ELSEVIER Journal of Banking & Finance 25 (2001) 445–478

Journal of BANKING & FINANCE

www.elsevier.com/locate/econbase

Share repurchase tender offers and bid–ask spreads

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Received 25 January 1999; accepted 11 November 1999

Abstract

This paper examines the impact of share repurchase tender offers on the market microstructure. We find that there is a temporary reduction in the bid–ask spread, and a temporary increase in volume and quotation depth during the offer period. Our evidence suggests that the bid–ask spread is asymmetric during the offer period with the bid-side spread smaller than the ask-side spread. The temporary reduction in the spread around offers is consistent with the competing-market-maker hypothesis which predicts that the intensified competition for the market maker raises bid prices and narrows the spread asymmetrically during the offer period. © 2001 Elsevier Science B.V. All rights reserved.

JEL classification: G10; G12; G13

Keywords: Market microstructure; Bid–ask spreads and competition; Spread asymmetry; Risk arbitrage; Repurchase tender offers

1. Introduction

An extensive body of literature has been written on the impact of corporate share repurchases on stock prices. However, few studies investigate the

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PII: S0378-4266(00)00084-4

behavior of the market microstructure around share repurchase programs. Barclay and Smith (1988), Cook et al. (1995), Miller and McConnell (1995), and Wiggins (1994) study the bid–ask spread around open-market repurchases. Barclay and Smith suggest two different but not mutually exclusive hypotheses about the direction of spread changes around open-market repurchases: (1) increased information asymmetry caused by firms' expected buy-back activities widens the spread (the information asymmetry hypothesis); (2) competition between the firm and the specialist for the sell order flow narrows the spread (the competing-market-maker hypothesis). [1] Empirical evidence on the two hypotheses, however, is mixed at best. Based on yearly data, Barclay and Smith document a significant increase in the bid–ask spread following the repurchase announcement. More recently, using intraday data, Miller and McConnell as well as Wiggins find no evidence of a significant change in spreads. Cook, Krigman, and Leach report that the spread on a corporate purchase day is wider than the pre-announcement period but narrower than the adjacent trading days. Cook et al. interpret this result as evidence that open-market repurchases increase both information asymmetry and competition for the specialist.

Though they occur less frequently than open-market repurchases, repurchase tender offers, which include both fixed-price and Dutch-auction offers, have a much greater impact on the market because of the substantial offer volume and premium involved. [2] For example, Comment and Jarrell (1991), in measuring returns over the three days around the announcement day, report the average net-of-market returns of 8.3% for fixed-price offers and 7.5% for Dutch-auction offers, compared with 2.3% for open-market repurchases. However, we know very little about the empirical patterns of the market microstructure surrounding repurchase tender offers. The extensive literature on open-market repurchases does not provide useful clues in analyzing market microstructure around repurchase tender offers, because the two types of repurchases can have different impacts on market microstructure. For example, as illustrated by Barclay and Smith (1988) and Cook et al. (1995), the announcement of an open-market repurchase can aggravate the information asymmetry problem facing the specialist because of the expected share pur-

[1] According to the information asymmetry hypothesis, open-market buy-backs increase the probability that the specialist is trading with an informed trader, thus aggravating the information asymmetry problem facing the specialist. In response, the specialist protects himself from the potential loss to the informed by raising the bid–ask spread, which leads to a rise in the company's cost of capital. The competing-market-maker hypothesis claims that the limit buy orders submitted by the firm establish a lower bound for the specialist's bid price, thus narrowing the spread that the specialist quotes.

[2] For details, see Bagwell and Shoven (1989), Barclay and Smith (1988), and Comment and Jarrell (1991).

chasing activities by the firm. However, during repurchase tender offers, it is not clear whether such a problem exists for the specialist since firms are not involved in secondary-market trading.

Studying the behavior of market microstructure around repurchase tender offers is important because it can show how firms' attempts to buy back their own shares affect the trading behavior of different market participants. We are especially interested in trading activities by risk arbitrageurs and the resulting market-making activity by the specialist. We know that risk arbitrage activity increases substantially during the repurchase tender offer period. [3] Risk arbitrageurs can have strong incentives to buy shares from the market and tender them back to the firm because of large gaps between pre-expiration market and offer prices, and the considerable price uncertainties surrounding expiration. Examining how various market microstructure variables react to this unusual situation and how liquidity is affected can be in and of itself an interesting issue.

Our primary finding is that there is a reduction in the spread by as much as 20% (measured by the quoted as well as effective spreads) during the repurchase tender offer period. This significant reduction is temporary, in that the spread bounces back to its pre-offer level as soon as the offer expires. Further, each component of the spread (e.g., the adverse selection costs, or the order processing costs) decreases significantly during the offer period. We find no statistical difference in spreads between the pre-announcement and post-expiration periods. Depths and volume show substantial, but temporary, increases during the offer period. The temporary patterns of the reduction in the spread and the increases in volume and depths are virtually identical in both fixed-price and Dutch-auction offers.

The findings in our study are best explained by the competing-market-maker hypothesis. That is, share repurchase tender offers temporarily increased competition for the specialist who makes a market for the stock, thus decreasing the bid–ask spread during the offer period. The increase in competition seems to arise from the increased trading activities by risk arbitrageurs. We note that the increased trading activities by risk arbitrageurs tend to put pressure on the specialist's bid price. For instance, risk arbitrageurs often submit limit buy orders to compete against the specialist's bid. The intensified competition for the specialist's bid prices temporarily reduces the specialist's bid-side markup (the bid spread, as opposed to the ask spread) and causes an asymmetric reduction in the bid–ask spread. The analysis of price locations of trades indicates that a substantial portion of trades is executed below the quote midpoint, which is consistent with the notion that the competition predominantly on the dealer buy side leads to the asymmetric reduction in the spread.

[3] See Lakonishok and Vermaelen (1990), and Larcker and Lys (1987).

The pattern of price locations also suggests that competition for the market maker during the offer period is more intense for Dutch auctions than for fixed-price offers. This is consistent with the fact that Dutch auctions convey more uncertainty about offer outcomes and consequently attract more arbitrage trading.

The rest of the article proceeds as follows. Section 2 describes share repurchase tender offers and the differences between fixed-price and Dutch-auction offers. Section 3 discusses the testable hypothesis, the competing-market-maker hypothesis, and its predictions. Section 4 describes the sample. In Section 5, we present empirical results of changes in the spread, components of the spread, depth, and volume surrounding repurchase tender offers, and provide evidence consistent with the competing-market-maker hypothesis. Concluding remarks are provided in Section 6.

2. Tender offer repurchases

Tender offer repurchases take two forms, fixed-price and Dutch-auction offers. In a fixed-price offer, the firm specifies a single offer price, the amount and class of securities it seeks and the termination date of the offer [see Items (d) and (f) of SEC Schedule 13E-4]. If the number of shares tendered exceeds the maximum number initially sought, firms usually purchase these shares on a pro-rata basis, but if the number of shares tendered is fewer, firms may purchase all of the shares tendered at the offer price, extend the offer to solicit further tendering of shares, or even cancel the offer (although offer cancellations are rare). A Dutch-auction repurchase is similar to a fixed-price offer except for the way in which the firm sets the offer price and determines purchase price. In a typical Dutch-auction offer, the firm announces a range of prices rather than a single offer price. Individual shareholders then choose a price within the range and tender their shares at this price.

An undersubscribed Dutch-auction offer works just like an undersubscribed fixed-price offer. However, if the offer is oversubscribed, the firm chooses the lowest price at which it can buy back the number of shares it seeks. The firm then pays this price to all of the shareholders who have tendered at or below that price. For the tendering shareholders in a Dutch auction, the chance of tendered shares being accepted is an inverse function of tender prices. Too high a tender price reduces the chance of the tendered shares being accepted. Bagwell (1991) argues that this special property makes shareholders tender at their reservation prices. Thus, a Dutch-auction offer ensures that the firm does not overpay participating shareholders when an offer is oversubscribed. Hence, by choosing a Dutch auction rather than a conventional fixed-price offer, the repurchasing firm can put itself in a less risky position.

3. Competition for the market maker during repurchase tender offers

This section briefly discusses the competing-market-maker hypothesis and its implications for the behavior of spread, volume and depth around the repurchase tender offers.

During repurchase tender offers, competition for the specialist becomes intensified because risk arbitrage activity greatly increases during this period (see Lakonishok and Vermaelen, 1990; Larcker and Lys, 1987). Risk arbitrageurs enter the stock market to take advantage of large gaps between offer prices and pre-expiration market prices and the considerable price uncertainty surrounding the offer. [4] In our sample, the average market prices during the offer period are 6.3% (8.1%) below the average offer price for the fixed-price offers (Dutch-auctions). [5] Expected returns to these risk arbitrageurs can be substantial (See Section 5.9 for details). Arbitrageurs can submit either market or limit buy orders when they purchase shares in the secondary market. If the majority of them prefer a trading strategy to get the best obtainable price discount rather than a fast sell, limit buy orders are expected to increase substantially during the offer period. To the extent these limit orders are quote-improving, they increase competition against the specialist's own bid prices by establishing the lower bound. [6] On the other hand, the arbitrage activity during the offer period will have less impact on the specialist's ask prices than on the bid prices. Therefore, competition for the market maker will be intensified mainly on the bid side. [7]

The competing-market-maker hypothesis predicts a reduction in the bid–ask spread during the offer period, reflecting the increased competition in market making. In particular, the reduction in the spread should be observed primarily on the bid side because the intensified competition for the market maker comes primarily on this side. "Offer expiration" refers to the end of the intensified trading activity by risk arbitrageurs. Hence, we should observe that the bid–ask spread returns to its pre-offer level when the offer expires. Similar arguments apply to the quotation depth with the depth increasing temporarily during the offer period and then returning to its normal level afterwards.

[4] Not only do risk arbitrageurs help reduce potential mispricing but they also provide risk-bearing services to investors who would rather sell at a discount than bear the uncertainty about the offer outcome.

[5] We use the maximum offer prices in the calculation for Dutch auctions.

[6] According to the New York Stock Exchange (NYSE) rule, a quote-improving limit order price is given priority over the specialist's market quote.

[7] During repurchase tender offers, risk arbitrageurs play a role similar to that played by firms engaging in open-market repurchases. Barclay and Smith (1988) argue that firms engaging in open-market repurchases can intensify the competition by placing limit buy orders. Following Barclay and Smith, we call our hypothesis "the competing-market-maker hypothesis".

Tendering shares to the firm or holding shares beyond the expiration date exposes shareholders to a certain amount of risk. Therefore, it is likely that many shareholders sell their shares at a discount to risk arbitrageurs during the offer period, which implies abnormally high trading volume during the offer period. On the other hand, the same excess return that attracts risk arbitrageurs will induce some investors who would otherwise sell in the secondary market to tender their shares to the firm instead. Hence, the volume pattern during the offer period depends on which of the above two possibilities is dominant. Since the increased competition during the offer period disappears as the offer expires, trading volume is predicted to return to its normal level following the offer expiration. In subsequent sections, we examine changes in the spread, depth, and volume by using a sample of firms that conducted either fixed-price or Dutch-auction repurchase tender offers.

4. The sample

We obtain a list of the firms that conduct fixed-price or Dutch-auction repurchase tender offers during the period 1983–1992, and detailed information on each offer, by searching the Dow Jones News Retrieval Service (DJNS or Broad Tape). [8] Each firm is listed either on the NYSE or the American Stock Exchange (Amex). Altogether, we collect 92 fixed-price and 78 Dutch-auction repurchase offer announcements. From this initial sample, we select offers that meet the following criteria: (1) the offer is not cancelled; (2) a complete set of information regarding offer conditions and offer results is available; (3) no firm is delisted by the NYSE or the Amex, or merged into another firm as a result of the offer; and (4) the offer is not open only to odd-lot shareholders. We drop three Dutch-auction and nine fixed-price offers because either the offer is cancelled or the firm is delisted or merged into another company as a result of the repurchase. [9] We also exclude 18 fixed-price offers initiated by closed-end mutual funds. The final sample contains 65 fixed-price and 72 Dutch-auction repurchase offers.

Table 1 presents the characteristics of the firms that conduct share repurchase tender offers. The firms conducting Dutch-auction offers have

[8] The keywords include the repurchase identifying tag, or "BBK", provided by the DJNS.

[9] We identified four cancelled offers (two Dutch auctions, and two fixed-price offers) which are not due to stock delisting, or merger. For these stocks, the change in the spread around the repurchase tender offers is small. For example, for the two (cancelled) Dutch auctions, the average quoted spreads during the pre-offer, offer, and post-offer periods are 17.0, 16.1, and 17.3 cents, respectively. We found our results robust when the four cancelled offers were included in our sample.

Table 1
Characteristics of firms conducting repurchase tender offfers[a]

	Mean	S.D.	Min.	First Qtr.	Median	Third Qtr.	Max.
Panel A. Fixed-price repurchases							
Price (in $)	32.78	32.17	2.94	9.95	28.82	43.22	165.10
Shares outstanding (in 1000)	28,652	32,870	898	6257	15,193	35,347	120,590
Market capitalization (in $million)	1079	1492	17	49	507	1478	7243
Daily share volume (in 1000)	89.23	138.95	0.03	7.02	39.20	90.81	673.78
Panel B. Dutch-auction repurchases							
Price (in $)	39.66	26.40	1.67	22.33	33.46	48.84	133.00
Shares outstanding (in 1000)	51,063	62,754	1606	11,150	28,585	69,734	284,715
Market capitalization (in $million)	2146	2607	8	373	1197	2592	11,810
Daily share volume (in 1000)	154.23	182.49	1.23	23.15	88.67	212.65	913.16

[a] This table presents the cross-sectional distribution of the average daily closing prices, total number of shares outstanding, market capitalization, and average daily trading volume for the 65 firms conducting fixed-price repurchase tender offers and the 72 firms conducting Dutch-auction repurchase tender offers during 1983–1992. For a given stock, the averages are calculated from the 25-day period prior to the offer announcement.

almost twice the total number of shares outstanding, the market capitalization and daily share volume as the firms conducting fixed-price offers. The average number of outstanding common shares for the firms with fixed-price offers and for those with Dutch-auction offers are 29 million (median of 15 million) and 51 million (median of 29 million), respectively. Of the 65 fixed-price offers, the average market capitalization is $1079 millions and the average daily share volume is 89,230 shares. In contrast, these statistics are $2146 millions and 154,230 shares for the 72 Dutch-auction offers.

In Table 2, we describe the terms and results of the offers for our sample. For fixed-price offers, the average offer price is 17% higher than the pre-offer market price, which we define as the closing price on trading day -25 relative to the announcement day of the offer. Firms seek to purchase approximately 20% of their outstanding shares. The proposed cash distributions are equivalent to 23% of the pre-offer market value of the equity. On an average, shareholders tender 227% of the maximum number of shares sought. Firms purchase only 67% of the total number of shares tendered. The percentage of shares purchased to shares sought is 99%. The actual cash distributions are 22% of the pre-offer market value of equity,

Table 2
Characteristics of repurchase tender offers[a]

Characteristics of offer	Fixed price			Dutch auction		
	Mean	S.D.	Med.	Mean	S.D.	Med.
Offer premium relative to the closing price on day −25 relative to announcement (%)	17.3	13.3	16.0			
(i) When the maximum offer price used				16.4	11.3	13.1
(ii) When the minimum offer price used				0.3	10.3	−0.2
Actual purchase premium relative to the closing price on day −25 relative to announcement (%)				12.9	11.8	10.5
Percent of outstanding shares sought	19.5	14.2	15.7	17.1	9.9	14.9
Percent of outstanding shares tendered	37.1	29.9	26.1	19.2	19.2	14.5
Percent of outstanding shares purchased	18.8	14.4	14.7	15.2	9.8	14.2
Percent of shares tendered to shares sought	226.8	192.8	163.7	110.8	90.8	100.7
Percent of shares purchased to shares sought	98.9	30.2	100.0	86.8	24.6	100.0
Percent of shares purchased to shares tendered (proration rate)	66.5	33.4	77.5	90.4	17.9	100.0
Value of proposed repurchase relative to pre-offer market value of equity (%)[b]	23.4	16.8	18.2	20.0	11.6	17.5
Value of actual repurchase relative to pre-offer market value of equity (%)[c]	22.1	16.8	16.6	16.8	10.4	14.6
Duration of offer (trading days)	27	16	23	23	8	21

[a] This table presents summary statistics of the terms and outcomes of the 65 fixed-price and 72 Dutch-auction repurchase tender offers conducted from 1983 to 1992.
[b] (Maximum offer premium + 1) × % of outstanding shares sought.
[c] (Purchase premium + 1) × % of outstanding shares purchased.

slightly below the proposed amount.[10] The average offer duration is 27 days.

The last three columns of Table 2 present the offer characteristics of Dutch-auction repurchases. On an average, the range of the offer premium is from 0% to 16% above the pre-offer market prices. The average actual purchase premium is 13%, or the 78th percentile within the offer-price range. Firms that conduct Dutch-auction repurchases seek 17% of their outstanding shares. The average proposed cash distribution is equivalent to 20% of the pre-offer market value of the equity. The average tender rate is 111% and the firms buy back 90% of the shares tendered. The percentage of shares purchased to shares

[10] The actual cash distributions equal (maximum offer premium + 1) times percent of outstanding shares purchased.

sought is 87%, and actual cash distributions are 17% of the pre-offer market value of equity.

5. Empirical results

Daily stock price data used in this study are obtained from the Center for Research in Security Prices (CRSP) tapes. Intraday data for spreads, depths, and trading volume are from the ISSM transaction data files. We use a series of filters to screen the trade and quote data from the ISSM database: (1) All trades and quotes that are identified by ISSM as errors are excluded; (2) nonstandard delivery trades and all quotes that are not Best Bid and Offer (BBO)-eligible are discarded; [11] (3) quotes are excluded if they are originated from markets other than the primary exchange where the stock is listed; (4) all trades and quotes that are time-stamped before 9:30 a.m. or after 4:04 p.m. EST are also discarded. [12] We also exclude daily opening trades, which are made in a call market rather than a continuous auction market, from the analyses except for the analysis of trading volume.

For all announcements, the DJNS database provides time stamps to the minute. If the announcement of an offer is made after 4:00 p.m. EST, the next trading day becomes the announcement date. Otherwise, the announcement date is the day on which the announcement is first reported in the DJNS database. Similarly, if the announcement of offer results is made after 4:00 p.m. EST, the next trading day becomes the expiration date.

Throughout this paper, we define the pre-offer and post-offer periods as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively. The offer period is from the trading day immediately following the offer announcement date to the trading day prior to the offer expiration date. We use the trading day immediately following the announcement date as the starting date of the offer period due to the following reason. While for most offers in the sample, the announcement date is either the same day as, or one day prior to, the offer starting date, for some firms the offer starting date is two or more days prior to the announcement date. [13] In such a case, the announcement date, not the offer start date, is more likely to be a turning point when arbitrage buying activity begins. All information about

[11] BBO-ineligible quotes are closing quotations, trading halts, pre-opening indications, and nonfirm quotations.

[12] We use 4:04 p.m. instead of 4:00 p.m. as recommended by the ISSM. See ISSM manual.

[13] For example, on 8 June 1987, Tektronix announced a Dutch auction repurchase for 10 million shares of its common stock at the price range of $35–$40. The firm began to accept tenders from shareholders on 10 June 1987.

offer conditions is released at the announcement date. There is no apparent reason for risk arbitrageurs to wait until the actual offer starts. [14]

5.1. Price

Table 3 reports the average cumulative excess returns during the pre-offer and offer periods, and the average announcement-day returns. The excess return is calculated as the raw return net of the CRSP equal-weighted portfolio return. [15] The firms in our sample experience substantial announcement-day abnormal returns: the cross-sectional average is 7.5% for fixed-price offers and 6.6% for Dutch-auction offers. Of firms conducting fixed-price (Dutch-auction) offers, 78% (86%) of them have positive, abnormal announcement-day returns. [16] Using the *t*-test and the nonparametric sign-test, we test the null hypothesis that the average (or median) abnormal returns are zero. For both types of offers, the positive announcement-day abnormal returns are statistically significant at the 1% level. On the other hand, the average cumulative abnormal return is not significantly different from zero for the pre-offer and offer periods. This result holds true for both types of offers. Fig. 1 shows the cumulative abnormal returns from 50 trading days before the announcement date to 50 trading days after the expiration date. The figure reveals that the announcement effect is almost fully captured within the announcement day, which is consistent with semi-strong form efficiency.

In Table 3, we also present the price behavior around the expiration of the offer. The average expiration-day abnormal returns for both types of offers are negative (−2.4% for fixed-price offers and −1.8% for Dutch-auction offers) and significant at the 1% level using both *t*-tests and sign tests. The abnormal returns during the post-expiration period are not significantly different from zero. These results are consistent with the findings in the existing literature on repurchase tender offers, and suggest that our sample firms are representative. We now turn to the analysis of microstructure variables including the spread, depth and volume.

5.2. Quoted spread

We use the quoted spread for a round-trip trade in the analysis. We define the round-trip quoted spread as

[14] To check the robustness of the results, we repeated our analysis by using the offer starting day in the calculation, and found similar results.

[15] Results using the CRSP value-weighted portfolio return are qualitatively similar.

[16] Comment and Jarrell (1991) report average three-day announcement abnormal returns of 8.3% for fixed-price offers and 7.5% for Dutch-auction offers. Bagwell (1992) reports an average announcement-day abnormal return of 7.7% for Dutch auctions.

Table 3
Cumulative excess returns for sample firms[a]

	Event period				
	Pre-offer period ($ad-25$ to ad -1)	*ad*	Offer period ($ad+1$ to ed -1)	*ed*	Post-offer period ($ed+1$ to ed $+25$)
Panel A. Fixed-price offers					
Mean	0.93	7.45	1.98	−2.37	−1.08
Median	1.07	7.46	1.22	−1.18	−1.11
(p: t-test)[b]	(0.44)	(0.00)	(0.78)	(0.00)	(0.45)
[p: Sign test][c]	[0.35]	[0.00]	[0.46]	[0.00]	[0.48]
% positive	66%	78%	61%	28%	48%
Panel B. Dutch-auction offers					
Mean	−0.01	6.59	0.68	−1.81	−1.22
Median	−0.35	5.46	0.12	−1.25	−1.35
(p: t-test)[b]	(0.99)	0	(0.15)	0	(0.27)
[p: Sign test][c]	[0.91]	[0.00]	[0.19]	[0.00]	[0.08]
% positive	46%	86%	56%	32%	33%

[a] This table presents summary and test statistics for the cumulative excess returns net of the CRSP equal-weighted returns around share repurchases for 65 fixed-price and 72 Dutch-auction offers conducted by firms listed on the NYSE or Amex. The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date (*ad*) and 25 trading days subsequent to the expiration date (*ed*), respectively. The offer period is from the day subsequent to the offer announcement date to the day prior to the expiration date.
[b] p-Values are reported from the$t$-test of the null hypothesis that the average cumulative return is 0.
[c] p-Values are reported from the sign-test of the null hypothesis that the medium cumulative return is 0.

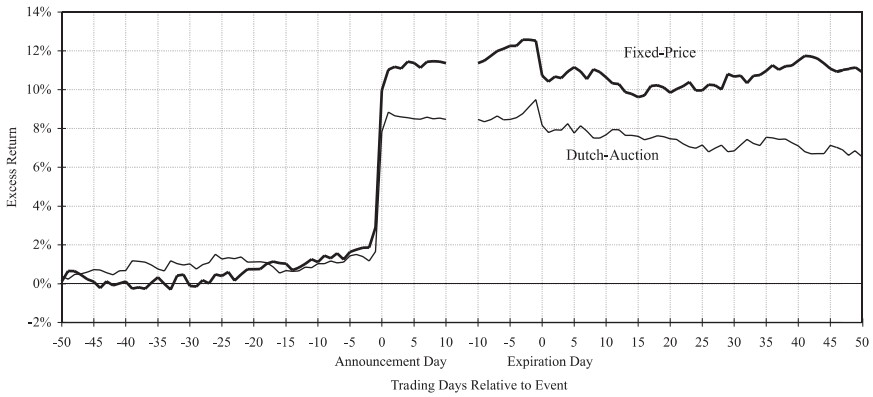

Fig. 1. Cumulative excess returns around repurchase tender offers.
Note: The figure plots the cumulative excess returns (net of the CRSP equal-weighted returns) around the share repurchase tender offers conducted from 1983 to 1992 (65 fixed-price and 72 Dutch-auction offers).

$$S_t = a_t - b_t, \tag{1}$$

where S_t is the quoted bid–ask spread, and a_t and b_t are the quoted ask and bid prices, respectively, at time t. We calculate the average spread on a given day as the time-weighted average of quoted spreads during the day as

$$\mathrm{AS} = \frac{\sum_{t=1}^{N}(T_{t+1} - T_t)S_t}{T_{N+1} - T_1}, \tag{2}$$

where AS denotes daily average spread, T_t the time in seconds at which the quote is posted by the specialist, T_1 the time when the first valid quote of the day is posted, and T_{N+1} the exchange closing time. [17]

Panels A and B of Fig. 2 plot the cross-sectional means of the quoted spread around the repurchase offers for fixed-price and Dutch-auction offers, respectively. They show that, for both types of offers, the quoted spread drops significantly subsequent to the announcement. The reduction in the spread is persistent during the offer period, but on the expiration day, the spread bounces back to approximately the pre-announcement level. The pattern of spread reduction appears to be uniform across both types of offers.

Table 4 presents the average quoted spread during the pre-offer, offer, and post-offer periods. For fixed-price offers, from the pre-offer to offer periods, the average quoted spread decreases by five cents from 25.9 to 20.9 cents (a 19% decrease) and, from the offer to post-offer periods, it increases by about five cents to 25.9. Similarly, in Dutch-auction offers, the average spread decreases by 5.8 cents from 26.5 to 20.7 from the pre-offer to offer periods (a 22% decrease). Then, the spread increases by 4.9 cents to 25.6 following the offer expiration.

To test the significance of changes in the spread, we use t-tests (and non-parametric sign tests) for the null hypothesis that the average (and median) spreads are equal between two periods. The test results show that both announcement and expiration spread changes are statistically significant. For both types of offers, the equality of the spread levels between the pre-offer and offer periods and between the offer and post-offer periods is strongly rejected at the 1% level (for both t-tests and sign tests). In addition, we examine the sign of changes in the spread. From the pre-offer to offer period, the sign of the spread change is positive for only 6% (4%) of firms, while from the offer to post-offer period, the spread change is positive for 81% (90%) of firms conducting the fixed-price (Dutch-auction) offers. Thus, majority of the firms experience a spread decrease from the pre-offer to offer period, and a spread increase from

[17] To eliminate possible recording errors, we exclude spreads that are greater than 20% of the quote midpoint. We also use several different filters, such as those suggested by Wiggins (1994), and find similar results.

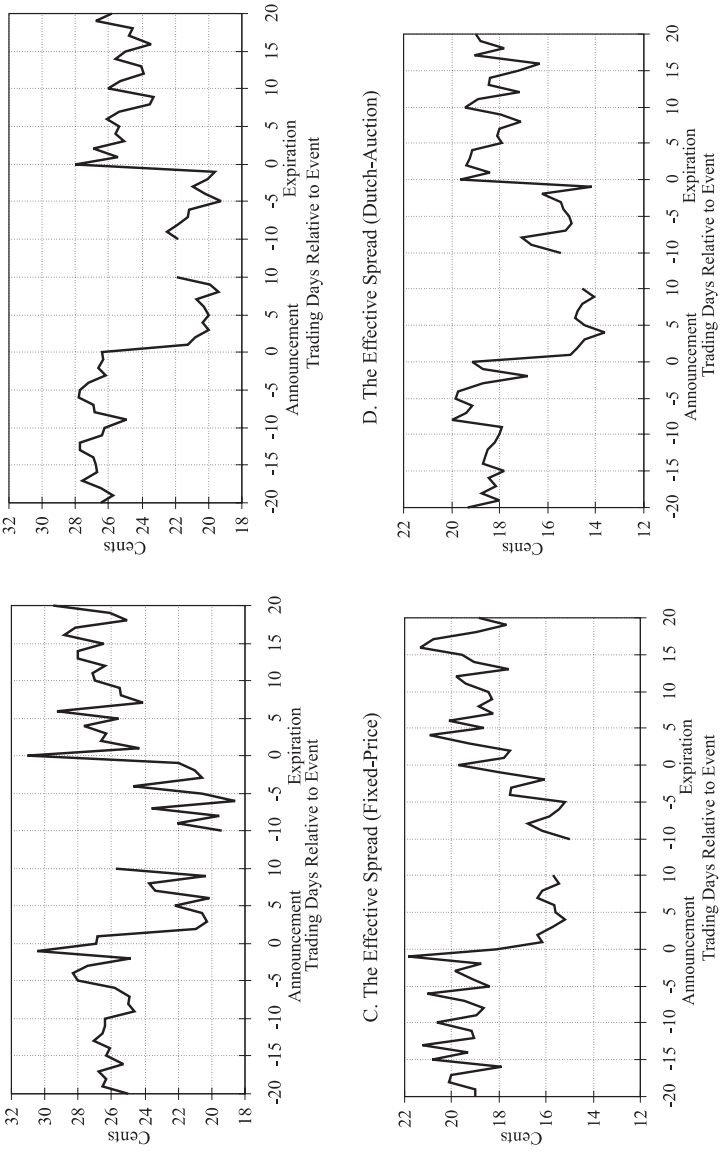

Fig. 2. Mean quoted and effective spreads in cents.

Note: The figures plot the cross-sectional means of the daily average quoted (effective) spread in cents around the announcement, and expiration dates of repurchase tender offers, 1983–1992. The daily average quoted spread is calculated as the time-weighted average of the quoted spread, which is the difference between the ask and bid prices. The daily average effective spread is calculated as the time-weighted average of the effective spread, which is defined as $2|p_t - q_t|$, where p_t is the price at time t and q_t is the quote midpoint in effect at t.

Table 4
The quoted spread in cents around repurchase tender offers[a]

	Event period			
	Pre-offer period ($ad-25$ to$ad-1$)	Offer period ($ad+1$ to $ed-1$)		Post-offer period ($ed+1$ to $ed+25$)
Panel A. Fixed-price offers[b]				
Mean	25.94	20.93		(25.91)
(S.E.)	(2.18)	(0.86)		(2.16)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.000	0.000	6%
H_0: Offer spread = Post-offer spread		0.000	0.000	81%
H_0: Pre-offer spread = Post-offer spread		0.982	0.999	54%
Panel B. Dutch-auction offers[b]				
Mean	26.50	20.73		25.56
(S.E.)	(1.55)	(1.22)		(1.67)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.000	0.000	4%
H_0: Offer spread = Post-offer spread		0.000	0.000	90%
H_0: Pre-offer spread = Post-offer spread		0.140	0.237	40%

[a] The quoted spread in cents is calculated as the difference between the ask and bid prices. The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively.
[b] Tests of the null hypothesis that there is no difference in quoted spreads between the periods; *p*-values are reported.

the offer to post-offer period. The test results between the pre- and post-offer spreads show that, in general, there is no statistically significant difference in the average (and median) spread between the two periods.

Besides quoted spread, we examine the percentage spread. It is calculated similarly as quoted spread, except that we replace quoted spread in Eq. (2) by quoted spread divided by the quote midpoint. The results for the percentage spread, which are reported in Table 5, are consistent with those for the quoted spread. For example, for fixed-price offers, the spreads are 1.18%, 1.01% and 1.21%, respectively, during the pre-offer, offer, and post-offer periods. The increase in the percentage spread is 14% from the pre-offer to offer periods, while the decrease is 20% from the offer to post-offer periods. Again, *t*-tests and sign tests reject the equality of the percentage spread between the pre-offer and offer periods, and between the offer and post-offer periods at 1% level. Collectively, the pattern of temporary reduction in the spread during the offer period is consistent with the explanation that repurchase tender offers induce a temporary increase in competition for the market maker.

Table 5
The percentage quoted spread around repurchase tender offers[a]

	Event period			
	Pre-offer period ($ad-25$ to $ad-1$)	Offer period ($ad+1$ to $ed-1$)		Post-offer period ($ed+1$ to $ed+25$)
Panel A. Fixed-price offers[b]				
Mean	1.18	1.01		1.21
(S.E.)	(0.16)	(0.14)		(0.16)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.000	0.000	4%
H_0: Offer spread = Post-offer spread		0.000	0.000	88%
H_0: Pre-offer spread = Post-offer spread		0.313	0.148	37%
Panel B. Dutch-auction offers[b]				
Mean	0.94	0.72		0.87
(S.E.)	(0.10)	(0.08)		(0.09)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.000	0.000	2%
H_0: Offer spread = Post-offer spread		0.000	0.000	88%
H_0: Pre-offer spread = Post-offer spread		0.120	0.064	18%

[a] The percentage quoted spread is calculated as the difference between the ask and bid prices as a percentage of the quote midpoint. The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively.
[b] Tests of the null hypothesis that there is no difference in % spreads between the periods; *p*-values are reported.

5.3. Effective spread

In many cases, quoted prices do not match the prices at which trades actually execute. Many studies, including Blume and Goldstein, (1992), Lee and Ready (1991), and McInish and Wood (1995), document that a significant portion of transactions execute within the posted bid and ask prices. Thus, the effective spread, which incorporates the possibility of trades executing between the bid and ask prices, is a better measure of actual transaction costs paid by investors than the quoted spread. We define the effective spread for a round-trip trade as

$$\mathrm{ES} = 2|p_t - q_t|, \tag{3}$$

where p_t is the transaction price at time t, and q_t the midpoint of bid and ask quotes in effect at t. Since trades are often reported with a lag (see Lee and Ready, 1991), we use quotes posted at least five seconds prior to the trade.

Panels C and D of Fig. 2 plot the cross-sectional means of the effective spread. The effective spread shows a similar pattern to that of the quoted spread. Table 6 presents the average effective spread around repurchase tender offers. Before the announcement of the offer, the average effective spread is 19.5 cents for fixed-price offers and 18.5 cents for Dutch-auction offers. Following the offer announcement, the effective spread falls by 3.5–16.0 cents for fixed-price offers (an 18% decrease) and by 3.8–14.7 cents for Dutch-auction offers (a 21% decrease). Subsequent to the offer expiration, the effective spread bounces back to its pre-offer level. It increases by 3.4–19.4 cents for fixed-price and by 3.6–19.4 cents for Dutch-auction offers. From the pre-offer to offer periods, the change in effective spread is positive for 15% (13%) of firms conducting the fixed-price (Dutch-auction) offers. In contrast, from the offer to post-offer periods, the fraction of firms with positive spread change is as high as 83% (76%). Both the *t*-test and the sign test show that the changes in the effective spread from the pre-offer to offer periods and from the offer to post-offer pe-

Table 6
The effective spread in cents around repurchase tender offers[a]

	Event period			
	Pre-offer period ($ad-25$ to $ad-1$)	Offer period ($ad+1$ to $ed-1$)		Post-offer period ($ed+1$ to $ed+25$)
Panel A. Fixed-price offers[b]				
Mean	19.53	16.02		19.44
(S.E.)	(1.94)	(1.24)		(1.49)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.003	0.000	15%
H_0: Offer spread = Post-offer spread		0.000	0.000	83%
H_0: Pre-offer spread = Post-offer spread		0.948	0.999	49%
Panel B. Dutch-auction offers[b]				
Mean	18.47	14.73		18.29
(S.E.)	(1.20)	(0.93)		(1.31)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.000	0.000	13%
H_0: Offer spread = Post-offer spread		0.000	0.000	76%
H_0: Pre-offer spread = Post-offer spread		0.764	0.135	36%

[a] The effective spread in cents is calculated as $2|p_t - q_t|$, where p_t is the price at time t and q_t is the midpoint of bid and ask quotes in effect at t. The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively.

[b] Tests of the null hypothesis that there is no difference in effective spreads between the periods; *p*-values are reported.

riods are significant, with p-values less than 0.01 for both types of offers. The reduction in the effective spread is also economically significant in that on average, investors pay approximately 3.5 cents less per share during the repurchase offer period. Further, Table 6 shows that the post-offer effective spread is not significantly different from the pre-offer effective spread for both types of offers.

As seen from Table 7, the above results hold true when the percentage effective spread is used in the analysis. Take the Dutch-auction offers as an example. The percentage effective spread is 0.82% during the pre-offer period, and 0.68% during the offer period (a 17% decrease). It then increases to 0.78% during the post-offer period (a 15% increase from the offer period). Therefore, after controlling for the price change from the pre-offer (or, the offer) to the offer (or the post-offer) periods, the percentage effective spread shows a pattern consistent with that of the effective spread.

Table 7
The percentage effective spread around repurchase tender offers[a]

	Event period			
	Pre-offer period ($ad-25$ to $ad-1$)	Offer period ($ad+1$ to $ed-1$)		Post-offer period ($ed+1$ to $ed+25$)
Panel A. Fixed-price offers[b]				
Mean	1.05	0.95		1.12
(S.E.)	(0.16)	(0.17)		(0.19)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.073	0.000	11%
H_0: Offer spread = Post-offer spread		0.056	0.000	83%
H_0: Pre-offer spread = Post-offer spread		0.431	0.635	29%
Panel B. Dutch-auction offers[b]				
Mean	0.82	0.68		0.78
(S.E.)	(0.14)	(0.13)		(0.14)
		t-Test	Sign test	% Positive
H_0: Pre-offer spread = Offer spread		0.000	0.000	7%
H_0: Offer spread = Post-offer spread		0.000	0.003	82%
H_0: Pre-offer spread = Post-offer spread		0.098	0.115	26%

[a] The percentage effective spread is calculated as $2|p_t - q_t|/p_t \times 100$, where p_t is the price at time t and q_t is the midpoint of bid and ask quotes in effect at t. The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively.

[b] Tests of the null hypothesis that there is no difference in effective spreads between the periods; p-values are reported.

The documented pattern of changes in the spread around tender offers contrasts with that for open-market repurchases. Barclay and Smith (1988) report an increase in the spread; while Miller and McConnell (1995) and Wiggins (1994) find no evidence of spread changes surrounding open-market repurchases. The difference in the two spread patterns can be explained by the different natures of the tender offers and open-market repurchases. As shown by Ikenberry et al. (1995), there is much less excitement around open-market repurchases, because the abnormal returns around the announcement are much lower than those around tender offers. Moreover, open-market repurchases are spread over a long time period and many firms end up buying much less shares than they initially sought. Therefore, arbitrageurs are less likely to be attracted to such opportunities.

5.4. The impact of volatility changes on spreads

Having presented empirical evidence showing a significant decrease in the spread from the pre-offer to offer periods, and a significant increase in the spread from the offer to post-offer periods, we now devote our attention to an important question: Is the change in the spread related to volatility changes during event periods? If so, is the change in the spread still significant after controlling for the change in volatility?

Indeed, return volatility changes dramatically during event periods. Measured by daily return standard deviation, return volatility decreases from 0.019 to 0.012 from the pre-offer to offer periods, and then increases to 0.018 from the offer to post-offer periods for fixed-price offers. Both changes are significant at 1% level using the t-test and sign-test. Similar results hold for firms conducting Dutch-auction offers. Controlling for the change in return volatility, we re-examine the significance of the change in the spread by using regression analysis. In this exercise, the dependent variable is the change in percentage spread (and percentage effective spread), and the independent variable is the logarithmic difference in daily return standard deviation. We use the percentage spread in the regression to minimize the impact of price level on our results. The regression model is estimated separately for firms conducting fixed-price and Dutch-auction offers.

We report estimation results in Table 8. The coefficient for the logarithmic difference in daily volatility is positive and significant at 5% for six regressions (out of eight). Thus, larger the change in volatility, larger the decrease in the percentage spread is from the pre-offer to offer periods, and larger the increase in the percentage spread is from the offer to post-offer periods. The R^2 ranges from 0.08 to 0.23. Further, the coefficient for the constant is generally significant at 5%. Its sign is negative (positive) when the dependent variable is percentage spread change from the pre-offer to offer (the offer to post-offer) periods. Although the spread change strongly relates to the volatility change,

Table 8
The cross-sectional regressions of changes in the percentage spread on changes in volatility[a]

Independent variable	Fixed price		Dutch auction	
	Difference in % quoted spread	Difference in % effective spread	Difference in % quoted spread	Difference in % effective spread
Panel A. From pre-offer to offer periods				
Intercept	−0.14*	−0.09**	−0.14*	−0.07**
Change in volatility	0.17**	0.21**	0.25**	0.13**
R^2	0.10	0.13	0.17	0.12
Panel B. From offer to post-offer periods				
Intercept	0.17*	0.16***	0.09*	0.06**
Change in volatility	0.11***	0.24***	0.13*	0.11**
R^2	0.08	0.10	0.23	0.10

[a] This table reports the coefficients for regressions of changes in the percentage spreads on changes in volatility measured as log differences in the standard deviations of daily returns from the pre-offer to offer periods and from the offer to post-offer periods for 65 fixed-price and 72 Dutch-auction offers. The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date (*ad*) and 75 trading days subsequent to the expiration date (*ed*), respectively. The offer period is from the day subsequent to the offer announcement date to the day prior to the expiration date.
* Statistical significance at the 1%.
** Statistical significance at the 5%.
*** Statistical significance at the 10%.

the decrease (or increase) in the spread is still significant after we control for the volatility change (see the estimated coefficient for the constant). Take the fixed-price offer as an example. When the dependent variable is the change in percentage quoted spread from the pre-offer to offer periods, the estimated constant is −0.14%, which is significant but smaller than the 0.17% spread reduction reported in Table 5. For the percentage effective spread, the reduction is 0.09% (0.20%) from the pre-offer to offer periods after (before) controlling for volatility change. Collectively, our evidence supports the view that the spread change is associated with a simultaneous change in volatility during the event period, and that the spread change is still significant after controlling for the volatility change.

5.5. Components of the spread

So far we have demonstrated a significant change in the bid–ask spread during offer period, we now take a closer look at the components of the spread. [18] As is standard in the literature, the bid–ask spread can be decomposed into two components, the costs associated with information asymmetry

[18] We are grateful to an anonymous referee who suggested this analysis.

(e.g., the adverse selection costs), and the costs charged by market makers (e.g., the order processing costs). The order processing costs include transaction costs, inventory costs, costs for bearing risk, and trading profit. We address three related questions in this subsection: (1) Is the reduction in the spread caused by the reduction in each component of the spread? (2) If both components of the spread decrease, which one experiences a larger reduction during the offer period? and (3) Is there any difference in the change of the adverse selection component between fixed-price and Dutch-auction offers?

Clearly, the offer period is unique in that large transactions at a known price (for fixed-price offers) or a nearly known price (for Dutch-auction offers) are anticipated. Thus, it is expected that the adverse selection costs will decline during the offer period. The order processing cost is predicted to decline, too, because of the increased competition in market making during the offer period. Further, since the purchase price is not known until the offer expiration, Dutch-auction offers expose tendering shareholders to greater uncertainty. Therefore, we hypothesize that the reduction in the adverse selection costs will be less for Dutch-auction offers than for fixed-price offers. Conversely, the greater uncertainty about the offer outcome under Dutch auctions can attract more risk arbitrageurs, who in turn help reduce the price uncertainties and mitigate the adverse selection problem during the offer period. Therefore, it is an open empirical question of which type of offer experiences a greater reduction in the adverse selection costs. We begin our discussion with a brief description of spread decomposition models, which we use to estimate components of the spread.

In recent microstructure literature, Glosten and Harris (1988) (GH), and Madhavan et al. (1997) (MRR), among many others, have developed structure models for the transaction price and bid–ask quotes. These models share a similar structure of the price dynamics and the decomposition of the spreads. The difference between these models are in the assumptions about order flow. The GH model assumes that order flow is serially uncorrelated and thus information contained in the previous trade does not affect the following transaction. The MRR model extends the GH model by considering correlated order flows. Both models produce estimates of order processing costs and adverse selection costs. We choose the GH model for the primary analysis. The estimation results from the MRR model are qualitatively similar to those from the GH model, and are available upon request.

In the GH model, a process of the expected value of the stock price and a process of the bid and ask prices are jointly specified. Consider the price and bid–ask quote generating process for one stock. Let I_t denote a trade indicator where $I_t = 1$ if the trade at t is buyer-initiated, -1 if seller-initiated, and 0 if both buyer- and seller-initiated. Further, let μ_t be the post-trade expectation of the value of the stock conditional on public information and the trade initiation variable I_t. The innovation in beliefs between $t-1$ and t due to new public

information is ϵ_t. Let p_t^a and p_t^b be the market maker's ask and bid prices at t conditional on the trade initiation variable at t. The model with unitary volume is

$$\mu_t = \mu_{t-1} + \theta I_t + \epsilon_t, \tag{4}$$

$$p_t^a = \mu_t + \phi \quad \text{if } I_t = 1, \tag{5}$$

$$p_t^b = \mu_t - \phi \quad \text{if } I_t = -1, \tag{6}$$

where θ measures the adverse selection cost per share, and ϕ is the order processing cost per share. We assume that a trade is executed at the middle of the bid and ask if it is not executed at the bid or ask price. The price generating process is given as follows:

$$p_t = \mu_{t-1} + \theta I_t + \phi I_t + \epsilon_t. \tag{7}$$

Then, the change in the price can be written as

$$p_t - p_{t-1} = -\phi I_{t-1} + (\phi + \theta) I_t + \epsilon_t. \tag{8}$$

We estimate components of the spread, θ and ϕ, by using the regression. [19] The estimation is done for each firm and for each period (i.e., the pre-offer, offer, or post-offer period). The cross-sectional averages of the cost components of the spread are reported in Table 9. According to Panels A and B of Table 9, for both fixed-price and Dutch-auction offers, there is a significant decrease in the adverse selection and order processing costs from the pre-offer to offer periods, and a significant increase in both costs from the offer to post-offer periods. For the fixed-price offers, for example, the adverse selection costs are, on average, 1.76, 0.79, and 1.92 cents per share, respectively, for the pre-, offer, and post-offer periods. [20] For ϕ, the order processing costs, the averages are 7.06, 6.53 and 7.75 cents per share, respectively, for the three periods. This result is consistent with the view that the adverse selection costs should decline during the offer period because of the reduction in price uncertainty – the offering price is known for fixed-price offers or nearly known for Dutch-auction offers. Our result also suggests that the competition in market making is intensified during the offer period. As a result, the order processing costs charged by market makers decrease. Although both components of the spread change dramatically during the offer period, the decrease in the adverse selection costs, in percentage term, is far more pronounced than that in the order processing costs is.

[19] The parameters θ and ϕ can also be estimated by using the generalized method of moments (GMM). The estimated parameters from the GMM are the same as those from the regression, but the estimated standard errors are different.

[20] The corresponding estimates from the MRR model are 1.38, 0.61, and 1.55 cents per share, respectively.

Table 9
The cost components of the spread around repurchase tender offers[a]

Period	θ (cent)		p-Value from Wilcoxon two-sample test (H_0: $\theta_{Fixed} = \theta_{Dutch}$)	ϕ (cent)		p-Value from Wilcoxon two-sample test (H_0: $\phi_{Fixed} = \phi_{Dutch}$)
	Fixed price	Dutch auction		Fixed price	Dutch auction	
Panel A. Adverse selection cost(θ) and order processing cost(ϕ) of the spread						
Pre-offer	1.76	2.05	0.698	7.06	7.51	0.212
Offer	0.79	0.83	0.659	6.53	6.72	0.326
Post-offer	1.92	1.69	0.337	7.75	7.50	0.740
	Change in θ's (cents)		p-Value from Wilcoxon two-sample test (H_0: $\theta_{Fixed} = \theta_{Dutch}$)	Change in ϕ's (cent)		p-Value from Wilcoxon two-sample test (H_0: $\phi_{Fixed} = \phi_{Dutch}$)
	Fixed price	Dutch auction		Fixed price	Dutch auction	
Panel B. Changes in cost components of the spread						
Pre-offer to offer	−0.97*	−1.22*	0.985	−0.53*	−0.79*	0.227
Offer to post-offer	1.13*	0.86*	0.454	1.22*	0.78*	0.723
Pre-offer to post-offer	0.16	−0.36***	0.322	0.69	−0.01	0.448

[a] The adverse selection cost(θ) and the order processing cost(ϕ) in cents are estimated using the Glosten and Harris, 1988 model, separately for each offer type and for each period. The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively. Panel A presents the cross-sectional means of the estimates of each cost component. Panel B presents the changes in the estimates from one period to another.

* Statistical significance at the 1% level, from the t-test of the null hypothesis that the mean change is 0.

*** Statistical significance at the 10% level, from the t-test of the null hypothesis that the mean change is 0.

Another interesting comparison is the difference in the adverse selection costs (and the change in the adverse selection costs) between firms conducting fixed-price and Dutch-auction offers. According to Table 9, the average adverse selection costs are 1.76 and 2.05 cents, respectively, for fixed-price and Dutch-auction offers during the pre-offer period. This difference is, however, insignificant based on the Wilcoxon two-sample test. During the offer period, the adverse selection costs are 0.79 and 0.83 cents, respectively, for each type offers. While the adverse selection costs are slightly higher for Dutch auctions, this difference between the two types of offers is not significant. Finally, the difference in the change of the adverse selection costs from the pre-offer to offer periods is not statistically significant. Therefore, there is little evidence of more information asymmetry (or less reduction in information asymmetry) for Dutch-auction offers based on our sample firms. [21]

5.6. Trading volume

We now turn our discussion to trading volume. Table 10 presents the daily abnormal trading volume around repurchase offers. Following Lakonishok and Vermaelen (1990) and Bagwell (1992), we measure daily abnormal volume as the ratio of the number of shares traded on a given day to the average daily number of shares traded during the control period. The control period is defined as trading days -50 to -25 relative to the offer announcement. We perform t-tests and sign tests for the null hypothesis that the volume ratio on any given trading day (or period) is not different from one. While the t-test is more powerful under the normality assumption, the nonparametric sign-test is more robust since the distribution of the ratio is skewed.

The mean and median volume ratios reported in Table 10 show that, prior to the repurchase announcement, trading volume is not qualitatively different from the normal period volume. On the announcement date, trading volume approaches 688% and 585% of the control-period volume for the fixed-price and Dutch-auction offers, respectively. This increase in volume is significant at the 1% level based on both the sign-test and the t-test. During the period between the offer announcement and its expiration, trading volume is about 260% of the control-period volume for both types of offers, and the increase is significant at the 1% level. The substantial increase in trading volume during the offer period suggests that traders are willing to sell their shares at a discount to risk arbitrageurs rather than to bear the risk associated with a post-offer drift in the market price. Recall that two offsetting factors affect trading volume during

[21] As a caveat, it is worthwhile to point out that the comparison of θ between the two types of offers is not perfect, since firms conducting fixed-price offers are not perfectly matched with firms conducting Dutch auctions.

Table 10
Abnormal trading volume[a]

	Event period				
	Pre-offer period ($ad-25$ to ad -1)	ad	Offer period ($ad+1$ to ed -1)	ed	Post-offer period ($ed+1$ to $+25$)
Panel A. Fixed-price offers					
Mean	1.17	6.88	2.62	1.21	0.87
Median	0.93	3.57	1.66	0.8	0.77
(p: t-test)[b]	(0.14)	(0.00)	(0.00)	(0.25)	(0.16)
[p: *Sign test*][c]	[0.18]	[0.00]	[0.00]	[0.44]	[0.26]
Panel B. Dutch-auction offers					
Mean	1.14	5.85	2.69	2.69	1.18
Median	0.98	3.19	1.83	1.25	0.90
(p: t-test)[b]	(0.15)	(0.00)	(0.00)	(0.00)	−0.43
[p: *Sign test*][c]	[0.34]	[0.00]	[0.00]	[0.00]	[0.11]

[a] This table presents the ratios of average daily trading volume relative to normal trading volume, which is the average daily trading volume calculated from trading days -50 to -25 relative to the announcement dates of the tender-offer share repurchases. The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date (*ad*) and 25 trading days subsequent to the expiration date (*ed*), respectively. The offer period is from the day subsequent to the offer announcement date to the day prior to the expiration date.
[b] p-Values are reported from the t-test of the null hypothesis that the average ratio is 1.
[c] p-Values are reported from the sign-test of the null hypothesis that the medium ratio is 1.

the offer period: (1) Many shareholders sell their shares to risk arbitrageurs, which leads to an increase in trading volume; and (ii) the firm's repurchase activity effectively redirects part of the supply of shares to the primary market. The evidence reveals that the former factor dominates.

Finally, Table 10 shows that, for both types of offers, the post-offer-period trading volume is not different from that of the normal-period. This result is also consistent with the competing-market-maker hypothesis in that trading volume falls back to its normal level following the offer expiration because the intensified competition during the offer period disappears as the offer expires.

5.7. Depths

Panels A and B of Fig. 3 illustrate the bid and ask depths around repurchase tender offers. While the pattern of changes in depths is conspicuous for the Dutch-auction offers, the fixed-price offers provide a somewhat noisy pattern. Nonetheless, Fig. 3 reveals a consistent pattern in depths: Depths rise following the announcement and fall subsequent to the expiration. Table 11 shows that the increase in depths around repurchase tender offers is statistically significant. For fixed-price offers, the average ask (bid) depth increases from 3036 to 5563

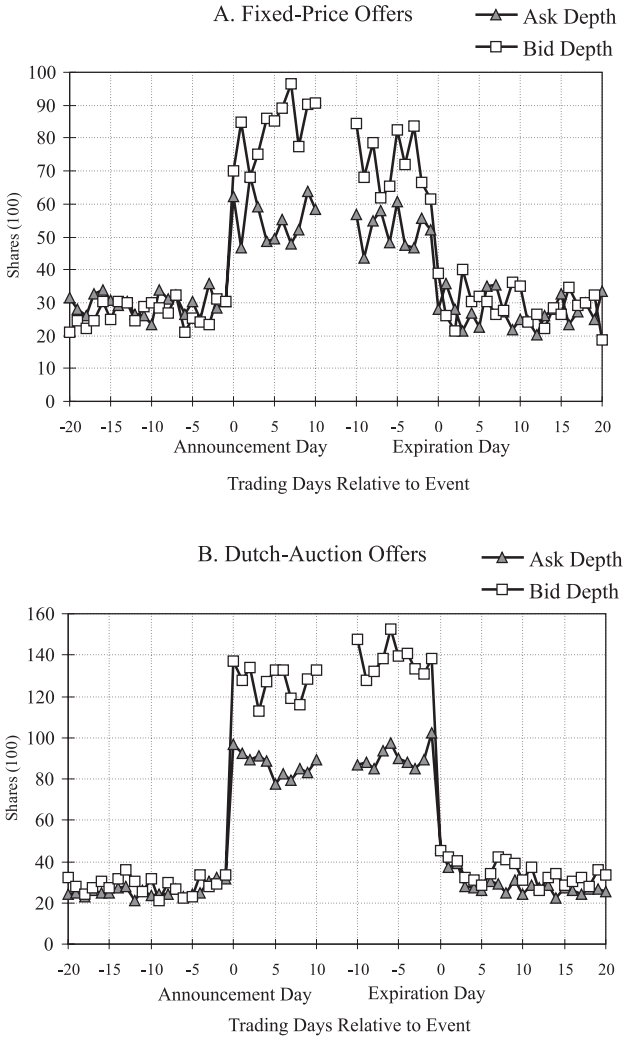

Fig. 3. Average depth.
Note: The figures plot the average ask and bid depths around the share repurchase tender offers conducted from 1983 to 1992 (65 fixed-price and 72 Dutch-auction offers).

shares (from 2606 to 7929 shares), or an 83% (204%) increase from the pre-offer to offer period. For Dutch auctions, the average ask (bid) depth increases from 2526 to 8936 shares (from 2903 to 13,753 shares), or a 250% (374%) from the pre-offer period to offer period. Two patterns are notable about the depth changes: Dutch auctions experience greater increases in depths than fixed-price

Table 11
Depths around repurchase tender offers [a]

		Event period			
		Pre-offer period ($ad-25$ to $ad-1$)	Offer period ($ad+1$ to $ed-1$)	Post-offer period ($ed+1$ to $ed+25$)	
Panel A. Fixed-price offers[b]					
Ask	Mean	30.36	55.63	25.27	
	(S.E.)	(5.00)	(9.39)	(4.14)	
Bid	Mean	28.06	79.29	28.08	
	(S.E.)	(3.87)	(16.65)	(6.35)	
			Ask	Bid	
			t-Test	Sign test	*t*-Test	Sign test
H_0: Pre-offer spread = Offer spread			0.000	0.000	0.000	0.000
H_0: Offer spread = Post-offer spread			0.000	0.000	0.000	0.000
H_0: Pre-offer spread = Post-offer spread			0.439	0.292	0.557	0.302
Panel B. Dutch-auction offers[b]					
Ask	Mean	25.26	89.36	29.39	
	(S.E.)	(2.49)	(12.58)	(3.20)	
Bid	Mean	29.03	137.53	34.33	
	(S.E.)	(3.08)	(18.01)	(3.32)	
			Ask	Bid	
			t-Test	Sign test	*t*-Test	Sign test
H_0: Pre-offer spread = Offer spread			0.000	0.000	0.000	0.000
H_0: Offer spread = Post-offer spread			0.000	0.000	0.000	0.000
H_0: Pre-offer spread = Post-offer spread			0.161	0.222	0.101	0.130

[a] The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively. Both means and standard errors are in units of 100 shares.
[b] Tests of the null hypothesis that there is no difference in the logs of depths between the periods; *p*-values are reported.

offers during the offer period; The depth increase is not uniform between the ask and bid. The increase in depth on the bid side is much more pronounced than that on the ask side, a finding that is consistent with the prediction of the competing-market-maker hypothesis that the abnormal increase in limit-buy orders placed by risk arbitrageurs thickens the bid-side depth.

The increase in depths subsequent to the offer announcement is consistent with the notion that depths move inversely with the spread (see Lee et al., 1993). The sizable increase in depths during the offer period and the reduction

in the bid–ask spread imply that liquidity improves substantially during the offer period.

5.8. Price location

The asymmetry in the offer-period spread reduction is a key feature of predictions by the competing-market-maker hypothesis, i.e., the reduction in the spread during the offer period should be observed primarily on the bid side. An empirical test of this proposition is difficult, because we cannot measure the bid-side spread alone. Therefore, we test the price locations of transactions as an alternative measure. The limit buy prices submitted by risk arbitrageurs can establish a lower bound on the bid price, and a substantial number of market sell orders can be filled at that price. To the extent that these limit prices are binding the bid price, more reductions in the spread on the bid side are possible. At the same time, more transactions can be executed below the quote midpoint. Hence, a shift towards the bid in the price location indicates an asymmetric reduction in the spread on the bid side.

Specifically, the price location variable is calculated as

$$L_t = 100 \times \frac{p_t - b_t}{a_t - b_t}, \tag{9}$$

where L_t is the location of a trade executed at t, p_t the price of the trade, and a_t and b_t are the ask and bid quotes in effect at t. It is noted that if the trade executes at the bid (or ask) price, the value of the price location variable will be 0% (or 100%). Similarly, when the trade executes at the midpoint of the bid–ask price, the price location variable will equal 50%.

Panels A and B of Fig. 4 plot the percentage of transactions made at the ask, bid, or quote midpoint. Both panels show that transactions at the bid (ask) increase (decrease) substantially during the offer period. Panels C and D plot the location of transaction prices within the bid–ask spread. During the offer period, the pattern of temporary downward shifts in price location within the spread reflects that many trades are made below the quote midpoint. The results of the tests reported in Table 12 indicate that the abnormal shift in price locations to the bid is statistically significant for both types of offers. For fixed-price offers, the decrease in price location from the pre-offer to offer period is 14.5% (from 46.57 to 39.82%), while this decrease for Dutch-auction offers is 24.3%.

The overall results presented so far imply that repurchase tender offers are unique corporate events during which risk arbitrage activity intensifies and competition in the stock market increases considerably. As a result, the market becomes extremely liquid with substantial spread reductions, and increases in depth and volume.

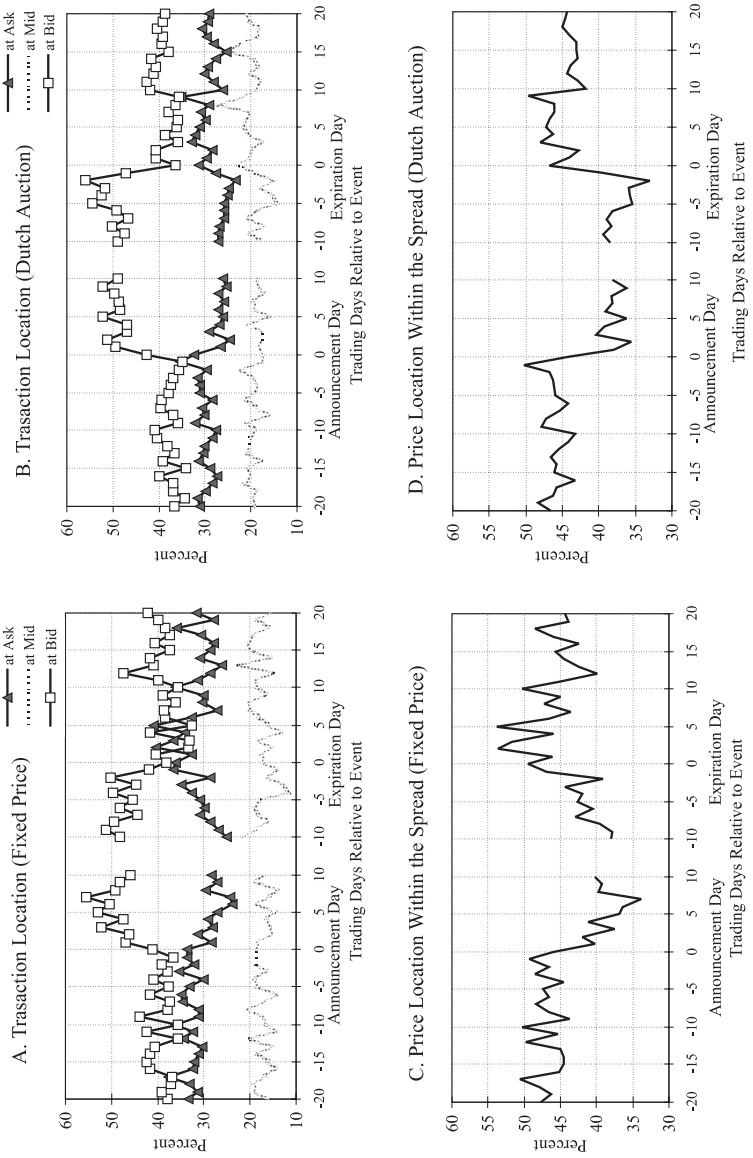

Fig. 4. Location of transactions at ask, bid, bid–ask midpoint, or within the bid/ask.
Note: Panels A and B plot the cross-sectional means of transaction locations made at the ask, bid, and the quote midpoint. Panels C and D the cross-sectional means of transaction locations within the quoted spread around the share repurchase tender offers conducted from 1983 to 1992 (65 fixed-price and 72 Dutch-auction offers). The location of the transaction prices is calculated as $L_t = 100 \times p_t - b_t/a_t - b_t$, where L_t is the location of a trade executed at t, p_t is the price of the trade, and a_t and b_t are the ask and bid quotes in effect at t.

Table 12
The price locations of transactions around repurchase tender offers [a]

	Event period		
	Pre-offer period ($ad-25$ to $ad-1$)	Offer period ($ad+1$ to $ed-1$)	Post-offer period ($ed+1$ to $ed+25$)
Panel A. Fixed-price offers[b]			
Mean (%)	46.57	39.82	45.19
(S.E.)	(1.67)	(1.91)	(1.66)
		t-Test	Sign test
H_0: Pre-offer spread = Offer spread		0.001	0.000
H_0: Offer spread = Post-offer spread		0.081	0.113
H_0: Pre-offer spread = Post-offer spread		0.368	0.277
Panel B. Dutch-auction offers[b]			
Mean (%)	44.67	33.81	43.35
(S.E.)	(1.45)	(1.62)	(1.52)
		t-Test	Sign test
H_0: Pre-offer spread = Offer spread		0.000	0.000
H_0: Offer spread = Post-offer spread		0.000	0.000
H_0: Pre-offer spread = Post-offer spread		0.412	0.576

[a] The price location variable is calculated as $L_t = 100\ [p_t - b_t/a_t - b_t]$, where L_t is the location of a trade executed at t, p_t is the price of the trade, and a_t and b_t are the ask and bid quotes in effect at t, respectively. The offer period is from the day subsequent to the offer announcement date (*ad*) to the day prior to the expiration date (*ed*). The pre-offer and post-offer periods are defined as 25 trading days prior to the announcement date and 25 trading days subsequent to the expiration date, respectively.

[b] Tests of the null hypothesis that there is no difference in price locations between the periods; *p*-values are reported.

5.9. Expected profits from risk arbitrage

This section discusses the expected profit from risk arbitrage activity around repurchase tender offers. We follow trading rules similar to those used by Lakonishok and Vermaelen (1990) who examine profitability of arbitrage trading around offer expiration. According to Lakonishok and Vermaelen, a trading strategy of buying shares during the offer period, then tendering them to the firm, and selling any unpurchased shares in the post-offer market yields the profit of

$$P_P(F_P/F_T) + P_E(1 - F_P/F_T) - P_B, \tag{10}$$

where P_P is the firm's purchase price of the stock, P_B the market price during the tender period at which the arbitrageur buys the stock, P_E the post-offer market price of the stock, and F_P (F_T) is the fraction of the shares purchased (tendered). When the offer is undersubscribed, the profit from the trading

strategy is $P_P - P_B$. While Lakonishok and Vermaelen use Eq. (10) to estimate the trading profit around fixed-price offers, the same equation applies to Dutch auctions as well. If a Dutch auction is oversubscribed, the profit for an investor who has tendered shares at a price below P_P will be $P_P - P_B$ while the profit for one who has tendered shares above P_P will be $P_E - P_B$.

We examine profits from two trading rules: (1) buying shares one day after the offer announcement date and selling any unpurchased shares two days after the expiration date; and (2) buying shares six days before the expiration date and selling unpurchased shares two days after the expiration date. Both trading rules assume that sales of unpurchased shares are made two days after the expiration date. This assumption reflects the fact that firms usually release information about the offer outcome one day after the expiration date. To allow for the usual settlement of five business days, we do not consider trading rules of buying shares fewer than six days before the expiration date.

To obtain abnormal returns, we adjust trading profits by using the CRSP equally weighted portfolio return. For each of the two trading rules, we find abnormal returns are positive and statistically significant at 1% level. For example, the first trading rule yields the average abnormal return of 2.77% for fixed-price offers and 3.42% for Dutch auctions. The median abnormal returns are 2.11% and 3.96%, respectively. If an arbitrageur follows the second trading rule, the average (median) abnormal return is 1.75% (1.57%) for fixed-price offers and 3.00% (2.84%) for Dutch auctions. Further, we check the robustness of our results with respect to the timing of purchases and sales. The result of positive and significant abnormal returns is persistent. Overall, these results suggest that expected profits from arbitrage activity around repurchase offers are economically significant.

Given that expected profits from risk arbitrage are positive and significant, a question that remains unanswered is whether trading profits depend on the overall market movement. In a recent study, Mitchell and Pulvina (1999) use a sample of 1981 stock swaps, cash mergers, and cash tender offers to examine the risk in risk arbitrage. For the sample period of 1963–1987, they find that risk arbitrage returns are positively associated with market returns in severely depreciating markets, but less correlated with market returns in flat and appreciating markets. We use a dummy variable regression to address this question. Specifically, we estimate the following cross-sectional regression model:

$$R_{[a+1,e+2]} - R_{\mathrm{f}} = \alpha_1 I_{\mathrm{low}} + \beta_1 I_{\mathrm{low}}(R_{\mathrm{market}} - R_{\mathrm{f}}) + \alpha_2 I_{\mathrm{high}} + \beta_2 I_{\mathrm{high}}(R_{\mathrm{market}} - R_{\mathrm{f}}) + \epsilon,$$

where $R_{[a+1,e+2]}$ is the return from one day after the offer announcement to two days after the expiration date, R_{f} the risk-free rate, R_{market} the return on the

CRSP equally weighted portfolio during the same period, I_{low} an indicator variable for whether the market return is less than -1%, and I_{high} an indicator variable for whether the market return is greater than -1% during $[a+1, e+2]$. The two dummy variables correspond to depreciating and appreciating markets. Mitchell and Pulvina (1999) argue that α_1 should be greater than α_2 and β_1 should be greater than β_2. For fixed-price offers, we find that $\alpha_1 = 0.092$, $\beta_1 = 1.862$, $\alpha_2 = 0.030$, and $\beta_2 = 0.663$. All coefficients are significant at 5%, and the adjusted R^2 is 55.6%. For Dutch auctions, the estimated coefficients are the following: $\alpha_1 = 0.124$, $\beta_1 = 1.794$, $\alpha_2 = 0.032$, $\beta_2 = 0.436$, and the adjusted R^2 is 68.6%. In addition, we reject both null hypotheses: H_0: $\alpha_1 = \alpha_2$ and H_0: $\beta_1 = \beta_2$. These results show that risk arbitrage return is higher during severe market conditions, and lower during appreciating markets. Our evidence suggests that arbitrage trading profits depend on overall market conditions.

5.10. The effect of the offer type

In this section, we briefly compare the effect of the offer type on the market microstructure. Tables 1 and 2 reveal that there are stark differences in characteristics of firm as well as offer characteristics between the two types of offers. For example, Dutch-auction firms are much larger and have higher prices than fixed-price offer firms. The percent of shares tendered to shares sought and the percent of share tendered to outstanding shares are much higher for fixed-price offers. The proration rates are lower for fixed-price offers. If tender rates are an indicator of the percent of shares involved in offer activity, then, one would expect that the fixed-price offer has a greater impact on market microstructure. However, the percentage increase in volume and the spread are close for both types of offers. Moreover, the price location moves closer to the bid for Dutch auctions. The increase in depth is greater and the depth imbalance to the bid is more notable for Dutch auctions. In sum, the effects on market microstructure documented in this paper are stronger for Dutch auctions.

One explanation for this difference is the uncertainty regarding the offer outcome and the intensity of arbitrage activity during the offer period. Dutch auctions involve greater uncertainty about the offer outcome than fixed-price offers since the purchase price is not known until the expiration. Consequently, arbitrageurs play a more important role of risk-bearing in Dutch auctions. Therefore, even if the overall tendering rates are lower for Dutch auctions, a larger portion of tendering must come from the result of arbitrage buying. For fixed-price offers, most of the tendering is from individual investors. This is consistent with the fact that the pattern of the bid-side shift in the price location is much weaker for fixed-price offers.

6. Conclusions

This paper examines the impact of share repurchase tender offers on the market microstructure. Our sample comprises 65 fixed-price and 72 Dutch-auction offers that are conducted between 1983 and 1992 for firms listed on the NYSE and Amex. We develop and test the competing-market-maker hypothesis, which predicts that increased competition for the market maker on the bid-side asymmetrically reduces the spread during the repurchase tender offer period. The temporary increase in competition is induced by an increase in limit buy orders by risk arbitrageurs. Our empirical results are consistent with the competing-market-maker hypothesis. Both the quoted and effective spreads during the repurchase tender offer period decline as much as 20%, regardless of whether the offer is a fixed-price offer or Dutch auction. These results hold true after we control for changes in return volatility. In addition, both components of the spread (the adverse selection and order processing costs) decrease significantly during the offer period. Trading volume and quotation depths increase temporarily during the offer period, which is also consistent with the competing-market-maker hypothesis. The price location of transactions during the offer period shows a significant bid-side shift, supporting the notion that competition increases mainly on the bid side. The pronounced increase in bid depth relative to that in ask depth during the same period provides additional evidence supporting the competing-market-maker hypothesis. Further, a close comparison of the market microstructure effects between fixed-price and Dutch-auction offers reveals that risk arbitrage activity is more intense for Dutch auctions and, consequently, competition for the market maker is stronger for this type of offers.

While the focus of this paper is on share repurchases, similar changes in market microstructure are expected around other types of corporate events that attract intense risk arbitrage activity. For events that involve corporate reorganizations, often the uncertainty surrounding the reorganization creates a gap between the market price and the price offered in the proposal. Then, risk arbitrageurs will step in for profit opportunities and resolve some of the uncertainty about the value of the firm. In the process, the risk arbitrageurs are more likely to choose limit orders than market orders in order to minimize price concession. An ensuing result is increased competition for market making, which reduces the spread and improves the market liquidity. Possible candidates for such events include mergers, inter firm tender offers, liquidations, and other corporate reorganizations. It will be interesting to see how risk arbitrageurs' involvement in these events affects the market microstructure. Such studies will certainly enrich our understanding of the role of market microstructure in the price formation process. Finally, the empirical issues and questions addressed in this paper can be re-examined using data for a longer

time period, or using data from other markets. We leave these extensions for future research.

Acknowledgements

We would like to thank two anonymous referees, Yakov Amihud, Jean-Francois Bacmann, Michael Barclay, Edward Coulson, Dennis Sheehan, Daniel Weaver, and participants at the 1998 European Finance Association Annual Meetings. Any errors are our responsibility alone. Address correspondence to Charles Cao, Department of Finance, 609 Business Administration Building,

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