels of inside ownership and in firms with low levels of outside ownership prior to warrant exercises. These results show that external blockholders use warrant exercises to increase their influence in the firm.

Next, we show that the market liquidity of the issuing firm's stock increases significantly following warrant exercises. These results are consistent with the ownership concentration and liquidity changes following publicly underwritten SEOs in Kothare's sample. Our findings are also consistent with those of Amihud *et al.* (2003). They examine changes in liquidity on the Tel Aviv Stock Exchange following warrant exercises and find that the dollar trading volumes increase following warrant exercises.

The extant literature finds that changes in ownership structure lead to changes in market liquidity. We estimate OLS regressions with the change in market liquidity as our dependent variable and changes in ownership as our main independent variable of interest. We also include changes in stock price, trading volume, stock return volatility, and firm size as control variables in these regressions. The results reveal a negative and significant relation between changes in a firm's inside ownership and changes in stock market liquidity. This finding means that the change in liquidity, due to the decrease in ownership concentration, is directly related to the transfer of inside ownership to a more diffuse external market. This transfer expedites the increase in market participants available to trade the issuing firm's stock.

Our study contributes to the security issuance, ownership concentration, and stock market liquidity literatures by examining the effects on stock market liquidity through changes in ownership structure caused by warrant exercises. To the best of our knowledge, this is the first study that investigates warrants through their entire life span (from issuance to exercise), as well as the first study to examine the liquidity effects of warrant exercises in the US market. Studying various forms of capital raising methods available to firms and their consequences broadens our understanding of the decisions and motivations facing corporate managers. The implications of this study apply directly to the choice of security design and its influence on firm value through liquidity and ownership structure effects.

## 2. Ownership concentration and market liquidity

Kothare (1997) argues that rights offerings impose other costs on the issuing firm, making them a less desirable financing method as compared to publicly underwritten offerings. Liquidity of the issuing firm's stock following the rights offering decreases, but liquidity increases following public underwritten offerings. These changes in liquidity correlate with changes in the ownership structure of the firm. With rights offerings, existing shareholders gain the rights to obtain additional shares. If the current shareholders retain and exercise their rights, the additional shares offered by the firm remain in the hands of existing shareholders and the ownership concentration of the firm will remain static. Conversely, we expect ownership concentration to decrease following public underwritten offerings, barring any major block purchases by existing shareholders. The firm offers additional shares to the public market, decreasing the likelihood that existing shareholders will hoard the new shares. Kothare's sample confirms the resulting changes in ownership concentration following the different equity offering methods. Based on these findings, managers take the ownership structure of the firm into consideration when determining the characteristics of the security offered in the market.

With a more concentrated ownership structure, there are fewer potential shareholders to participate in trading, thus reducing the liquidity of the firm's stock (Demsetz, 1968). In addition, market makers are likely to increase their spreads to offset the greater likelihood of trading against (concentrated) informed investors. Holmström and Tirole (1993) contend that higher ownership concentration leads to greater information asymmetry because of the reduced presence of stock market participants. This finding is confirmed by Lang *et al.* (2012) who show that the positive relation between firm transparency and market liquidity is stronger for firms with more concentrated ownership structures. Less liquidity from larger spreads means greater costs for firms issuing equity with a rights offering, providing a potential solution to the equity financing paradox[1]. Investors holding company stock with larger spreads require higher rates of return to compensate for the higher expected costs of trading (Amihud and Mendelson, 1986).

Heflin and Shaw (2000) examine the level of ownership concentration as represented by holders of large blocks of a firm's stock. They find that as the equity fraction held by blockholders increases, the information-related component of the spread increases and liquidity decreases. While Shleifer and Vishny (1986) argue that large shareholders help monitor management, increasing firm value, the presence of large blockholders reduces the liquidity of the firm's stock. Controlling blockholders in foreign firms capitalize on the increased liquidity following a cross-listing to reduce the costs of unloading shares (Ayyagari and Doidge, 2010).

### 3. Warrant offerings

Schultz (1993) contends that offering warrants at the IPO is similar to the staged financing structure of a venture capital-backed firm. If the firm can prove it has future economic viability, the market will reward the firm by increasing its stock price until the exercise price is reached, which releases the next “stage” of financing for the firm. Firms may also provide warrants as a quality signal (Chemmanur and Fulghieri, 1997). Several studies examine these two theories for warrants offered at the IPO (Jain, 1994; How and Howe, 2001) and find support for both theories. Firms that issue warrants are typically younger, smaller, and riskier than firms that issue shares alone. Byoun and Moore (2003) apply this argument to a sample of SEOs that offer warrants and find the same characteristics for warrant issuers.

Other research finds that including warrants reduces the costs associated with the equity offering. Dunbar (1995) shows that average underpricing is lower for offerings that include warrants compared to offerings without warrants. Abnormal returns are higher for SEO warrant offerings than SEOs offering only shares, consistent with the cost minimization theory (Byoun and Moore, 2003).

### 4. Warrant exercise and market liquidity

The issuance and subsequent exercise of warrants alter the ownership structure of the firm in different ways. Warrants as part of an overall equity offering do not alter the structure of ownership around the date of issuance of the underlying securities. Ownership concentration may change as warrant holders exercise their warrants. The degree of change depends on who owns the warrants when exercised. The warrant holders may not be the original investors in the equity offering. If we assume that outstanding warrants are diffusely held outside of the firm at exercise, then the number of shareholders remains the same while the fractional holdings by insiders and blockholders decrease when warrant holders exercise their warrants. Under this scenario, ownership concentration will decrease following warrant exercises for public offerings.

If we assume that large external blockholders hold warrants at exercise, then the concentration of ownership may not decrease. Depending on the degree of participation in the offering by concentrated investors, ownership concentration may increase when all warrant holders exercise. It is also possible that insiders own a substantial fraction of outstanding warrants and increase their ownership subsequent to exercise. This discussion highlights the complexity of how ownership “composition” prior to warrant issuance plays a role in the “concentration” of ownership after warrant exercise. We state our null hypothesis related to warrant exercises following public offerings as follows:

*H1.* For public equity offerings, ownership concentration will not change significantly following warrant exercises.

When warrant holders exercise their holdings, the liquidity of the issuing firm’s stock can change. The different effects of warrant issuance and exercise on the ownership structure provide a new test of the relation between ownership concentration and stock market liquidity. Kothare (1997) and others predict that a decrease in ownership concentration following warrant exercises will lead to increased liquidity. Wruck (1989) analyzes private placements of equity and finds a correlation between changes in firm value and changes in ownership concentration resulting from the equity sale. Similar to the nonlinear relation between ownership and firm value documented in

Morck *et al.* (1988), the relation between firm value and ownership concentration changes from positive to negative at the 5 percent ownership level, then back to positive at the 25 percent level. The purchaser of the equity also plays an important role. If the purchaser obtains a controlling interest in the firm, gains a seat on the firm's board of directors, or yields authority to firm management, the marginal effect on firm value is negative. Wruck's finding that ownership becomes more concentrated following a private placement of stock suggests that the liquidity of the firm's stock will decrease. Qian (2005) finds evidence to the contrary, showing that liquidity subsequent to a private placement does not significantly differ from pre-placement liquidity. We state the null of our second hypothesis as follows:

*H2.* A significant relation does not exist between the change in ownership concentration following warrant exercises and the change in liquidity of the issuing firm's stock.

Amihud *et al.* (2003) examine the exercise of warrants on the Tel Aviv Stock Exchange and its effects on the liquidity of a firm's stock. Their study looks at stock and warrants that are deep in the money at expiration. At the expiration date, trading of the two securities is consolidated as the firm issues additional shares against the expiring warrants. The warrant exercise is fully anticipated since market participants know the expiration date. This institutional structure provides an effective test of the liquidity effects of the trading consolidation of a firm's securities. The authors find that stock market liquidity improves and stock prices appreciate, on average, following warrant exercises.

## 5. Data and sample description

We obtain all domestic offerings of equity shares and warrants issued by public firms from Thomson Financial's SDC New Issues database that occur between 1994 and 2004. We eliminate firms without available SEC filings, and firms with missing price or financial data. Panel A of Table I describes the development of our sample firm set. The initial sample from the SDC database is 493 firms. We lose 110 firms from unavailable SEC filings, 181 firms from missing financial data, and 38 firms from missing pricing data. The final sample includes 164 firms[2].

For each firm, we review annual reports, beginning with the year of the security offering until warrant holders exercise their holdings or the warrants expire, and develop a timeline of warrant exercise, redemption, or expiration. The final sample includes 164 issues. IPOs dominate the final sample, accounting for 80 percent of all public equity offerings (131 of 164)[3].

### 5.1 Offering characteristics

Table I Panel B provides details of the warrants and underlying securities of the issues for our sample. The typical offering provides \$9.33 million in initial proceeds with an additional \$12.92 million expected from the future warrant exercise. Warrants account for over half (50.8 percent) of the firm's outstanding equity, which includes the shares offered at the issue. The average exercise price premium is 122 percent, i.e. the warrant exercise price is 22 percent above the IPO offering price for the shares. The average life of the warrant is about four years. Warrants typically cannot be traded or transferred for the first month after the offering, yet we must note the majority of the sample has

*Panel A: sample development*

	<i>n</i>
SDC public equity offerings, 1994-2004	493
LESS unavailable SEC filings	- 110
LESS missing financial data	- 181
LESS missing stock price data	- 38
Final sample	164
IPOs	131
SEOs	28
Rights	3
Preferred stock	2

*Panel B: summary of the offerings*

	<i>Full sample</i>	<i>IPOs</i>	<i>Others</i>	
<i>n</i>	164	131	33	
Offering characteristics				Other offering details
Offering proceeds	9.33	9.57	8.38	Percentage of issues offering:
Proceeds expected from warrant exercise	12.92	13.52	10.55	Units (shares + warrants) 84.6
Warrants as percent of equity	50.8	55.6	31.9	Redeemable warrants 63.8
				Secondary warrants 14.0
Warrant characteristics				Percentage of UNIT issues offering:
Exercise price premium (%)	122	124	115	Multiple shares per unit 21.4
Warrant life, in years	4.2	4.3	3.9	Multiple A warrants per unit 13.5
Days until tradable/ transferrable	27.2	29.8	16.8	
Days until exercisable	99.3	120.4	15.5	

**Notes:** This table provides details of the sample development (Panel A) and examines the offering characteristics for our sample of public equity offerings, issued from 1994 through 2004, as identified by SDC's New Issues database (Panel B); "offering proceeds" is based on the offer price and the number of individual securities offered, in \$ millions; "proceeds expected from warrant exercise" describes the potential proceeds if all warrants issued are exercised; "warrants as a percent of equity" equals the number of warrants offered divided by the sum of outstanding shares prior to the offering and the number of shares being issued in the offering; "exercise price premium" equals the warrant exercise price divided by the share or unit offering price on a per share basis

**Table I.**  
Summary of the  
sample offerings

immediately tradable warrants (median = 0). The offerings limit the warrant holders' ability to exercise for an average of three months.

Segregating our sample into IPO firms and all others (e.g. SEOs), we find some differences between the two subsamples. IPO firms offer a higher fraction of their outstanding equity as warrants, accounting for more than half, while non-IPO firms offer less than one third of their outstanding equity. IPO investors endure longer periods before their warrants are tradable and exercisable, while investors in other offerings wait less than three weeks.

Most of the issues (84.6 percent) offer shares and warrants as a package, commonly referred to as a "unit." The warrants are most often redeemable warrants, allowing the issuing firm to call the warrants after the stock price has traded above a specified level over a specified period. When warrants are redeemed, warrant holders have the opportunity to exercise their warrants before the redemption, which calls for the

firm to purchase the warrants at an extremely discounted price (e.g. \$0.10 or \$0.25). Thus, announcing the redemption of warrants is one way for the firm to force warrant exercise.

A small fraction of offerings (14.0 percent) issue more than one warrant type, typically one primary warrant and one secondary warrant. While the primary warrants (often called “A” warrants) provide the holder the right to buy one or more shares of equity at the exercise price, the secondary warrants (or “B” warrants) may provide the right to buy one or more shares of equity plus one or more “A” warrants. While the majority of unit offerings issue a simple package of one equity share and one warrant, less than one in four offerings issue more than one equity share within the unit. Also, 13 percent of the offerings issue more than one primary warrant within the unit. Typically, the secondary warrants have an exercise price higher than the primary warrants. The expiration date for these “B” warrants occurs after the “A” warrant expiration. Secondary warrants and units that include multiple warrants per unit provide the opportunity for additional stages of financing beyond the exercise of the primary warrants.

Table II describes the offering characteristics for sample firms that achieve warrant exercise (40 percent of our sample) compared to firms with warrants that expire unexercised. Firms that offer their warrants with a lower exercise price premium are more likely to have their warrants exercised, all else equal. Whether warrants are callable or not does not influence the likelihood of exercising. While most of our sample firms issue redeemable warrants, about one third of the subsample of firms that had their warrants exercised had issued callable warrants. Firms with unexercised warrants included a significantly larger portion of the redeemable sample (86.3 percent). A larger percentage of firms (32.6 percent) with exercised warrants originally issued more than one common share, higher than the 15.0 percent with unexercised warrants.

### 5.2 Firm characteristics

In this section, we examine the change in firm characteristics around the exercise of the outstanding warrants. We limit our sample to offerings that experience an exercise of the majority of their outstanding warrants before the warrants expire, resulting in a final sample of 66 firms. Table III reviews the characteristics of the final sample firms with exercised warrants, including the IPO subsample (53 firms) and all other sample firms (13), statistically comparing median firm traits for the fiscal year before warrant exercise to the fiscal year following exercise. Total assets increase significantly for the full sample and the IPO sample. As firms receive cash proceeds from warrant exercises, we expect the total assets to increase. Firms in the full sample and the IPO sample significantly increase their revenues across the warrant exercise time period by a factor of two.

The market-to-book (MTB) ratio decreases significantly for our full and IPO sample firms. The market’s perspective of the firms’ future prospects is notably pessimistic. If the stock price increases as warrant expiration approaches, we should not expect a decrease in the MTB ratio. This result is consistent with a price run-up prior warrant exercises, followed by a more normal pricing environment after warrant exercises. The price/sales ratio also decreases significantly for the full and IPO samples, reflecting an increase in sales.

In the far rightmost columns in Table III, we perform difference tests to examine how the IPO subsample compares to the rest of our sample prior to warrant exercises[4]. Our IPO firms have fewer assets, less long-term debt, lower leverage, and lower revenues. Return on

	All offerings	Warrants exercised	Warrants not exercised	Exercised vs not
<i>n</i>	164	66	98	
Offering characteristics				
Offering proceeds	9.33	9.06	9.51	0.38
Proceeds expected from warrant exercise	12.92	13.22	12.73	0.26
Warrants as percent of equity	50.8%	48.1%	52.6%	0.65
Warrant characteristics				
Exercise price premium	122.0%	117.0%	125.0%	1.96*
Warrant life, in years	4.2	4.2	4.2	0.27
Days until tradable/transferrable	27.2	24.0	29.4	0.67
Days until exercisable	99.3	89.5	105.8	0.59
Other offering details				
Percentage of issues offering				
Units (shares + warrants)	84.6	82.1	86.0	0.63
Redeemable warrants	63.8	30.8	86.3	8.20***
Secondary warrants	14.0	13.6	14.3	0.12
Percentage of UNIT issues offering				
Multiple shares per unit	21.4	32.6	15.0	2.18**
Multiple A warrants per unit	13.5	15.2	12.5	0.43

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table examines the offering characteristics for our sample of public equity offerings, issued from 1994 through 2004, as identified by SDC's New Issues database, comparing the offerings of firms that experience warrant exercises to the offerings of firms that do not; "offering proceeds" is based on the offer price and the number of individual securities offered, in \$ millions; "proceeds expected from warrant exercise" describes the potential proceeds if all warrants issued are exercised; "warrants as a percent of equity" equals the number of warrants offered divided by the sum of outstanding shares prior to the offering and the number of shares being issued in the offering; "exercise price premium" equals the warrant exercise price divided by the share or unit offering price on a per share basis; the rightmost column provides the *t*-statistic from the difference in means two-tailed test, comparing the means for the "exercised to not exercised" groups

**Table II.**  
Summary statistics  
of the offerings

equity is significantly lower for our IPO firms. Overall, the firms in our full sample and the IPO subsample are poor performers. Return on assets, return on equity, and earnings per share are negative throughout. These results are consistent with studies of warrant-issuing firms, noting that these firms are riskier than firms that do not issue shares.

Based on the characteristics of firms with exercised warrants, the market is not rewarding these firms with higher valuations after reaching the warrant exercise stage. Despite an increase in revenues, their continuing weak performance likely plays a role in the market's assessment of these firms[5]. If firm performance is higher for more liquid stocks, as suggested by the literature (Fang *et al.*, 2009), we should expect the market liquidity to decrease following warrant exercises, particularly for our IPO firms[6].

## 6. Changes in ownership structure

We quantify ownership concentration using measures employed by Kothare (1997). The first measure, beneficial ownership, represents the aggregate fractional holdings of all owners, internal and external to the firm, of at least 5 percent of the firm's outstanding shares. The second measure, inside ownership, represents the aggregate fractional



	Full sample ( <i>n</i> = 66)			IPOs ( <i>n</i> = 53)			Others ( <i>n</i> = 13)			IPOs vs others
	Pre-exercise	Post-exercise	Difference test	Pre-exercise	Post-exercise	Difference test	Pre-exercise	Post-exercise	Difference test	Pre-exercise
<i>Balance sheet</i>										
Market value	29.71	44.54	0.61	29.10	46.76	0.69	35.74	37.69	0.15	0.32
Total assets	12.46	44.46	3.17***	11.03	41.17	3.26***	35.03	55.06	0.77	2.35**
Long-term debt	0.22	0.73	1.43	0.12	0.57	1.57	1.50	2.25	0.10	2.43**
Debt/total assets	0.41	0.46	0.47	0.38	0.43	0.42	0.50	0.56	0.21	2.02**
<i>Performance</i>										
Revenue	13.12	25.88	2.46**	8.56	20.25	2.27**	25.26	34.20	1.08	3.14***
ROA	-0.09	-0.15	0.76	-0.24	-0.16	0.88	0.01	0.01	0.15	1.52
ROE	-0.11	-0.05	0.26	-0.36	-0.15	0.35	0.07	0.08	0.15	2.24**
EPS	-0.20	-0.21	0.55	-0.29	-0.32	0.80	0.05	0.24	0.28	1.49
Market-to-book	3.56	1.77	3.31***	4.30	2.00	3.45***	1.81	1.43	0.67	1.85*
P/E ratio	-1.96	-0.53	1.12	-2.82	-0.62	1.41	11.42	2.40	0.21	1.24
Price/sales	0.35	0.15	3.09***	0.87	0.19	3.02***	0.18	0.08	1.28	3.04***

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table examines the median financial characteristics for our sample, comparing the pre-warrant exercise period to the post-warrant exercise period for the full sample, the IPOs within the sample, and the non-IPOs; “market value” equals the stock price times the number of outstanding shares, in \$ millions; “total assets” and “long-term debt” are represented in \$ millions; “debt/total assets” equals the ratio of total debt to total assets; *Revenue* is represented in \$ millions; “ROA” is the return on assets, measured as net income divided by total assets; “ROE” is the return on equity, measured as net income divided by the book value of common equity; “EPS” is the earnings per share, in dollars; “market-to-book” equals the ratio of the market value of common equity, measured as above, to the book value of common equity; “P/E ratio” is the price to earnings ratio; “price/sales” is the ratio of the market value of equity to revenues; the “difference test” column within each panel provides the “Wilcoxon z-statistic” from the difference in medians two-tailed test, comparing the medians for “pre-exercise” to “post-exercise”; the last column provides the “Wilcoxon z-statistic” from the difference in medians two-tailed test, comparing the medians for the “IPOs” to “others” groups prior to warrant exercise

**Table III.**  
Financial characteristics of firms achieving warrant exercise

holdings of managers and directors of the firm. We add a third measure, outside ownership, which represents the aggregate fractional holdings of all external owners that own at least 5 percent of firm equity. The beneficial ownership measure overlaps with the inside ownership measure, requiring the outside ownership measure neglected by Kothare. By including the outside ownership measure we may learn more information about the composition as well as the concentration of the ownership structure of the issuing firm. Equity ownership data comes from SEC filings for the fiscal years before and after warrant exercises.

Table IV describes the changes in ownership structure for the sample, comparing pre- to post-warrant exercise. For the full sample, beneficial and inside holders of firm equity experience a significant decline in their fractional holdings following warrant exercises.

	Full sample ( <i>n</i> = 66)			IPOs ( <i>n</i> = 53)			Others ( <i>n</i> = 13)		
	Pre-exercise	Post-exercise	Difference test	Pre-exercise	Post-exercise	Difference test	Pre-exercise	Post-exercise	Difference test
Beneficial ownership	0.396	0.290	2.38**	0.445	0.305	2.74***	0.279	0.240	0.21
Inside ownership	0.312	0.196	2.79***	0.363	0.216	3.23***	0.205	0.169	0.15
Outside ownership	0.070	0.064	0.40	0.071	0.062	0.11	0.068	0.088	0.62

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table shows the median change in ownership for the full sample, the IPO subsample, and the non-IPOs subsample; only firms which have the majority of their warrants exercised are examined; we compare ownership variables from the year before warrant exercises to the year following warrant exercises; “beneficial ownership” equals the aggregate fraction of equity owned by all holders of at least 5 percent of firm shares; “inside ownership” equals the aggregate fraction of equity owned by directors and managers of the firm; “outside ownership” equals the aggregate fraction of equity owned by external holders of at least 5 percent of firm shares; the “difference test” column within each panel provides the “Wilcoxon z-statistic” from the difference in medians two-tailed test, comparing the medians for “pre-exercise” to “post-exercise”

**Table IV.**  
Changes in ownership  
structure

The average beneficial shareholder’s equity fraction decreases significantly from 0.396 to 0.290, and the average insider’s fraction decreases from 0.312 to 0.196. The average outside ownership does not significantly change. The IPO group follows a similar pattern. Beneficial ownership decreases from 0.445 to 0.305, and inside ownership decreases from 0.363 to 0.216, with both changes statistically significant at the 1 percent level. The remaining firms reveal no significant changes in ownership concentration. These results show that ownership concentration decreases after warrant exercises following IPOs.

The beneficial ownership measure includes all owners of at least 5 percent of the firm’s equity, which includes our outside ownership measure and a substantial portion of our inside ownership measure. The significant decrease in the beneficial and inside ownership numbers, coupled with the insignificant outside ownership change, shows that the ownership decreases are dominated by decreases in the ownership fractions held by insiders. IPO shares tend to be distributed diffusely in the market relative to the holdings before the IPO. The increased diffusion of ownership continues with the warrant exercise, further reducing the ownership concentration of the firm. External blockholders are not consolidating their holdings based on these results.

We examine ownership concentration further to determine if the composition of ownership is related to the change in the concentration of ownership. In Table V Panel A, we divide the sample into high (above median) and low (below median) beneficial ownership prior to warrant exercises. Ownership concentration, dominated by the insider holdings, significantly decreases in firms with both higher and lower beneficial ownership prior to warrant exercises.

Table V Panel B examines high vs low inside ownership. Beneficial and inside ownership significantly decrease in firms with both higher and lower inside ownership prior to warrant exercises. External ownership increases from 0.0 to 6.9 percent, significant at the 10 percent level. Firms with lower inside ownership show no significant changes in ownership concentration. This result shows that the greater the concentration

<i>Panel A: high vs low beneficial ownership pre-exercise</i>									
	Full sample			High beneficial ownership			Low beneficial ownership		
	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>
Beneficial ownership	0.396	0.290	2.38**	0.531	0.407	2.87***	0.253	0.146	2.16**
Inside ownership	0.312	0.196	2.79***	0.483	0.342	3.12***	0.192	0.131	2.37**
Outside ownership	0.070	0.064	0.40	0.057	0.069	0.51	0.076	0.063	0.03
<i>Panel B: high vs low inside ownership pre-exercise</i>									
	Full sample			High inside ownership			Low inside ownership		
	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>
Beneficial ownership	0.396	0.290	2.38**	0.498	0.407	2.28**	0.253	0.143	2.44**
Inside ownership	0.312	0.196	2.79***	0.486	0.382	3.82***	0.171	0.138	1.79*
Outside ownership	0.070	0.064	0.40	0.000	0.069	1.63*	0.105	0.063	1.25
<i>Panel C: high vs low outside ownership pre-exercise</i>									
	Full sample			High outside ownership			Low outside ownership		
	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>	<i>Pre-exercise</i>	<i>Post-exercise</i>	<i>Difference test</i>
Beneficial ownership	0.396	0.290	2.38**	0.386	0.305	1.51	0.409	0.282	1.91*
Inside ownership	0.312	0.196	2.79***	0.262	0.173	1.73*	0.441	0.252	2.51**
Outside ownership	0.070	0.064	0.40	0.143	0.146	0.55	0.000	0.000	1.89*

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table shows the median change in ownership for the full sample, examining ownership composition effects; only firms which have the majority of their warrants exercised are examined; we compare ownership variables from the year before warrant exercises to the same variables from the year following warrant exercises; “beneficial ownership” equals the aggregate fraction of equity owned by holders of at least 5 percent of firm shares; “inside ownership” equals the aggregate fraction of equity owned by directors and managers of the firm; “outside ownership” equals the aggregate fraction of equity owned by external holders of at least 5 percent of firm shares; we compare the changes in equity ownership for ownership levels above (high) and below (low) the median of ownership prior to warrant exercises; the “difference test” column within each panel provides the “Wilcoxon z-statistic” from the difference in medians two-tailed test, comparing the medians for “pre-exercise” to “post-exercise”

**Table V.**  
Changes in ownership structure based on ownership composition

of ownership of firm insiders, the more significant the diffusion of ownership that occurs as a result of warrant exercises. Notably, the significant increase in external ownership in the high inside ownership group implies that large external shareholders are benefiting from the ownership transfer from the insiders.

Table V Panel C provides a notable contrast to ownership changes compared to the first two panels. For high outside ownership firms prior to warrant exercise, the decrease in insider ownership is significant at the 10 percent level, but the change in beneficial ownership is indistinguishable from zero. However, firms with low outside ownership exhibit significant decreases in beneficial and inside ownership, yet a

significant increase in outside ownership (i.e. the mean outside ownership increases from 0.011 to 0.045). Similar to the high inside ownership group, the low outside ownership group results illustrate a transfer of ownership from the insiders to the outsiders. The decrease in beneficial ownership is large enough in spite of the significant increase in outside ownership, suggesting that the diffusion of ownership to the broader investor base is even stronger. We therefore reject the null hypothesis that ownership concentration does not change following warrant exercises.

We next compare our results to the findings of Kothare (1997). Table VI summarizes the contents of Table 2 from Kothare (1997) and our Table IV. Panel A shows that the ownership structure following rights offerings in Kothare's sample does not change in a statistically significant manner. By contrast, firms using public underwritten offerings (SEOs) experience a statistically significant decrease in ownership concentration, as measured by the decrease in beneficial and inside ownership.

In Panel B of Table VI, our results provide a new insight into the results of Kothare. In the full sample and the IPO offering group, the ownership by beneficial and inside equity holders significantly decreases in similar fashion to Kothare. Indeed, the absolute change in the equity fraction for Kothare's SEO sample and our IPO sample is very comparable. For beneficial owners, fractional holdings decrease by 0.123 for Kothare, 0.106 for our full sample, and 0.140 for our IPOs. For inside owners, our full sample shows a decrease in fractional holdings of 0.116, our IPO sample decreases by 0.147, and Kothare's sample decreases by 0.101.

Panel A: Kothare results

	Kothare Rights offerings			Kothare Public underwritten offerings		
	<i>Pre-ex- rights</i>	<i>Post-ex- rights</i>	<i>Change</i>	<i>Pre- offering</i>	<i>Post- offering</i>	<i>Change</i>
Beneficial ownership	0.365	0.404	0.039	0.264	0.142	-0.123***
Inside ownership	0.235	0.269	0.033	0.284	0.183	-0.101***

Panel B: our results

	Our study Full sample			Our study IPOs		
	<i>Pre- exercise</i>	<i>Post- exercise</i>	<i>Change</i>	<i>Pre- exercise</i>	<i>Post- exercise</i>	<i>Change</i>
Beneficial ownership	0.396	0.290	-0.106**	0.445	0.305	-0.140***
Inside ownership	0.312	0.196	-0.116***	0.363	0.216	-0.147***
Outside ownership	0.070	0.064	-0.006	0.071	0.062	-0.009

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table compares the mean change in ownership structure of Kothare (1997) in Panel A, compared to our median results in Panel B (the results are similar when comparing means); the event day for the rights offerings is the ex-rights date; the event day for the public underwritten offerings (SEOs) is the offering date; the event day for our study is the warrant exercise date; the asterisks denote whether the pre-event value is significantly different than the post-event value; "beneficial ownership" equals the aggregate fraction of equity owned by holders of at least 5 percent of firm shares; "inside ownership" equals the aggregate fraction of equity owned by directors and managers of the firm; "outside ownership" equals the aggregate fraction of equity owned by external holders of at least 5 percent of firm shares

**Table VI.**  
Ownership structure  
change vs Kothare (1997)

Although Kothare's study does not indicate whether the sample offerings include shares with warrants (although the preponderance of shares-only offerings over unit offerings suggests that this is likely) and we focus on warrant exercises following an equity offering, the scenarios provide comparable results. At the IPO, the issuing firm disperses shares to potential new investors in the market. If the IPO includes warrants, the new investors will also hold the warrants in their portfolios. If these new investors retain then exercise their warrants, the concentration of ownership will decrease even further following such exercises.

For a pure SEO (i.e. no warrants included), shares are diffusely sold to the market, resulting in a decrease in ownership concentration. If the SEO includes warrants, we expect this scenario will emulate the exercise of warrants following an IPO. Based on these results, we would expect the market liquidity of the issuing firms' stock in our sample to significantly improve as shown by Kothare.

### 7. Changes in market liquidity

We compare the market liquidity for the stock of issuing firms prior to warrant exercises to the market liquidity after warrant exercises. To measure market liquidity, we employ the illiquidity measure from Amihud (2002), a price impact estimate associated with one dollar of trading volume. While the extant literature has examined several measures of market liquidity, Hasbrouck (2009) finds that the Amihud measure provides the strongest correlation with a price impact measure using TAQ data[7]. Also, Amihud's illiquidity measure is calculated from readily accessible data, which is particularly important for our sample of mostly small, young firms. Illiquidity is measured as the ratio of the absolute value of the daily stock return to the dollar trading volume, averaged for each firm over all days within a specified time span. We calculate the average illiquidity over the pre- and post-warrant exercise periods, eliminating the top and bottom 1 percent of the distribution as recommended by Amihud[8].

Table VII provides the results of our liquidity analysis. We examine three time spans prior to and following warrant exercises: 100, 200, and 400 days. The 200-day span is most applicable to our study because the fiscal year ownership data is obtained from the 10-Ks filed within one year around the exercise date. For the full sample and for the IPO subsample in Panel A (we drop the remaining firms due to the small size of this subsample), the issuing firms realize a significant decrease in the illiquidity of their shares. That is, the market liquidity of firms issuing warrants significantly increases following the exercise of the warrants. Examining the 100-day comparison, the median illiquidity significantly decreases from 0.163 to 0.065 for the full sample, and from 0.152 to 0.052 for IPOs. We see a more pronounced decrease in illiquidity (i.e. an increase in liquidity) for the longer measurement windows. The 200-day period shows a drop in illiquidity from 0.319 to 0.101 for the full sample, and 0.288 to 0.084 for the IPO sample, both statistically significant at the 1 percent level. The 400-day period shows a decrease in illiquidity from 0.769 to 0.219 for the full sample, and 0.715 to 0.193 for the IPO subsample, both statistically significant at the 1 percent level. Overall, these results clearly show that the market liquidity of the issuing firm's stock increases significantly after warrant exercises.

In Table VII Panel B we look at how changes in our three measures of ownership affect the change in market liquidity. We compare the illiquidity change pre- to post-warrant exercise for firms with an above-median ownership change to firms with a below-median ownership change. For the 100-day span, for example, we see a significant

Panel A: change in illiquidity

Window	Full sample (n = 66)		IPOs (n = 53)	
	Pre- exercise	Post- exercise	Pre- exercise	Post- exercise
[-100, -1] - [0, +99]	0.163	0.065**	0.152	0.052**
[-200, -1] - [0, +199]	0.319	0.101***	0.288	0.084***
[-400, -1] - [0, +399]	0.769	0.219***	0.715	0.193***

Panel B: effects of changes in ownership on change in illiquidity – full sample

Window		Beneficial		Inside		Outside	
		Pre- exercise	Post- exercise	Pre- exercise	Post- exercise	Pre- exercise	Post- exercise
[-100, -1] - [0, +99]	Above median	0.186	0.092*	0.237	0.103*	0.165	0.088
	Below median	0.106	0.043	0.125	0.045*	0.086	0.041
[-200, -1] - [0, +199]	Above median	0.419	0.147***	0.360	0.156**	0.419	0.089***
	Below median	0.204	0.077**	0.264	0.070**	0.270	0.067
[-400, -1] - [0, +399]	Above median	0.817	0.220***	0.661	0.290**	1.026	0.220***
	Below median	0.422	0.188**	0.799	0.202**	0.394	0.159

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table describes the median changes in market liquidity for the full sample and the IPO subsample; only firms which have the majority of their warrants exercised are examined; we use illiquidity (Amihud, 2002) as our measure of market liquidity; a decrease in the value of illiquidity indicates an increase in the market liquidity of the issuing firm's stock; we compare illiquidity averaged over the pre-exercise period to the illiquidity averaged over the post-exercise period; "illiquidity" is measured as the ratio of the absolute value of the daily stock return to the dollar trading volume, multiplied by  $10^6$ ; Panel A examines the change in market illiquidity for the sample; Panel B examines the effects on illiquidity based on the change in ownership on the full sample, using our three ownership measures; the change in ownership denotes above or below the median ownership change; the asterisks denote whether the "pre-exercise" value is significantly different than the "post-exercise" value

**Table VII.**  
Changes in market  
liquidity

decrease in illiquidity for firms that experience an above-median change in beneficial ownership and for firms above and below the median change in insider ownership. As we increase the time spans to 200 and 400 days, we see significant decreases in market illiquidity for both above- and below-median changes in beneficial ownership. The same results occur with changes in inside ownership. Increases in outside ownership, represented by the above-median changes (the median is zero for outside ownership), show significant decreases in illiquidity. Illiquidity changes for firms with decreases in outside ownership, however, are not significant.

These results imply that the magnitude of the ownership change for the beneficial and inside measures does not drive the change in illiquidity. Our results confirm the idea that a decrease in ownership concentration is related to an increase in the firm's stock market liquidity. In addition, positive (above median) changes in external ownership are linked to significant increases in market liquidity, while negative (below median)

changes are not. These results directly reflect our hypothesis that decreases in ownership concentration lead to increases in stock market liquidity. The significant increase in market liquidity of the firms in our sample following warrant exercises is also consistent with Kothare (1997), who shows a significant increase in market liquidity following publicly underwritten offerings (SEOs). We next examine the effects of ownership concentration changes on market liquidity.

### 8. Ownership effects on market liquidity

Our second hypothesis considers the relation between the market liquidity of firms following a change in ownership concentration after warrant exercises. As described above, our univariate results are consistent with a negative relation between the change in ownership concentration and the subsequent change in market liquidity of the issuing firm's stock. Tables IV and V recount a significant decrease in ownership concentration, and Table VII shows a significant increase in market liquidity for our sample firms.

We analyze the relation between changes in ownership concentration and changes in the market liquidity of the firms' stock by running OLS regressions to test the direction and significance of the relation. Kothare (1997) regresses the change in liquidity on changes in ownership and finds a significantly negative relation between these two variables. Similarly, we regress the change in market liquidity on ownership changes. In contrast, we also include other determinants of stock market liquidity as control variables. Benston and Hagerman (1974) and Stoll (1978) show that the liquidity of a firm's stock is positively related to the stock's price and trading volume, and negatively related to the risk of the firm's equity (represented by stock return volatility). The stocks of large firms have greater liquidity than the stocks of smaller firms (Amihud and Mendelson, 1986). Thus, we add firm size as measured by total assets to evaluate the possible effects of firm size on market liquidity.

We again use illiquidity as our measure of market liquidity. Consistent with the literature, we expect negative coefficients for the price, trading volume, and firm size variables, and a positive coefficient for the volatility variable. We allow the model to provide the sign for the coefficient on the ownership variable. We examine the following functional relation:

$$\text{Illiquidity} = f(\text{Ownership}, \text{Price}, \text{Volume}, \text{Volatility}, \text{Firm size}).$$

Table VIII describes the results of the OLS regressions for illiquidity as the dependent variable, examining our three time spans. We perform one regression for each ownership measure[9].

The adjusted  $R^2$  values for our regressions range from 0.64 to 0.71. The  $F$ -values are sufficiently large to indicate statistically significant regressions at the 1 percent level[10]. In each regression, the price, volume, and volatility variables have statistically significant coefficients with the expected signs. The changes in price and trading volume are negatively related to the change in stock illiquidity. The change in return volatility is positively related to the change in stock illiquidity. Both results are consistent with the literature. The coefficients on firm size are not statistically significant in any of the regressions.

Within our 100-day window, the coefficient for the change in inside ownership is negative and significant. The coefficients for the other ownership measures – beneficial and outside ownership – are not significant. A significant coefficient for inside

	Window [-100, -1], [0, +99]	Window [-200, -1], [0, +199]	Window [-400, -1], [0, +399]
Beneficial ownership	-0.048		
Insider ownership	-0.512**	0.024	-0.106
Outside ownership			
Price	-1.190*** -1.192*** -1.232***	-0.086 -1.182*** -1.148***	-0.488 -1.392*** -1.279***
Volume	1.502***	1.523***	2.331***
Volatility	0.099	-0.065	-0.002
Firm size	-0.339**	-0.504***	-0.418**
Intercept	0.69	0.71	0.64
Adjusted R <sup>2</sup>	24.43***	28.14***	18.93***
F-value		23.76***	0.66
		19.65***	0.66
		19.58***	22.28***
			0.65
			22.20
			20.96***
			0.020
			-0.776**
			-0.850**
			-1.327***
			-1.243***
			2.304***
			2.356***
			2.251***
			-0.070
			-0.430**
			0.66
			22.20

**Notes:** Statistically significant at: \*10, \*\*5 and \*\*\*1 percent levels; this table describes the relation between changes in ownership and changes in market liquidity for the full sample; only firms which have the majority of their warrants exercised are examined; we perform OLS regressions on the following relation:

$$Illiquidity = f(Ownership, Price, Volume, Volatility, Firm size)$$

Each parameter is represented as the log ratio of the average value during the post-exercise period to the average value during the pre-exercise period; we perform the regressions using three pre- and post-exercise windows; "illiquidity" is measured as the ratio of the absolute value of the daily stock return to the dollar trading volume, multiplied by 10<sup>6</sup>; "ownership" represents the change in beneficial, inside, or outside ownership; "price" represents the change in stock price; "volume" represents the change in trading volume; "volatility" represents the change in the standard deviation of the firm's stock returns; "firm size" represents the change in total assets

**Table VIII.**  
Changes in ownership  
structure and the effects  
on market liquidity



ownership and not beneficial ownership, which includes inside and outside owners of at least 5 percent of a firm's equity, indicates that insiders drive the change in ownership experienced by a firm after warrant exercises. More specifically, we see a clear decrease in the ownership concentration of the firm's outstanding equity. This decrease in ownership concentration leads to an increase in the market liquidity of the issuing firm's stock. These results are consistent with the idea that increasing the number of market participants should increase trading activity and, thus, the liquidity of the stock. The results are also consistent with Kothare (1997) who finds a significant negative relation between the change in ownership concentration and the change in market liquidity. In a recent paper on rights offerings and shareholder takeover, Balachandran *et al.* (2012) also find that ownership concentration significantly decreases market liquidity.

### 9. Conclusion

When managers choose to issue new equity, their decision has ramifications for the trading characteristics of the firm's stock. New equity issues change the ownership structure of the firm, which in turn influences stock market liquidity. Kothare (1997) compares rights offerings and publicly underwritten offerings (SEOs) to show that a negative relation exists between ownership concentration and the market liquidity of an issuing firm's stock. We extend this analysis by examining the relation between liquidity and ownership concentration for firms that issue warrants as part of their capital raising efforts. This is the first study to our knowledge that examines firms that issue warrants from the initial issuance through their exercise and expiration.

We construct a hand-collected sample of firms that publicly issue equity with warrants and then focus on changes from pre- to post-warrant exercises. We find that ownership concentration significantly decreases after warrant exercises. More specifically, the ownership of firm insiders decreases, regardless of the degree of insider ownership prior to warrant exercises. The exercises of warrants continue the transfer of ownership from insiders to external market participants. We find that the composition of ownership also matters with our sample. Outside ownership increases significantly in firms with high levels of inside ownership and in firms with low levels of outside ownership before warrant exercises. This finding shows that outside equity holders increase their influence and control of the firm during the warrant offering. In contrast, insiders appear to be more interested in raising additional equity capital for the firm than in obtaining more control over the firm.

We also examine the effects of the change in ownership structure on the market liquidity of the issuing firm's stock. Using Amihud's illiquidity measure, we find that market liquidity improves significantly following warrant exercises. This result has important valuation implications since previous studies find a direct, causal relation between liquidity and the firm's cost of capital (Amihud and Mendelson, 1986; Diamond and Verrecchia, 1991). We find a negative relation between changes in ownership concentration and changes in firm liquidity. The decrease in ownership concentration following warrant exercises results in an increase in the liquidity of the firm's common stock. Furthermore, the change in liquidity occurs through the change in inside ownership. Beneficial ownership and outside ownership do not significantly change when examined in the multivariate setting. The fraction of equity held by insiders decreases during warrant exercises, thus decreasing ownership concentration and increasing firm liquidity.

Overall, our results are consistent with the equity paradox literature, notably Kothare (1997). Our findings also agree with Amihud *et al.* (2003), who find increased liquidity for stocks trading on the Tel Aviv Stock Exchange following warrant exercises.

## Notes

1. The equity financing paradox describes the preponderance of underwritten equity offerings despite the lower issuance costs associated with rights offerings. Several studies attempt to explain this anomaly (Smith, 1977; Hansen, 1989; Eckbo and Masulis, 1992).
2. Firms also issue warrants as a way to compensate underwriters, so-called, underwriter warrants. Issuing underwriter warrants as compensation is related to cost minimization when issued at the IPO (Dunbar, 1995) or the SEO (Ng and Smith, 1996), and a smaller effect on post-SEO performance (Bae and Jo, 2007). We cannot, however, determine if the presence of underwriter warrants in an offering influences the market liquidity of the issuing firms stock. For the firms in our sample with available prospectuses, most underwriters are offered warrants as a purchase option as part of their compensation. These warrants typically have the same exercise characteristics as the standard warrants offered to the public. Reviewing our sample firms, when we can distinguish between the baseline warrants and the underwriter warrants, the exercises occur together. We therefore are unable to parse out liquidity change effects (if any) for underwriter warrants separately.
3. The initial IPO sample includes corrections from Jay Ritter's IPO web site and from a review of prospectuses (Howe and Olsen, 2009). Prospectuses prior to May 1996 are largely unavailable online, requiring a review of subsequent SEC filings to fill holes in the data.
4. We identify these differences, yet we also recognize the small sample size of our non-IPO firms may limit the statistical power of this comparison. The results of our study are qualitatively unchanged if we remove the non-IPO firms from the sample.
5. Ursel (2006) shows that firms with successful rights offerings show improvement in their financial condition following shareholder takeup of the issue, suggesting that rights offerings are a viable method of raising capital for financially distressed firms. Our results are inconsistent with Ursel's findings and call into question the motives for using warrants as a capital raising instrument. Several studies investigate these motives (Chemmanur and Fulghieri, 1997; How and Howe, 2001).
6. To investigate the potential for industry-related effects, we adjust firms' financial characteristic values by their respective industry values. The most notable differences between industry-adjusted and non-adjusted results are that the changes in total assets and revenues lose their significance after industry adjustment. The MTB ratios, significant in both cases, are below the typical industry firm, showing that the market assigns lower values to our sample firms.
7. Goyenko *et al.* (2009) also support the use of Amihud's illiquidity to measure price impact. We also examine changes in trading volumes and the high-low spread estimator (HLSE) using the two-day high-low price approach in Corwin and Schultz (2012). We do not find statistically significant changes around warrant exercises for these alternative components of liquidity.
8. Our results remain quite similar if we do not eliminate the extremes of the distribution.
9. Our results do not change when we test for the effects of the move to 16ths and then decimals in minimum price changes that took effect in 1997 and 2001, respectively. We also find no significant change to our results when we add market trading volume as an explanatory variable to control for variations in market liquidity during our sample period.

10. We test for and verify within each of our models that multicollinearity is not an issue. In separate tests, we include the trading volume of the market as an explanatory variable to account for market-wide liquidity effects. The results are very similar to those presented herein.

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#### About the authors

Paul Brockman is Professor of Finance and Joseph R. Perella and Amy M. Perella Chair of the Department of Finance at Lehigh University. His research interests include corporate decision making and examining the context in which business decisions are made, implemented, and interpreted by capital markets.

Brett C. Olsen is Assistant Professor of Finance of the Department of Finance at the University of Northern Iowa. Research interests include corporate governance, boards of directors, securities issuance, ownership, and young firms. Brett C. Olsen is the corresponding author and can be contacted at: [brett.olsen@uni.edu](mailto:brett.olsen@uni.edu)

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