Why are firms able to buy back below average market prices?

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Abstract

This paper examines why U.S. firms are able to conduct open market repurchases 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: Firms tend to buy back after decreases in the stock price and thus buy back at prices which are lower than average market prices. Pseudo-market timing, which is the result of firms staying away from the market when the stock price goes up, explains why event-time returns subsequent to actual repurchases are abnormally high on the short-run. When using the calendar time portfolio approach, I do not find abnormal returns after actual repurchases and conclude that there is no evidence consistent with the notion of managerial timing ability. While the results suggest that insider ownership increases the propensity to trade contrary to the market, the results do not confirm earlier findings that firms with high insider ownership buy back below the average market price because of managerial timing ability.

"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 research in corporate finance. For very good reasons: in a survey of 384 Chief Financial Officers by Brav et al. (2005), 86.4% of respondents indicate that market undervaluation of the stock is an important factor for buying back shares. 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)). In 2004, when the SEC modified rule 10b-18 on share repurchases, this 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]

I make use of a unique data set of monthly repurchase activity of U.S. stocks to examine whether firms buy back below average market prices. In line with two recent studies (cf. De Cesari et al. (2012), Ben-Rephael et al. (2012)), I find that firms buy back at prices which are both statistically and economically significantly lower than average market prices, i.e., firms seem to buy back at a bargain. The goal of this paper is to examine why firms are able to buy back below average market prices.

The *market-timing-hypothesis* suggests that managers have private information with respect to the value of the stock which enables them to buy back at low prices. Consequently, the bargain would be the result of an abnormal increase in the stock price after the repurchase transaction. The empirical prediction of this hypothesis would be a positive relation between current respectively subsequent abnormal return and the bargain. On the other hand, the *contrarian-trading hypothesis* predicts that firms buy back after drops in the stock price because they either believe in mean reversion or they want to provide price support. For example, 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. As the bargain measures

[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.

compares average repurchase prices to average market price on a monthly basis, 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 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 35,396 repurchase months of 2,934 repurchasing firms.

An analysis of the within-firm variation of repurchases reveals that lagged and contemporaneous stock returns are the best predictors of repurchase activity and repurchase intensity. While positive monthly returns decrease the probability as well as size of share repurchases, negative monthly returns have the opposite effect. In particular, the results suggest that large repurchases predominantly take place after drops in the stock price.

For the subsequent analysis of the bargain, I relate the average monthly repurchase price to either the monthly average of the daily market price (equally-weighted bargain) or the average of the daily market price weighted by trading volume (volume-weighted bargain). When comparing means and medians, the two measures are not statistically significantly different from each other. For the equally-weighted (volume-weighted) bargain, I document an average of 0.66% (0.65%) and a median of 0.27% (0.26%). In terms of U.S. Dollars (USD), the average bargain in a given month is equal to approximately 94,000 USD which amounts to 3.3 billion USD over the 35,396 repurchase months. Although mean and median values reported for the volume-weighted bargain are very similar to the results obtained for the equally-weighted bargain, the corresponding dollar value which is equal to 1.7 billion USD represents only about 50% of the equally-weighted bargain. Obviously, this difference has to be related to the daily trading volume by which daily closing prices are weighted when using the volume-weighted bargain. A further analysis of the drivers of trading volume and the difference between the two measures suggests that while the equally-weighted bargain is driven by large repurchases after drops in the stock price, the volume-weighted measure is driven by small repurchases before an increase in the stock price.

A multivariate regression analysis of the bargain measures supports the notion that the bargain is driven by both negative and positive monthly returns. When controlling for realized returns, I find that negative abnormal returns are driving the equally-weighted bargain while positive abnormal returns have no significant impact. In the meantime, the volume-weighted bargain is primarily driven by positive realized monthly returns. Positive abnormal returns have a statistically significant, but economically insignificant impact on the volume-weighted bargain as well. Irrespective of which measure is analyzed, monthly returns are able to explain approximately 60% of the average bargain. The observation that the volume-weighted bargain is related weakly to positive abnormal returns might indicate managerial market timing ability. However, the measures of the bargain and cumulative abnormal returns over the subsequent six months are negatively correlated which is the opposite of what one would expect if the bargain was a measure of managerial timing ability.

I therefore conclude that the findings are in line with the contrarian-trading hypothesis which suggests that firms buy back after declines in the stock price and stop buying after increases in the stock price which is the reason why small repurchases drive the volume-weighted bargain. Firms buy back below average market prices because–like insiders–they are contrarian traders.

In order to investigate whether there is managerial timing ability which is unrelated to my measures of the bargain, I run Ibbotson's RATS (IRATS) method and the calendar time portfolio method to examine abnormal returns around actual repurchases. In line with the contrarian trading hypothesis, I document negative abnormal returns over the six months before the repurchase as well as in the month of the repurchase irrespective of which estimation method I use. When using IRATS, I am able to document positive abnormal returns over the three months following the repurchase. However, using the same method delivers negative cumulative abnormal returns over the 12 months following the repurchase. When using the calendar-time portfolio approach, I do not document abnormal returns subsequent to repurchase months at all. I conclude that the positive abnormal returns documented by IRATS are driven by a phenomenon Schultz (2003) has called "pseudo market timing" which in the context of repurchases is evoked by contrarian trading. The calendar-time portfolio approach solves the problem of pseudo market timing as it controls for the clustering of events im market downturns and consequently abnormal returns disappear.

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, i.e. the inclination to trade after abnormal price declines increases in insider ownership. Meanwhile, the gains from positive returns remain unrelated to insider ownership.

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".

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–like the only other study of this kind for the U.S. by Cook et al. (2004)–fail to link the bargain directly to managerial timing ability.

This paper contributes to the literature on the timing of actual stock repurchases in at least three important ways. First, it suggests that the bargain documented in the literature is 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 firms being contrarian traders. Second, the analysis implies that comparing repurchase prices to average market prices is not a useful approach to measure and examine managerial timing ability. Third, it provides evidence suggesting that in particular firms with high insider ownership engage in contrarian trading. I do not find evidence in favor of the notion that insiders use private information to expropriate selling shareholders as suggested by De Cesari et al. (2012).

The rest of this paper is structured as follows. Section 2 is dedicated to a thorough review of the hypotheses and the related literature. The regulatory environment of share repurchases in the United States is briefly summarized in Section 3. Section 4 describes the selection of the data set and the construction of the sample. Section 5 entails the empirical analysis. Section 6 concludes.

2 Hypotheses & related literature

I will subsequently outline two hypotheses that may explain why firms buy back below average market prices, derive their empirical predictions, and discuss the empirical results of the existing literature with respect to these hypotheses.

2.1 Market timing hypothesis

Managerial timing ability refers to the idea that managers have private information with respect to the value of the stock which they use to buy back when the stock price is low. While the concept of managerial timing ability is intuitively clear, it is not entirely obvious why managers should have an interest in buying back at low prices. If firms buy back below true value, the selling shareholders are paid less than their share's worth. The non-selling shareholders proportionately gain the selling shareholders' loss. A repurchase below fair value can thus be regarded as a transfer of wealth from selling to non-selling shareholders (Barclay and Smith (1988)). Additionally, the controlling power of large non-selling shareholders increases to the extent that shares are bought back. The more shares that can be bought back given a specified repurchase program size, the larger the increase in power of large non-selling shareholders. There are therefore at least two reasons why managers might have an interest in buying back at low prices. (1) Managers themselves own stock of the firm. (2) Large shareholders pressure managers to buy back at low prices, because they gain from doing so.

Even if the timing of share repurchases is based on by private information, the market will adjust its assessment of the stock price only to the extent that the private information becomes public. In semistrong efficient capital markets, stock prices should reflect all publicly available information. If firms buy back shares on the grounds of private information which becomes public shortly after the transaction, we should thus observe positive abnormal returns within the same period of time. If the market only slowly adjusts its assessment of the stock's value or, if the firm buys back a sufficiently large amount of shares so that the share price adjusts continuously, the stock price should converge to its true value only on the long-run.

If the firm's ability to buy back below average market prices stems from managerial timing ability, we should be able to observe positive abnormal returns within the period for which average market prices are measured. The market timing hypothesis would thus translate into the following empirical predictions:

1. *Bargain and positive abnormal returns should be positively correlated.* The bargain measure which is used primarily in this study can by definition (relative difference between monthly repurchase price and average market price) only pick up short-run adjustments of the stock price. Therefore the bargain should be positively related to abnormal returns measured for the same month.

2. *Bargain and subsequent abnormal returns should be positively correlated.* Assuming that private information is revealed entirely in the same month, prices would fully adjust

immediately and we should only observe a correlation between bargain and same month abnormal return. If, however, private information is only revealed gradually to the market–which should be the case in a significant number of instances–, there should be a positive relation between the bargain and subsequent abnormal returns as well.

3. *Actual repurchases should be followed by positive abnormal returns.* If firms are able to time the market, we should observe positive abnormal returns shortly after the actual repurchase.

2.2 Contrarian trading hypothesis

On the other hand, the *contrarian-trading hypothesis* predicts that firms buy back after drops in the stock price because they either believe in mean reversion or want to provide price support. Hong et al. (2008) present a model and empirical evidence for the U.S. that firms act as buyers of last resort, i.e. provide liquidity to investors when no one else will. By construction of the bargain measure, contrarian traders will buy back at bargain prices, if they buy shortly after drops in the stock price. The results of Hong et al. (2008) are also in line with a survey by Brav et al. (2005), where Chief Financial Officers indicate price support as an important motivation for repurchase trading.

An implication of the contrarian-trading hypothesis is that firms are less likely to repurchase stock when the stock price increases. Such a repurchase behavior might result in an empirical pattern which Schultz (2003) has coined pseudo market timing. If firms stop buying back shares as soon as the stock price increases (abnormally), it will appear empirically as if repurchasing firms are able to predict returns. The contrarian trading hypothesis therefore translates into the following empirical predictions.

1. *Both lagged negative and positive returns and share repurchases should be negatively correlated.* If firms trade contrary to the market, lagged returns should predict repurchase activity and repurchase volume. In particular, lagged negative (positive) returns should predict an increase (decrease) in share repurchase activity and share repurchase volume.

2. *Negative (abnormal) returns and the bargain should be correlated.* It is obvious that the bargain should be related to negative returns in the month of the repurchase. It is however unclear whether contrarian trading is triggered simply by negative returns or by negative abnormal returns. The empirical evidence should resolve this question.

3. *Positive returns and the bargain should be correlated.* Contrarian trading also implies that share repurchases stop when the stock price increases. Thus, also contrarian

trading predicts that positive returns and the bargain should be correlated.

4. *Abnormal returns subsequent to share repurchases should be zero.* As contrarian traders react to changes in the stock price but are unable to predict future stock prices, the expected subsequent abnormal return of such a strategy should be zero.

2.3 Related literature

While the timing of repurchase announcements has been studied extensively (cf. e.g. Vermaelen (1981); Dann (1981); Ikenberry et al. (1995, 2000); Chan et al. (2007)), 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)).

Stephens and Weisbach (1998) are the first to thoroughly examine the determinants of actual open market repurchases which they derive from quarterly data from CRSP. The authors document that actual share repurchases are negatively related to lagged stock returns. Furthermore, the authors find that both expected and unexpected cash flows predict share repurchases. In conclusion, managers seem to make wide use of the flexibility of open market repurchase programs and time repurchases accordingly.

A survey of 384 financial executives by Brav et al. (2005), sheds further light on the motives behind actual share repurchases. Managers' responses indicate that keeping dividends stable is a top priority when it comes to payout decisions. Consequently, share repurchases are used to cope with the variability in earnings which might require lower respectively higher payouts over time.[3] 86.4% of managers furthermore indicate that they use the flexibility of open market repurchases to buy back when the share price is low making it the top motive for the timing of share repurchases.

In order to examine managerial timing ability of share repurchases, the literature has so far resorted to two different approaches. A widely used approach of the literature is to compare repurchase prices to naive benchmarks such as the average market price. The alternative approach is to study abnormal returns subsequent to repurchase trades.

For a large sample of actual repurchases conducted in Canada, Ikenberry et al. (2000) document that an "increase in price leads to a reduction in the number of shares repurchased, whereas a drop in stock prices leads to a larger fraction of shares repurchased". The authors conclude that the results obtained for the analysis of long-run returns subsequent to actual

[3] Dittmar (2000) presented empirical evidence for the notion that repurchases are used to deal with the variability of earnings while holding dividends constant already five years earlier.

repurchases is in line with the undervaluation hypothesis. The authors do not document managerial timing ability.

Using the unique disclosure environment of the Hong Kong Stock Exchange, which requires reporting of repurchase activity on the next trading day, Brockman and Chung (2001) find that "managers exhibit substantial timing ability". By randomly repurchasing shares via bootstrapping, the authors demonstrate that managers buy back at prices which are below the ones obtained without the use of private information. Zhang (2005) extends the analysis by examining the share price performance following actual share repurchases. At least on the short run, the results are in line with the ones of Brockman and Chung (2001). The abnormal return from the day of the transaction to two days after is statistically significant but in magnitude similar to the average bid-ask spread which questions economic significance. Zhang (2005) does not find abnormal returns on the long-run on average.

Using survey data, Cook et al. (2004) find weak evidence for "timing or execution expertise" for a sample of 64 U.S. firms. The authors show that NYSE firms are able to beat naive benchmarks whereas NASDAQ firms are not. Cook et al. (2004) also document that firms seem to back off from repurchasing shares around announcement dates. Their observation that firms predominantly use limit orders is also more in line with contrarian trading than with market timing.

For a sample of repurchases conducted in France, 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.

Given that managers' incentive to time share repurchases should be related to both insider and institutional ownership, it is surprising that the empirical evidence on this matter is scarce. To my knowledge, De Cesari et al. (2012) provide the only evidence on the impact of ownership structure on actual repurchases by examining monthly repurchase activity in the United States between 2004 and 2006. In their article, the authors compare repurchase prices to average market price and relate the difference to measures of insider ownership and institutional ownership. The results of this analysis are surprising. The authors document that firms buy back at a bargain and conclude that "OMRs are timed to benefit non-selling shareholders". Moreover, insider ownership increases the bargain up to a certain threshold of insider ownership. For high levels of insider ownership the bargain decreases again which–according to the authors– was the result of insiders predominantly trading against themselves. Meanwhile, institutional ownership is negatively related to the bargain as it "reduces companies' opportunities to repurchase stock at bargain prices.

In conclusion, the articles by Cook et al. (2004) and De Cesari et al. (2012) constitute the only empirical evidence on managerial timing ability of share repurchases for the United States. In line with the literature, the authors' findings are inconclusive. The study of Cook et al. (2004) suffers from a small data set and a potential selection bias as firms that possess timing ability most likely won't have responded to the survey. The research design of De Cesari et al. (2012) faces severe methodological shortcomings such as the inability to relate the bargain to managerial timing ability.

3 Regulation of share repurchases in the United States

In 2003, the Securities and Exchange Commission adopted amendments to Rule 10b-18 which provides issuers with a "safe harbor" from liability for stock price manipulation when buying back stock. In addition to these amendments, the rule specified additional disclosure requirements to increase the transparency of share repurchases.

The "safe harbor" rules exempt firms from prosecution with respect to the violation of anti-manipulations provisions. Violation of these rules does not constitute violation of SEC law per se.[4] The safe harbor conditions prohibit firms among other things (1) to use more than one broker or dealer on a single day, (2) to buy back at a price which is higher than the highest independent bid or last independent transaction price, (3) to buy back more than 25% of average daily trading volume (block trades are exempted), and (4) to conduct repurchases at the beginning or the end of the trading day.[5]

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 quarterly filing (new Item 2(e) of Form 10–Q) and annual filings (new Item 5(c) of Form 10–K) with the SEC. In particular, 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.[6]

[4] As a matter of fact, Cook et al. (2004) document that only 10% of repurchase programs are fully compliant with SEC rule 10b-18.

[5] Rule 10b-18 purchases must not be (1) effected during the 10 minutes before the scheduled close of trading for a security that has an ADTV (average daily trading volume four weeks prior) value of $1 million or more and a public float value of $150 million or more or (2) effected during 30 minutes before the scheduled close of trading for all other securities .

[6] The difference between the total number of shares purchased and the number of shares purchased under

As firms have to report their repurchase activity in their quarterly filings, information regarding repurchase activity is released only after the transactions have taken place. Therefore, at the time of the repurchase transaction, there is no announcement made that the firm is currently buying back shares.

4 Data & Sample Construction

4.1 Sample construction

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 lie within the sample period. Since many firms do not adhere to the proposed disclosure format, we 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. As I am only interested in open market repurchases, I disregard tender offers, dutch auctions, private placements, and accelerated share repurchases and accordingly set repurchase volume in these cases to zero. 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

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).

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.

4.2 Variable definition

Table 1 describes all variables used in this study. *Bargain* denotes the percentage 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. Both measures are computed similarly in Ben-Rephael et al. (2012) and De Cesari et al. (2012). 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.[7]

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).[8]

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

[7] 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.

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

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 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 cover mostly medium-sized and 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.

5 Empirical analysis

5.1 Stock returns and repurchase activity

5.1.1 Model

As I am interested in the impact of stock returns on the decision to repurchase, I regress a measure of stock repurchases on lagged positive returns and lagged negative returns and a range of controls.

$$Repurchases_{i,t} = \alpha + \beta_1 Return_{i,t-1} > 0 + \beta_2 Return_{i,t-1} < 0 + \sum_{l=1}^{l=K} \gamma_l Control_{i,t-1,l} + \mu_i + \eta_t + u_{t,i}. \quad (1)$$

Here, $Repurchases_{i,t}$ refers to either repurchases scaled by shares outstanding or a dummy variable indicating share repurchases of stock i in month t. $Return_{t-1} > 0$ either denotes the positive previous month return or is zero, $Return_{t-1} > 0$ is coded accordingly, $Control_l$ is one of K control variables, μ_i is a time-invariant firm fixed effect, and η_t is a year dummy. I restrict the sample to firms that conduct at least one open market repurchase during the sample period.

5.1.2 Results

I present estimates of equation (1) in Table 4. In columns (1), (2) and (3), I regress the model on repurchases to shares outstanding. In columns (4), (5), and (6) I regress the model on a dummy variable indicating repurchases making the model a linear probability model. In general, the models have very low explanatory power. If I do not include lagged dependent variables, the model does explain only 1.1% to 1.3% of time-series variation of the dependent variable. When including lagged dependent variables in model (3) respectively model (6), the model explains 5.5% of variation in repurchases to shares outstanding and 18.8% of variation in the linear probability model. Thus, previous repurchases seem to be the by far strongest predictor of repurchase activity.

The coefficients on $Return_{t-1} > 0$ and $Return_{t-1} < 0$ are in line with the contrarian trading hypothesis. Notice that lagged negative returns have a stronger impact on repurchase activity than lagged positive returns. Positive lagged returns do not significantly impact repurchase size as depicted in model (1), they however significantly reduce the probability of a repurchase as depicted in column (4). Negative lagged returns have a significant impact on repurchase size and repurchase activity: The more negative previous month returns are, the higher both the repurchase volume relative to shares outstanding and repurchase activity in general. Including contemporaneous returns in model (2) generates an additional insight: Repurchase size and positive monthly returns are negatively correlated. Thus, we observe the smallest repurchases when the stock price goes up. In conclusion, the results are consistent with repurchase activity being triggered by negative abnormal returns with the intention of price support. Repurchases stop as soon as the stock price increases again.

The control variables I include are frequently used in the literature and do not merit much discussion. Notice that most of the coefficients on the control variables come in with expected signs (cf. Dittmar (2000) and Stephens and Weisbach (1998)). *Total assets* and *book-to-market* (undervaluation hypothesis) as well as *cash to assets* and *EBITDA to assets* (excess capital hypothesis) have a positive impact on share repurchases. *Leverage* (optimal leverage hypothesis) and *dividends to assets* have a negative impact on share repurchases. Firms being in the process of acquiring a company (*acquiror dummy*) or in the process of being acquired (*target dummy*) purchase significantly less. This result is not in line with Dittmar (2000), but still reasonable as today most firms repurchase stocks regularly of which most will stop buying back shares. Only those firms using repurchases as a takeover deterrent will increase repurchase activity. As these will however constitute a minority, it is reasonable to assume that the effect of acquisitions on repurchase activity will be negative on average.

5.2 Descriptive analysis of the bargain

In line with earlier studies by Ben-Rephael et al. (2012) and De Cesari et al. (2012), Table 5 reports an economically and statistically significant bargain. 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 value as for the volume-weighted bargain which compares repurchase prices to market prices weighted by daily trading volume. Median values of both measures of the bargain are substantially lower and again of similar size.[9] Table 5 furthermore reports tests on whether the bargain measures are statistically significant from zero (which they are) and whether the bargain measures are statistically significant from each other (which they are not).

In terms of U.S. Dollars (USD), the average bargain in a given month is equal to approximately 94,000 USD which amounts to 3.3 billion USD over the 35,396 repurchase months between January 2004 and September 2008. Total bargains account for 0.17% of total re-

[9] 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.

purchase volume which is equal to 1.9 trillion dollars. Although mean and median values reported for the volume-weighted bargain are very similar to the results obtained for the equally-weighted bargain, the dollar value which is equal to 1.7 billion USD represents only about 50% of the equally-weighted bargain. Obviously, this difference has to be related to the daily trading volume by which daily closing prices are weighted when using the volume-weighted bargain.

In order to get a rough idea of what drives monthly trading volume, I regress trading volume on repurchase volume and returns in Table 6. In column (1) and column (2) I include all firm months, whereas in column (3) and column (4) I include repurchase months only. In repurchase months, a buyback of shares equal to one percent of shares outstanding, increases trading volume relative to shares outstanding by almost two percentage points. I conclude that when using the volume-weighted bargain measure, those days of the month where repurchases take place gain a stronger weight. The market price weighted by trading volume is thus a more adequate benchmark for repurchase prices.

Adding the earlier gained insight that repurchase size is relatively small in months with positive returns (cf. Table 4) to the observation that positive returns increase trading volume (cf. Table 6), might explain why the volume-weighted bargain and the equally weighted bargain are very similar: In months with positive returns, repurchases tend to be small and thus do not increase trading volume. In the meantime an increase in returns subsequent to repurchase trades increases trading volume and therefore stock prices post repurchase gain a stronger weight when using the volume-weighted bargain.

In order to analyze the determinants of the difference between equally-weighted bargain and volume-weighted bargain in further detail, I regress this difference on repurchases to shares outstanding, positive returns, and negative returns. The results are presented in Table 7 and confirm my earlier presumptions. Both repurchase size measured as repurchase volume scaled by shares outstanding and negative returns increase the equally weighted bargain. Positive returns in turn increase the volume-weighted bargain.

In conclusion, the equally weighted bargain seems to be driven by firms buying back after the stock price declines. The bargain is thus to a large extent the result of higher stock prices before the repurchase. The volume-weighted bargain in the meantime appears to be driven by increases in the stock price after the repurchase was made. As repurchase trades in months with positive returns tend to be small, the dollar value of the volume-weighted bargain is consequently much smaller than the one of equally-weighted bargain.

The results thus lend support to the contrarian trading hypothesis: If firms buy back after declines in stock price as, for example, a means of price support, the equally-weighted bargain measure will be driven up. If firms start buying back stock at the beginning of the month because of a decrease in stock price in the previous month, they will continue to buy back until the stock price increases. The sooner the stock price increases, the less firms will have bought back and the higher (in relative terms and NOT in dollar terms) the volume-weighted bargain will be.

5.3 Regression analysis of the bargain

5.3.1 Motivation and model

As I have already discussed above, 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).

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.

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 order to examine whether the bargain is driven by managerial timing ability, I conduct a multivariate regression analysis of the bargain.

$$\begin{aligned} Bargain_{i,t} \;=\; & \alpha + \beta_1 Return_{i,t} > 0 + \beta_2 Return_{i,t} < 0 + \beta_3 AR_{i,t} > 0 \\ & + \beta_4 AR_{i,t} < 0 + \beta_4 CAR(1,6)_{i,t} + \beta_5 Repurchases\,to\,trading\,volume_{i,t} \\ & + \beta_5 Repurchases\,to\,shr.\,out._{i,t} + \beta_6 Liquidity_{i,t-1} + \mu_i + u_{t,i} \qquad (2) \end{aligned}$$

Here, $Bargain_{i,t}$ refers to either the equally-weighted bargain or the volume weighted bargain of stock i in month t.$Return_t > 0$ either denotes the positive month return or is zero, $Return_t > 0$ is coded accordingly, $AR_t > 0$ either denotes the positive abnormal return or is zero, $AR_t < 0$ is coded accordingly, $CAR(1,6)_{i,t}$ denotes the cumulative abnormal return over the six months subsequent to the repurchase, $Repurchases\, to\, trading\, volume$ denotes repurchase scaled by trading volume, $Repurchases\, to\, shr.\, out.$ denotes repurchase scaled by shares outstanding, $Liquidity$ denotes a measure of liquidity such as the bid-ask spread, and μ_i is a time-invariant firm fixed effect. I restrict the sample to firms that conduct at least one open market repurchase during the sample period.

5.3.2 Results on hypotheses

Table 8 presents the results of the regression analysis of the bargain (Panel A) and the volume-weighted bargain (Panel B). The fixed-effects models explain between 1.8% and 6.3% of within-firm variation. 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 1.5% and 1.8%.

I start the analysis of the bargain by examining its relation to returns (column 1) and abnormal returns (column 2) separately. Both positive returns and positive abnormal returns increase the equally-weighted bargain in Panel A. Simultaneously, both negative returns and negative abnormal returns increase the bargain as well and in about the same magnitude. When including both returns and abnormal returns in model (3), it turns out that while the positive return increases the bargain, the inclusion of the positive abnormal return has no significant impact on the bargain. I conclude from these observations that the bargain is not related to positive abnormal returns when controlling for realized returns. The evidence is thus not in line with managerial timing ability which would require positive abnormal returns to drive the bargain. In the meantime, negative abnormal returns explain the bargain while negative realized returns do not. I interpret this finding as evidence in favor of contrarian trading with the motive of price support.

The picture changes slightly but not unexpectedly when looking at the volume-weighted bargain in Panel B. Here, only the coefficients on the positive return and positive abnormal return variables 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 usually increase trading volume (cf. Table 6). However, this will obviously be less the case for small repurchases, in particular when these are followed by positive abnormal returns which increase trading volume as well (cf. Table 6). Consequently, the volume-weighted bargain measure should be rather driven by subsequent increases of the stock price which is in line with the results presented in Panel B of Table 8.

Model (3) of Panel B again sheds light on the question of whether returns or abnormal returns are a better "predictor" of the volume-weighted bargain. It turns out that the majority of the bargain is driven by realized returns. The coefficient on the positive abnormal return is statistically significant as well but not economically significant. Multiplying the coefficient (0.020) with the average positive abnormal return results in an average volume-weighted bargain equal to only 0.05%. The observation that the coefficients on positive returns and positive abnormal returns go into exactly opposite directions obviously raises multicollinearity concerns. The variance inflation factor on returns and abnormal returns however does not exceed 3.5. This is usually still acceptable, but I will refrain from interpreting the results as model (1) and model (2) make it clear that negative (abnormal) returns are not driving the volume-weighted bargain.

If bargains are driven by private information respectively managerial timing ability, bargains and cumulative abnormal returns after the repurchase should be positively related as well. In order 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. The results, which are of same magnitude in Panel A and Panel B, suggest that repurchases which had lower bargains subsequently display higher long-run abnormal returns. This finding is not in line with managerial timing ability. Considering that informed traders might be willing to pay a premium (i.e., receive a smaller or negative bargain) in order to profit from subsequent increases in the stock price, this result might however make sense. The relation between falling stock prices and the bargain measure also again points at contrarian trading as it is in line with repurchasing firms continuously providing price support for (abnormally) declining stocks.

Model (3) also allows for quantifying the effect of returns and abnormal returns on the bargain by multiplying the coefficients with the variable's averages. This delivers almost identical results for the equally-weighted (0.44%) and the volume-weighted bargain (0.43%) accounting for approximately 65% of the average bargain which is equal to 0.66%. A large fraction of the bargain can thus be explained by changes in the stock price post or prior to share repurchases.[10]

In conclusion, the empirical evidence presented in this section suggests that a large share of the bargain can be explained by monthly realized returns and abnormal returns. The overall evidence presented strongly supports the contrarian trading hypothesis which predicts that

[10] Quantifying the effect of returns with model (1) and abnormal returns with model (2) delivers similar results.

the bargain is the result of both buying after decreases in the stock price and refraining from buying as soon as the stock price increases.

5.3.3 Results on controls

In models (1) to (4), I include repurchases scaled by trading volume in order to control for the price impact of large repurchase trades. In all specifications, an increase of repurchases relative to trading volume substantially reduces the bargain. A repurchase representing one percent of trading volume decreases the bargain by between 3.5 and 3.8 percentage points. Although the SEC has implemented safe harbor provisions with the intention to prevent firms from driving up stock prices, repurchase trades appear to have a significant impact on prices. In model (5) and model (6), I form quintiles of repurchases to trading volume in order to examine the functional form of the effect which turns out to be linear. In the highest quintile, the equally-weighted bargain decreases by between 3.9 and 4.1 percentage points on average and the volume-weighted bargain decreases by between 4.5 and 4.7 percentage points on average.

After controlling for price impact, I add another repurchase size variable which is scaled by shares outstanding. There are two potential explanations of why the bargain should be related to repurchase size.

As we have seen earlier, a large share of the bargain is most likely the result of price support. In order to support prices, repurchase size must be above a certain threshold. Therefore, repurchase size could be positively related to the bargain.

Another explanation relates to how large trades are usually executed. 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 related to repurchase size. Therefore, after controlling for price impact, repurchases relative to shares outstanding should have a positive impact on the bargain.

The results of models (1) to (4) suggest that repurchase size has no impact on the bargain. However, after including repurchase intensity quintiles instead of repurchases scaled by turnover, the effect becomes statistically significant (see model (5) and model (6)). As repurchases to trading volume and repurchases to shares outstanding are positively correlated (correlation coefficient: 0.38) and explanatory power increases when including repurchase intensity quintiles, models (5) and models (6) seem to be better capable of disentangling the effect of repurchase intensity and repurchase size.

The observation that the repurchase size effect is slightly stronger for the equally-weighted measure indicates that (1) both explanations play a role and (2) the limit-order explanation seems to be more convincing. As discussed earlier, the volume-weighted bargain appears to be a more adequate benchmark which is not as strongly driven by contrarian trading. That the coefficients of repurchase size decrease by only about twenty percent when using the volume-weighted bargain thus suggests that contrarian trading is not the major driver of the effect.

As suggested already above, firms should be able to buy back at bargain prices if 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. An obvious implication of these considerations is that the exogenous bid-ask spread and bargains are positively correlated, i.e. a higher spread is accompanied by higher bargains.

To show this empirically is difficult for primarily two reasons. First, as Hillert et al. (2012) demonstrate in a recent working paper, 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 (eventually, spread are used as a measure of liquidity). 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 include the previous month spread in specifications (1), (2), and (3). The empirical results do not support the idea that repurchasing firms earn the spread: An increase in the spread by one percentage point decreases the bargain by 0.01 percentage points in model (3).[11] However, the majority of months prior to the repurchase have seen repurchase activity as well. It is therefore not clear whether using the lagged spread solves or at least mitigates the endogeneity problem. 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 26,460 repurchase month observations. The effect of the relative spread on the bargain becomes insignificant 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.

Specifications (5) and (6) try to disentangle the positive limit-order effect from the negative price impact effect and thus address the problem that the price impact of repurchase trade on the bargain should depend on the spread. For this to achieve, I interact the repurchase intensity quintiles with the lagged relative spread. Now, 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. I conclude that firms are able to earn their spread as long as they keep repurchase intensity at a low level.

5.3.4 Robustness tests

I have conducted a couple of untabulated robustness tests of which none changes the key results discussed in this section. In particular, the results are robust to computing the average market prices from the NYSE Trades and Quotes database instead of using the CRSP daily closing prices. The results are also robust to controlling for month fixed-effects. Eventually, all results also hold for OLS models without fixed-effects.

[11] The results using the six-month average spread of months without repurchase activity are very similar.

5.4 Abnormal returns around actual repurchases

5.4.1 Motivation and methodology

I have shown earlier that there is, if any at all, only weak evidence in favor of the notion that firms are buying back below average market prices because they exhibit timing ability. However, the finding that the bargain is not driven by managerial timing ability does not per se mean that there is no managerial timing ability of actual repurchases. Therefore, I subsequently analyze abnormal returns around actual repurchases. If managers possess timing ability, we should observe positive long-run abnormal returns as private information becomes public or the market corrects its misvaluation. If we do not find evidence for timing ability, this would also cast even stronger doubts on that firms buy back below average market prices because of managerial timing ability.

In order to examine long-run abnormal returns, the literature resorts to applying both Ibbotson's RATS (IRATS) methodology and the calendar-time approach as both have specific advantages and disadvantages.[12] Furthermore, both models have the advantage of not requiring an estimation period which becomes a problem if events are overlapping over time as it is the case with actual repurchases. Therefore, these methods are also more appropriate for estimating short-run abnormal returns than standard event study methodology.

I use IRATS in combination with the Fama-French (1993) three-factor model to estimate abnormal returns. The following cross-sectional regression is run for each event month (an actual share repurchase):

$$R_{i,t} - R_{f,t} = a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + \epsilon_{i,t} \quad (3)$$

where $R_{i,t}$ is the monthly return on stock i, $R_{f,t}$ is the risk-free rate, $R_{m,t}$ is the equally weighted return of all stocks available in CRSP, SMB_t is the monthly return on the size factor, and HML_t is the monthly return on the book-to-market factor in calendar month t. The coefficients a_j, b_j, and c_j are the result of cross-sectional regressions of event month j.

The calendar-time portfolio approach is similar to the above econometric specification. It is different to IRATS in that one forms monthly portfolios of stocks which had an event in the months over the event period. For example, if one was to examine 12 month post

[12] I will comment on the advantages and disadvantages of these methods to the extent that it is relevant in the context of this paper below. Peyer and Vermaelen (2009) provide a thorough discussion of IRATS and the calendar-time portfolio method. Obviously, Ibbotson (1975) should be consulted regarding the foundations of the IRATS methodology. Fama (1998) and Mitchell and Stafford (2000) discuss and advocate the calendar-time portfolio approach. Schultz (2003) provides an excellent analysis of the shortcomings of event time studies over calendar-time studies.

repurchase abnormal returns, a portfolio would contain all stocks that had a repurchase within the previous 12 months. Consequently, the calendar-time portfolio estimation is conducted by one single time-series regression (whereas IRATS is conducted for every event month separately).

Schultz (2003) points out that event-time methods such as IRATS might be subject to pseudo market timing[13] as these methods allow for the clustering of events over time. The author demonstrates that as the probability of an IPO increases with increasing stock prices, for pure technical reasons, we should observe an underperformance of IPOs because IPOs cluster at market peaks. Schultz (2003) documents that the long-run underperformance of IPOs disappears when using calendar-time abnormal returns. A similar argument can be made for share repurchases: if one assumes (in line with the results of this paper) that the probability of a stock repurchase increases with falling stock prices, we should observe positive abnormal returns after the repurchase in event-time and no abnormal returns in calendar-time.

5.4.2 Results

Table 9 reports abnormal returns over several time windows prior, post, and at actual repurchases. Notice that while IRATS produces cumulative abnormal returns over the time period taken into consideration, calendar-time abnormal returns represent average monthly abnormal returns over the period.

Regardless of the methodology employed, abnormal returns before actual repurchases are negative and highly significant. The month prior to the repurchase displays the highest negative abnormal returns irrespective of the method used. Nevertheless, abnormal returns remain negative over the event month. The evidence is clearly consistent with the contrarian-trading hypothesis and the finding that abnormal returns are less pronounced in the event month can well be explained as the outcome of price support.

The picture becomes less consistent when looking at subsequent abnormal returns. On the short-run, IRATS produces positive abnormal returns over the first three months suggesting managerial timing ability. The effect is reversed, but still significantly positive over the first six months and becomes negative after 12 months. The evidence on long-run abnormal returns is thus definitely not consistent with managerial timing ability.

The calendar-time portfolio approach does not produce positive abnormal returns after actual repurchases. As I have stressed earlier, the calendar-time portfolio methodology is not

[13] In the spirit of Schultz (2003), pseudo market timing represents the methodological problem that, ex-post, empirical analyzes detect abnormal returns and thus suggest timing ability although ex-ante expected abnormal returns are zero.

subject to the bias caused by the clustering of events. All results corroborated in this paper however suggest that share repurchases are driven by declines in the stock price (positively) and increases in the stock price (negatively) and thus cluster when the market is at a (local) bump. That I only document short-run abnormal returns, while IPO underperformance can be observed over longer periods of time makes sense as well: Firms usually have to time their repurchase within a twelve month period, whereas issuing companies will have much more patience in order to receive a good offering price. Consequently, abnormal returns of actual repurchases should only be observable on the short-run. Therefore, I conclude that the abnormal returns of repurchases documented by IRATS are the result of pseudo market timing. Again, I do not find convincing evidence in favor of managerial timing ability given that abnormal returns over the 12 months after the actual repurchase are not positive irrespective of the method employed.

5.5 Bargain 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 10 reports the regression results on the effect of ownership on the equally-weighted bargain. In addition to the variables reported in this table, the analysis includes all variables reported in specification (5) respectively (6) of Table 8.

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 0.020 for the insider ownership variable. Thus, a 10 percent higher insider ownership goes along with a higher bargain by 0.20 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 substantially. Remarkably, the point estimate is still very similar to the one for the OLS-model.

Institutional ownership has also a positive, 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 primarily 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.

For the OLS-model, column (3) reports a positive and statistically significant relation between the interaction of positive abnormal returns and insider ownership and the bargain measure. For the fixed-effects model in column (4), the coefficient remains numerically similar but loses its statistical significance. If these results were weak evidence in favour of the notion that the bargain is higher for firms with high insider ownership because of managerial timing ability, we should also see a positive relation between the interaction of the abnormal return of the subsequent month and insider ownership on the one hand and the bargain on the other hand. However, the coefficients of this interaction term in column (3) and column (4) are both close to zero and statistically insignificant. Thus, accounting for insider ownership does not change the earlier documented observation that higher bargains are followed by lower abnormal returns which is the opposite of what one would expect in case of managerial timing ability.

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

I conclude from this section that the statistically significant impact of insider ownership on the bargain measures is driven by the cross-sectional variation of the bargain. When including firm-fixed effects, the interaction between negative abnormal returns and insider ownership is the only variable that remains its significant impact on the bargain. The results are thus only consistent with the notion that insider ownership increases the propensity to trade contrary to the market.

6 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 weak 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.

The analysis of abnormal returns around actual repurchases strongly supports the contrarian trading hypothesis. Regardless of the methodology employed, abnormal returns before actual repurchases are negative and highly significant. When using the calendar-time portfolio approach, which accounts for pseudo market timing, to estimate abnormal returns after the actual repurchase, I do not find significant abnormal returns. I therefore conclude that there is no convincing evidence in favor of managerial timing ability.

The evidence presented in this paper furthermore suggests that firms are able to buy back at bargain prices as they 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 ownership and that this is the result of firms with high insider ownership being more inclined to buy back after abnormal declines in the stock price. As insider ownership and positive abnormal returns are not correlated, I do not find evidence in favor of the notion that insiders use private information to expropriate selling shareholders as suggested by De Cesari et al. (2012).

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Table 1: **Definition of variables**

Name	Definition (Source)	Unit
Acquiror	1 if firm is currently (time between announcement and end of the offer) bidding for another company	binary
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
Book to market	Book value equity / market cap, winsorized at 1% (COMPUSTAT)	ratio
Book value equity	Common equity (item: ceqq) (COMPUSTAT)	million
Cash to Assets	Cash (item: cheq) divided by total assets (item: atq) (COMPUSTAT)	ratio
Dividends to Assets	Dividends (item: dvc) divided by total assets (item: atq)	ratio
EBITDA to Assets	Sales (item: saleq) - COGS (item: cogsq) - Expenses (item: xsgaq) divided by total assets (item: atq) (COMPUSTAT)	ratio
Insider ownership	% shares and options held by corporate executives (Execucomp)	ratio
Institutional ownership	% shares held by institutional investors (Thomson)	ratio
Leverage	(Total asset - book value equity) / (total asset - book value equity + market cap) (CRSP/COMPUSTAT)	ratio
Market capitalization	Monthly average of daily market capitalization (CRSP)	million
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
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
Target	1 if firm is currently (time between announcement and end of the offer) a target of another company	binary
Total assets	Total assets (Compustat item: atq) (ln)	million

Table 2: **Descriptives - Total Sample**

	N	Mean	Median	S.D.	1^{st} Perc.	99^{th} Perc.
Panel A. All firm months						
AR(0,0)	128285	-0.41%	-0.60%	9.79%	-28.42%	31.10%
CAR(1,6)	128285	-2.33%	-2.39%	31.64%	-88.63%	87.43%
Monthly return	128218	0.67%	0.37%	11.64%	-28.90%	33.46%
Repurchase dummy	128285	27.29%	0.00%	44.55%	0.00%	100.00%
Relative spread	128285	0.59%	0.16%	1.23%	0.02%	5.94%
Order Imbalance (volume)	128285	-4.07%	1.29%	32.03%	- 100.00%	54.76%
Market capitalization	128285	5639	742	21364	16	95220
Cash to assets	128285	16.72%	7.84%	19.16%	0.10%	78.07%
EBITDA to assets	128285	2.75%	2.67%	3.34%	-7.50%	12.02%
Dividends to assets	128285	0.90%	0.00%	1.93%	0.00%	11.04%
Leverage	128285	39.90%	32.57%	28.29%	2.10%	93.30%
Book to market	128285	54.13%	46.98%	41.51%	-7.96%	207.84%
Panel B. Repurchase Months						
Bargain (equally-weighted)	35396	0.66%	0.27%	3.45%	14.71%	10.23%
Bargain (volume-weighted)	35396	0.65%	0.26%	3.47%	14.77%	10.17%
Monthly Return	35396	-0.01%	0.16%	8.77%	-24.10%	23.22%
Monthly Return > 0	18043	6.07%	4.45%	6.22%	0.09%	27.57%
Monthly Return < 0	17245	-6.36%	-4.51%	6.20%	-29.21%	-0.10%
AR(0,0)	35396	-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)	35396	-2.01%	-2.11%	26.49%	-74.06%	74.58%
Repurchases to turnover	35396	6.60%	3.40%	9.47%	0.00%	49.58%
Repurchases to shr. out.	35396	0.66%	0.36%	0.96%	0.00%	4.51%
Relative spread	35396	0.43%	0.10%	1.01%	0.02%	5.00%
Order Imbalance (volume)	35396	-3.30%	0.90%	29.20%	-99.99%	52.34%
Market capitalization	35396	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 (equally-weighted)	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: **Analysis of Repurchases.** The dependent variable is either repurchases scaled by shares outstanding (*Rep. to shr. out.*) or a binary variable which is 1 if a repurchase takes place in the respective month *(Rep. Dummy). Return > (<) 0* is equal to the monthly realized 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. 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) Rep. to shr. out.	(2) Rep. to shr. out.	(3) Rep. to shr. out.	(4) Rep. dummy	(5) Rep. dummy	(6) Rep. dummy
$\text{Return}_{t-1} > 0$	–0.000	–0.000	–0.000	–0.119***	–0.122***	–0.091***
	(–1.36)	(–1.51)	(–1.61)	(–6.85)	(–6.96)	(–6.52)
$\text{Return}_{t-1} < 0$	–0.006***	–0.006***	–0.006***	–0.171***	–0.179***	–0.191***
	(–12.51)	(–12.62)	(–12.32)	(–7.67)	(–8.15)	(–10.11)
Return > 0		–0.001***	–0.001***		–0.108***	–0.093***
		(–4.11)	(–4.20)		(–6.58)	(–6.44)
Return < 0		–0.001*	–0.001***		0.011	–0.060***
		(–1.84)	(–2.86)		(0.54)	(–3.27)
$\text{Total Assets}_{t-3}$ (ln)	0.001***	0.001***		0.071***	0.068***	
	(6.90)	(6.62)		(6.97)	(6.68)	
$\text{Cash to Assets}_{t-3}$	0.002***	0.002***	0.002***	0.096***	0.097***	0.075***
	(4.60)	(4.65)	(4.88)	(2.92)	(2.96)	(3.72)
$\text{EBITDA to Assets}_{t-3}$	–0.001	–0.000	0.000	0.114	0.140	0.139**
	(–0.77)	(–0.44)	(0.21)	(1.30)	(1.58)	(2.37)
$\text{Dividends to Assets}_{t-3}$	0.002	0.002	0.001	–0.055	–0.059	–0.183*
	(0.98)	(0.97)	(0.31)	(–0.32)	(–0.35)	(–1.72)
Leverage_{t-3}	–0.005***	–0.005***	–0.004***	–0.548***	–0.538***	–0.309***
	(–10.75)	(–10.45)	(–10.04)	(–12.41)	(–12.10)	(–11.75)
$\text{Book to Market}_{t-3}$	0.000	0.000	0.000**	0.027**	0.030**	0.022***
	(1.36)	(1.54)	(2.07)	(2.21)	(2.43)	(2.89)
Acquiror Dummy	–0.000***	–0.000***	–0.000***	–0.054***	–0.054***	–0.035***
	(–6.67)	(–6.67)	(–6.58)	(–10.65)	(–10.65)	(–9.73)
Target Dummy	–0.001***	–0.001***	–0.001***	–0.120***	–0.110***	–0.075***
	(–3.45)	(–3.10)	(–2.67)	(–6.63)	(–6.05)	(–5.02)
$\text{Repurchases to shr. out.}_{t-1}$			0.206***			
			(18.00)			
$\text{Repurchase Dummy}_{t-1}$						0.416***
						(65.59)
Constant	–0.002*	–0.001*	0.003***	0.026	0.042	0.282***
	(–1.94)	(–1.79)	(16.49)	(0.38)	(0.60)	(23.38)
R^2	0.018	0.018	0.059	0.025	0.025	0.192
Observations	122225	122179	121923	122243	122197	121955
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: **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 6: **Analysis of Trading Volume.** The dependent variable is the monthly average of daily trading volume from CRSP. *Return > (<) 0* is equal to the monthly realized 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. 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)
	b/t	b/t	b/t	b/t
Repurchases to ShrOut	1.308***	1.610***	1.830***	1.871***
	(10.97)	(14.30)	(13.97)	(17.41)
Market Cap (ln)	0.061***		0.008	
	(8.39)		(0.50)	
L.Return > 0	0.500***		0.172**	
	(2.58)		(2.21)	
Return > 0		0.734***		0.279***
		(3.19)		(4.12)
L.Return < 0	–0.560***		–0.311***	
	(–5.49)		(–7.85)	
Return < 0		–0.652***		–0.451***
		(–5.80)		(–7.01)
L.Volatility	0.044***		0.033***	
	(4.36)		(8.98)	
Volatility		0.087***		0.087***
		(8.84)		(20.86)
Constant	–0.102	0.461***	0.215*	0.480***
	(–1.53)	(9.17)	(1.76)	(30.45)
R^2	0.045	0.101	0.077	0.244
Observations	147306	147646	35396	35396
Firm FE	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes

Table 7: **Analysis of Difference between bargains.** The dependent variable is the relative difference between the monthly repurchase price and the monthly average CRSP closing price weighted by trading volume. *Return > (<) 0* is equal to the monthyl realized 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. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	Equally-weighted bargain - Volume-weighted bargain
	b/t
Repurchases to trading volume	–0.000
	(–0.17)
Repurchases to shr. out.	0.043***
	(5.08)
Return > 0	–0.055***
	(–16.90)
Return < 0	–0.045***
	(–15.58)
Constant	0.000
	(0.33)
R^2	0.143
Observations	35396

Table 8: **Panel A. 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)
	b/t	b/t	b/t	b/t	b/t	b/t
Repurchases to trading volume	–0.033***	–0.033***	–0.033***	–0.037***		
	(–8.48)	(–8.47)	(–8.49)	(–8.48)		
Repurchases to shr. out.	0.008	0.004	0.012	0.026	0.104**	0.128***
	(0.18)	(0.10)	(0.30)	(0.56)	(2.51)	(2.73)
L.Relative spread (ln)	–0.001*	–0.001	–0.002**		0.001	
	(–1.92)	(–1.14)	(–2.44)		(1.25)	
CAR(1,6)	–0.007***	–0.008***	–0.007***	–0.008***	–0.006***	–0.008***
	(–6.58)	(–6.84)	(–6.27)	(–5.96)	(–5.75)	(–5.40)
Return $>$ 0	0.078***		0.090***	0.090***	0.085***	0.084***
	(10.46)		(8.52)	(7.63)	(8.20)	(7.33)
Return $<$ 0	–0.039***		0.010	–0.011	0.012	–0.008
	(–4.50)		(0.78)	(–0.75)	(0.97)	(–0.56)
AR(0,0) $>$ 0		0.073***	–0.007	–0.011	–0.008	–0.012
		(9.72)	(–0.73)	(–0.96)	(–0.80)	(–1.03)
AR(0,0) $<$ 0		–0.050***	–0.066***	–0.066***	–0.065***	–0.065***
		(–6.51)	(–6.12)	(–5.14)	(–6.09)	(–5.10)
Exog. Relative spread (ln)				0.000		0.003**
				(0.38)		(2.17)
Rep. to trading volume Q2					–0.009	–0.010
					(–1.14)	(–1.09)
Rep. to trading volume Q3					–0.025***	–0.027***
					(–3.47)	(–3.09)
Rep. to trading volume Q4					–0.032***	–0.032***
					(–4.59)	(–3.74)
Rep. to trading volume Q5					–0.039***	–0.041***
					(–5.49)	(–4.83)
Rel. spread x Rep. to tv Q2					–0.001	–0.001
					(–0.61)	(–0.61)
Rel. spread x Rep. to tv Q3					–0.002**	–0.003**
					(–2.50)	(–2.11)
Rel. spread x Rep. to tv Q4					–0.003***	–0.003**
					(–3.26)	(–2.43)
Rel. spread x Rep. to tv Q5					–0.004***	–0.004***
					(–3.68)	(–3.05)
Constant	–0.003	0.000	–0.006	0.007	0.019***	0.033***
	(–0.68)	(0.07)	(–1.41)	(1.13)	(2.65)	(3.31)
R^2	0.021	0.018	0.024	0.025	0.032	0.035
Observations	35396	35396	35396	26460	35396	26460
Firm FE	Y	Y	Y	Y	Y	Y

Table 8: **Panel B. 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)
	b/t	b/t	b/t	b/t	b/t	b/t
Repurchases to trading volume	–0.034***	–0.033***	–0.034***	–0.038***		
	(–8.59)	(–8.37)	(–8.52)	(–8.60)		
Repurchases to shr. out.	–0.032	–0.049	–0.034	–0.016	0.079**	0.102**
	(–0.79)	(–1.21)	(–0.83)	(–0.35)	(1.97)	(2.27)
L.Relative spread (ln)	–0.001**	–0.000	–0.001**		0.002*	
	(–2.22)	(–0.41)	(–2.34)		(1.80)	
CAR(1,6)	–0.007***	–0.008***	–0.007***	–0.009***	–0.007***	–0.008***
	(–6.80)	(–7.55)	(–6.70)	(–6.45)	(–6.16)	(–5.86)
Return > 0	0.129***		0.118***	0.118***	0.113***	0.112***
	(17.26)		(12.25)	(11.65)	(11.94)	(11.42)
Return < 0	0.010		0.035***	0.014	0.038***	0.017
	(1.23)		(2.77)	(0.94)	(3.01)	(1.17)
AR(0,0) > 0		0.126***	0.020**	0.013	0.019**	0.013
		(15.84)	(2.09)	(1.21)	(2.04)	(1.16)
AR(0,0) < 0		0.006	–0.035***	–0.034***	–0.034***	–0.033***
		(0.78)	(–3.33)	(–2.79)	(–3.26)	(–2.72)
Exog. Relative spread (ln)				0.001		0.004***
				(1.10)		(3.02)
Rep. to trading volume Q2					–0.012	–0.013
					(–1.53)	(–1.33)
Rep. to trading volume Q3					–0.027***	–0.028***
					(–3.54)	(–3.21)
Rep. to trading volume Q4					–0.037***	–0.037***
					(–5.10)	(–4.23)
Rep. to trading volume Q5					–0.045***	–0.047***
					(–6.16)	(–5.42)
Rel. spread x Rep. to tv Q2					–0.001	–0.001
					(–0.98)	(–0.84)
Rel. spread x Rep. to tv Q3					–0.003***	–0.003**
					(–2.60)	(–2.25)
Rel. spread x Rep. to tv Q4					–0.004***	–0.004***
					(–3.74)	(–2.89)
Rel. spread x Rep. to tv Q5					–0.004***	–0.005***
					(–4.29)	(–3.57)
Constant	–0.004	0.004	–0.005	0.012*	0.025***	0.042***
	(–0.91)	(0.95)	(–1.18)	(1.94)	(3.31)	(4.24)
R^2	0.052	0.040	0.052	0.045	0.063	0.057
Observations	35396	35396	35396	26460	35396	26460
Firm FE	Y	Y	Y	Y	Y	Y

Table 9: **Event returns.** I use IRATS in combination with the Fama-French (1993) three-factor model to estimate mean cumulative abnormal returns. I test their significance by assuming time-series independence and, therefore, I divide the mean cumulative abnormal return by the the square root of the sum of the squares of the standard errors for the individual months that constitute the window. The calendar-time portfolio estimation is different to IRATS in that one forms monthly portfolios of stocks which had an event in the months over the event period. From the abnormal calendar time estimation, I obtain the monthly average over the event period. I use a standard t-test to examine the statistical significance of the average abnormal returns. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

	(-6,-2)	(-1,0)	(0,0)	(+1,+3)	(+1,+6)	(+1,+12)
I-RATS (cumulative ARs)	-0.76%	-0.73%	-0.16%	0.46%	0.27%	-0.66%
t-stat	-8.018***	-11.716***	-3.546***	5.632***	2.219**	-3.499***
Calendar time (average AR)	-0.25%	-0.58%	-0.41%	-0.08%	0.00%	0.02%
t-stat	-2.54***	-4.62***	-2.96**	-0.68	-0.02	0.15

Table 10: **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)
	b/t	b/t	b/t	b/t	b/t	b/t
Market cap (ln)	–0.000		–0.000		0.000	
	(–0.54)		(–0.66)		(0.95)	
AR(1,1)	–0.008**	–0.013***	–0.010**	–0.014***	–0.008**	–0.013***
	(–2.12)	(–3.30)	(–2.07)	(–2.68)	(–2.06)	(–3.31)
AR(0,0) > 0	0.058***	0.056***	0.045***	0.042***	0.059***	0.056***
	(6.86)	(6.22)	(4.13)	(3.53)	(6.96)	(6.21)
AR(0,0) < 0	–0.041***	–0.029***	–0.022*	–0.010	–0.042***	–0.029***
	(–4.46)	(–2.95)	(–1.93)	(–0.81)	(–4.57)	(–2.95)
Institutional Ownership	0.007***	0.006	0.007***	0.006	0.006***	0.006
	(4.57)	(0.99)	(4.76)	(1.08)	(3.70)	(0.94)
Insider ownership	0.020***	0.022	0.000	0.002		
	(4.89)	(1.55)	(0.02)	(0.12)		
AR(0,0) > 0 x ins. own.			0.240*	0.256		
			(1.81)	(1.49)		
AR(0,0) < 0 x ins. own.			–0.349***	–0.359**		
			(–3.20)	(–2.58)		
CAR(1,1) x Insider ownership			0.030	0.006		
			(0.61)	(0.13)		
Insider ownership Q2					0.002***	–0.001
					(3.42)	(–0.43)
Insider ownership Q3					0.003***	0.000
					(4.28)	(0.12)
Insider ownership Q4					0.004***	0.001
					(5.29)	(0.44)
Insider ownership Q5					0.006***	0.002
					(6.40)	(0.86)
Constant	0.034***	0.028**	0.035***	0.029**	0.031***	0.029***
	(3.92)	(2.53)	(4.01)	(2.57)	(3.53)	(2.60)
R^2	0.027	0.015	0.028	0.016	0.027	0.015
Observations	24438	24438	24438	24438	24438	24438
Controls Table 1 (5),(6)	Y	Y	Y	Y	Y	
Firm FE	N	Y	N	Y	N	Y

Table 10: **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)
	b/t	b/t	b/t	b/t	b/t	b/t
Market cap (ln)	–0.000		–0.000		0.000	
	(–1.41)		(–1.55)		(0.01)	
AR(1,1)	–0.010***	–0.015***	–0.011**	–0.014***	–0.010**	–0.015***
	(–2.59)	(–3.59)	(–2.32)	(–2.74)	(–2.55)	(–3.60)
AR(0,0) > 0	0.103***	0.099***	0.089***	0.084***	0.104***	0.099***
	(11.73)	(10.56)	(7.95)	(6.83)	(11.81)	(10.56)
AR(0,0) < 0	0.008	0.023**	0.030***	0.045***	0.008	0.023**
	(0.94)	(2.43)	(2.76)	(3.71)	(0.85)	(2.43)
Institutional Ownership	0.007***	0.007	0.007***	0.007	0.005***	0.007
	(4.30)	(1.20)	(4.51)	(1.29)	(3.54)	(1.17)
Insider ownership	0.022***	0.022	–0.001	–0.000		
	(5.21)	(1.62)	(–0.10)	(–0.03)		
AR(0,0) > 0 x ins. own.			0.254*	0.269		
			(1.89)	(1.53)		
AR(0,0) < 0 x ins. own.			–0.389***	–0.407***		
			(–3.70)	(–2.98)		
CAR(1,1) x Insider ownership			0.021	–0.006		
			(0.42)	(–0.12)		
Insider ownership Q2					0.002***	–0.001
					(3.01)	(–0.59)
Insider ownership Q3					0.003***	0.000
					(3.95)	(0.01)
Insider ownership Q4					0.004***	–0.000
					(4.60)	(–0.07)
Insider ownership Q5					0.006***	0.002
					(6.60)	(0.90)
Constant	0.039***	0.036***	0.040***	0.037***	0.037***	0.037***
	(4.55)	(3.21)	(4.65)	(3.26)	(4.20)	(3.33)
R^2	0.043	0.035	0.045	0.036	0.043	0.035
Observations	24438	24438	24438	24438	24438	24438
Controls Table 1 (5),(6)	Y	Y	Y	Y	Y	Y
Firm FE	N	Y	N	Y	N	Y