

## Dutch Auction Repurchases: An Analysis of Shareholder Heterogeneity

LAURIE SIMON BAGWELL\*

### ABSTRACT

This paper documents that firms face upward-sloping supply curves when they repurchase shares in a Dutch auction, and it analyzes the market reaction to these offers. The announcement price increase is highly correlated with the ultimate repurchase premium. Prices decline at expiration only for pro-rated offers. The cumulative return is positive and highly correlated with the repurchase premium, excepting pro-rated offers. Much of this price increase is consistent with movement along an upward-sloping supply curve. Trading volume around the Dutch auction parallels fixed-price repurchases. Supply elasticity is larger for firms with large trading volume, firms included in the S&P 500 Index, and takeover targets.

THIS PAPER DOCUMENTS THAT firms face upward-sloping supply curves when they repurchase shares in a Dutch auction. Until now, there has been little direct empirical assessment of the elasticity of the supply curve for corporate equity. At issue is whether or not the hypothesis of shareholder homogeneity of valuations, and therefore perfect supply elasticity, is a good approximation to actual markets. Both the advantages and limitations of assuming homogeneous valuations are highlighted in *The Theory of Finance* by Fama and Miller (1972), who in discussing the perfect capital market observed that

no such market exists in the real world, nor could it. Rather, what we have here is an idealization . . . permit(ing) us to focus more sharply on a limited number of aspects of the problem and usually greatly facilitat(ing) both the derivation and statement of the sought-for empirical generalizations. In the nature of the case, however, the generalizations so obtained can never be anything more than approximations to the real phenomena that they are supposed to represent. The question is whether, considered as approximations, they are close enough; and this, of course, is a question that can only be answered empirically and in light of the specific uses to which the approximations are put. (pp 21-22)

\* From the Department of Finance, Northwestern University. I would like to thank Kyle Bagwell, Doug Bernheim, Dave Brown, Harry DeAngelo, Mike Fishman, Kathleen Hagerty, Bob Hodrick, Ken Judd, Narayana Kocherlakota, two anonymous referees and René Stulz (the editor) for their comments. I also thank the seminar participants at Duke, Indiana, Northwestern, Ohio State, Princeton and Stanford Universities, the Universities of Chicago and Michigan, the 1991 NBER Summer Institute on Corporate Finance and Banking and the Sixth World Congress of the Econometric Society. I am grateful to Donald Jacobs for his assistance in obtaining the data and to Latha Ramchand for her research assistance. Financial support from National Science Foundation Grant SES-8821666 is gratefully acknowledged.

This paper's provocative empirical findings imply that the hypothesis of homogeneous valuations is not a good approximation for understanding Dutch auction stock repurchases.

I examine 32 Dutch auction stock repurchases which took place between 1981 and 1988. In a Dutch auction, the company states the number of shares it will buy during a stipulated period, and it sets a price range between which shareholder bids will be accepted. The repurchase price is the lowest price necessary to acquire the number of shares sought. Though not publicly available, I have obtained the individual shareholder bids in these auctions directly from the companies. Shareholder valuations are not homogeneous; rather, in each repurchase, the bids differ markedly across shareholders. This indicates that the repurchasing firms encounter upward-sloping supply curves for their shares.

I then analyze the share price reaction to the repurchase. Prices increase 7.7% on average at the announcement of a Dutch auction. The correlation between the announcement day return and the ultimate repurchase premium is over 80%. Prices decline 1.9% on average at expiration. This decline is, however, limited to repurchases with pro-rated offers, where firms buy back fewer shares than were tendered at or below the purchase price. Firms with pro-rated offers have a -6.9% expiration return on average and a negative correlation between their expiration return and the repurchase premium of 63%. Firms with non-pro-rated offers have zero expiration return on average and little correlation between their expiration return and the repurchase premium. The sample average cumulative return during the period beginning the day before the announcement through the expiration of the offer is 6.7%. For non-pro-rated offers, the sample cumulative return is 9.8%, with a correlation between the cumulative return and the repurchase premium of 87%. For pro-rated offers, the sample cumulative return is zero, with a correlation between the cumulative return and the repurchase premium of only 35%.

The average elasticity measure implies that to purchase 15% of the outstanding stock, a firm must offer a 9.1% premium above its pre-announcement market price. Much of the observed 7.7% price increase therefore may be movement along an upward-sloping supply curve. This is confirmed by the high correlation between the announcement return and the ultimate repurchase premium. In light of the evidence in this paper, all homogeneous valuation explanations of the market reaction to the announcement of these offers, including signaling models wherein homogeneous shareholder valuations are revised in response to the repurchase, are suspect. Hybrid models which allow signaling in the presence of heterogeneous valuations, however, seem consistent with the evidence.

The difference between the expiration day price reaction for pro-rated and non-pro-rated offers can be explained with movement along an upward-sloping supply curve. The firm buys back all shares tendered at or below the purchase price in a non-pro-rated offer. The documented facts that there is typically no price decline at expiration, that the offer results in a large

cumulative return, and that there is a high correlation between the cumulative return and the repurchase premium are all consistent with an alteration of the marginal holder of stock to one with a higher reservation price, the repurchase price. By contrast, the firm buys back fewer shares than were tendered at or below the purchase price in a pro-rated offer. For these cases the expiration day return is typically negative even when most of the shares submitted for sale are bought back, the cumulative return is zero, and there is little correlation between the cumulative return and the repurchase premium. These facts are consistent with there being no change in the marginal shareholder. Since the marginal valuation is below the purchase price, the price falls at expiration.

In addition, this paper documents that changes in trading volume around Dutch auction repurchases are comparable to the findings for fixed-price repurchases. On average, volume increases dramatically during the repurchase, and it appears to fall below pre-announcement levels after the expiration of the offer. Cross-sectional analysis indicates that the share price elasticity calculated from the individual bids is larger for firms with large trading volume, firms included in the S&P 500 Index, and firms that have been takeover targets.

The organization of the paper is as follows. Section I describes the Dutch auction stock repurchase and the data. Section II documents the upward-sloping supply curves. Section III evaluates the market reaction to these offers. Section IV argues that an explanation emphasizing shareholder heterogeneity is consistent with the evidence. Section V measures trading volume around the Dutch auction repurchases. Section VI examines the cross-sectional variability in supply elasticity. Section VII concludes that the presence of heterogeneous shareholder valuations may be an important determinant of the market reaction to any event which alters the marginal shareholder.

## I. Dutch Auction Repurchases

The first firm to utilize the Dutch auction was Todd Shipyards in 1981. Planning a tender offer at \$28 for between 200,000 and 550,000 of its 5,500,000 shares, Todd instead was convinced by Bear Stearns to offer a Dutch auction at a price not to exceed \$28 (although shareholders could tender for less). The fee paid to Bear Stearns would be 30% of the savings if the ultimate purchase price was less than \$28. Todd chose the Dutch auction, and the purchase price was \$26.50.<sup>1</sup>

Including the Todd Shipyards offer, 52 Dutch auction repurchases commenced prior to December 31, 1988. Thirty-nine of these firms were traded on the NYSE, seven on the AMEX, and six OTC (NASDAQ). The firms are listed in Appendix A. The sample was created from a search of *The Wall*

<sup>1</sup> *Wall Street Journal*, September 23, 1981.

*Street Journal* (hereafter WSJ), *The Business Periodicals Index*, and correspondence with Morgan Stanley and Bear Stearns. Since firms publicly disclose only the final terms of the offer (and not the individual shareholder tenders), I wrote the Chief Executive Officer at each of the 52 companies and requested the shareholder tendering responses. I was ultimately provided with the data for 32 of these firms (approximately 60%).<sup>2</sup> Fourteen of the firms requested confidentiality.

The fundamental difference between the fixed-price tender offer and the Dutch auction repurchase is that the tender offer is made for one price, whereas the Dutch auction offer specifies a range from which shares will ultimately be purchased.<sup>3</sup> Shareholders are invited to tender their stock, if they desire, at any price within the stated range. The firm compiles these responses, creating the supply curve for the stock, and pays as the purchase price the lowest price that allows it to buy the number of shares sought in the offer. Under the nondiscrimination or "best-price provision" required by the SEC, the purchase price is paid to all investors who tendered at or below that price. Item 1 of Schedule 13E-4 requires the firm to specify exactly at the time of the offer the number of shares to be repurchased. Nevertheless, prior to two SEC no-action letters in 1987, this was not always enforced, due to questions of interpretation, and therefore sometimes firms instead specified a range of shares that were sought.<sup>4</sup>

If the number of shares tendered exceeds the number sought, the company purchases less than all shares tendered at or below the purchase price on a pro-rata basis to all who tendered at or below the purchase price. That is, the firm repurchases shares in proportion to the total number of shares tendered. If too few shares are tendered, the firm either cancels the offer (provided it had been made conditional on a minimum acceptance), or buys back all tendered shares at the maximum price.

The announcement day of the offer is defined as the earliest trading day at which the principal terms of the offer were publicly available.<sup>5</sup> The expiration day of the offer is defined as the earliest trading day to end after the offer expired. Most of the offers expired at midnight, in which case the next trading day is designated the expiration day. These dates were determined

<sup>2</sup> The data are analyzed for 31 firms. Hospital Corporation is excluded due to confounding circumstances during its offer. After the October 1987 market crash, the minimum specified price for the offer was over 50% above the market price at expiration of the offer. Eighty-six percent of the outstanding shares were tendered at this price. Interestingly, an additional 6% of the outstanding shares were tendered at higher prices in the offer's range.

<sup>3</sup> Dutch auctions are permitted under Rule 13e-4 governing tender offers, if conducted pursuant to certain procedures (as described in SEC Release No. 23421, fn. 64, July 11, 1986).

<sup>4</sup> Moreover, Rule 13e-4(f)(1)(ii) provides that, in the event of an increase in the percentage of securities sought by more than 2%, the offer must be extended at least 10 business days from the date that notice of the increase is given. I am grateful to the staff attorneys at the SEC for providing me with this information.

<sup>5</sup> In the one case where the price terms of the offer were changed, the announcement date of the final offer terms is used.

by examining WSJ announcements, SEC 8-K reports, news releases provided by the firms, and the offering statements. These sources were consulted to find also (1) the date the offer commenced, (2) the number of outstanding shares of the repurchasing firm, (3) the number of shares sought, and (4) the tender price range. The number of shares tendered and repurchased were obtained from the firms and confirmed with SEC 13E-4 filings.

Most bids are submitted at the very end of the offer's duration.<sup>6</sup> This is not surprising, given the shareholders' option to submit or revoke their bids until the expiration of the offer. At the time shareholders tender, they cannot observe the tendering responses of others. Moreover, tendering borrowed shares (short tendering) is prohibited by the SEC.

The range of premia offered, percentage of equity sought and acquired, and other terms of the offers for the sample are given in Table I.<sup>7</sup> The purchase price is 13.4% higher on average than the closing market price on the day preceding the announcement of the offer. The price range specified by the firm is on average from 2.64% to 17.17% above the pre-announcement price. On average, these firms have sought to acquire between 18.03% and 20.07% of their outstanding shares. The mean duration of the offer is 22 business days. The mean fraction of outstanding shares reacquired was 15.28%, where 17.84% of the outstanding shares were tendered at or below the purchase price, and 23.87% were tendered within the price range of the offer. None of these firms made more than one Dutch auction offer in the 1981-1988 time period.

## II. The Evidence

For each firm in the sample, the tendering responses are ordered from lowest to highest prices. This schedule of offers is the supply curve for shares that the company faced in the repurchase. Documenting significant upward slope to the supply curves contradicts the perfect supply elasticity hypothesis.

Appendix B provides the Dutch auction supply curves for the 17 firms which did not require confidentiality. The supply curves display an upward slope. The bid prices are normalized so that the pre-announcement market price is 100. The normalized quantities measure the cumulative percentage of outstanding shares tendered at or below a given price.

Consider as an example the 1986 Dutch auction in which J. P. Stevens offered to buy back up to 13% of its outstanding stock. The highest normalized bid in the specified range was 114, or a 14% premium above the pre-announcement market price, while the lowest bid was 102, or 2% above the pre-announcement market price. Twenty-nine percent of the outstanding shares were tendered at various prices within this range.

<sup>6</sup> This observation arose repeatedly during discourse with executives of the firms who conducted the Dutch auctions.

<sup>7</sup> The terms and outcomes of this sample of Dutch auction repurchases are comparable to the sample in Comment and Jarrell (1991), which includes all Dutch auctions between 1984-1989.

**Table I**  
**Descriptive Statistics of the Sample**

This table reports the mean and median values of the terms and the outcomes for 31 firms conducting Dutch auction stock repurchases, 1981-1988.

Statistic	Mean	Median
1. Purchase price premium percentage relative to market price one day prior to announcement	13.43	11.46
2. Purchase price premium percentage relative to market price one month prior to announcement	11.60	8.91
3. Lower bound price premium percentage relative to market price one day prior to announcement	2.64	4.19
4. Upper bound price premium percentage relative to market price one day prior to announcement	17.17	16.06
5. Lower bound percentage of outstanding shares sought	18.03	12.18
6. Upper bound percentage of outstanding shares sought	20.07	15.86
7. Percentage of outstanding shares tendered in price range	23.87	17.87
8. Percentage of outstanding shares tendered at or below purchase price	17.84	12.07
9. Percentage of outstanding shares acquired	15.28	12.07
10. Duration of offer (number of trading days from open to close)	22.13	21.00

### A. Upward-Sloping Supply Curves: Alternative Measures

Because fourteen firms required confidential use of the shareholder tendering responses, this section provides various measures of the average slope of the supply curves in the sample. Table II provides the difference between the bid corresponding to the 6th percentile tender and the bid corresponding to the 1st percentile tender, scaled by the pre-announcement market price.<sup>8</sup> Similar calculations are made to determine the difference between the 11th percentile and the 6th percentile tendering bids, and between the 16th percentile and the 11th percentile tendering bids for each of the 31 firms.<sup>9</sup>

In Row 1, the difference between the 6th percentile bid and the 1st percentile bid is 4.5%. The reported average understates the true average premium, since five of the firms were excluded, because less than 6% of the outstanding shares tendered in the price range offered. That is, the observations in which the smallest percentage of stockholders were willing to sell their shares are omitted.

The average difference between the 11th percentile bid and the 6th percentile bid is 2.6%. Again, the reported average underestimates the true average. Nine firms are omitted because they have less than 11% of their outstanding shares tendering. The difference between the 16th percentile bid and the 11th percentile bid is 2.0%. This is based on 19 firms, because an additional three have less than 16% tendering within the range.

Therefore, the average difference between the 16th percentile bid and the 1st percentile bid is 9.1%.<sup>10</sup> This 9.1% price premium to obtain 15% of the outstanding stocks implies an average elasticity measure of 1.65.

I next measure the extent of the upward slope by computing 31 separate least squares best fits of the firms' supply curves. Again, price is normalized so that the pre-announcement price is equal to 100 for each firm, and quantity is normalized to measure the cumulative percentage of outstanding shares tendered at or below each price. Points on the supply curves are denoted  $P_{ji} - Q_{ji}$ , where subscript  $j$  represents different price-quantity points on firm  $i$ 's supply curve. The results from the individual firm regressions:

$$P_{ji} = \alpha_i + \beta_i Q_{ji} + \varepsilon_{ji}$$

are reported in Table III. The average slope is 1.46, with a median of .95. These least squares best fit results suggest that for the typical firm in this sample, to acquire an additional 10% of the outstanding stock, one must offer an average (median) additional premium of 14.6% (9.5%) of the

<sup>8</sup> On average the lower range price is 2.64% above the pre-announcement market price. Any shareholders willing to sell between the market price and the lower bound price would bid the lower bound price. Therefore, elasticity measurements begin at 1% of the outstanding shares.

<sup>9</sup> Five percent quantity intervals are small enough to allow the elasticity to vary within the supply curve, yet large enough to avoid some of the effects of tendering lumpiness. They allow useful stylized facts about the nature of the supply curve, while never assuming that this piece-wise linear curve is the best functional description of a supply curve.

<sup>10</sup> For the 19 firms where at least 16% of the outstanding shares tendered, the difference between the 16th percentile price and the 1st percentile price varies from 0% to 23.3%.

Table II  
**Arc Elasticity Measures of the Dutch Auction Supply Curves**

This table reports the difference between the bid corresponding to the 6th percentile tender and the bid corresponding to the 1st percentile tender, scaled by the pre-announcement market price, for firms conducting Dutch auction stock repurchases, 1981-1988. Similar calculations are made to determine the differences between the 11th percentile and the 6th percentile tendering bids, and between the 16th percentile and 11th percentile tendering bids for each of the firms. The implied elasticities are also calculated.

5% Quantity Change Intervals (%)	Mean % Price Change	Median % Price Change	Mean Arc $\eta = \%Q/\%P$	No. of Firms
1-6	4.54	3.66	1.10	26
6-11	2.55	2.01	1.96	22
11-16	1.99	1.69	2.51	19
Sum: 1-16	9.08		1.65*	

\*This figure is computed using the mean sum price change over the 15% quantity interval.



Table III

**Best Fit Line Measures of the Dutch Auction Supply Curves**

This table reports the slope of the normalized supply curve for each of 31 firms conducting Dutch auction stock repurchases, 1981–1988. For each firm, the pre-announcement price is set at 100 and quantity is normalized as the cumulative percentage of outstanding shares tendered at or below each price. Points on the supply curves are denoted  $P_{jt} - Q_{jt}$ , where subscript  $j$  represents different price-quantity pairs for firm  $i$ . The regressions are  $P_{jt} = \alpha_i + \beta_i Q_{jt} + \varepsilon_{jt}$ . The slopes are then sorted from highest to lowest, with the average slope equal to 1.46.

$\beta_i$	$t$ -Statistic	$p$ Value	Firm Name
7.37	1.94	.084	Farwest
4.96	3.33	.045	Sage
4.79	5.08	.000	Standard
2.43	7.28	.000	Axia
2.31	52.44	.000	Pennwalt
1.98	3.63	.001	Confidential
1.86	4.88	.000	Todd
1.73	3.48	.007	Confidential
1.57	8.81	.000	Knogo
1.47	7.39	.000	Confidential
1.39	8.44	.000	Ralston
1.31	8.83	.000	Confidential
1.18	12.57	.011	Confidential
1.02	6.75	.000	Confidential
0.96	6.39	.000	Barnes
0.95	29.73	.000	RJR Nabisco
0.87	8.83	.000	Confidential
0.78	8.42	.000	NL Ind.
0.67	11.67	.000	Jostens
0.67	11.92	.000	Carl Karcher
0.66	11.51	.000	Confidential
0.60	11.05	.000	Gen. Sig.
0.53	26.23	.000	Confidential
0.50	4.16	.009	Confidential
0.44	27.24	.000	Confidential
0.40	8.34	.000	J P Stevens
0.38	9.91	.000	Whittaker
0.36	4.99	.000	Confidential
0.36	9.77	.000	Confidential
0.35	7.48	.001	FMC
0.31	18.12	.000	Confidential

preannouncement market price. This implies an average (median) elasticity of .68 (1.05).

*B. Other Evidence of Upward-Sloping Supply Curves*

The results in this section provide direct evidence that firms face upward-sloping supply curves when they repurchase shares in a Dutch auction. Evidence consistent with upward-sloping supply curves has been detected in

similar transactions. For example, Bradley, Desai, and Kim (1988) find that the premium paid in interfirm tender offers is increasing in the fraction of target shares purchased by the acquirer, while Brown and Ryngaert (1990) find a positive relation between the premium and the fraction of outstanding shares tendered in fixed-price repurchase tender offers.

Holthausen, Leftwich, and Mayers (1990) consider buyer-initiated block transactions, finding that buyers of large blocks of stock pay a premium above the price before the block transaction, with the premium representing a permanent price effect. This premium increases with the size of the block traded, evidence consistent with upward-sloping supply curves.<sup>11</sup> Shleifer (1986) finds that the share price increase at the announcement of the inclusion of firms to the S&P 500 Index is positively related to the increased buying of the shares by Index funds. Since being included in the Index does not necessarily signal any information about stock value, the findings suggest that the price increase is being driven by increased demand in the presence of upward-sloping supply curves. The innovation of the Dutch auction evidence is that it is direct evidence of the upward-sloping supply curves faced by the repurchasing firms.

### *C. Sources of Upward-Sloping Supply Curves*

Heterogeneous tendering responses could result from various sources, the first being heterogeneous (private) valuations due to objective characteristics like capital gains tax lock-in as in Bagwell (1991a) or Stulz (1988), or transaction costs as in Mayshar (1981) or Bagwell and Judd (1989). In this case, the different bids across shareholders reflect buyers' distinct valuations. In a Technical Appendix (available from the author), I demonstrate natural conditions under which shareholders optimally bid their true (private) reservation values. Similar to standard findings for second-price auctions (for example, Vickrey (1961)), atomistic shareholders truthfully reveal their reservation prices in Dutch auction stock repurchases. That is, a price-taking shareholder who does not expect to alter the outcome of the repurchase by his behavior offers to sell his shares at their true valuation. Second, differential reservation prices may arise from asymmetric information about a common valuation as in Milgrom and Weber (1982). Third, they may result from differences of opinion as in Miller (1977) or Varian (1985).<sup>12</sup>

<sup>11</sup> Scholes (1972) finds a permanent negative price reaction to the sale of large blocks. Greater price changes occur if the seller is presumed to have adverse information motivating the sale. Mikkelsen and Partch (1985) reconsider block sales in light of a downward-sloping demand curve, documenting a significant negative price reaction to seller-initiated secondary distributions regardless of the type of seller, with the magnitude of the price response positively related to the size of the offering. Loderer, Cooney, and Van Drunen (1991) find that stock offerings by regulated firms depress stock prices, even after controlling for information releases.

<sup>12</sup> If these differences of opinion are generated by the repurchase, then the observed tendering differences might overestimate the heterogeneity of valuations that would be present absent the repurchase.

### III. Price Reaction: Announcement, Expiration, and Cumulative Excess Returns

The next two sections evaluate the share price reaction to Dutch auction stock repurchases. The market response to announcements is measured with daily stock excess returns, obtained from the CRSP Daily Returns File. A firm's daily excess return is its daily return less a CRSP equally weighted market return. Table IV presents the cross-sectional mean excess return on the equally weighted portfolio of the sample securities, in event time. The announcement day excess return for the sample is 7.7%, with 27 of the 31 (87%) individual security returns positive.<sup>13</sup> This is significantly different from zero at the 1% level, with a *t*-statistic of 5.7. In contrast, the mean portfolio daily excess return for the 50-day period beginning 60 days prior to the announcement day is not significantly different from zero.

I also compute the daily stock excess returns at the Dutch auction expiration.<sup>14</sup> The expiration day portfolio excess return is -1.9%. This is significantly different from zero at the 5% level, with a *t*-statistic of -2.2. Unlike the announcement day effect which is positive for 27 of 31 firms, 9 of the 30 (30%) individual security excess returns are positive on the expiration day.<sup>15</sup> In contrast, the mean portfolio daily excess return for the 50-day period beginning 10 days after the expiration day is not significantly different from zero.

The average cumulative excess return for the period beginning the day before the announcement through the expiration day is 6.7%, with 24 of the 30 (80%) individual security cumulative returns positive. This is significantly different from zero at the 1% level, with a *t*-statistic of 3.3.

#### A. Price Reaction: The Importance of Pro Rata

I next examine whether the pro-ration of an offer is an important determinant of the magnitudes of the excess returns reported above. Panel A of Table V shows that firms with non-pro-rated offers experience no significant price reduction at expiration, while firms with offers that are pro-rated experience a negative price reaction at expiration.<sup>16</sup> For the 22 firms whose repurchase offers were not pro-rated, the average expiration day excess return is -0.1%, which is not significantly different from zero. Only 13 out of 22 (59%) individual security excess returns are negative on the expiration

<sup>13</sup> Comment and Jarrell (1991) find a three-day return of 7.5%. Kamma, Kanatas, and Raymar (1990) find a 6.6% return, with 86% positive on the announcement day.

<sup>14</sup> Expiration statistics are computed for 30 firms, excluding Excello Corporation. Five days after the expiration, Textron bid for Excello, successfully acquiring it within two weeks. The takeover bid generated significant price reaction and trading volume.

<sup>15</sup> Kamma, Kanatas, and Raymar (1990) find a -1.3% average abnormal residual at the expiration, with 30% of the expiration abnormal returns positive.

<sup>16</sup> This analysis excludes two firms whose offers were canceled.

Table IV  
**Excess Returns Around the Dutch Auction Stock Repurchase**

This table reports one-day and cumulative common stock rates of return net of market around the Dutch auction repurchase for 31 firms conducting Dutch auction stock repurchases, 1981-1988.

Panel A: Daily excess returns are daily returns less a CRSP equally weighted market return.					
Time Period	Mean Rate of Return, %	Standard Deviation, %	<i>t</i> -Statistic (H0: Mean Return = 0)	<i>p</i> Value (H0: Mean Return = 0)	No. Pos.: No. Neg.
Announcement day	7.668	7.431	5.745	.000	27:4
Expiration day	-1.939	4.836	-2.196	.036	9:21
60 days before to 10 days before announcement (31 firms)	0.001	0.480	0.021	.983	
10 days after to 60 days after expiration (30 firms)	-0.050	0.280	-1.261	.213	
Panel B: Cumulative returns are daily excess returns cumulated around the Dutch auction repurchase.					
Time Period	Cumulative Rate of Return, %	Standard Deviation, %	<i>t</i> -Statistic (H0: Mean Return = 0)	<i>p</i> Value (H0: Mean Return = 0)	No. Pos.: No. Neg.
Day before announcement through expiration	6.728	11.021	3.344	.002	24:6

day.<sup>17</sup> In contrast, for the six firms where the repurchase offer was pro-rated, the average expiration day excess return is  $-6.9\%$ , significantly different from zero at the 5% level, with a  $t$ -statistic of  $-2.8$ . All six individual security excess returns are negative on the expiration day, ranging from  $-1.7\%$  to  $-18.4\%$ .<sup>18</sup> The null hypothesis that the expiration excess returns of the two subsamples are the same is rejected at the 1% level, with a  $t$ -statistic of 4.4. These findings are consistent with the expiration day price reaction found in Dann (1981) and Masulis (1980) for fixed-price tender offers.

Panel B presents the cumulative excess returns during the repurchase. For non-pro-rata firms, the cumulative excess return from the day before the announcement through expiration is  $9.8\%$ . This is significant at the 1% level, with a  $t$ -statistic of 5.9. 20 of the 22 (91%) individual security cumulative excess returns are positive. Since firms with offers that are not pro-rated experience no significant price decline at expiration, the positive announcement effect remains. By contrast, the cumulative excess return for the pro-rata firms is  $.1\%$ , which is not significantly different from zero. 4 of the 6 (67%) individual security cumulative excess returns are positive. Since firms with offers that are pro-rated suffer a price decline at expiration, the announcement effect is offset. The null hypothesis that the cumulative excess returns of the two subsamples are the same is rejected at the 5% level, with a  $t$ -statistic of 2.1.

Potentially, there is a fundamental difference between the interpretation of oversubscription in fixed-price repurchases and Dutch auction repurchases. In fixed-price tender offers, oversubscribed offers are associated with larger post-expiration price declines because high tendering rates occur when the offer price is high relative to the expected post-expiration price (Brown and Ryngaert (1990)). In Dutch auctions the purchase price is determined by shareholder tendering responses rather than being set by the firm. Therefore, an offer is not always pro-rated because the offer price was set in excess of that necessary to obtain the shares sought. While oversubscription in Dutch auctions can occur because even the lower range price terms were generous, oversubscription can also occur because there is a mass of tenders at the purchase price, due to the lumpiness of bidding schedules.

To examine this distinction, I compare those pro-rated offers where the purchase price was the lowest price of the specified range, suggesting that even the lowest price was generous, to those offers where the purchase price was above the minimum price, suggesting that the pro-ratio reflects tendering lumpiness. Panel C reports the expiration day excess returns for the

<sup>17</sup> Of these 22, none closed at the lowest price in the range, nine closed at some price within the range, and the remaining 13 closed at the highest price in the range. Of these 13, 10 were undersubscribed; the number of shares tendered in the range was below the lower bound of shares sought.

<sup>18</sup> For these six offers, three closed at the lowest price in the range, two at some price within the range, and the remaining one closed at the highest price in the range.

**Table V**  
**Expiration and Cumulative Returns: The Importance of Pro-Ration**

This table reports the relationship between pro-ration and expiration and cumulative excess returns, for 31 firms conducting Dutch auction stock repurchases, 1981-1988.

Panel A: Firms with non-pro-rated offers experience no significance price reduction on the expiration day, while offers that are pro-rated experience a significant negative price reaction at expiration.						
Sample	No. of Firms	Expiration Day Excess Return, %	<i>t</i> -Statistic (H0: Mean Return = 0)	<i>p</i> Value (H0: Mean Return = 0)	No. Pos.: No. Neg.	
Non-pro-rata firms	22	-0.107	-0.214	.833	9:13	
Pro-rata firms	6	-6.900	-2.798	.038	0:6	
Difference across samples (H0: same mean)			-4.359	.000		
Panel B: Firms with non-pro-rated offers experience significant cumulative excess returns from the day before the announcement through expiration, while firms with offers that are pro-rated experience no cumulative return.						
Sample	Cumulative Excess Rate of Return, %	Standard Deviation, %	<i>t</i> -Statistic (H0: Mean Return = 0)	<i>p</i> Value (H0: Mean Return = 0)	No. Pos.: No. Neg.	
Non-pro-rata firms	9.788	7.768	5.910	.000	20:2	
Pro-rata firms	0.133	16.404	0.020	.985	4:2	
Difference across samples (H0: same mean)			2.091	.046		

Table V. Continued

Panel C: Pro-rated firms closing at the minimum price are compared to those closing above the minimum price.

Subsample of Pro-rata Firms	No. of Firms	Expiration Day Excess Return, %	t-Statistic (H0: Mean Return = 0)	p Value (H0: Mean Return = 0)	Range of Excess Returns	Range of Pro-rata Fractions
Offers closing at minimum price	3	-8.567	-1.698	.282	-1.7, -5.6, -18.4	.52, .60, .98
Offers closing above minimum price	3	-5.233	-3.544	.071	-2.8, -5.0, -7.9	.88, .92, .97
Difference across samples (H0: same mean)			0.634	.561		

subsamples. The offers closing at the lowest price of the specified range have a larger price decline on average (although the difference across samples is not significant), as might be expected given the nature of their oversubscription. The offers closing above the minimum price, however, also experience significant price decline at expiration, even though they repurchase between 88% and 97% of the shares tendered at or below the purchase price.

#### *B. Price Reaction: Comparison to the Purchase Price Premium Ultimately Paid*

It is interesting to compare the stock price reaction to the Dutch auction repurchases to the purchase price premium ultimately paid by each firm. The purchase price premium is computed as the premium of the purchase price above the pre-announcement price, scaled by the pre-announcement price.

Panel A of Table VI reports that the sample correlation between the announcement day excess return and the purchase price premium is 86%. In contrast, there is little correlation between the expiration day excess return and the purchase price premium. The correlation between the cumulative return from the period beginning the day before the announcement through expiration and the purchase price premium is 64%.

Panel B reports the correlation between firm excess returns and the purchase premium, based on whether the firm's offer was pro-rated. Both non-pro-rata and pro-rata firms experience high correlation between the announcement excess return and the purchase price premium, with correlations of 89% and 80%, respectively. One notable difference between the subsamples is the correlation between the expiration excess return and the purchase price premium. Firms with non-pro-rated offers have a small positive correlation of 14%, while firms with pro-rated offers have a significant negative correlation of 63%. This difference is also captured in the correlation between the cumulative excess return and the purchase price premium. Firms with non-pro-rated offers have a significant positive correlation of 87%, while firms with pro-rated offers have a much smaller correlation of 35%.

### **IV. Interpreting the Price Reaction Evidence**

In this section I examine an explanation of the market price reaction documented in section III: one effect of a repurchase on price is due to an upward-sloping supply curve. If the supply curve is less than perfectly elastic, movement along the supply curve in a non-pro-rata repurchase changes the marginal shareholder to one having a higher reservation price, while a pro-rata repurchase does not.

Common explanations of the price reaction generally assume that homogeneous shareholder valuations are revised in response to the repurchase. Vermaelen (1984), for example, suggests that the willingness of a firm to pay a premium for its shares "signals" favorable information about the firm.



**Table VI**  
**The Correlation Between Stock Excess Returns and Purchase Premium**

This table reports the correlation between firm excess returns and the purchase premium paid, for 31 firms conducting Dutch auction stock repurchases, 1981-1988. The purchase premium is calculated as the purchase price of the repurchase less the pre-announcement market price, scaled by the pre-announcement market price.

Panel A: This panel reports the correlation between firm excess returns and the purchase premium.		
Time Period Return	Correlation Between Return and Purchase Premium	No. of Firms*
Announcement day excess return	.862	29
Expiration day excess return	.028	28
Day before announcement through expiration cumulative excess return	.638	28

Panel B: This panel reports the correlation between firm excess returns and the purchase premium, based on whether the firm's offer was pro-rated.			
Subsample	Excess Return Correlation		
	Announcement	Expiration	Day before Announcement Through Expiration Cumulative
Non-pro-rata firms	.893	.136	.869
Pro-rata firms	.800	-.625	.350
			No. of Firms
			22
			6

\*This correlation can be computed only for firms with completed (not canceled) repurchases.

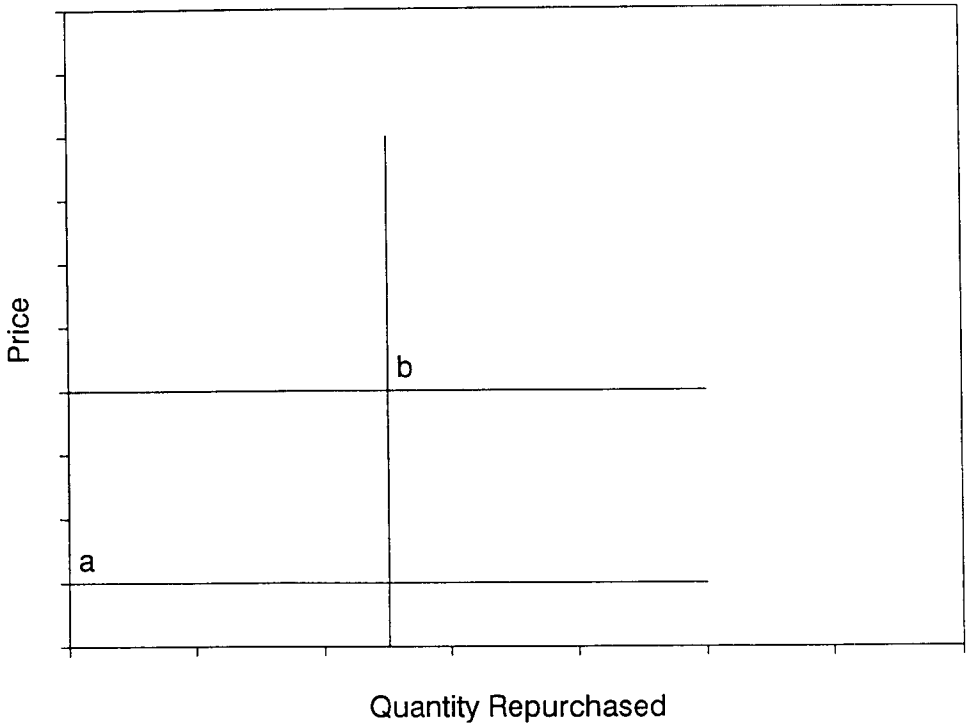
Jensen (1986) argues that firm value is enhanced by disgorging free cash that otherwise would be used inefficiently. The alternative explanation developed here in no way precludes signaling nor free cash considerations; on the contrary, if asymmetric information underlies the heterogeneity of shareholder valuations, then the change to a new marginal shareholder may be tantamount to a change in the information impounded in the market price. The fundamental distinction, therefore, is that the explanation developed in this section incorporates heterogeneous valuations explicitly into any explanation of the stock price reaction to the repurchase.

To introduce the heterogeneous valuations hypothesis, I begin by abstracting from many of the potentially salient components of the market reaction to the repurchase. When the cumulative excess return from the day before the announcement through expiration is positive for non-pro-rated offers, there are numerous explanations. The price increase could reflect only revised information in the presence of homogeneous valuations, as measured by the movement from point a to point b in Figure 1. The evidence presented in section II, however, does not favor this interpretation. By contrast, the price increase could reflect only changes in the marginal shareholder, as measured by the movement from point a to point b in Figure 2. Recall that this explanation, which does not include revisions in shareholder valuations, nevertheless does not rule out a signaling hypothesis based on heterogeneous valuations. As well, the price reaction could incorporate interactions of revised valuations and changes in the marginal shareholder, for example from point a to point c in Figure 2. The lack of a definitive model of the sources of shareholder heterogeneity, and therefore how shareholder valuations change due to the repurchase, limits our ability to distinguish between the second and third hypotheses. Therefore, I refer to such hypotheses, relying on movement along an upward-sloping supply curve, collectively as the heterogeneous valuations hypothesis.

The heterogeneous valuations hypothesis is consistent with all of the price reaction evidence presented above. The typical Dutch auction repurchase buys 15% of the outstanding shares and increases the market price at its announcement by 7.7%. If we assume that the repurchase caused only movement along the supply curve, recall that the average elasticity measure implies that to purchase 15% of the outstanding stock, a firm must offer a 9.1% premium above its pre-announcement price. Since the average announcement price increase is less than that, one consistent explanation of the price increase is that it results from shareholder heterogeneity.<sup>19</sup> This is confirmed by the high correlation between the announcement return and the ultimate repurchase premium.

The expiration price decline only for pro-rated offers is also consistent with shareholder heterogeneity. An important distinction between pro-rated and

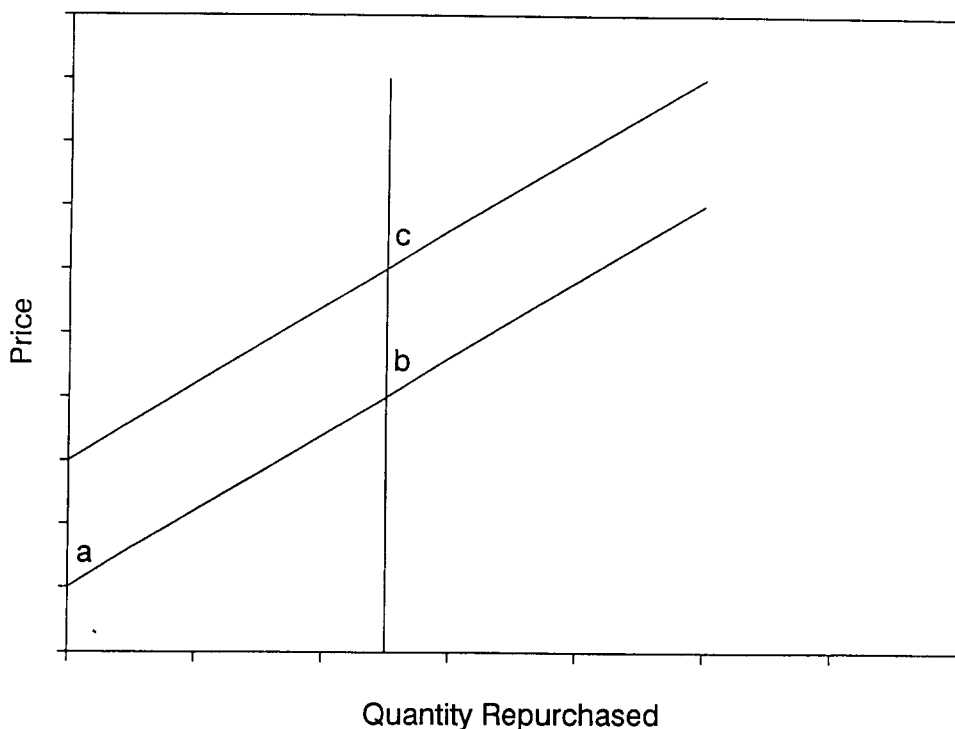
<sup>19</sup> Bagwell (1991b) reconsiders the price reaction at the announcement of other corporate events in light of an upward-sloping supply curve.



**Figure 1. Explanations of the price reaction to non-pro-rated Dutch auction repurchases.** The positive cumulative excess return from the day before the announcement through expiration could reflect only revised information in the presence of homogeneous valuations, as measured by the movement from point a to point b. The evidence presented in section II, however, does not favor this interpretation.

non-pro-rated offers in the Dutch auction is the effect on the marginal shareholder. In a non-pro-rated offer the reservation price of the post-offer marginal shareholder is at least the purchase price. Movement along the supply curve causes a persistent price increase, and hence there is no price decline at expiration. In a pro-rated repurchase each selling shareholder retains a positive number of shares. Thus, in the pro-rated repurchase the marginal shareholder is not changed by the offer. The reservation price of the marginal shareholder after the offer is less than the purchase price and therefore the price declines at expiration.

This hypothesis is confirmed by the cumulative excess returns from the day before the announcement through expiration. While for the sample the cumulative return is 6.7%, this is driven by non-pro-rated offers, with a 9.8% cumulative return. There is zero cumulative return for pro-rated offers. While the cumulative return is highly correlated with the purchase premium for non-pro-rated firms, it is not highly correlated for pro-rata firms.



**Figure 2. Explanations of the price reaction to non-pro-rated Dutch auction repurchases.** By contrast to Figure 1, the positive cumulative excess return from the day before the announcement through expiration could reflect only changes in the marginal shareholder, as measured by the movement from point a to point b. Recall that this explanation, which does not include revisions in shareholder valuations, nevertheless does not rule out a signaling hypothesis based on heterogeneous valuations. As well, the price reaction could incorporate interactions of revised valuations and changes in the marginal shareholder, for example from point a to point c.

### V. Abnormal Trading Volume

This section documents the pattern of trading volume during the period surrounding the Dutch auction repurchase. In the presence of an upward-sloping supply curve, a non-pro-rata (pro-rata) repurchase removes all (some) of the shareholders with valuations at or below the purchase price. After repurchases one might expect a decline in trading volume, with few trades being made at the post-repurchase price, as well as increases in bid-ask spreads. Models based on asymmetric information about common valuations seem not to predict a reduction in trading volume. Therefore, examination of trading volume patterns may produce corroborative evidence of shareholder heterogeneity.

Trading data were obtained from the CRSP tapes and the S&P Daily Stock

Price Record. The ratio of daily trading volume relative to estimated “normal” pre-repurchase volume is computed analogously to Lakonishok and Vermaelen (1990). For each firm, the trading volume around the announcement and expiration are compared to the average number of shares traded per day in the period from 50 days to 25 days prior to the announcement of the Dutch auction. The average ratio of trading volume relative to the estimates of average volume for the sample are reported in Table VII.

Panel A shows that the pattern of trading volume around the repurchase announcement is similar to the volume pattern found in fixed-price tender offers. In the ten days prior to the announcement, trading volume almost never exceeds 200% of the normal trading volume. Also comparable to fixed-price repurchases, substantial increases in trading activity follow the announcement of the Dutch auction. Average trading volume is very high on the announcement day, over 800% of normal volume. The median volume level is four times the usual volume, with 87% of the firms experiencing above-normal volume. On each of the first ten days after the announcement, volume on average is over 250% of normal volume. The magnitude of the post-announcement increase appears slightly smaller than found in fixed-price tender offers where 300% increases occur on average.

Panel B shows that on average the trading volume is at least twice as large as normal in each of the ten days prior to the expiration day. On the day before expiration, there is over three times the normal trading volume. The median level is 230% of normal, with 77% of the firms experiencing above-normal volume. This finding is comparable to that found for the expiration day for fixed-price repurchases. The expiration day here, in contrast, does not demonstrate significant increase in trading volume, with an average of 132% of normal levels, a normal median level, and exactly half of the firms above normal levels. This result may stem from the timing convention used here to define the expiration day. In particular, since 25 of the 30 (83%) offers expired at midnight, the next trading day is denoted the expiration day, and not the calendar day of the expiration.

It appears that by the second day past expiration unusual trading volume disappears, and daily volume may even be lower than preceding the announcement of the repurchase. Most of the firms have below-normal volume levels, and the median levels are lower than the lowest figure from the pre-announcement period. By the tenth day after expiration the trading volume appears similar to that found in the period preceding the announcement of the repurchase. While these results are inconclusive, lacking statistical significance at traditional levels, trading volume does appear temporarily lower following the expiration of the offer.<sup>20</sup> Similar findings emerged for fixed-price repurchases in Lakonishok and Vermaelen (1990). Further

<sup>20</sup> I was unable to conclude whether the trading volume following the expiration is a function of whether the offer was pro-rated.

Table VII  
**Abnormal Trading Volume Around Dutch Auction Repurchases**

This table reports the number of shares traded around the announcement and expiration of the offer relative to normal, which is the average daily trading volume computed from days -50 to -25 relative to the announcement. Under the null hypothesis, the mean ratio is one. Note that the median ratio for normal periods is less than one, and the percentage of positive cases is less than 50%.

Panel A: Trading volume around the announcement of the offer (31 firms).												
Day	-20	-19	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Mean	1.20	1.03	1.21	1.76	0.79 <sup>c</sup>	0.91	1.54	1.27	1.11	1.23	1.05	1.17
Med.	0.66	0.79	0.72	0.70	0.68	0.76	0.68	0.74	0.81	0.78	0.89	0.97
% > 1	32	42	32	42	32	29	39	42	35	42	39	45
Day	0	1	2	3	4	5	6	7	8	9	10	20
Mean	8.83 <sup>a</sup>	4.30 <sup>a</sup>	2.75 <sup>a</sup>	2.04 <sup>a</sup>	2.47 <sup>a</sup>	2.45 <sup>b</sup>	2.59 <sup>b</sup>	2.85 <sup>c</sup>	2.58 <sup>b</sup>	2.28 <sup>b</sup>	1.53	1.53 <sup>b</sup>
Med.	4.13	2.31	2.48	1.85	1.34	1.20	1.40	1.31	1.31	1.05	1.09	.87
% > 1	87	84	68	65	61	58	61	68	61	52	55	45

Panel B: Trading volume around the expiration of the offer (30 firms).												
Day	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1
Mean	1.90 <sup>c</sup>	2.74	2.43 <sup>b</sup>	2.35 <sup>c</sup>	2.48 <sup>b</sup>	2.29 <sup>b</sup>	3.58	2.98 <sup>a</sup>	2.12 <sup>a</sup>	3.61 <sup>b</sup>	2.30	2.30
Med.	1.12	1.15	1.32	1.15	1.17	1.17	1.48	1.56	1.69	2.30	1.69	1.69
% > 1	53	57	67	57	70	60	60	60	63	77	63	77
Day	1	2	3	4	5	6	7	8	9	10	20	33
Mean	1.32	1.24	1.40	1.10	0.88	0.86	0.95	0.94	1.58	1.00	0.62	0.62
Med.	1.00	0.95	0.54	0.51	0.64	0.64	0.91	0.80	0.94	0.62	0.62	0.62
% > 1	52	47	23	13	27	40	40	33	43	43	33	33

<sup>a</sup>Significantly different from one at the 1% level (two-tailed test).

<sup>b</sup>Significantly different from one at the 5% level (two-tailed test).

<sup>c</sup>Significantly different from one at the 10% level (two-tailed test).

empirical work, therefore, should explore possible reductions in trading volume resulting from similar corporate events.

## **VI. Cross-Sectional Variations in Supply Elasticity**

This section examines the characteristics of firms that face less elastic supply curves when they repurchase stock using the Dutch auction. Although the robustness of the results is limited by the smallness of this sample, the findings suggest that firms with low trading volume, firms not included in the S&P 500 Index, and firms that are not takeover targets face supply curves with greater upward slope. There is no difference based on whether a firm required confidential use of the shareholder tendering responses.

I examine first the relation between a stock's trading volume and its Dutch auction supply curve elasticity. Firms with large daily trading volume prior to the offer are more likely to have many shareholders with valuations close to the market price, since many shares are transactable at or near the market price, and hence may possess more elastic supply curves. Daily trading volume, obtained from the CRSP tapes and the S&P Daily Stock Price Record, is averaged over the period from 50 days to 25 days prior to the announcement of the Dutch auction. This window is the same as used to calculate "normal" volume in section V. Firms with no more than the sample median of 54,508 shares traded per day on average are classified as "Thin" stocks, while those with daily trading volume above the median are considered "Thick" stocks.<sup>21</sup>

A second (although less precise) proxy for liquidity is inclusion in the S&P 500 Index. Index funds as well as non-index institutions generate significant volume for these stocks.<sup>22</sup> Fourteen of the 31 firms were included in the S&P 500 Index at the time of the repurchase.

Second, I document whether firms initiating Dutch auction repurchases in the presence of rumored or actual takeover activity have different elasticities than firms without takeover activity. Takeover activity might increase the valuation dispersion by generating uncertainty about the takeover's outcome. Alternatively, if takeover activity has encouraged shareholders to sell to arbitrageurs, then more agreement in tendering prices could be observed after these transactions were completed. Also, if the target of a takeover is an endogenous choice, firms with relatively elastic supply curves are easier to take over. Based on WSJ accounts, takeover activity was considered to exist if at any time from one year before the announcement of the repurchase until expiration of the repurchase either (1) there were takeover rumors published, (2) an outsider acquired a significant holding, (3) antitakeover amendments were implemented, or (4) an actual takeover bid was made. Twelve firms satisfied at least one of the conditions for takeover activity.

<sup>21</sup> The mean daily trading volume for the 31 firms is 118,375 shares per day.

<sup>22</sup> For discussion, see Shleifer (1986), Harris and Gurel (1986), and Pruitt and Wei (1989).

Third, I investigate whether the 14 firms that demanded confidentiality in my use of the tendering data have significantly different elasticities than the firms which allowed free disclosure of the data. I am interested in whether the sample collected here is representative of all Dutch auction repurchases or is biased because the firms were willing to reveal the shareholder tendering responses. If confidential firms are not different than nonconfidential ones within Dutch auction firms that provided shareholder tendering data, it is less likely that the ones that provided data are different from those that refused to provide data.

The results are reported in Panels A through D of Table VIII. Firms with large daily trading volume have an average elasticity of 2.4, significantly greater than the elasticity of 1.3 for those with lighter volume. Firms included in the S&P 500 Index have an average elasticity of 1.9, somewhat greater than the elasticity of 1.4 for those that are not, although the differences are not statistically significant. Firms with takeover activity have an average elasticity of 2.2, greater than the elasticity of 1.4 for those that are not targets, especially above the bottom decile of the supply curve. There are no discernible differences across the elasticities of firms depending on whether the firm allowed free disclosure of the shareholder tendering responses.

I also consider these factors collectively in a multiple regression, allowing for correlation and interaction between these factors, using the regressions:

$$NP_i = \alpha + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + \varepsilon_i$$

where  $NP_i$  measures for firm  $i$  the difference between bids, for example, corresponding to the 6th percentile tender and the bid corresponding to the 1st percentile tender, scaled by the pre-announcement market price, and  $D1$ ,  $D2$ ,  $D3$ , and  $D4$  are dummy variables whose sample values are:

- $D1 = 1$  if the firm has "Thick" volume, else 0
- $D2 = 1$  if the firm is included in the S&P 500 Index, else 0
- $D3 = 1$  if the firm is a takeover target, else 0
- $D4 = 1$  if the firm required confidentiality, else 0.

The results of the multiple regression analysis (table not reported) confirm the bivariate cross-sectional variations in supply curve elasticities documented in Panels A through D. Firms with large trading volume, firms included in the S&P 500 Index, and takeover targets have more elastic supply curves. Whether a firm required confidentiality never significantly influences the elasticities, and including a dummy for confidentiality in the multiple regressions consistently lessens the statistical significance against the hypothesis of no cross-sectional differences. Moreover, there appear to be interactions between trading volume, takeover activity, and inclusion in the S&P 500 Index, warranting further examination with larger samples.

It is also interesting that even the subsamples of more elastic firms, including firms with heavy trading volume, firms that are included in the



Table VIII

**Arc Elasticity Measures: Cross-Sectional Variation**

This table reports the percentage price change necessary to acquire additional shares, scaled by the pre-announcement price, going from 1% to 6% of outstanding shares, 6% to 11%, and 11% to 16%. The cross-sectional variations in the price change (and implied elasticity) are reported for subsamples of firms based on the size of their trading volume, whether they are included in the S&P 500 Index, whether they have been the target of takeover activity, and whether they required confidential use of the data, for 31 firms conducting Dutch auction stock repurchases, 1981-1988.

Panel A: Sixteen firms had no more than the sample median of 54,508 shares traded per day and are considered "Thin" stocks, while 15 firms had daily trading volume above the median and are considered "Thick" stocks.

% Price Change for 5% Quantity Changes: Intervals	Thick Firms	Thin Firms	Price Diff. of Means <i>t</i> -Statistic	<i>p</i> Value	Mean		No. Thick:	
					Thick Arc $\eta = \%Q/\%P$	Thin Arc $\eta = \%Q/\%P$	No.	Thin
1-6	2.83	5.92	-2.05	.051	1.77	0.85	14	12
6-11	1.80	3.36	-1.56	.133	2.78	1.49	12	10
11-16	1.52	2.53	-1.12	.280	3.29	1.98	12	7
Sum: 1-16	6.15	11.81			2.44*	1.27*		

Panel B: Fourteen firms were included in the S&P 500 Index at the time of repurchase, while 17 were not.

% Price Change for 5% Quantity Changes: Intervals	S&P 500 Firms	Non-S&P 500 Firms	Price Diff. of Means <i>t</i> -Statistic	<i>p</i> Value	Mean		No. S&P:	
					S&P Arc $\eta = \%Q/\%P$	Non-S&P Arc $\eta = \%Q/\%P$	No.	Non-S&P
1-6	3.49	5.59	-1.35	.191	1.43	0.89	13	13
6-11	2.61	2.48	0.13	.900	1.92	2.02	11	11
11-16	1.62	2.50	-1.01	.328	3.09	2.00	11	8
Sum: 1-16	7.72	10.57			1.94*	1.42*		

Table VIII-Continued

Panel C: Twelve firms were takeover targets in the year preceding or during the repurchase, while 19 were not.									
% Price Change for 5% Quantity Changes: Intervals	Takeover Firms	Non- takeover Firms	Price Diff. of Means <i>t</i> -Statistic	<i>p</i> Value	Mean		No. Takeover: No. Non-takeover		
					Takeover Arc $\eta =$ %Q/%P	Non- takeover Arc $\eta =$ %Q/%P			
1-6	3.71	5.15	-0.90	.379	1.35	0.97	11:15		
6-11	1.64	3.31	-1.69	.106	3.05	1.51	10:12		
11-16	1.43	2.49	-1.25	.229	3.50	2.01	9:10		
Sum: 1-16	6.78	10.95			2.21*	1.37*			
Panel D: Fourteen firms required confidential use of the tendering bids, while 17 did not.									
% Price Change for 5% Quantity Changes: Intervals	Confident Firms	Non- confident Firms	Price Diff. of Means <i>t</i> -Statistic	<i>p</i> Value	Mean		No. Confident.: No. Non-confident		
					Confident Arc $\eta =$ %Q/%P	Non confident Arc $\eta =$ %Q/%P			
1-6	4.95	4.24	0.43	.670	1.01	1.18	11:15		
6-11	2.03	2.90	-0.83	.418	2.46	1.72	9:13		
11-16	1.87	2.10	-0.26	.798	2.67	2.38	9:10		
Sum: 1-16	8.85	9.24			1.70*	1.62*			

\* This figure is computed using the mean sum price change over the 15% quantity interval.

S&P 500 Index, or takeover targets, have an average elasticity of approximately two. This suggests that the model of perfect supply elasticity is not appropriate even for these firms.

## VII. Conclusion

Finance theory often assumes that the supply curve for shares is perfectly elastic. Nevertheless, this paper provides direct evidence that repurchasing firms face significantly upward-sloping supply curves for their shares. Shareholders' valuations differ dramatically, as revealed by their bids in Dutch auction repurchases of stock.

The average elasticity measure implies that to purchase 15% of the outstanding stock, a firm must offer a 9.1% premium above its pre-announcement market price. Much of the observed 7.7% announcement day price increase therefore is consistent with movement along an upward-sloping supply curve. This is confirmed by the high correlation between the announcement return and the ultimate repurchase premium. The expiration price decline only for pro-rated offers is also consistent with shareholder heterogeneity. In a non-pro-rated offer, movement along the supply curve causes a persistent price increase, and hence there is no price decline at expiration. By contrast, in a pro-rated repurchase the marginal shareholder is not changed by the offer, and hence there is a price decline at expiration. This is confirmed by the cumulative excess returns from the day before the announcement through expiration.

The findings force a reconsideration of all hypotheses which rely on homogeneity of valuations, and underscore the need to explicitly incorporate upward-sloping supply curves into explanations of the market reaction to the repurchase. Shareholder heterogeneity and signaling need not be in conflict; yet, for a true understanding of the price reaction, an explicit model of the sources of shareholder heterogeneity, and therefore how shareholder valuations change due to the repurchase, is imperative. This evidence herein also leaves unanswered the question of whether some of the price changes observed during other repurchases, takeovers, or large block transactions may also be due to upward-sloping supply curves.

Changes in trading volume around Dutch auction repurchases are comparable to the findings for fixed-price repurchases. On average, volume increases dramatically during the repurchase, and it appears to fall below pre-announcement levels after the expiration of the offer. Future research should examine post-expiration trading activity for similar corporate events.

The share price elasticity calculated from the individual bids is larger for firms with large trading volume, firms included in the S&P 500 Index, and firms that have been the targets of takeover activity. In future research, I will differentiate between various potential sources of the observed cross-sectional variation in Dutch auction supply curve elasticity. These sources include taxation, transaction costs, and the divergence of information and opinion.

**Appendix A**  
**Firms Conducting Dutch Auction Stock Repurchases:**  
**1981-1988**

---

Alco Standard Corp.  
American Presidents Co.  
Axia Inc.  
Barnes Group Inc.  
Brown-Forman Corp.  
Cabot Corp.  
Caesars World Inc.  
Chelsea Industries Inc.  
CSX Corp.  
Equitable Bancorp.  
Excello Corp.  
Far West Financial Corp.  
FHP International Corp.  
FMC Corp.  
Geico Corp.  
Gelco Corp.  
General Signal Corp.  
Graco Inc.  
Holiday Corp.  
Hospital Corp. of America  
Household International Inc.  
Jewelcor Inc.  
Jostens Inc.  
Carl Karcher Enterprises Inc.  
Knogo Corp.  
Masco Industries Inc.  
May Department Stores Co.  
MEM Company  
NL Industries Inc.  
Pennwalt Corp.  
Progressive Corp.  
Quadrex Corp.  
Quantum Chemical Corp.  
Quantum Corp.  
Ralston Purina Co.  
Resorts International Inc.  
Rex-Noreco Inc.  
RJR Nabisco Inc.  
Sage Energy Company  
Schlumberger LTD  
SmithKline Beckman Corp.  
Standard Brands Paint Co.  
Sterling Software Inc.  
J. P. Stevens and Company  
Superior Surgical  
Tektronix Inc.  
Tenneco Inc.  
Todd Shipyards  
Torchmark Corp.  
TRW Inc.  
Vulcan Materials  
Whittaker Corp.

---

**Appendix B**  
**Dutch Auction Supply Curves**

For each firm, the shareholder tendering responses from the Dutch auction are ordered from lowest to highest prices within the price range of the offer. This schedule of offers is the supply curve for the shares that the company faces in the repurchase. This table documents the supply curves for the 17 firms not requesting confidentiality. The prices at which shares were tendered are normalized with the pre-announcement price set to 100. Quantity is normalized to measure the cumulative percentage of outstanding shares tendered at or below each price. The percent sought is the upper bound of outstanding shares sought.

Axia	Far West			FMC			Jostens		
	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price
84.51	0.100	85.33	0.037	104.88	7.576	103.08	0.896		
85.92	0.100	88.00	0.038	105.91	7.818	103.85	0.896		
87.32	0.100	90.67	0.038	106.94	11.181	104.62	0.982		
88.73	0.100	93.33	0.039	107.97	12.572	105.39	0.982		
90.14	0.100	96.00	0.040	108.98	15.282	106.15	0.983		
91.55	0.100	98.67	0.041	110.03	17.636	106.92	1.089		
92.96	0.100	101.33	0.042	111.05	24.903	107.69	2.705		
94.37	0.100	104.00	0.043			108.46	4.030		
95.78	0.117	106.67	0.071			109.23	5.956		
97.18	0.119	109.33	0.224			110.00	6.638		
98.59	0.121	112.00	2.216			110.77	9.869		
100.00	0.198					111.54	10.160		
101.41	0.396					112.31	11.482		
102.82	0.594					113.08	12.237		
104.23	1.488					113.85	14.195		
105.63	1.709								
107.04	2.156								
108.45	2.208								
109.86	3.896								
111.27	4.893								
112.68	5.987								
114.08	6.236								
115.49	8.586								
116.90	9.206								
118.31	12.989								

General Signal			Pennwalt		
Price	Quantity	Price	Quantity	Price	Quantity
100.57	7.422	108.86	10.854	94.44	72.519
100.86	7.597	109.14	10.855	94.72	72.779
101.14	7.597	109.43	11.921	95.00	72.792
101.43	7.597	109.71	12.210	95.28	72.795
101.71	7.597	110.00	12.350	95.56	72.902
102.00	7.597	110.29	12.358	95.83	72.903
102.29	7.597	110.57	12.360	96.11	72.922
102.57	7.597	110.86	12.364	96.39	72.928
102.86	8.799	111.14	12.364	96.67	73.191
103.14	8.799	111.43	12.366	96.94	73.196
103.43	8.974	111.71	12.368	97.22	73.450
103.71	8.974	112.00	13.222	97.50	73.450
104.00	9.092	112.29	13.222	97.78	73.478
104.29	9.092	112.57	13.311	98.06	73.828
104.57	9.092	112.86	13.320	98.33	73.829
104.86	9.092	113.14	14.149	98.61	73.929
105.14	9.868	113.43	14.709	98.89	74.150
105.43	9.868	113.71	16.130	99.17	74.150
105.71	10.030	114.00	19.278	99.44	74.158
106.00	10.030	114.29	21.618	99.72	74.202
106.29	10.031	114.57	22.768	100.00	74.987
106.57	10.031	114.86	22.881	100.28	75.006
106.86	10.032	115.14	22.883	100.56	75.014
107.14	10.032	115.43	27.029	100.83	75.037
107.43	10.847	115.71	27.036	101.11	75.651
107.71	10.847	116.00	28.270	101.39	75.659
108.00	10.849	116.29	28.465	101.67	75.670
108.29	10.850	116.57	38.210	101.94	75.817
108.57	10.854			102.22	76.105

Price Range: 44.51  
 Pre-ann. Price: 43.75  
 Percent Sought: 31.5

Price Range: 85.97  
 Pre-ann. Price: 90  
 Percent Sought: 37.6

Ralston Purina				Standard Brands				Carl Karcher			
Price Range:	76.85	Price Range:	25.28	Price Range:	21.24	Price Range:	21.24				
Pre-ann. Price:	79.125	Pre-ann. Price:	21.5	Pre-ann. Price:	19.125	Pre-ann. Price:	19.125				
Percent Sought:	7.4	Percent Sought:	53.1	Percent Sought:	17.1	Percent Sought:	17.1				
Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity				
96.05	1.074	101.26	1.111	116.28	84.165	109.80	3.056				
96.21	1.074	101.42	1.112	116.86	84.169	110.46	3.056				
96.37	1.074	101.58	1.112	117.44	84.188	111.11	3.069				
96.52	1.074	101.74	1.116	118.02	84.188	111.76	3.069				
96.68	1.074	101.89	1.117	118.60	84.249	112.42	3.428				
96.84	1.074	102.05	1.117	119.19	84.249	113.07	3.829				
96.99	1.074	102.21	1.118	119.77	84.277	113.73	3.832				
97.16	1.074	102.37	1.637	120.35	84.283	114.38	3.834				
97.31	1.075	102.53	1.637	120.93	84.524	115.03	4.402				
97.47	1.075	102.69	1.637	121.51	84.524	115.69	4.408				
97.63	1.075	102.84	1.637	122.09	84.543	116.34	4.409				
97.79	1.075	103.00	1.723	122.67	84.546	116.99	4.420				
97.95	1.075	103.16	1.723	123.26	84.647	117.65	6.605				
98.10	1.075	103.32	1.738	123.84	84.651	118.30	6.680				
98.26	1.075	103.48	1.738	124.42	84.661	118.95	7.805				
98.42	1.075	103.63	1.938	125.00	84.666	119.61	7.967				
98.58	1.076	103.79	1.939	125.58	84.929	120.26	15.315				
98.74	1.076	103.95	1.939	126.16	84.930	120.92	15.320				
98.89	1.076	104.11	1.939	126.74	84.930	121.57	16.019				
99.05	1.076	104.27	2.676	127.33	84.932	122.22	16.072				
99.21	1.076	104.42	2.676	127.91	84.964	122.88	17.657				
99.37	1.076	104.58	2.773	128.49	84.964	123.53	17.693				
99.53	1.076	104.74	2.774	129.07	84.975	124.18	18.127				
99.68	1.076	104.89	3.689	129.65	84.976	124.84	18.166				
99.84	1.078	105.06	3.690	130.23	87.463	125.49	23.685				
100.00	1.078	105.21	4.362								
100.16	1.078	105.37	4.513								
100.32	1.078	105.53	5.675								
100.47	1.080	105.69	5.729								
100.63	1.080	105.85	6.299								
100.79	1.080	106.00	6.302								
100.95	1.081	106.16	8.178								
101.11	1.111										

Barnes Group			J.P. Stevens			Whittaker			Todd Shipyards		
Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity
104.26	0.428	101.87	2.685	110.09	3.864	86.60	0.000				
105.32	0.428	102.62	2.687	111.01	3.864	98.97	0.007				
106.38	0.436	103.37	2.689	111.93	3.869	100.00	0.043				
107.45	0.436	104.12	2.803	112.84	3.870	102.06	0.063				
108.51	0.437	104.87	3.178	113.76	4.609	103.09	0.166				
109.57	0.438	105.62	3.179	114.68	4.611	105.15	1.496				
110.64	0.799	106.37	3.191	115.59	4.618	106.19	2.043				
111.70	0.809	107.12	3.636	116.51	4.780	107.22	3.621				
112.77	1.463	107.87	5.363	117.43	7.712	108.25	3.639				
113.83	1.564	108.61	6.641	118.35	12.514	109.28	7.149				
114.89	5.652	109.36	10.063	119.27	13.943	110.31	7.150				
115.96	8.385	110.11	11.159	120.18	21.575	111.34	7.152				
117.02	8.991	110.86	15.554	121.10	25.317	113.40	7.225				
118.09	10.734	111.61	16.966	122.02	27.534	115.46	7.234				
119.15	12.070	112.36	21.748	122.94	28.813						
		113.11	23.429	123.85	29.753						
		113.86	29.420	124.77	35.689						



Knogo	NL Industries			RJR Nabisco			Sage Energy		
	Price Range: Pre-ann Price: Percent Sought:	Quantity	Price	Price Range: Pre-ann Price: Percent Sought:	Quantity	Price	Price Range: Pre-ann Price: Percent Sought:	Quantity	Price
116.50	15,18	4.625	107.08	15,125,16	48.064	108.33	52,58	6,715	94.55
118.45	12,875	4.625	107.96	14,125	50.695	109.38	48	6,964	101.82
120.39	47.6	4.641	108.85	16.7	51.324	110.42	8.1	7,710	109.09
122.33		4.641	109.73		53.444	111.46		8,396	116.36
124.27		5.373	110.62		53.776	112.50		10,169	123.64
126.21		5.728	111.50		54.267	113.54		10,865	
128.16		6.484	112.39		54.495	114.58		12,873	
130.09		8.547	113.27		56.518	115.63		13,350	
132.04		10.105				116.67		15,087	
133.98		11.067				117.71		16,057	
135.92		13.497				118.75		17,252	
137.86		14.284				119.79		17,489	
139.81		18.178				120.83		18,646	

## REFERENCES

- Bagwell, Laurie Simon, 1991a, Share repurchase and takeover deterrence, *Rand Journal of Economics* 22, 72-88.
- , 1991b, Shareholder heterogeneity: Evidence and implications, *American Economic Review* 81, 218-221.
- and Kenneth L. Judd, 1989, Transaction costs and corporate control, Unpublished manuscript, Northwestern University.
- Bradley, M., A. Desai, and E. H. Kim, 1988, Synergistic gains from corporate acquisitions and their division between the stockholders of target and acquiring firms, *Journal of Financial Economics* 21, 4-40.
- Brown, David T. and Michael Ryngaert, 1990, Heterogeneous shareholders: Evidence from buybacks and control contests, Unpublished manuscript, University of Florida.
- Comment, Robert and Greg A. Jarrell, 1991, The relative signalling power of Dutch auction and fixed-price self-tender offers and open-market share repurchases, *Journal of Finance* 46, 1243-1271.
- Dann, Larry Y., 1981, Common stock repurchases: An analysis of returns to bondholders and stockholders, *Journal of Financial Economics* 9, 113-138.
- Fama, Eugene F. and Merton H. Miller, 1972, *The Theory of Finance* (Dryden Press, Hinsdale, IL).
- Harris, Lawrence and Eitan Gurel, 1986, Price and volume effects associated with changes in the S&P 500: New evidence for the existence of price pressures, *Journal of Finance* 41, 815-829.
- Holthausen, Robert, Richard Leftwich, and David Mayers, 1990, Large-block transactions: The speed of response, and temporary and permanent stock-price effects, *Journal of Financial Economics* 26, 71-95.
- Jensen, Michael, 1986, Agency costs of free cash flow, corporate finance and takeovers, *American Economic Review* 76, 323-329.
- Kamma, Sreenivas, George Kanatas, and Steven Raymar, 1990, Dutch auction vs. fixed-price self-tender offers for common stock: An empirical examination, Unpublished manuscript, Indiana University.
- Lakonishok, Josef and Theo Vermaelen, 1990, Anomalous price behavior around repurchase tender offers, *Journal of Finance* 45, 455-477.
- Loderer, Claudio, John Cooney, and Leonard Van Drunen, 1991, The price elasticity of demand for common stock, *Journal of Finance* 46, 621-651.
- Masulis, Ronald W., 1980, Stock repurchase by tender offer: An analysis of the causes of common stock price changes, *Journal of Finance* 35, 305-321.
- Mayshar, Joram, 1981, Transaction costs and the pricing of assets, *Journal of Finance* 36, 583-597.
- Mikkelson, Wayne and Megan Partch, 1985, Stock price effects and costs of secondary distributions, *Journal of Financial Economics* 14, 165-194.
- Milgrom, Paul and Robert Weber, 1982, A theory of auctions and competitive bidding, *Econometrica* 50, 1089-1122.
- Miller, Edward, 1977, Risk, uncertainty, and divergence of opinion, *Journal of Finance* 32, 1151-1168.
- Pruitt, Stephen and K. C. John Wei, 1989, Institutional ownership and changes in the S&P 500, *Journal of Finance* 44, 509-513.
- Scholes, Myron, 1972, The market for securities: Substitution versus price pressure and the effects of information on share prices, *Journal of Business* 45, 179-211.

- Shleifer, Andrei, 1986, Do demand curves for stock slope down? *Journal of Finance* 41, 579-590.
- Stulz, René M., 1988, Managerial control of voting rights: Financial policies and the market for corporate control, *Journal of Financial Economics* 20, 25-54.
- Varian, Hal R., 1985, Divergence of opinion in complete markets, *Journal of Finance* 40, 309-317.
- Vermaelen, Theo, 1981, Common stock repurchases and market signalling: An empirical study, *Journal of Financial Economics* 9, 139-183.
- , 1984, Repurchase tender offers, signalling and managerial incentives, *Journal of Financial and Quantitative Analysis* 19, 163-181.
- Vickrey, William, 1961, Counterspeculation, auctions, and competitive sealed tenders, *Journal of Finance* 16, 8-37.