Why do firms buy back below average market prices?

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Abstract

This paper examines why firms buy back at prices below the average market price. The results of the empirical analysis suggest that contrarian trading is the major driver of the difference between average monthly repurchase price and average monthly market price. There is also evidence in favor of the notion that at least some firms are able to time the market by exploiting private information. Moreover, contrarian trading and managerial timing are not exclusive explanations of why firms buy back at a bargain. The *limit-order-hypothesis* suggests that firms are able to buy back at bargain prices because they predominantly use limit orders for buying back their shares. By submitting limit orders at the prevailing bid, repurchasing firms are able to earn the spread. One of the implications of this hypothesis is that the exogenous bid-ask spread and bargains are positively correlated, i.e. a higher spread is accompanied by higher bargains. Furthermore, the bargains should be higher the more trades are executed at the ask. Therefore, an order imbalance towards trades at the ask price should as well increase the bargain. The empirical evidence presented in this paper is in line with these predictions.

"Keywords:" share repurchases, managerial timing, contrarian trading, price support, market microstructure, liquidity, limit order markets

JEL classifications: G10, G14, G30, G32, G35

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1 Introduction

Ever since the seminal paper by Barclay and Smith (1988), managerial timing ability of stock repurchases has been a fundamental concern of academic research. For very good reasons: in a survey of 384 Chief Financial Officers by Brav et al. (2005), 86.6% of respondents agree that the most popular reason for stock repurchases is that the stock price is low. While the timing of repurchase announcements has been studied extensively (cf. e.g. Vermaelen (1981); Dann (1981); Ikenberry et al. (1995, 2000)), the empirical evidence on the timing of actual stock repurchases is scarce, mixed, and hampered by the fact that in most countries, including the United States, firms have not been required to provide detailed reports of their repurchase activity (cf. Stephens and Weisbach (1998); Brockman and Chung (2001); Cook et al. (2004); Ginglinger and Hamon (2007)). Since 2004, when the SEC modified rule 10b-18 on share repurchases, this has changed for the United States.[1] Today, firms publicly traded in the U.S. are required to report their monthly repurchase activity in their quarterly filings. With the newly available data at hand, it has not only become possible to examine repurchase trading on a monthly basis, but also to compare average repurchase prices to average market prices and thus to examine whether firms buy back at a bargain.[2]

Two studies have so far made use of the newly available data and document that firms buy back at an economically and statistically significant bargain. De Cesari et al. (2012) examine the effects of ownership and stock liquidity on the bargain and find that open market repurchases are timed to benefit non-selling shareholders. In their working paper, Oded et al. (2011) find that small firms, which repurchase less frequently than large firms, buy back at prices "which are significantly lower than average market prices". Both studies have in common that they regard the difference between repurchase price and average market price as a measure of managerial timing ability. However, both studies fail to link the bargain directly to the use of private information and managerial timing ability.

This paper examines existing and new hypotheses on why firms buy back at bargain prices. The starting point of the analysis is the insight that the bargain which is defined as the monthly relative difference between average repurchase price and average market price can be driven by the repurchasing firm's ability to either buy back below the current market price (real bargain) or to predict changes of the current market price (managerial timing). While a real bargain results from buying below the current market value of a stock, a timing

[1] Studies before 2004 analyzing actual stock repurchases had to use proxies for the number of shares bought back derived from CRSP and Compustat, cf. for example Stephens and Weisbach (1998). See Banyi et al. (2008) for an exhaustive overview on research papers using proxies from CRSP and Compustat and the reliability of these measures.

[2] Throughout this paper I will refer to the relative difference between average monthly repurchase price and average monthly market price as bargain or bargain measure.

gain results from either an increase in the stock price after the repurchase or a drop in the stock price before the repurchase within the same month. By distinguishing between a real bargain and a timing gain, I am able to disentangle several mechanisms which enable firms to buy back at bargain prices in a coherent framework.

My *limit-order-hypothesis* suggests that firms are able to buy back at bargain prices because they predominantly use limit orders for buying back their shares. Repurchase trades based on limit orders are executed at the bid whereas the average market price should be located between the bid and the ask. Consequently, by submitting limit orders at the prevailing bid repurchasing firms are able to earn the spread. The underlying presumption of this hypothesis is that the repurchasing firm is usually among the best informed traders in the market. Several papers suggest that better informed traders are more likely to submit limit orders when trading in limit order markets. Goettler et al. (2009) develop a model where the investors with the highest inclination to become informed use limit orders. Bloomfield et al. (2005) use an experimental setting to show that informed traders may use more limit orders than liquidity traders. Kaniel and Liu (2006) both theoretically and empirically demonstrate that limit orders may be optimal for informed traders if information is sufficiently long-lived. One of the implications of this hypothesis is that the exogenous bid-ask spread and bargains are positively correlated, i.e. a higher spread is accompanied by higher bargains. Furthermore, the bargains should be higher the more non-repurchase trades are executed at the ask. Assuming that firms use limit orders, i.e. buy back at the bid, an order imbalance towards trades at the ask price should increase the bargain.

The *price-impact-hypothesis* predicts that the ability to buy back at bargain prices critically depends on the share of repurchases in total trading volume which I refer to as repurchase intensity. If share repurchases represent a large share of trading volume, stock prices are driven up and consequently the bargain decreases.[3] Large trades should have a price impact irrespective of whether firms buy back via limit or market orders. In any case, for trades to be executed, repurchasing firms have to climb up the demand curve.

The *market-timing-hypothesis* suggests that firms are able to time the market and thus buy back at low prices. Consequently the bargain would results from an increase in the stock price after the repurchase transaction. The empirical prediction of this hypothesis is a positive relation between positive abnormal returns and the bargain measure. On the other hand, the *contrarian-trading hypothesis* predicts that firms buy back after drops in the stock

[3] Oded et al. (2011) examine the impact of repurchase intensity on the bargain measure for S&P 500 firms but do not find any effect. McNally et al. (2006) examine open market repurchases in Canada and find that the "average intraday price impact of repurchase trades is negative, since, because of execution rules, 60% are seller-initiated". Rasbrant (2011) examine the impact of stock repurchases on stock prices for a sample of Swedish stocks and conclude that repurchase intensity generates positive abnormal returns, i.e. drives prices up.

price because they either believe in mean reversion or they want to provide price support. Hong et al. (2008) present evidence for the U.S. that firms act as buyers of last resort, i.e. provide liquidity to investors, when no one else will. The authors document that firms with the ability to repurchase shares in large numbers, have lower short-run return variances. By construction of the bargain measure, contrarian traders will buy back at bargain prices. An empirical implication of the *contrarian-trading hypothesis* would thus be that the bargain measure is related to negative abnormal returns.

For the empirical analysis, I am able to use a unique data set covering monthly repurchase volume and prices of all repurchasing firms publicly traded in the United States between January 2004 and October 2008. Overall, the data set comprises 129,684 firm-months including 35,397 repurchase months of 2,934 repurchasing firms.

The analysis provides strong support for both the *limit-order-hypothesis* and the *price-impact-hypothesis*. The empirical analysis reveals that only up to a certain repurchase volume firms are able to buy back at a bargain. After controlling for the price impact of repurchase trades, order imbalance towards the ask and the relative bid-ask spread increase the bargain. For high repurchase volumes, the relation between the spread and bargain is reversed. When the repurchase intensity is high, a higher spread ceteris paribus leads to a lower bargain. It also turns out that repurchase size as a fraction of shares outstanding increases the bargain. This observation is in line with Hillert et al. (2012), whose findings suggest that repurchasing firms predominantly use limit orders for large trades and thus further evidence in favor of the *limit-order-hypothesis*.

An analysis of abnormal returns reveals that repurchase months display more negative abnormal returns than months without repurchases. Hence, it is very difficult to argue that the bargain is driven by within-month timing ability. I am however able to show that a large portion of the bargain can be explained by either positive or negative abnormal returns in the same month. I conclude that firms buy back after abnormal declines in the stock price in order to provide price support and that this is picked up by the bargain measure. As I also document that positive abnormal returns are positively correlated with the bargain measure, I furthermore conclude that some firms exhibit timing ability which is as well picked up by the bargain measure. However, a positive relation between the bargain measure and positive abnormal returns, can also be explained by contrarian trading. If firms do not buy back after increases in the stock price, they must buy back at prices below the average market price in months which exhibit abnormal returns. Therefore, contrarian trading seems to be the most convincing and major driver of the difference between average repurchase price and market price.

An additional analysis of ownership structures reveals that bargains are related to insider

ownership and that this is the result of firms buying back after abnormal declines in the stock price. As insider ownership and positive abnormal returns are not correlated, I reject the notion that insiders use private information to expropriate selling shareholders as suggested by De Cesari et al. (2012). I also find no evidence suggesting that there is an inversely u-shaped relation between timing gains and insider ownership. Finally, the empirical evidence is not in line with the notion that institutional ownership decreases timing gains.

Earlier literature documents evidence for both managerial timing and contrarian trading. Using survey data, Cook et al. (2004) find weak evidence in favor of managerial timing ability for a sample of 64 U.S. firms. The authors show that NYSE firms are able to beat their benchmark whereas NASDAQ firms are not. Using the unique disclosure environment of the Hong Kong Stock Exchange, Brockman and Chung (2001) find that "managers exhibit substantial timing ability". By simulating repurchases via bootstrapping, the authors were able to demonstrate that managers buy back at prices which are below the ones obtained without the use of private information. By comparing average market prices of repurchase days to the days before and after the repurchase for a sample of French firms, Ginglinger and Hamon (2007) conclude that "share repurchases largely reflect contrarian trading rather than managerial timing ability".

This paper contributes to the literature on the timing of actual stock repurchases in several ways. First, it is the first one to distinguish between bargains and timing gains and therefore to provide a profound understanding of what the bargain measure actually measures. Second, it is the first to suggest that repurchasing firms might be able to buy back below average prices as it predominantly operates with limit orders. Third, it suggests that most of the bargain documented in the literature are the result of contrarian trading which naturally takes place after drops in the stock price and thus at prices below average market prices. The results are thus in line with earlier studies providing evidence for repurchases being employed for price support (e.g. Hong et al. (2008)). Fourth, it provides evidence suggesting that in particular firms with high insider ownership engage in contrarian trading.

The rest of this paper is structured as follows. Section 2 describes the selection of the data set and the construction of the sample. Section 3 entails the empirical analysis. Section 4 concludes.

2 Data & Sample Construction

The requirement to disclose detailed information on share repurchases applies to all periods ending on or after March 15, 2004. The new disclosure requirements mandate the publication of monthly share repurchases under the new Item 2(e) of Form 10–Q and under the new

Item 5(c) of Form 10–K. Under these rules firms have to report the total number of shares purchased, the average price paid per share, the number of shares purchased under specific repurchase programs, and either the maximum dollar amount or the maximum number of shares that may still be purchased under these programs. The difference between the total number of shares purchased and the number of shares purchased under programs are often shares delivered back to the issuer for the payment of taxes resulting from the vesting of restricted stock units and the exercise of stock options by employees and directors. Besides the number of shares purchased and the purchase price, firms have to indicate the method of repurchase (e.g., open market repurchase, private transaction, tender offer).

I use the CRSP monthly stock file as a starting point to construct the data set. I identify all ordinary shares (share code 10 and 11) that are traded on the NYSE, AMEX, and NASDAQ (exchange code 1, 2, and 3). I set the end of the sample period before the start of the financial market crisis (October 2008) in order to ensure that results are not driven by extreme price changes during the crisis. I require firms to be reported in both CRSP and Compustat and that the CRSP-Compustat merged linking table provides the central index key (cik), which is the main identifier of the Securities and Exchange Commission and therefore necessary to obtain the repurchase data from the 10-Q and 10-K filings.

For all firms in the CRSP-Compustat merged database with available cik, a computer script is used to download all 10-Q and 10-K filings that correspond with the sample period. Since many firms do not adhere to the proposed disclosure format, a group of research assistants manually checked and corrected observations where necessary. In the next step I merge the data with TAQ using historical CUSIP numbers. I eliminate all observations from the final sample for which the variables used in the baseline analysis are not available. Finally, I delete all firms with no active repurchase program and no repurchase activity within the sample period. This procedure leaves me with 129,684 firm-months and 35,397 repurchase months observations of 2,934 different firms over the period from January 2004 to September 2008.

For the analysis on the relevance of ownership for bargain prices, I additionally include information on insider ownership from Execucomp and institutional investors from Thomson Reuters' 13-F database. In particular, the addition of data from Execucomp reduces the data set substantially. The addition of ownership structures leaves me with 74,043 firm-month and 24,084 repurchase-month observations of 1,590 different firms. This sample is only used in the analysis of the impact of ownership on the bargain.

Table 1 describes all variables used in this study. *Bargain* denotes the relative difference between the average repurchase price and the average market price. I compute the market price as the monthly average of daily closing prices from CRSP. *Bargain (volume-*

weighted) is basically the same measure, but with the daily closing price being weighted by daily trading volume. For the sake of readability and intuition I want the bargain to be a positive number and thus I multiply the bargain measures by -1. *Insider ownership* is expressed in terms of shares outstanding and comprises (1) the aggregate number of shares held by the named executive officer excluding stock options (SHROWN_EXCL_OPTS), (2) not exercised exercisable options (OPT_UNEX_EXER_NUM), and (3) restricted stock holdings (STOCK_UNVEST_NUM) from the Compustat Executive Compensation (Execucomp) database. *Institutional Ownership,* from Thomson Reuters' Institutional Holdings (13-F) database, is defined as the total number of shares held by investors (data item: SHARES) divided by the number of shares outstanding.

For measures of the spread and order imbalance, I use the NYSE TAQ database to extract the necessary intraday transaction data. For each trade I assign the prevailing bid and ask quotes that are valid at least one second before the trade took place. If there is more than one transaction in a given second, the same bid and ask quotes will be matched to all of these transactions. If there is more than one bid and ask quote in a given second, I assume that the last quote in the respective second is the prevailing quote.[4]

For the spread measure, I use the NBBO (National Best Bid and Offer) quotes. The NBBO offer size is computed by aggregating all offer sizes at the best bid and best offer (=ask) over all U.S. exchanges (see WRDS website).[5]

I calculate the quote midpoint price as the average of the prevailing bid and ask quotes. I subsequently use the algorithm of Lee and Ready (1991) to classify trades into buys and sells. I define trades with a transaction price above the quote midpoint as buys and those with a transaction price below the quote midpoint as sells. If a transaction price is equal to its quote midpoint, I compare the current transaction price with the previous transaction price. If $P_t < P_{t-1}$, I consider a trade to be seller-initiated; if $P_t > P_{t-1}$, I consider it to be buyer-initiated. Should the two prices be equal, I leave the trade unclassified.

The spread is defined as the difference between the prevailing ask and the prevailing bid quote. The relative spread is defined as the spread divided by the quote midpoint price. The *time-weighted relative spread* which I use for this analysis represents the monthly average of all NBBO spreads for a given stock weighted by the time the respective quote is prevailing. *Order imbalance (volume)* is defined as the dollar-volume difference between seller- and buyer-initiated trades scaled by trading volume.

Abnormal returns are computed using the market model. The benchmark market index is

[4]Henker and Wang (2006) consider this procedure to be more appropriate compared to the classical Lee and Ready (1991) five-second rule. Bessembinder (2003) tries zero to thirty-second delays in increments of five seconds and does not find any differences in the results.

[5]http://wrds-web.wharton.upenn.edu/wrds/research/applications/microstructure/NBBO%20derivation/

the CRSP equally weighted index. The estimation window ends 6 months prior to the event month. The estimation length is 60 months with a minimum of 36 months being required. Fama-French monthly factors (from Kenneth French's web site at Dartmouth) are added to estimate the expected return.

Table 2 provides descriptive statistics for all variables used in the analysis. Panel A describes the whole sample, i.e. both months with and without repurchases. The average abnormal return for the whole sample is equal to -0.41% which is significantly different from zero at the one percent level. The same is true for the median value which is equal to -0.60%. The cumulative abnormal return over the following six months is negative as well with the mean being -2.33% and the median being -2.39%. When looking only at repurchase months (Panel B), the average abnormal return is even more negative, while the median abnormal return is of similar magnitude.

Table 3 reports descriptive statistics for the insider ownership sub-sample. Market capitalization of the median firm is more than twice as high as for the whole sample which makes sense as Execucomp does only cover sufficiently large firms. The exclusion of mostly small firms changes the descriptives of the liquidity measures drastically. The average spread decreases by approximately 75% and the order imbalance switches towards the bid. Thus, in the ownership sub-sample, there are more seller-initiated trades than buyer-initiated trades. Compared to the total sample, repurchases are lower relative to turnover and larger relative to shares outstanding.

3 Analysis

In line with earlier studies by Ben-Rephael et al. (2012) and De Cesari et al. (2012), Table 4 reports an economically and statistically significant bargain. The reader should again notice that—for the sake of readability—I have multiplied the bargain measure which is defined as the relative difference between monthly average repurchase price and average market price by -1. After this adjustment, the bargain is a positive number which is equal to 0.66% on average. This is almost the same as the value for the volume-weighted measure. Median values are still negative but substantially lower. De Cesari et al. (2012) report values which are of lower magnitude. The authors report an average bargain of 0.619% and a median bargain of 0.207% for their sample of 2,316 observations. Given that the authors' sample is without obvious selection bias but of a much smaller size, I consider the numbers reported similar to mine. When computing the average bargain, for S&P 500 firms only, I furthermore obtain very similar results to the ones in Ben-Rephael et al. (2012) who restrict their sample to S&P 500 firms. Table 4 furthermore reports tests on whether the bargain measures are

statistically significant from zero (which they are) and from each other (which they are not).

In terms of dollars, the average bargain in a given month is equal to approximately 94,000 dollars which amounts to 3.3 billion dollars over the 35,397 repurchase months between January 2004 and October 2007. Total bargains account for 0.17% of total repurchase volume which is equal to 1.9 trillion dollars.

The rest of this chapter is dedicated to examining why firms buy back at bargain prices.

3.1 Bargain repurchases and market microstructure

In Table 5, I regress the bargain measure (Panel A) and the volume-weighted bargain measure (Panel B) on a set of repurchase and market microstructure variables. Every regression model, I run first without and subsequently with firm-fixed effects. To control for unobserved heterogeneity related to firm size within the OLS-regression, I additionally include the natural logarithm of market capitalization. The OLS-models explain between 2.3% and 4.1% of cross-sectional variation in the dependent variable. While the R^2 is rather low in absolute terms, it is relatively high when compared to a similar analysis of Ben-Rephael et al. (2012) who report an R^2 in the range of between 1.54% and 1.77%. The fixed-effects models explain between 0.9% and 2.7% of within-firm variation.

I include repurchases to trading volume in order to control for the price impact of large repurchase trades. In all specifications, an increase of repurchases to trading volume substantially reduces the bargain. A one percentage point increase in the variable decreases the bargain by between 3.5 and 5.0 percentage points. Whether a firm is able to realize a bargain or not thus critically depends on the repurchase intensity relative to the liquidity of the market.

After controlling for price impact, I add another repurchase size variable which is scaled by shares outstanding. When submitting limit-orders, there is no guarantee that the trade is executed. The execution risk can be ruled out by placing market orders. Market orders, however, face the risk of being executed at prices higher than the current ask price. The price risk associated with market orders obviously increases with trade size. The gravitational pull-model by Cohen et al. (1981) predicts that traders switch from market to limit orders as soon as the price risk exceeds a certain threshold. In the context of share repurchases, their model therefore postulates that firms supply liquidity to the market if they repurchase a large number of shares in any given period and they consume liquidity if they repurchase a smaller number of shares. Hence, the propensity of repurchasing shares by submitting limit orders should be positively correlated to repurchase size. Hillert et al. (2012) support this notion by showing that the liquidity impact of repurchase trades and repurchase size are positively correlated. Therefore, after controlling for price impact, repurchases relative to

shares outstanding should have a positive impact on the bargain. In fact, the coefficient is negative, i.e. it increases the bargain, for all of the OLS-models and for the most elaborate of the fixed-effects models (specification 6). This is in line with my *limit-order-hypothesis* which suggests that firms are able to buy back at bargain prices because they predominantly use limit orders for buying back their shares.

The limit-order hypothesis furthermore implies that an order imbalance towards trades at the ask price should increase the bargain. Seller-initiated trades take place at the bid and buyer-initiated trades take place at the ask. Order imbalance measures the relative difference between the dollar value of buyer and seller initiated trades. Conceptually, the average market price is a weighted average of trades taking place at the bid and trades taking place at the ask. Therefore, if firms use limit orders for share repurchases, the bargains should be higher, the higher the share of trades that are executed at the ask. The results further support the *limit-order-hypothesis*. A one percentage point increase in order imbalance increases bargains by half a percent.

Finally, the *limit-order hypothesis* suggests that the bargain should be higher with a higher spread. To show this empirically is difficult for primarily two reasons. First, as Hillert et al. (2012) demonstrate, firms buying back by submitting limit orders substantially decrease the spread, i.e. improve their stock's liquidity. Therefore, the spread is a highly endogenous measure which is smaller (and not larger) in months when firms operate with limit orders. Second, the price impact of large repurchase trades depends on the slope of the demand function. If small increases in quantity lead to large changes in the stock prices, large repurchase trades have a high price impact. It is reasonable to assume that on average the slope of the demand function is more steep for stocks with ceteris paribus larger spreads. Therefore, the spread is also a variable aggravating the price impact of repurchase trades. In conclusion, the spread may have two opposing effects on the bargain and it is ex ante not clear which of the two effects will be stronger on average.

In order to address the problem of endogeneity, I start with a measure of the current relative spread in specifications (1) and (2) and subsequently include a lagged measure of the relative spread in specifications (3) and (4) which is not affected by current repurchase trading. The empirical results support my presumption that the results are driven by endogeneity. In particular, within the fixed-effects model it makes a huge difference whether one includes the current or the lagged relative spread: While an increase in the spread by one percentage point decreases the bargain by 0.03 percentage points in specification (2), the impact decreases by two thirds when using the lagged spread in specification (4).[6]

[6]The results using the six-month average spread of months without repurchase activity are very similar. See the Section 8 on robustness tests for the exact results.

Specifications (5) and (6) try to disentangle the positive limit-order effect from the negative price impact effect and thus address the problem of opposing effects of the relative spread on the bargain. For this to achieve, I transform the variable which measures repurchases to trading volume into quintiles and subsequently interact the quintiles with the lagged relative spread. This specification allows me to disentangle the overall effect of the spread on the bargain from the effect related to price impact. Here, the overall effect of an increase of the spread on the bargain is positive, i.e the bargain is higher with the lagged spread being higher. For high repurchase intensities, the effect of the spread on the bargain is reversed. For the highest repurchase to trading volume quintile, a one percentage point increase in the spread decreases the bargain by between 0.3 and 0.4 percentage points. Although still rather low at between 3.5% and 2.0%, the explanatory power of this model with respect to the dependent variable is substantially higher as the ones without repurchase volume quintiles. Therefore, I will use this specification as my baseline specification in the subsequent analysis.

The analysis of the volume-weighted bargain measure reveals qualitatively and mostly also quantitatively the same results for specifications (5) and (6). Noteworthy, the effect of the relative spread on the volume-weighted bargain measure becomes even stronger. This makes sense as the average market price, used as the benchmark to which the average repurchase price is compared, is weighted by daily trading volume which should be higher on days where firms buy back.[7] Consequently, the measure over weights repurchase days and thus is a more adequate measure of the bargain than the equally weighted spread which in turn should pick up relatively more of the timing gains. As the more precise measure of the bargain delivers even stronger results in favor of the *limit-order hypothesis*, this finding strengthens the overall evidence on that matter.

3.2 Bargain vs. timing gain

A major limitation of the bargain measure is the implicit assumption that repurchases are distributed randomly over the month for which they are measured. However, the average market price and the average repurchase price in a given month usually cover different periods of time. In the most extreme case, the market price consists of all daily closing prices, while the average repurchase price represents repurchase trades taking place on only one day. As a result, the bargain measure might be driven by both firms buying back after drops in stock price (contrarian trading) and firms buying back before increases in the stock price (market timing).

[7] Hillert et al. (2012) provide evidence that share repurchases increase monthly trading volume. Consequently, it is fair to assume that repurchases increases trading volume on those days where repurchases take place.

To understand whether the bargain is driven by contrarian trading or market timing is important. In efficient capital markets, market timing only works if private information is used. If firms are able to buy back below fair value by exploiting private information, selling shareholders receive a price in return which is too low. Repurchase trading would then take place at the expense of selling shareholders. On the other hand, if the bargain measure is driven by contrarian trading, there is nothing we need to worry about as there is no private information involved.

The literature documents evidence for both managerial timing and contrarian trading. Using survey data, Cook et al. (2004) find weak evidence in favor of managerial timing ability for a sample of 64 U.S. firms. The authors show that NYSE firms are able to beat their benchmark whereas NASDAQ firms are not. Using the unique disclosure environment of the Hong Kong Stock Exchange, Brockman and Chung (2001) find that "managers exhibit substantial timing ability". By simulating repurchases via bootstrapping, the authors were able to demonstrate that managers buy back at prices which are below the ones obtained without the use of private information. Ginglinger and Hamon (2007) document that repurchasing firms trade contrary to the market, which is in line with what we know from the literature on insider trading (cf. Rozeff and Zaman (1988), Lakonishok and Lee (2001), Jenter (2005), and Fidrmuc et al. (2006)). While insiders seem to be able to pick mean reverting stocks and therefore realize timing gains (cf. e.g. Lakonishok and Lee (2001)), Ginglinger and Hamon (2007) do not find evidence for managerial timing ability of repurchases. In a survey by Brav et al. (2005), Chief Financial Officers indicate price support as an important motivation for repurchase trading. As the belief in mean reversion, price support results in contrarian trading.

A strong relation between positive abnormal returns and the bargain measure would indicate that repurchases take place before abnormal increases in the stock price and thus indicate managerial timing ability. On the other hand, if the bargain measure is related to negative abnormal returns, this would indicate that the measure is driven by contrarian trading.

In the regression analysis of bargains presented on Table 6, I control for all variables used in Table 5 and the abnormal return in the respective month in order to examine whether bargains are driven by managerial timing (ability).[8] The results reported in models (1) and (2) suggest that abnormal returns (*AR(0,0)*) and bargains are correlated. The magnitude of the effect, however, critically depends on which bargain measure is used. When using the equally weighted bargain measure (Panel A), the effect is rather small. An abnormal return of 10 percent would increase the bargain by between 0.07 and 0.09 percentage points. When

[8]See Section 2 "Data & Sample Construction" for details on how I compute abnormal returns

using the volume-weighted bargain measure (Panel B), the effect gains economic significance. Now, an abnormal return of 10 percent increases the bargain by between 0.57 and 0.60 percentage points.

In order to gain a deeper understanding of why the impact of *AR(0,0)* on equally-weighted and volume-weighted bargains is so different, I split the abnormal return into two separate variables in specifications (3) and (4) - one capturing positive abnormal returns and the other one capturing negative abnormal returns. Noteworthy, this specification increases the explanatory power of the model by approximately one percentage point. In Panel A, this translates into an increase of explanatory power by between 30% and 35%. In the regression analysis of volume-weighted bargains in Panel B, for which the explanatory power is in general higher, the r-squared increases by between 16% and 18%.

In Panel A, the coefficients on both positive abnormal return ($AR(0,0)>0$) and negative abnormal return ($AR(0,0)<0$) increase substantially in magnitude relative to the coefficient of *AR(0,0)* which is included in specifications (1) and (2). An abnormal return of 10% increases the bargain by between 0.61 and 0.78 percentage points which might indicate managerial timing ability. However, contrarian trading might also explain why positive abnormal returns are related to bargains. If firms do not buy back after abnormal increases in the stock price, they have bought back shares either earlier in the respective month or not at all. Consequently, in months with positive abnormal returns, the market price must be on average higher than the repurchase price. Meanwhile, a negative abnormal return of -10% increases the bargain by between 0.46 and 0.58 percentage points. This result is strong evidence in favor of the notion that repurchasing firms trade contrary to the market.

In Panel B, only the coefficients on the positive abnormal return variable ($AR(0,0)>0$) are statistically and economically significant. As outlined earlier, it is reasonable to assume that the volume-weighted bargain measure puts a stronger weight on those days during which firms buy back as repurchases on average increase trading volume. However, this might not necessarily be a fair assumption for months which display positive abnormal returns. Assuming that positive abnormal returns represent the reaction of the market to new information, due to higher investor attention, stock prices and trading volume should increase simultaneously. Therefore, the average volume-weighted market price should over weight those days where stock price increases. In conclusion, the observation that positive abnormal returns are stronger related to volume-weighted bargains suggests that firms buy back before abnormal increases in the stock price. This is further evidence in line with the notion that some firms exhibit timing ability. From the observation that the bargain is not related to negative abnormal returns, I conclude that firms buy back only after an abnormal decline in the stock price and consequently are able to stabilize or even increase prices by their repurchase

activity representing a large share of trading volume. This interpretation suggests that firms employ contrarian trading as a means of price support.

Putting descriptive statistics on abnormal returns in Table 2 and the results of Table 6 together allows for quantifying the share of the bargain which is explained by abnormal returns. According to Table 2, the average positive abnormal return over 16,422 observations is equal to 5.75 percent and the average negative abnormal return over 19,031 observation is equal to -6.04%. Multiplying the average abnormal returns with the coefficients reported on *AR(0,0)*>0 and *AR(0,0)*<0 respectively in models (3) and (4) on Table 6 and weighting by the number of observations yields an equally-weighted bargain of 0.40% (3) and 0.35% (4)[9]. In terms of the overall mean equally-weighted bargain reported in Table 3 of 0.66%, abnormal returns explain 53% to 61% of the total bargain. Applying the same computations to the volume-weighted bargain, yields very similar results.[10] In this case, abnormal returns explain 59% to 57% of the total bargain.

If bargains are driven by private information, bargains and cumulative abnormal returns after the repurchase should be positively related. To examine this issue, I include the cumulative abnormal return of the six months after the repurchase transaction *(CAR(1,6))* as an additional explanatory variable in models (1) and (2) of Table 6. The results, which are of same magnitude in both Panel A and Panel B, suggest that repurchases which had lower bargains subsequently displays higher long-run abnormal returns. This finding is not in line with managerial timing ability. In models (3) and (4), I separate positive and negative cumulative abnormal returns from each other to exclude that negative returns are driving this result. In both Panel A and Panel B, firms with lower bargains seem to have slightly higher positive abnormal returns. Considering that informed traders might be willing to pay a premium in order to profit from subsequent increases in the stock price, this result makes sense. It, however, does not explain why firms buy back at a bargain. Meanwhile, the relation between bargains and negative long-run returns is of opposite direction but even weaker in magnitude. The lower subsequent cumulative abnormal returns, the higher the bargain in the respective repurchase months. The inverse relation between falling stock prices and the bargain measure one more time point at contrarian trading. In particular, the results are in line with repurchasing firms continuously providing price support for (abnormally) declining stocks.

In conclusion, the empirical evidence presented in this section suggest that a large share

[9]Impact of positive and negative abnormal returns on the equally-weighted bargain: (3) : $\frac{(5.78\%*7.90\%*16422)+(-6.04\%*-5.90\%*19031)}{(16422+19031)} = -0.40\%$ (4) : $\frac{(5.78\%*7.10\%*16422)+(-6.04\%*-4.80\%*19031)}{(16422+19031)} = -0.35\%$

[10]Impact of positive and negative abnormal returns on the volume-weighted bargain: *Model* (3) : $\frac{(5.78\%*-12.80\%*16422)+(-6.04\%*-0.80\%*19031)}{(16422+19031)} = -0.37\%$ *Model* (4) : $\frac{(5.78\%*11.90\%*16422)+(-6.04\%*0.05\%*19031)}{(16422+19031)} = -0.32\%$

of the bargain can be explained by abnormal returns. It is also safe to argue that both positive and abnormal returns increase the bargain. The positive impact of negative abnormal returns on the bargain can be explained by contrarian trading. The positive impact of positive abnormal returns on the bargain furthermore indicates managerial timing ability. However, as outlined earlier, this relationship can as well be explained by contrarian trading. Furthermore, the results on subsequent cumulative abnormal returns do not suggest that bargains and private information are related. Overall, I interpret the results as convincing evidence on contrarian trading and rather weak evidence on managerial timing ability.

Specifications (5) and (6) are equivalent to (3) and (4) but based on the sample for which I have information on both insider and institutional ownership which I use for the subsequent analysis. The inclusion of ownership variables reduces the sample by approximately 9,000 observations. As ownership information is in particular missing for small companies, concerns regarding a sample selection bias need to be addressed. It turns out that the results are robust to excluding in particular small stocks.

3.3 Bargain repurchases and insider ownership

If one follows the argument on managerial timing ability through, insider ownership should be an important aspect to look at as the dollar incentive to buy back at low prices (and thus to exploit private information) increases with the amount of shares held by corporate managers. In line with this presumption, De Cesari et al. (2012) present evidence that open market repurchases "are timed to benefit non-selling shareholders" by documenting a positive relationship between insider ownership and their bargain measures. Furthermore, the authors conclude from their results that this relationship is inversely u-shaped. The researchers rationalize this observation by outlining that after a certain level of insider ownership, insiders would predominantly trade against themselves and, therefore, private information could not be exploited any more which in turn would lead to lower bargains.

Panel A of Table 7 reports the regression results on the effect of ownership on equally-weighted bargains. In addition to the variables reported in this table, the analysis includes all variables reported in specification (3) respectively (4) of Table 6.

In specifications (1) and (2) I include insider and institutional ownership into the regression analysis. For the OLS-specification, I document a statistically significant negative coefficient of -0.017 for the insider ownership variable. Thus, a 10 percent higher insider ownership goes along with a higher bargain by 0.17 percentage points. For the fixed-effects specification, results are numerically very similar, but no longer statistically significant. As insider ownership is a variable only reported on an annual basis, the time-series variation of this variable is very low. Therefore, it is not surprising that standard errors increase sub-

stantially. Remarkably, the point estimate is still very similar to the one for the OLS-model.

Institutional ownership has a similar, but smaller effect on the bargain. A 10 percent increase in institutional ownership increases the bargain by 0.06 percentage points. Again, the estimate is no longer statistically significantly different from zero when applying the firm-fixed effects model. It should also be noted that De Cesari et al. (2012) find the opposite effect which is that institutional ownership decreases the timing gains from buying back shares. The authors argue that institutional ownership can be seen as a proxy for the quality of corporate governance which, if good, should prevent managers from exploiting private information to time their repurchases. I have shown earlier that managerial timing ability does, if at all, explain only a fraction of the bargain measure. Strong institutional investors could also encourage firms to buy back after drops in stock prices in order to support the stock price or because they believe in mean reversion. However, an untabulated regression analysis with an interaction between institutional ownership and abnormal returns does not document a significant relationship between these two variables and the bargain. Given that the effect is very small anyway, I conduct no deeper investigation.

In specifications (3) and (4) I interact insider ownership with both positive abnormal returns and negative abnormal returns in order to examine whether gains related to insider ownership are also related to abnormal returns. The results suggest that this is the case. In this specification, insider ownership is no longer related to the bargain measure. When investigating the interaction terms, it turns out that the effect is now captured by the interaction between insider ownership and negative abnormal returns. Thus, if both negative abnormal returns and insider ownership increase, the bargain increases as well. I interpret this finding as evidence in favor of the notion that insider ownership increases the propensity of engaging in contrarian trading. Buying back after negative abnormal returns does not exploit private information. As there is no relation between the interaction of positive abnormal returns and insider ownership and the bargain measure, the evidence is not in line with the presumption that insiders use open market repurchases to expropriate selling shareholders. If anything, one may wonder whether repurchases are employed to provide short-term price support at the expense of non-selling shareholders, as repurchases might have been undertaken at prices above the stock's fair value.

Specifications (5) and (6) examine the functional relationship between insider ownership and bargain. De Cesari et al. (2012) use insider ownership and squared insider ownership to examine the functional relationship and document an inversely u-shaped relationship between insider ownership and the bargain. However, to my understanding their specification forces a concave function into an inversely u-shaped relationship. Therefore, I form insider ownership quintiles in order to tease out level effects for each of the quintiles. The results suggest that

the effect is steadily increasing in insider ownership but at a decreasing rate. This is the very definition of a convex function, but not in line with the presumption that the relationship is inversely u-shaped.

Table 7 Panel B documents the same analysis for the volume-weighted bargain measures. The results stay both qualitatively and quantitatively the same.

3.4 Robustness tests

Table 8 reports several alternative specifications in order to examine the robustness of the main findings. Overall, the results appear to be robust to changes of the market price benchmark, the inclusion of month fixed effects, and another exogenous measure of the relative spread.

In specifications (1) and (2), I include a volume weighted bargain measure where the average market price is computed from intraday data. Here, the stock price of every trade reported in the NYSE TAQ database is weighted by trading size and averaged over the whole month. Compared to the volume weighted CRSP price which is measured once a day at the end of trading, this measure obviously reflects the trading over the whole trading day better and therefore should also convey more information. This is in particular true as complying with the safe harbor rules specified in SEC rule 10b-18 requires firms to suspend their repurchase activity during at least the last ten minutes of trading.[11] The results of this analysis need to be compared with specifications (3) and (4) in Panel B of Table 6 where I run the same analyses on the volume-weighted bargain measure. It turns out that the much simpler CRSP based measure conveys the same information as the TAQ based measure as all of the coefficients reported are both qualitatively and quantitatively very similar.

In specifications (3) and (4), I include separate dummy variables for each month of the sample period in order to control for time-fixed effects. Again, the results of the analysis need to be compared with specifications (3) and (4) in Panel B of Table 6 where I run the same analyses without time-fixed effects. The coefficient estimates suggest that the results are also robust to controlling for month fixed-effects. Repurchases to shares outstanding even regain their statistically significant effect on the bargain when controlling for both month and firm-fixed effects.

Finally, specifications (5) and (6) address concerns that the results on the effect of the lagged spread on the bargain measure might be driven by an endogeneity bias. Hillert et al.

[11] Complying with the safe harbor rules of SEC rule 10b-18 exempts repurchasing firms from the anti-manipulation provisions of sections 9(a)(2) or 10(b) and of SEC rule 10b-5. The safe harbor rule specify the number of brokers, price of purchases, volume of purchases, and the time of purchases. Cook et al. (2004) document that only very few firms never violate any of the safe harbor conditions.

(2012) demonstrate that repurchases have an impact on stock liquidity which suggests that the contemporaneous spread is endogenous. As almost two thirds of the repurchase months display repurchase activity in the month before, it is hard to argue that the one month lag of the relative spread is an entirely endogenous measure with respect to repurchase activity. Therefore, I compute a measure of the relative spread which is not directly affected by share repurchases by averaging the relative spread over those of the six months prior to the repurchase without repurchases Consequently, I exclude all observations where all of the six months prior to the respective repurchase month have seen repurchase activity. This leaves me with 26,461 repurchase month observations. The effect of the relative spread on the bargain increases slightly when using the exogenous measure of the relative spread. However, regressing the same sample on the specification with the lagged relative spread produces very similar results. Therefore, the differences appear to be driven by the composition of the sample where very frequent repurchasers are excluded from the sample.

3.5 Beyond the bargain: An analysis of abnormal returns

A profound analysis of the relation between abnormal returns and repurchase activity is beyond the scope of this paper. However, it is worth having a brief look at the impact of several of the previously examined variables on the abnormal return with respect to whether the conclusions drawn earlier are supported by the evidence on abnormal returns. Table 9 provides the results of a regression analysis of abnormal returns on repurchase, market microstructure, and ownership variables. For the analysis of abnormal returns, I include both months with and without repurchase activity for all firms in the sample.

Repurchases to trading volume has been introduced at the beginning of this paper as a measure of the price impact of repurchase trades. In this spirit, repurchases to trading volume should be positively related to abnormal returns. The results in Table 9 are in line with this empirical prediction. A one percentage point increase in repurchases relative to trading volume increases the abnormal return by about 0.03 percentage points in specifications (1) and (2). When looking at the insider ownership sample which consists of relatively larger firms, the effect is more than twice as strong.

Repurchase dummy is a binary variable that denotes months in which repurchases take place. As outlined earlier, the abnormal return is statistically significantly lower in repurchase months by about 0.3 percentage points. This result does not correspond with the notion that managers are on average capable of within-month timing. This observation makes it even more unlikely that the bargain is driven by firms being able to time the market.

A positive order imbalance indicates that more trades are buyer- than seller-initiated. It is not a stretch to see that buyer-initiated markets should go up. Therefore, a positive

correlation between order imbalance and abnormal return is in line with what we should expect. As liquidity (usually measured in terms of the spread) is a risk factor[12], abnormal returns should be positively related to the relative spread. Furthermore, it also indicates that the price impact of repurchase trades is higher for stocks with ceteris paribus higher spreads.

As specifications (3) and (4) document and interesting in its own right, insider ownership is positively related to abnormal returns for my sample of repurchasing firms. Notably, this is only true for the fixed-effects model which one should trust more than the OLS-model as it removes all of the firm-related unobserved heterogeneity. The effect is however more than reversed in repurchase months, as the coefficients on the interaction term between repurchase dummy and insider ownership demonstrates. Again this finding neatly fits to earlier results on the bargain measure. Insiders seem to buy back shares after abnormal drops in the stock price.

Institutional ownership is as well positively related to abnormal returns. As the interaction between repurchase dummy and institutional ownership does not display a coefficient which is statistically significantly different from zero, I however conclude that the relationship is not related to repurchase trading and thus also not to buying back at bargain prices.

4 Discussion and Conclusion

In this paper, I examine why firms buy back at bargain prices. In line with earlier studies, I document that firms buy back at an economically and statistically significant bargain. Approximately two thirds of this bargain can be explained by either positive or negative abnormal returns. Contrarian trading appears to be the most consistent explanation of why both negative and positive abnormal returns increase the bargain. While the relation between positive abnormal returns and the bargain is evidence in line with managerial timing ability, it can as well be explained by contrarian trading. The fact that abnormal returns are significantly lower in repurchase months, casts further doubts on that the bargain measure is primarily driven by managerial timing ability. Hence, I interpret the empirical evidence as strong with regard to the *contrarian-trading-hypothesis* and weak with respect to the *market-timing-hypothesis*.

The evidence presented in this paper furthermore suggests that firms are able to buy back at bargain prices as they predominantly buy back by using limit orders. Consequently, repurchasing firms buy back at the bid and are thus able to earn (parts of) the spread relative to the market.

An analysis of insider ownership furthermore reveals that bargains are related to insider

[12] Cf. Amihud and Mendelson (1986b,a); Amihud (2002)

ownership and that this is the result of firms with high insider ownership being even more inclined to buy back after abnormal declines in the stock price. As insider ownership and positive abnormal returns are not correlated, I reject the notion that insiders use private information to expropriate selling shareholders as suggested by De Cesari et al. (2012). I also find no evidence suggesting that there is an inversely u-shaped relation between timing gains and insider ownership. Finally, the empirical evidence is not in line with the notion that institutional ownership decreases timing gains.

This paper takes a fresh look at why firms buy back at a bargain. Although related, this paper does not directly deal with the question of whether managers are able to time actual repurchases on the short and long-run. This will be the subject of another paper which has yet to be written.

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Table 1: **Definition of variables**

Name	Definition (Source)	Unit
AR(0,0)	Abnormal return in the event month	
CAR(1,6)	Cumulative abnormal return in the six months post event	
Bargain (equally-weighted)	Relative difference between repurchase price and monthly average of CRSP closing price * (-1) (CRSP/SEC 10Q or 10K)	ratio
Bargain (volume-weighted)	Relative difference between repurchase price and volume-weighted monthly average of CRSP closing price * (-1) (CRSP/SEC 10Q or 10K)	ratio
Order imbalance (value)	Monthly average of daily dollar-difference between total buys and sells relative to trading volume (TAQ)	ratio
Relative spread	Time weighted average of quoted relative spread (TAQ)	ratio
Market capitalization	Monthly average of daily market capitalization (CRSP)	million
Insider Ownership	% shares and options held by corporate executives (Execucomp)	ratio
Institutional Ownership	% shares held by institutional investors (Thomson)	ratio
Repurchase dummy	1 if repurchase transaction takes place (SEC 10Q or 10K)	binary
Repurchases to shr. out.	Number of shares repurchased during the month divided by the number of shares outstanding at the last trading day of the previous month (SEC 10Q or 10K)	ratio
Repurchases to turnover	Dollar volume of shares repurchased in respective month (SEC 10Q or 10K)	ratio

Table 2: **Descriptives - Total Sample**

	N	Mean	Median	S.D.	1^{st} Perc.	99^{th} Perc.
Panel A. All firm months						
AR(0,0)	129684	-0.41%	-0.60%	9.79%	-28.42%	31.10%
CAR(1,6)	129684	-2.33%	-2.39%	31.64%	-88.63%	87.43%
Repurchase dummy	129684	27.29%	0.00%	44.55%	0.00%	100.00%
Relative spread	129684	0.59%	0.16%	1.23%	0.02%	5.94%
Order Imbalance (volume)	129684	-4.07%	1.29%	32.03%	-100.00%	54.76%
Market capitalization	129684	5639	742	21364	16	95220
Panel B. Repurchase Months						
Bargain	35397	0.66%	0.27%	3.45%	14.71%	10.23%
Bargain (volume-weighted)	35397	0.65%	0.26%	3.47%	14.77%	10.17%
AR(0,0)	35397	-0.56%	-0.57%	7.95%	-23.92%	23.39%
AR(0,0) > 0	16422	5.78%	4.19%	5.32%	0.07%	23.39%
AR(0,0) < 0	19031	-6.04%	-4.52%	5.35%	-23.92%	-0.09%
CAR(1,6)	35397	-2.01%	-2.11%	26.49%	-74.06%	74.58%
Repurchases to turnover	35397	6.60%	3.40%	9.47%	0.00%	49.58%
Repurchases to shr. out.	35397	0.66%	0.36%	0.96%	0.00%	4.51%
Relative spread	35397	0.43%	0.10%	1.01%	0.02%	5.00%
Order Imbalance (volume)	35397	-3.30%	0.90%	29.20%	-99.99%	52.34%
Market capitalization	35397	11624	1649	34801	26	183976

Table 3: **Descriptives - Insider Ownership Sample**

	N	Mean	Median	S.D.	1^{st} Perc.	99^{th} Perc.
Panel A. All firm months						
AR(0,0)	74043	-0.23%	-0.33%	9.05%	-25.66%	26.56%
CAR(1,6)	74043	-1.55%	-1.27%	28.63%	-80.81%	78.10%
Repurchase dummy	74043	32.53%	0.00%	46.85%	0.00%	100.00%
Relative spread	74043	0.15%	0.09%	0.40%	0.02%	0.98%
Order Imbalance (volume)	74043	5.89%	4.00%	16.44%	-35.59%	52.01%
Market capitalization	74043	9453	2034	27597	84	141766
Insider Ownership	74043	5.53%	2.79%	7.89%	0.17%	45.46%
Institutional Ownership	74043	76.50%	79.56%	18.38%	24.38%	100.00%
Panel B. Repurchase Months						
Bargain	24084	0.70%	0.31%	3.25%	13.37%	9.28%
Bargain (volume-weighted)	24084	0.68%	0.31%	3.24%	13.13%	9.17%
AR(0,0)	24084	-0.52%	-0.46%	7.58%	-22.38%	20.56%
CAR(1,6)	24084	-1.74%	-1.34%	24.37%	-70.23%	63.08%
Repurchases to turnover	24084	4.24%	2.65%	5.13%	0.00%	23.17%
Repurchases to shr. out.	24084	0.70%	0.40%	0.97%	0.00%	4.58%
Relative spread	24084	0.10%	0.07%	0.15%	0.02%	0.58%
Order Imbalance (volume)	24084	4.65%	2.89%	15.09%	-33.26%	47.92%
Market capitalization	24084	16770	3590	41161	133	222852
Insider Ownership	24084	4.70%	2.31%	6.94%	0.16%	38.44%
Institutional Ownership	24084	75.88%	78.35%	17.18%	27.65%	100.00%

Table 4: **Descriptives - Bargain Analysis.** Bargain is defined in Table 1. A one-sample t-test is used to examine whether means are significantly different from zero. A paired t-test is used to examine whether the differences are significantly different from zero. A Wilcoxon signed-rank test is used to examine whether medians are significantly different from zero and from each other. N = 35,397.

	Mean (%)	Mean (million $)	Median (%)	Median (million $)	Total (million $)
Bargain	0.661%	0.094	0.269%	0.003	3332.583
(t-stat/z-score)	36.03	2.41	37.62	37.11	
Bargain (volume-weighted)	0.653%	0.050	0.263%	0.003	1786.816
(t-stat/z-score)	35.34	1.23	36.00	33.20	
Difference	0.009%	0.044	0.006%	0.000	1545.767
(t-stat/z-score)	1.46	5.42	1.68	6.10	

Table 5: **Panel A. Market Microstructure Analysis of Bargains.** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price. *Rep. to trading volume Qn* denotes the n-th quintile of the respective variable. *Rel. Spread$_{t-1}$ x Rep. to tv Qn* denotes the interaction between *Relative spread$_{t-1}$* and *Rep. to trading volume Qn*. All other variables are defined in Table 1. Independent variables denoted with (ln) are expressed as natural logarithms. (D) indicates dummy variables. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Repurchases to trading volume	–0.049***	–0.035***	–0.050***	–0.035***		
	(–19.43)	(–9.98)	(–19.93)	(–10.10)		
Repurchases to shr. out.	0.106***	–0.000	0.116***	0.008	0.202***	0.125***
	(3.87)	(–0.00)	(4.31)	(0.23)	(6.95)	(3.48)
Order imbalance (volume)	0.006***	0.005***	0.007***	0.006***	0.007***	0.005***
	(8.71)	(6.15)	(9.09)	(6.28)	(9.25)	(5.88)
Market cap (ln)	–0.002***		–0.002***		–0.001***	
	(–8.76)		(–7.74)		(–5.96)	
Relative spread (ln)	–0.001***	–0.003***				
	(–2.77)	(–4.44)				
Relative spread$_{t-1}$ (ln)			–0.001*	–0.001**	0.001*	0.002*
			(–1.64)	(–2.11)	(1.89)	(1.80)
Rep. to trading volume Q2					0.002	–0.013*
					(0.30)	(–1.86)
Rep. to trading volume Q3					–0.014***	–0.027***
					(–2.63)	(–4.29)
Rep. to trading volume Q4					–0.021***	–0.032***
					(–4.18)	(–5.28)
Rep. to trading volume Q5					–0.036***	–0.040***
					(–7.57)	(–6.44)
Rel. spread$_{t-1}$ x Rep. to tv Q2					0.001	–0.001
					(1.10)	(–1.11)
Rel. spread$_{t-1}$ x Rep. to tv Q3					–0.001	–0.003***
					(–1.22)	(–2.97)
Rel. spread$_{t-1}$ x Rep. to tv Q4					–0.002**	–0.003***
					(–2.14)	(–3.49)
Rel. spread$_{t-1}$ x Rep. to tv Q5					–0.003***	–0.004***
					(–4.28)	(–4.04)
Constant	0.015***	–0.008**	0.017***	0.001	0.033***	0.027***
	(10.26)	(–2.01)	(11.28)	(0.36)	(7.14)	(4.23)
R^2	0.023	0.009	0.023	0.008	0.035	0.020
Observations	38292	38292	38290	38290	38290	38290
Firm FE	N	Y	N	Y	N	Y

Table 5: **Panel B. Market Microstructure Analysis of Bargains (volume-weighted).** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price weighted by trading volume.

	(1)	(2)	(3)	(4)	(5)	(6)
Repurchases to trading volume	–0.046***	–0.031***	–0.048***	–0.032***		
	(–18.32)	(–8.82)	(–19.11)	(–8.98)		
Repurchases to shr. out.	0.041	–0.069**	0.059**	–0.059*	0.173***	0.089***
	(1.54)	(–1.96)	(2.28)	(–1.67)	(6.37)	(2.61)
Order imbalance (volume)	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***
	(13.02)	(10.81)	(13.70)	(10.94)	(13.48)	(10.39)
Market cap (ln)	–0.002***		–0.001***		–0.001***	
	(–8.87)		(–6.94)		(–4.68)	
Relative spread (ln)	–0.001*	–0.002***				
	(–1.65)	(–4.02)				
Relative spread$_{t-1}$ (ln)			0.000	–0.000	0.003***	0.003***
			(0.42)	(–0.47)	(3.80)	(3.29)
Rep. to trading volume Q2					–0.003	–0.018**
					(–0.54)	(–2.47)
Rep. to trading volume Q3					–0.016***	–0.028***
					(–2.80)	(–4.32)
Rep. to trading volume Q4					–0.028***	–0.037***
					(–5.19)	(–5.92)
Rep. to trading volume Q5					–0.041***	–0.045***
					(–8.17)	(–7.04)
Rel. spread$_{t-1}$ x Rep. to tv Q2					0.000	–0.002*
					(0.32)	(–1.66)
Rel. spread$_{t-1}$ x Rep. to tv Q3					–0.001	–0.003***
					(–1.34)	(–2.98)
Rel. spread$_{t-1}$ x Rep. to tv Q4					–0.002***	–0.004***
					(–3.04)	(–4.07)
Rel. spread$_{t-1}$ x Rep. to tv Q5					–0.003***	–0.004***
					(–4.85)	(–4.61)
Constant	0.019***	–0.006	0.021***	0.008**	0.042***	0.038***
	(11.89)	(–1.55)	(13.55)	(2.02)	(8.70)	(5.75)
R^2	0.026	0.012	0.026	0.011	0.041	0.027
Observations	38292	38292	38290	38290	38290	38290
Firm FE	N	Y	N	Y	N	Y

Table 6: **Panel A. Timing Analysis of Bargains.** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price. *Rep. to trading volume Qn* denotes the n-th quintile of the respective variable. *Rel. Spread$_{t-1}$ x Rep. to tv Qn* denotes the interaction between *Relative spread$_{t-1}$* and *Rep. to trading volume Qn*. *Abnormal return* is a variable denoting the abnormal return (AR) of the stock in the event month (=current month). *CAR (1,6)* is a variable denoting the cumulative abnormal return (CAR) of the respective stock in the six months following the repurchase month. Abnormal returns are computed using the market model. The benchmark market index is the CRSP equally weighted index. The estimation window ends 6 months prior to the event month. The estimation length is 60 months with a minimum of 36 months being required. Fama-French monthly factors are added to estimate the expected return. *AR(0,0) > (<) 0* is equal to the abnormal return if it is positive (negative) and zero. All other variables are defined in Table 1. Independent variables denoted with (ln) are expressed as natural logarithms. (D) indicates dummy variables. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Repurchases to shr. out.	0.196***	0.127***	0.130***	0.091**	0.137***	0.080*
	(6.47)	(3.38)	(4.25)	(2.40)	(3.89)	(1.78)
Order imbalance (volume)	0.007***	0.005***	0.006***	0.005***	0.006***	0.009***
	(9.00)	(5.22)	(8.34)	(5.10)	(4.14)	(4.58)
Relative spread$_{t-1}$ (ln)	0.001**	0.002**	0.002**	0.002**	0.003***	0.003***
	(2.01)	(2.52)	(2.21)	(2.46)	(3.14)	(2.60)
Rep. to trading volume Q2	0.000	–0.014*	0.001	–0.013*	–0.000	–0.014
	(0.02)	(–1.94)	(0.16)	(–1.85)	(–0.03)	(–1.36)
Rep. to trading volume Q3	–0.013**	–0.027***	–0.013**	–0.027***	–0.026***	–0.042***
	(–2.41)	(–4.20)	(–2.43)	(–4.22)	(–2.91)	(–4.08)
Rep. to trading volume Q4	–0.022***	–0.034***	–0.022***	–0.033***	–0.041***	–0.052***
	(–4.19)	(–5.36)	(–4.14)	(–5.37)	(–4.88)	(–5.38)
Rep. to trading volume Q5	–0.035***	–0.041***	–0.033***	–0.041***	–0.050***	–0.049***
	(–7.16)	(–6.38)	(–6.94)	(–6.39)	(–6.19)	(–4.94)
Rel. spread$_{t-1}$ x Rep. to tv Q2	0.001	–0.001	0.001	–0.001	0.001	–0.001
	(0.82)	(–1.24)	(0.90)	(–1.19)	(0.43)	(–0.95)
Rel. spread$_{t-1}$ x Rep. to tv Q3	–0.001	–0.003***	–0.001	–0.003***	–0.003**	–0.005***
	(–1.10)	(–3.01)	(–1.29)	(–3.12)	(–2.28)	(–3.52)
Rel. spread$_{t-1}$ x Rep. to tv Q4	–0.002**	–0.003***	–0.002**	–0.003***	–0.004***	–0.006***
	(–2.31)	(–3.77)	(–2.49)	(–3.90)	(–3.94)	(–4.61)
Rel. spread$_{t-1}$ x Rep. to tv Q5	–0.003***	–0.004***	–0.003***	–0.004***	–0.005***	–0.005***
	(–4.04)	(–4.19)	(–4.26)	(–4.41)	(–4.77)	(–3.98)
Market cap (ln)	–0.001***		–0.001***		–0.001***	
	(–5.74)		(–3.73)		(–3.61)	
AR(0,0)	0.007*	0.009**				
	(1.93)	(2.27)				
CAR(1,6)	–0.004***	–0.007***				
	(–3.85)	(–6.36)				
AR(0,0) $>$ 0			0.079***	0.071***	0.069***	0.062***
			(11.92)	(10.29)	(8.63)	(7.30)
AR(0,0) $<$ 0			–0.059***	–0.048***	–0.056***	–0.046***
			(–8.94)	(–6.89)	(–6.90)	(–5.21)
CAR(1,6) $>$ 0			–0.005***	–0.010***	–0.009***	–0.013***
			(–3.01)	(–5.23)	(–3.88)	(–5.88)
CAR(1,6) $<$ 0			–0.002	–0.004**	–0.003	–0.003
			(–1.47)	(–2.08)	(–1.41)	(–1.61)
Constant	0.033***	0.032***	0.026***	0.028***	0.040***	0.034***
	(7.08)	(4.70)	(5.74)	(4.16)	(5.52)	(3.59)
R^2	0.033	0.023	0.043	0.031	0.034	0.024
Observations	35396	35396	35396	35396	24084	24084
Firm FE	N	Y	N	Y	N	Y

Table 6: **Panel B. Timing Analysis of Bargains (volume-weighted).** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price weighted by trading volume.

	(1)	(2)	(3)	(4)	(5)	(6)
Repurchases to shr. out.	0.173***	0.091**	0.107***	0.057	0.115***	0.043
	(6.12)	(2.56)	(3.72)	(1.59)	(3.52)	(1.03)
Order imbalance (volume)	0.009***	0.008***	0.008***	0.007***	0.005***	0.007***
	(11.47)	(7.81)	(10.86)	(7.69)	(3.37)	(3.53)
Relative spread$_{t-1}$ (ln)	0.002***	0.003***	0.003***	0.003***	0.004***	0.004***
	(3.25)	(3.39)	(3.47)	(3.34)	(3.55)	(3.38)
Rep. to trading volume Q2	–0.004	–0.018**	–0.003	–0.017**	–0.001	–0.016
	(–0.69)	(–2.43)	(–0.56)	(–2.35)	(–0.14)	(–1.63)
Rep. to trading volume Q3	–0.015**	–0.028***	–0.015***	–0.028***	–0.029***	–0.045***
	(–2.57)	(–4.18)	(–2.61)	(–4.20)	(–3.21)	(–4.49)
Rep. to trading volume Q4	–0.027***	–0.038***	–0.027***	–0.038***	–0.042***	–0.054***
	(–5.06)	(–5.82)	(–5.03)	(–5.84)	(–4.97)	(–5.55)
Rep. to trading volume Q5	–0.040***	–0.047***	–0.039***	–0.047***	–0.055***	–0.055***
	(–8.07)	(–7.05)	(–7.88)	(–7.06)	(–6.99)	(–5.60)
Rel. spread$_{t-1}$ x Rep. to tv Q2	0.000	–0.002*	0.000	–0.002*	0.000	–0.002
	(0.14)	(–1.70)	(0.21)	(–1.66)	(0.36)	(–1.19)
Rel. spread$_{t-1}$ x Rep. to tv Q3	–0.001	–0.003***	–0.001	–0.003***	–0.003**	–0.005***
	(–1.22)	(–3.00)	(–1.41)	(–3.11)	(–2.52)	(–3.90)
Rel. spread$_{t-1}$ x Rep. to tv Q4	–0.002***	–0.004***	–0.002***	–0.004***	–0.005***	–0.006***
	(–3.07)	(–4.22)	(–3.27)	(–4.34)	(–3.94)	(–4.75)
Rel. spread$_{t-1}$ x Rep. to tv Q5	–0.003***	–0.005***	–0.004***	–0.005***	–0.006***	–0.006***
	(–4.80)	(–4.83)	(–5.04)	(–5.03)	(–5.44)	(–4.59)
Market cap (ln)	–0.001***		–0.001***		–0.001***	
	(–5.98)		(–3.94)		(–4.25)	
AR(0,0)	0.057***	0.060***				
	(15.77)	(15.33)				
CAR(1,6)	–0.005***	–0.007***				
	(–4.81)	(–7.03)				
AR(0,0) $>$ 0			0.128***	0.119***	0.111***	0.104***
			(18.97)	(16.51)	(13.52)	(11.62)
AR(0,0) $<$ 0			–0.008	0.005	–0.003	0.010
			(–1.25)	(0.70)	(–0.41)	(1.24)
CAR(1,6) $>$ 0			–0.006***	–0.011***	–0.008***	–0.013***
			(–3.32)	(–5.83)	(–3.77)	(–6.03)
CAR(1,6) $<$ 0			–0.004**	–0.004**	–0.004**	–0.004*
			(–2.28)	(–2.30)	(–1.97)	(–1.79)
Constant	0.041***	0.039***	0.034***	0.035***	0.046***	0.043***
	(8.53)	(5.66)	(7.26)	(5.17)	(6.27)	(4.46)
R^2	0.057	0.050	0.067	0.058	0.050	0.044
Observations	35396	35396	35396	35396	24084	24084
Firm FE	N	Y	N	Y	N	Y

Table 7: **Panel A. Ownership Analysis of Bargains.** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price. *Abnormal return* is a variable denoting the abnormal return (AR) of the stock in the event month (=current month). *CAR (1,6)* is a variable denoting the cumulative abnormal return (CAR) of the respective stock in the six months following the repurchase month. Abnormal returns are computed using the market model. The benchmark market index is the CRSP equally weighted index. The estimation window ends 6 months prior to the event month. The estimation length is 60 months with a minimum of 36 months being required. Fama-French monthly factors are added to estimate the expected return. *AR(0,0) > (<) 0* is equal to the abnormal return if it is positive (negative) and zero. *Abnormal return > 0* x IO is an interaction between *Abnormal return > 0* and *Insider Ownership*. All other variables are defined in Table 1. Independent variables denoted with (ln) are expressed as natural logarithms. (D) indicates dummy variables. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
AR(0,0) > 0	0.066***	0.061***	0.057***	0.054***	0.067***	0.061***
	(8.34)	(7.20)	(5.69)	(4.82)	(8.41)	(7.20)
AR(0,0) < 0	–0.054***	–0.046***	–0.037***	–0.031***	–0.055***	–0.046***
	(–6.61)	(–5.25)	(–3.77)	(–2.83)	(–6.70)	(–5.24)
CAR(1,6)	–0.005***	–0.008***	–0.005***	–0.008***	–0.005***	–0.008***
	(–4.60)	(–6.22)	(–4.62)	(–6.30)	(–4.53)	(–6.24)
Market cap (ln)	–0.000		–0.000		0.000	
	(–0.86)		(–0.96)		(0.37)	
Institutional Ownership	0.006***	0.005	0.006***	0.005	0.005***	0.004
	(4.27)	(0.85)	(4.42)	(0.87)	(3.50)	(0.78)
Insider ownership	0.017***	0.019	0.002	0.005		
	(4.60)	(1.51)	(0.28)	(0.36)		
AR(0,0) > 0 x ins. own.			0.164	0.144		
			(1.32)	(0.94)		
AR(0,0) < 0 x ins. own.			–0.292***	–0.282**		
			(–2.99)	(–2.32)		
Insider ownership Q2					0.002***	–0.001
					(2.83)	(–0.50)
Insider ownership Q3					0.002***	0.000
					(3.32)	(0.25)
Insider ownership Q4					0.004***	0.001
					(4.81)	(0.83)
Insider ownership Q5					0.004***	0.001
					(5.51)	(0.62)
Constant	0.034***	0.030***	0.034***	0.031***	0.031***	0.030***
	(4.55)	(2.97)	(4.65)	(3.02)	(4.22)	(3.00)
R^2	0.035	0.024	0.036	0.024	0.036	0.023
Observations	24084	24084	24084	24084	24084	24084
Controls Table 1 (5),(6)	Y	Y	Y	Y	Y	
Firm FE	N	Y	N	Y	N	Y

Table 7: **Panel B. Ownership Analysis of Bargains (volume-weighted).** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price weighted by trading volume.

	(1)	(2)	(3)	(4)	(5)	(6)
AR(0,0) $>$ 0	0.109***	0.103***	0.099***	0.094***	0.110***	0.103***
	(13.29)	(11.52)	(9.51)	(8.03)	(13.35)	(11.52)
AR(0,0) $<$ 0	–0.001	0.010	0.018*	0.029***	–0.002	0.010
	(–0.16)	(1.23)	(1.91)	(2.74)	(–0.23)	(1.23)
CAR(1,6)	–0.006***	–0.008***	–0.006***	–0.008***	–0.006***	–0.008***
	(–4.98)	(–6.50)	(–5.01)	(–6.58)	(–4.94)	(–6.53)
Market cap (ln)	–0.000		–0.000*		–0.000	
	(–1.52)		(–1.65)		(–0.32)	
Institutional Ownership	0.006***	0.005	0.006***	0.006	0.005***	0.005
	(4.09)	(1.00)	(4.27)	(1.03)	(3.41)	(0.95)
Insider ownership	0.019***	0.018	0.000	0.002		
	(5.00)	(1.54)	(0.03)	(0.11)		
AR(0,0) $>$ 0 x ins. own.			0.193	0.174		
			(1.51)	(1.08)		
AR(0,0) $<$ 0 x ins. own.			–0.344***	–0.340***		
			(–3.69)	(–2.86)		
Insider ownership Q2					0.002**	–0.001
					(2.46)	(–0.69)
Insider ownership Q3					0.002***	0.000
					(3.13)	(0.11)
Insider ownership Q4					0.003***	0.000
					(4.25)	(0.25)
Insider ownership Q5					0.005***	0.001
					(5.89)	(0.67)
Constant	0.039***	0.039***	0.040***	0.039***	0.037***	0.040***
	(5.30)	(3.78)	(5.41)	(3.84)	(4.98)	(3.86)
R^2	0.052	0.043	0.053	0.044	0.052	0.043
Observations	24084	24084	24084	24084	24084	24084
Controls Table 1 (5),(6)	Y	Y	Y	Y	Y	Y
Firm FE	N	Y	N	Y	N	Y

Table 8: **Robustness tests.** The dependent variable is the relative difference between the monthly repurchase price and the volume-weighted market price. If the market price benchmark is from TAQ, the average market price is the average of all trade price weighted by trade size. If the market price benchmark is from CRSP, the average market price is the average CRSP daily closing price weighted by daily trading volume. *Rep. to trading volume Qn* denotes the n-th quintile of the respective variable. *Rel. Spread*$_{t-1}$ *x Rep. to tv Qn* denotes the interaction between *Relative spread*$_{t-1}$ and *Rep. to trading volume Qn*. *Abnormal return* is a variable denoting the abnormal return (AR) of the stock in the event month (=current month). *CAR (1,6)* is a variable denoting the cumulative abnormal return (CAR) of the respective stock in the six months following the repurchase month. Abnormal returns are computed using the market model. The benchmark market index is the CRSP equally weighted index. The estimation window ends 6 months prior to the event month. The estimation length is 60 months with a minimum of 36 months being required. Fama-French monthly factors are added to estimate the expected return. *Abnormal return > (<) 0* is equal to the abnormal return if it is positive (negative) and zero. *Exog. relative spread* is the average relative spread over all of the previous six months which have had no repurchase transaction. All other variables are defined in Table 1. Independent variables denoted with (ln) are expressed as natural logarithms. (D) indicates dummy variables. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Repurchases to shr. out.	0.098***	0.027	0.118***	0.088**	0.126***	0.095**
	(3.44)	(0.74)	(4.03)	(2.38)	(3.82)	(2.36)
Order imbalance (volume)	0.005***	0.005***	0.008***	0.007***	0.009***	0.008***
	(6.11)	(5.16)	(9.62)	(6.64)	(10.12)	(7.15)
Relative spread$_{t-1}$ (ln)	0.003***	0.003***	0.002***	0.002*		
	(3.55)	(3.01)	(2.91)	(1.87)		
Rep. to trading volume Q2	–0.001	–0.015*	–0.004	–0.017**	–0.001	–0.014**
	(–0.11)	(–1.91)	(–0.60)	(–2.40)	(–0.24)	(–2.06)
Rep. to trading volume Q3	–0.013**	–0.028***	–0.015**	–0.028***	–0.013**	–0.024***
	(–2.28)	(–3.94)	(–2.57)	(–4.14)	(–2.19)	(–3.74)
Rep. to trading volume Q4	–0.025***	–0.037***	–0.026***	–0.037***	–0.025***	–0.033***
	(–4.69)	(–5.30)	(–4.93)	(–5.70)	(–4.76)	(–5.50)
Rep. to trading volume Q5	–0.032***	–0.041***	–0.038***	–0.045***	–0.037***	–0.042***
	(–6.46)	(–5.73)	(–7.69)	(–6.83)	(–7.96)	(–7.16)
Rel. spread$_{t-1}$ x Rep. to tv Q2	0.000	–0.001	0.000	–0.002*	0.001	–0.001
	(0.58)	(–1.33)	(0.17)	(–1.72)	(0.63)	(–1.23)
Rel. spread$_{t-1}$ x Rep. to tv Q3	–0.001	–0.003***	–0.001	–0.003***	–0.001	–0.002**
	(–1.19)	(–2.99)	(–1.40)	(–3.06)	(–0.80)	(–2.36)
Rel. spread$_{t-1}$ x Rep. to tv Q4	–0.002***	–0.004***	–0.002***	–0.004***	–0.002***	–0.003***
	(–3.08)	(–4.09)	(–3.20)	(–4.20)	(–2.60)	(–3.54)
Rel. spread$_{t-1}$ x Rep. to tv Q5	–0.003***	–0.004***	–0.003***	–0.004***	–0.003***	–0.004***
	(–3.84)	(–4.07)	(–4.83)	(–4.72)	(–4.38)	(–4.42)
AR(0,0) $>$ 0	0.090***	0.083***	0.132***	0.125***	0.125***	0.114***
	(13.09)	(11.64)	(19.14)	(17.21)	(15.46)	(13.41)
AR(0,0) $<$ 0	–0.001	0.006	–0.009	0.002	–0.026***	–0.013*
	(–0.11)	(0.94)	(–1.44)	(0.34)	(–3.53)	(–1.73)
CAR(1,6) $>$ 0	–0.007***	–0.011***	–0.005**	–0.009***	–0.005**	–0.011***
	(–4.35)	(–6.14)	(–2.47)	(–4.57)	(–2.37)	(–4.86)
CAR(1,6) $<$ 0	–0.002	–0.004**	–0.005***	–0.006***	–0.004**	–0.005**
	(–1.15)	(–2.00)	(–2.89)	(–3.20)	(–2.46)	(–2.41)
Exog. Relative spread (ln)					0.003***	0.004***
					(4.12)	(3.89)
R^2	0.043	0.039	0.074	0.068	0.065	0.053
Observations	34508	34508	35396	35396	26460	26460
Firm FE	N	Y	N	Y	N	Y
Month FE	N	N	Y	Y	N	N
Market Price Benchmark	TAQ	TAQ	CRSP	CRSP	CRSP	CRSP

Table 9: **Abnormal Return Analysis.** The dependent variable is the abnormal return (AR) of the stock in the event month (=current month). Abnormal returns are computed using the market model. The benchmark market index is the CRSP equally weighted index. The estimation window ends 6 months prior to the event month. The estimation length is 60 months with a minimum of 36 months being required. Fama-French monthly factors are added to estimate the expected return. *Repurchase dummy x ins. own.* is an interaction between *repurchase dummy* and *insider ownership. Repurchase dummy x inst. own.* is an interaction between *repurchase dummy* and *institutional ownership.* All other variables are defined in Table 1. Independent variables denoted with (ln) are expressed as natural logarithms. (D) indicates dummy variables. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	b/t	b/t	b/t	b/t	b/t	b/t
Repurchases to trading volume	0.031***	0.033***	0.076***	0.077***	0.075***	0.082***
	(6.43)	(5.57)	(5.52)	(4.54)	(5.28)	(4.68)
Repurchases to shr. out.	–0.084	–0.101	–0.257***	–0.166	–0.246**	–0.184
	(–1.37)	(–1.45)	(–2.73)	(–1.50)	(–2.50)	(–1.59)
Repurchase dummy	–0.003***	–0.003***	–0.003***	–0.005***	0.000	–0.004
	(–4.56)	(–3.26)	(–4.04)	(–4.23)	(0.05)	(–0.98)
Order imbalance (volume)	0.047***	0.059***	0.063***	0.092***	0.063***	0.092***
	(47.47)	(30.99)	(31.61)	(23.21)	(31.64)	(23.22)
L.Relative spread (ln)	0.015***	0.016***	0.016***	0.018***	0.016***	0.018***
	(29.78)	(16.98)	(18.72)	(11.63)	(18.63)	(11.69)
Market cap (ln)	0.007***		0.006***		0.006***	
	(24.15)		(15.04)		(14.75)	
Insider ownership			–0.000	0.031*	0.007	0.042**
			(–0.10)	(1.78)	(1.29)	(2.39)
Institutional ownership			0.012***	0.081***	0.013***	0.081***
			(5.88)	(11.26)	(5.17)	(11.02)
Repurchase dummy x ins. own.					–0.032***	–0.050***
					(–3.29)	(–4.29)
Repurchase dummy x inst. own.					–0.002	0.003
					(–0.62)	(0.52)
Constant	0.041***	0.097***	0.049***	0.054***	0.049***	0.054***
	(22.60)	(16.75)	(12.12)	(4.88)	(11.77)	(4.87)
R^2	0.020	0.023	0.019	0.026	0.019	0.026
Observations	129162	129162	73753	73753	73753	73753
Firm FE	N	Y	N	Y	N	Y